NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER
WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

NORTH ISLAND ELECTRICAL DISTRIBUTION UPGRADES
100% SUBMITTAL
CONSTRUCTION DOCUMENTS

Power Services
Engineering and Management Services®

January 2014

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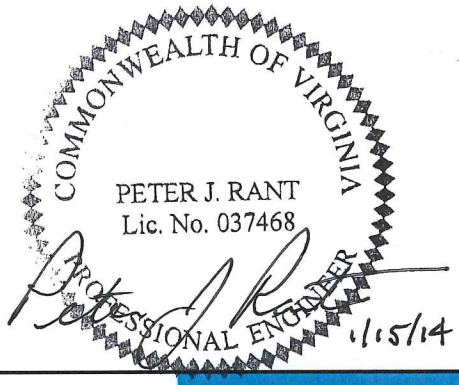

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TABLE OF CONTENTS

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100% CONSTRUCTION DOCUMENTS

Section **Title**

1 **Introduction and Background**

2 **Overview of Feeder Design Parameters & Considerations**

3 **Underground Distribution Line Design Data Summary**

4 **Specifications**

UFGS Division	Number	Title
01	01 00 00	General Requirements
	01 33 00	Submittal Procedures
	01 35 26	Governmental Safety Requirements
	01 42 00	Sources for Reference Publications
	01 45 00.00 40	Quality Control
	01 50 00	Temporary Construction Facilities and Controls
	01 58 00	Project Identification
	01 62 35	Recycled/Recovered Materials
	01 74 19	Construction and Demolition Waste Management
	01 78 23	Operation and Maintenance Data
	01 86 26.07 40	Reliability Centered Acceptance for Electrical Systems
03	03 00 00	Concrete
	03 40 00.00 10	Plant-Precast Concrete Products for Below Grade Construction
26	26 00 00	Electrical
	26 00 00.00 20	Basic Electrical Materials & Methods
	26 05 00.00 40	Common Work Results for Electrical
	26 05 13.00 40	Medium-Voltage Cables
	26 05 19.00 10	Insulated Wire & Cable
	26 05 70.00 40	High Voltage Overcurrent Protective Devices
	26 08 00	Apparatus Inspection & Testing
	26 12 19.00 40	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers
	26 12 19.10	Three-Phase Pad-Mounted Transformers

	26 13 00.00 20	SF6/High-Firepoint Fluids Insulated Padmounted Switchgear
	26 18 23.00 40	Medium-Voltage Surge Arrestors
27	27 00 00	Communications
	27 13 23.0 40	Communications Optical Backbone Cabling
31	31 00 00	Earthwork
	31 11 00	Clearing and Grubbing
	31 23 00.00 20	Excavation and Fill
32	32 00 00	Exterior Improvements
	32 11 23	Aggregate and/or Graded-Crushed Aggregate Base Course
33	33 00 00	Utilities
	33 05 23.19	Trenchless Excavation Using Micro Tunneling
	33 70 02.00 10	Electrical Distribution System, Underground
	33 71 02.00 20	Underground Electrical Distribution
	33 77 19.00 40	Medium-Voltage Gas Switch
	33 77 36.00 40	Medium-Voltage Utility Fuses

5 Manufacturer & Vendor Material Data Sheets

	Section	**Title**
	26 00 00	Electrical
	26 05 00	Common Work Results for Electrical
	26 05 13	Medium-Voltage Electrical Power Conductors and Cables-Cable Accessories
	26 05 26	Grounding and Bonding for Electrical Systems and Enclosures
	26 05 43	Underground Ducts and Raceways for Electrical Systems and Enclosures
	26 05 53	Identification for Electrical Systems
	26 09 00	Instrumentation and Control for Electrical Systems
	26 10 00	Medium-Voltage Electrical Distribution
	26 13 00	Medium-Voltage Switchgear
	26 18 00	Medium-Voltage Circuit Protection Devices
	26 18 19	Medium-Voltage Lightning Arresters

NOTE: All vendor specific material data is intended for use but may also represent performance requirements. Actual materials supplied may vary dependent upon material availability, delivery, and cost. If any vendor is other than those listed here are utilized, the actual vendor data will be submitted for approval unless this requirement is waived by the Government.

TABLE OF CONTENTS

	Attachments
DRAWING NO.	DESCRIPTION
TS-1	TITLE SHEET
LS-1	LEGEND, SYMBOLS & ABBREVIATIONS
GN-1	GENERAL NOTES, SAFETY & CONTACTS
EOL	EXISTING ELECTRICAL DISTRIBUTION SYSTEM ONE-LINE DIAGRAM
POL	PROPOSED ELECTRICAL DISTRIBUTION SYSTEM ONE-LINE DIAGRAM
POL-1	PROPOSED ELECTRICAL DISTRIBUTION SYSTEM ONE-LINE DIAGRAM
POL-2	PROPOSED ELECTRICAL DISTRIBUTION SYSTEM ONE-LINE DIAGRAM
POL-3	PROPOSED ELECTRICAL DISTRIBUTION SYSTEM ONE-LINE DIAGRAM
POL-4	PROPOSED ELECTRICAL DISTRIBUTION SYSTEM ONE-LINE DIAGRAM
PCP-1	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-2	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-3	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-4	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-5	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-6	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-7	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-8	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-9	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-10	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-11	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-12	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-13	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-14	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-15	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-16	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PCP-17	UNDERGROUND ELECTRICAL SYSTEM CONDUIT PLAN
PE-1	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-2	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-3	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-4	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-5	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-6	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-7	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-8	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-9	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-10	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-11	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-12	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-13	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-14	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-15	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-16	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PE-17	UNDERGROUND ELECTRICAL SYSTEM PRIMARY & SECONDARY CABLE PLAN
PED-1	EXISTING ELECTRICAL SYSTEM DEMOLITION PLAN
PED-2	EXISTING ELECTRICAL SYSTEM DEMOLITION PLAN
PED-3	EXISTING ELECTRICAL SYSTEM DEMOLITION PLAN
UD-1	UNDERGROUND ELECTRICAL SYSTEM CONSTRUCTION DETAILS
UD-2	UNDERGROUND ELECTRICAL SYSTEM CONSTRUCTION DETAILS

TABLE OF CONTENTS

UD-3	UNDERGROUND ELECTRICAL SYSTEM CONSTRUCTION DETAILS
UD-4	UNDERGROUND ELECTRICAL SYSTEM CONSTRUCTION DETAILS
UD-5	EQUIPMENT SCHEDULE
UD-6	EQUIPMENT SCHEDULE
UD-7	EQUIPMENT SCHEDULE
CMP-1	CABLE PULLING MAP
CMP-2	CABLE PULLING MAP
CMP-3	CABLE PULLING MAP
CMP-4	CABLE PULLING MAP
CMP-5	CABLE PULLING MAP
CMP-6	CABLE PULLING MAP
CMP-7	CABLE PULLING MAP
CMP-8	CABLE PULLING MAP

6 Design Review Responses

- **A. 30% Design Review Responses**
- **B. 60% Design Review Responses**

7 Cost Estimates

- **A. 60% Design Review Cost Estimate**
- **B. 90% Design Review Cost Estimate**
- **C. 100% Design Review Cost Estimate**
- **D. Project Schedule**

8 Safety Requirements

- **A. Goddard Procedural Requirements (GPR) 350/Occupational Safety & Health (OS&H) Division – Occupational Safety Program at Goddard Space Flight Center**
- **B. Goddard Procedural Requirements (GPR) 350/Occupational Safety & Health (OS&H) Division – Electrical Safety**
- **C. Code 350/Occupational Safety & Health (OS&H) Division – Control of Hazardous Energy (Lockout/Tagout)**
- **D. Energized Electrical Work Permit (EEWP)**
- **E. Code 350/Occupational Safety & Health (OS&H) Division – Confined Space Program at the Goddard Space Flight Center (GSFC)**

INTRODUCTION & BACKGROUND

1 INTRODUCTION AND BACKGROUND

NASA Wallops Flight Facility is undergoing a series of phased expansions and upgrades which will result in a significantly increased mission support capability in the near term (2-5 years). Specifically, the North and South Island Areas will be served through a multi-bus switchgear lineup at Building X-141 to looped 15 kV underground electrical feeders. In addition to capacity increased, this upgrade is a part of a longer term strategy to develop the Wallops Island electrical distribution facilities into a more robust and operationally effective asset supporting payload processing, launch support, and mission support system. At the core of the design concept is a focus on reliability, increased capacity, and rapid outage restoration. This summary is a brief overview of design parameters which are under development for a proposed 12.47/7.2 kV distribution feeder loop which will serve the North Island. The "feeder loop" will consist of two underground feeders enabling each load to have a backup circuit from the X-141 substation. Additional upgrades including the installation of new communication conduits are also proposed, which will enable expansion of the fiber optic network. Additional data will be provided in future submittals.

The Wallops Island electrical distribution system is in the midst of a series of upgrades. North Island feeder upgrades will incorporate concepts developed for the previously completed work on the South Island feeders. These include the ability for each load (transformer) to be selectively served from either side of an underground loop depending upon NASA's requirements and preferences at a given time. This is accomplished using a combination of pad mounted switchgear and 15 kV primary junctions. This arrangement allows for manual isolation and restoration of service in the event of a fault.

Several enhancements are being proposed for the North Island Design to improve system selectivity, protection, and outage restoration. The feeder loop will be divided into quadrants by inserting automated, motor operated tie-

switches at an intermediate point near V-16 and at the end of the feeder to allow for remote restoration to approximately 75% of the feeder length with manual switching needed for the remaining 25% (faulted) quadrant in order to isolate a faulted section or component. The intent is to utilize fiber communications links as a part of the isolated operational network to allow for communication between SEL relays and controls to provide both monitoring and control capability. The specifications under development will fully detail these requirements.

Included in this submittal is a brief listing of design parameters and considerations, a preliminary design data summary, and proposed feeder routing. The design data summary will be revised as the project progresses to incorporate each added aspect of the detailed design. Detail design drawings which depict more precise dimensions are currently under development. The basic initial layout and design is included in the attached preliminary review plan submittal, although additional detail drawings will be added as the design progresses to handle each of the conditions encountered along the line route.

OVERVIEW OF FEEDER DESIGN PARAMETERS & CONSIDERATIONS

2 OVERVIEW OF FEEDER DESIGN PARAMETERS & CONSIDERATIONS

1.0 General

The North Island Distribution Feeders are configured and located as shown on the attached drawings to provide a redundant source to serve the loads throughout the full project length. The source for each feeder is the new X-141 substation which is served from two feeders running to the island along each side of the causeway from the V-012 switchgear. Each of the two feeders will be supplied from a separate circuit breaker bay. The two circuits which will be active will each be fed from separate busses at the X-141 substation. Provisions are available for additional feeder capacity at the substation as mission support requirements develop.

2.0 Routing

As shown on the attached maps, the proposed line route takes into consideration natural and manmade existing boundaries and obstacles while providing a reasonably short, direct path to serve both critical loads and non-critical. Space is available along the routes for as yet undetermined future tap points, if needed, as well. Other considerations include clearance to roads and other utilities and simplicity of construction which minimizes total project cost. The design provides two separate physical paths to the extent possible, and installation shall be accomplished by directional bore in most cases, with some open cut possible in a few areas, particularly around connection points.

3.0 Right-of-Way

No additional right-of-way clearing is anticipated at this time.

2 OVERVIEW OF FEEDER DESIGN PARAMETERS & CONSIDERATIONS

4.0 Switch and Junction Support Structure Design

The South Island Feeder design incorporates switchgear mounted on top of raised manholes (vaults) with primary 15 kV junctions located within the manholes. Some constructability issues were encountered and solved during construction. For the North Island, it is proposed that the switches be elevated on open bottom concrete cable vaults, but the junctions be located in separate pad mounted enclosures, which themselves will be mounted on smaller concrete "box pads" or "ground sleeves" with enough elevation and structure to guard against mower strikes. The basic equipment remains the same.

5.0 Connection to Distribution Loads

Distribution loads will be connected using new and existing SF6 switchgear. Each feeder will require one (1) 600A way with one being normally open. Transformers will be supplied by a 200A switch position. See PE sheets for electrical connectivity attached.

6.0 Line Protection

Overcurrent protection for the feeders will be provided by circuit breakers at the X-141 substation. Settings will be determined based on studies being done concurrently with the line design. All protection beyond the X-141 substation is being developed based upon switchgear capabilities. Surge arresters will also be provided for overvoltage and surge protection.

7.0 Power Factor and Line Regulation

2 OVERVIEW OF FEEDER DESIGN PARAMETERS & CONSIDERATIONS

The maximum line capacity and efficiency is dependent upon the actual power factor and line regulation. Initial capacity computations for the lines assume a power factor of 0.9 or greater based upon a line ampacity of 315 amps. Once the feeder configuration is approved, system modeling will be used to determine line regulation and power factor control requirements.

8.0 Metering

No additional metering is provided as a part of the line design package.

9.0 Design and Material Concept Overview

9.1 Switchgear will be SF6 insulated gear. Enclosures will be stainless steel.

9.2 Transformers will be the standard style currently employed at Wallops Island. Enclosures will be stainless steel.

9.3 Junction cabinets will be above ground enclosures supported by concrete ground sleeves. Enclosures will be stainless steel.

9.4 All conduit will be installed by directional bored method, unless noted otherwise on the drawings.

9.5 Service conductors will be installed in conduit. Conduit may be direct buried for secondary cable.

9.6 Currently communication plans call for 2-4" communication conduits.

9.7 Existing conduit systems where conductors will be removed and not replaced are to be capped/plugged at each end and abandoned in place in lieu of being removed.

9.8 A single spare 4" conduit will be stubbed out of switchgear, enclosures, or transformers, per circuit run in lieu of 2-4" conduit spares.

9.9 All primary underground circuits will utilize 4/0 AWG CU and 1/0 AWG CU EPR cables with copper tape shield. All secondary and service conductors will be stranded copper.

9.10 Existing pad mount transformers will be reused.

10.0 Cable Pulling Calculations

The following cable pulling calculations represents a typical 500 ft. pull of 4/0 cable.

Pull-Planner™ 3000

Pull Tension Calculations

Pull I.D.: Wallops

Conduit Inner Diameter: 4Inch(es) Conduit Fill: 23.6%

Total of 3 Cable(s) of 1 different types being pulled.

Type # 1 3 Cable(s) O.D. of 1.12 Inch(es) Weight of 1.17 lbs/ft

Total Cable Weight: 3.51 lbs/ft

2 OVERVIEW OF FEEDER DESIGN PARAMETERS & CONSIDERATIONS

Calculated weight correction factor: 1.2

Configuration: Cradled

Jam/Clearance Analysis: Jamming Not Probable

COF: 0.5 Incoming Tension: 50 lbs

	Straight Sidewall Pressure Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius	Bend Radius Angle	Tension (lbs)	(lbs/ft)
SEG 1	90	D	6	VU	D	4	90	36	5
SEG 2	--	--	500	VU	U	4	90	2799	373
SEG 3	90	U	6	N	--	--	--	2820	--

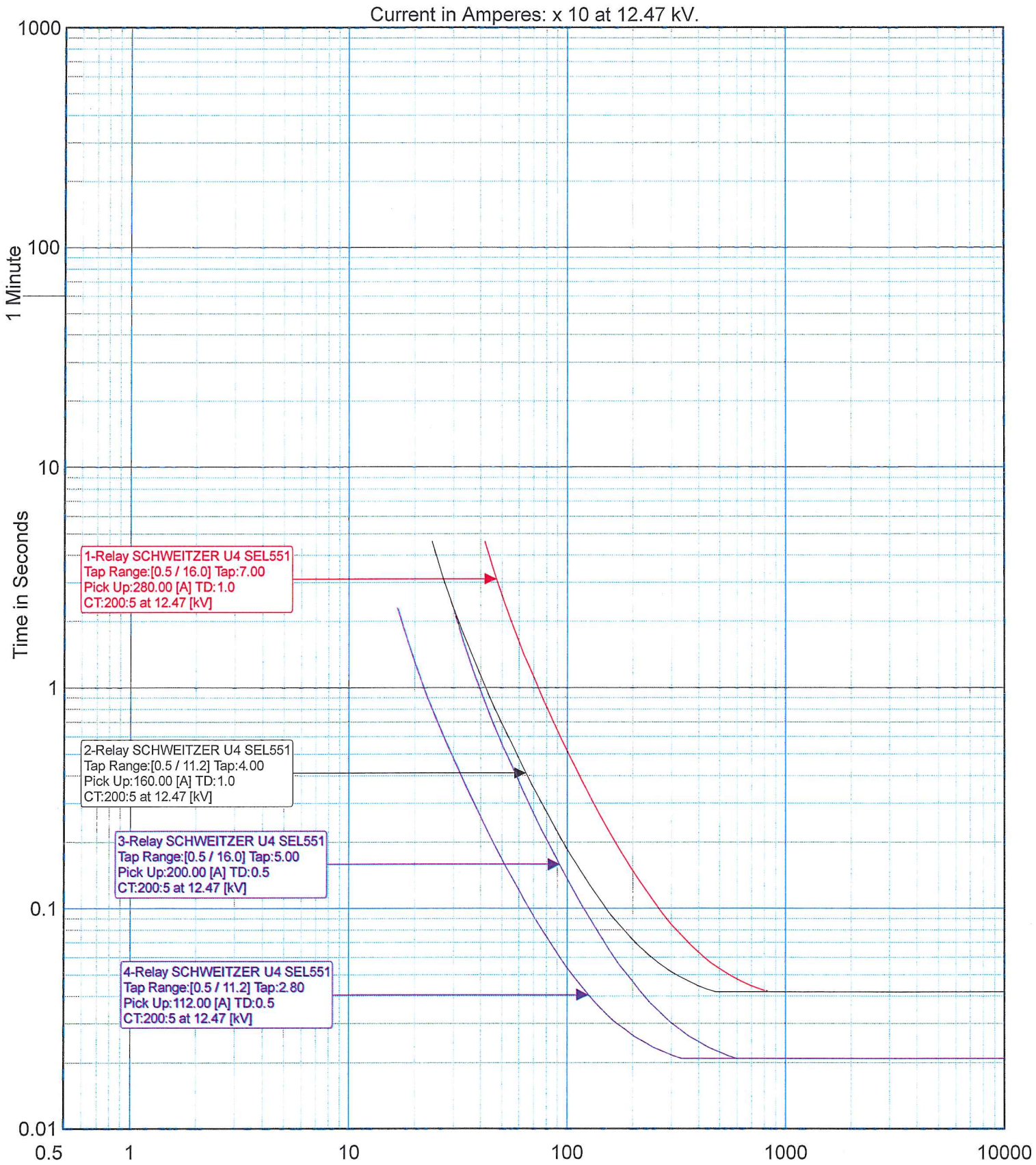
Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;

VD = Vertical Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

2 OVERVIEW OF FEEDER DESIGN PARAMETERS & CONSIDERATIONS

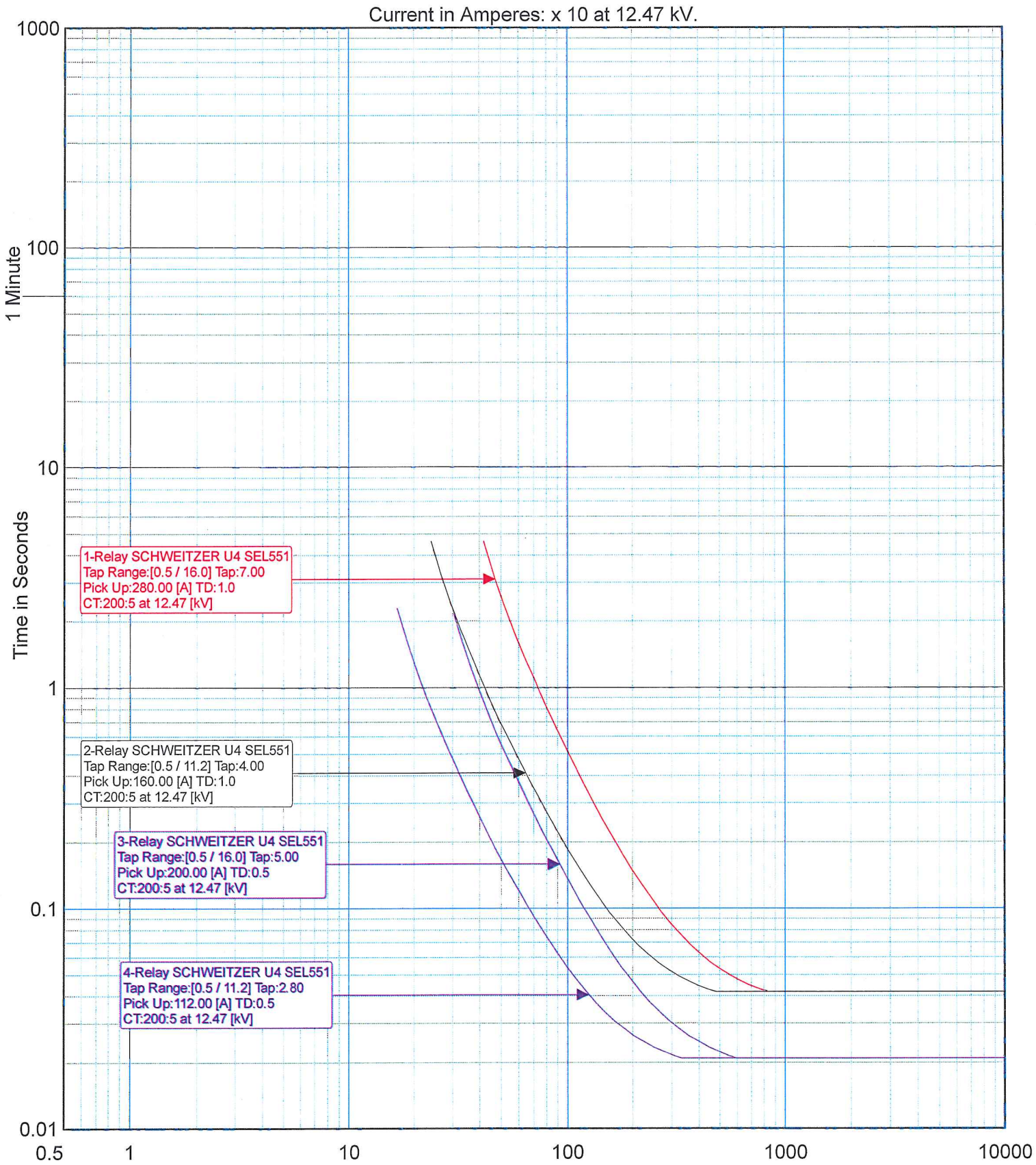
11.0 System Protection (Time Current Coordination Curves)

At this time, Time Current Coordination Curves (TCC) have been created for the main feeder, tie bus switchgear, and transformer loads for review and discussion.



Wallops Island	PLOTTING VOLTAGE:12.47 kV	
Main Line Coordination	BY:	
Feeder to Breaker		NO:
		DATE: 10/9/2012

Study: V:\Clients\Wallops Island\TCC\Study1.tcc

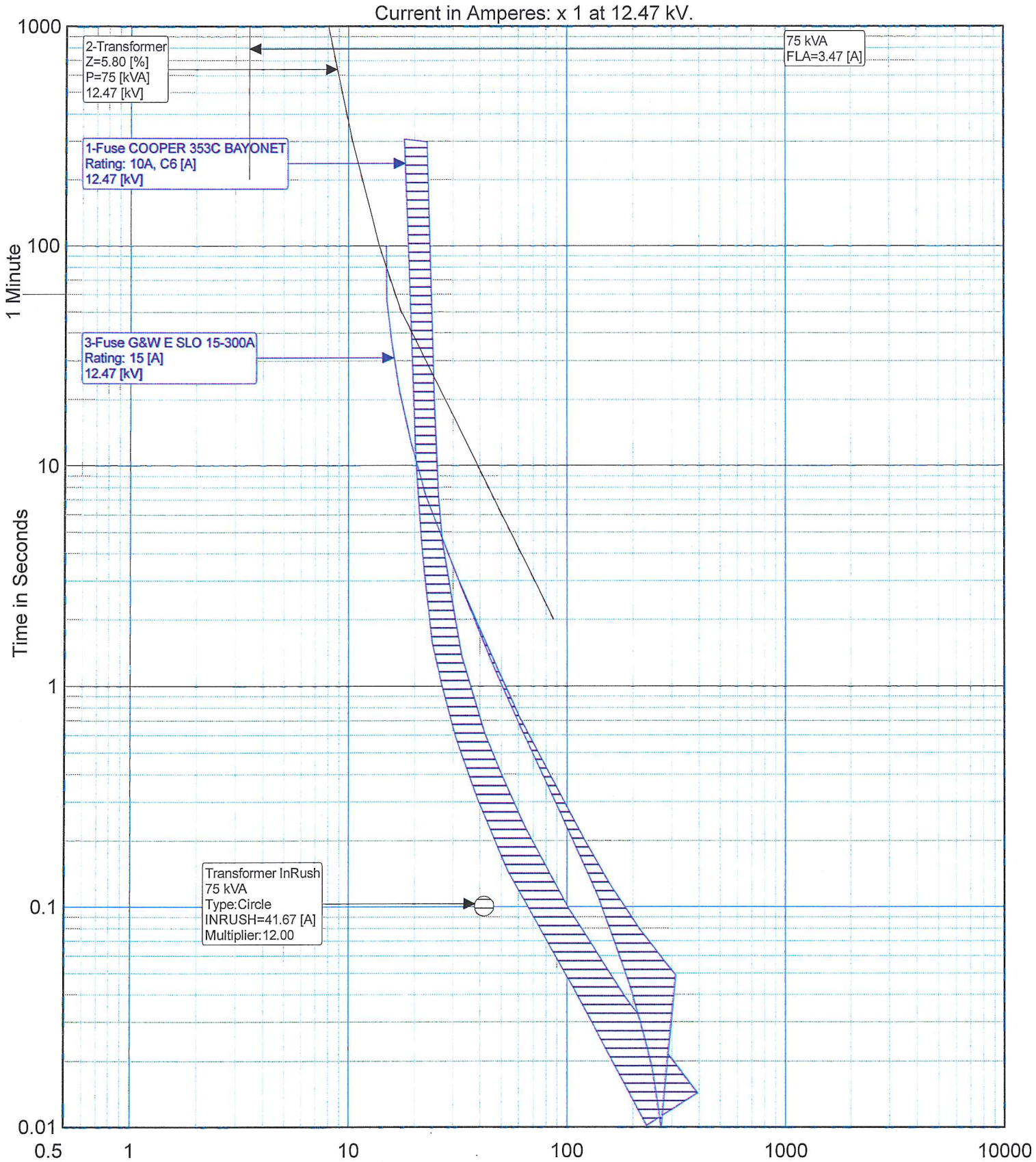


Wallops Island
Main Line Coordination
Feeder to Breaker

PLOTTING VOLTAGE:12.47 kV
BY:

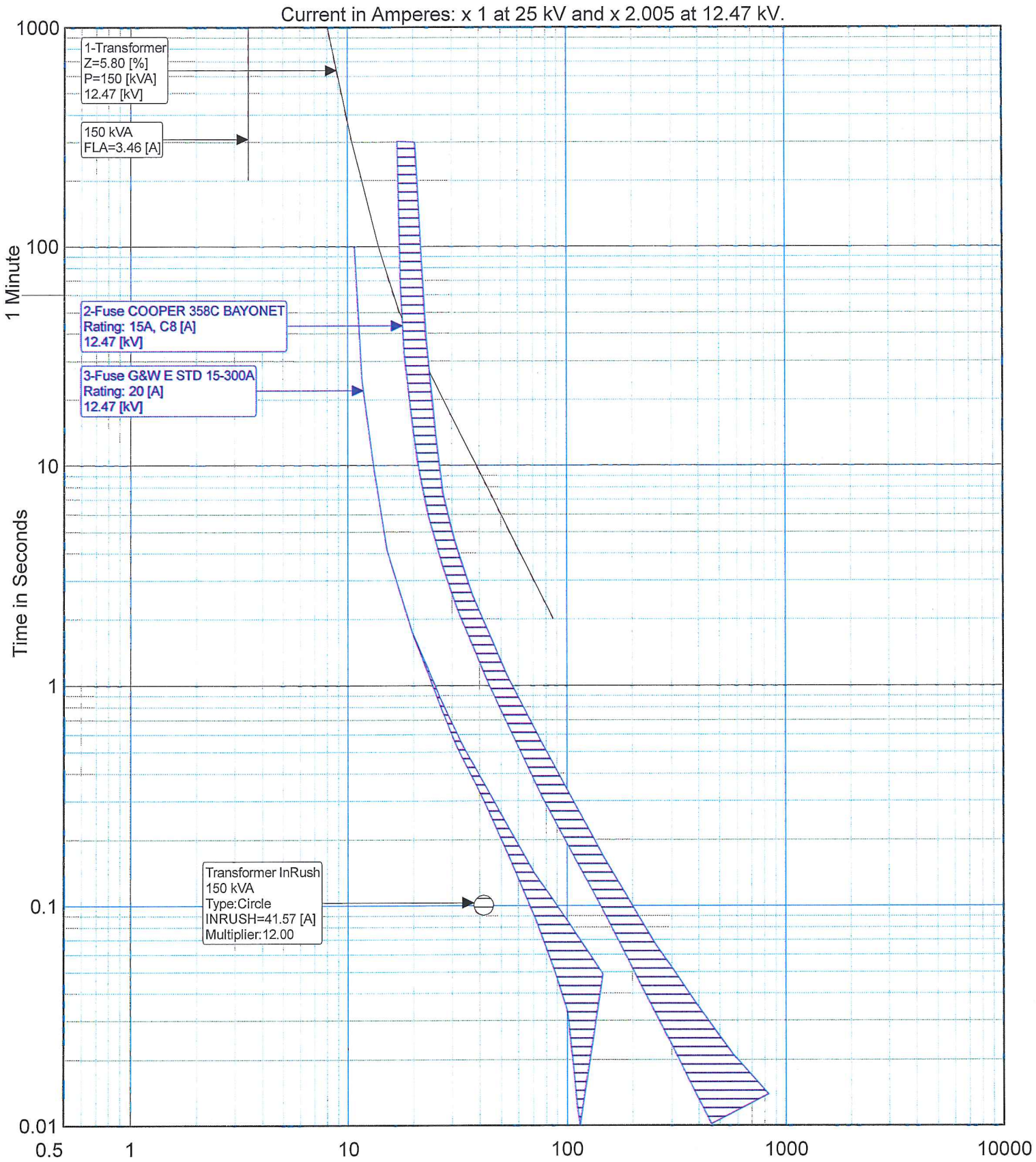
NO:
DATE: 10/9/2012

Study: V:\Clients\Wallops Island\TCC\Feeder Breaker.tcc



Wallops Island	PLOTTING VOLTAGE:12.47 kV	
VFI Coordination	BY:	
75 kVA Transformer		NO:
		DATE: 10/9/2012

Study: V:\Clients\Wallops Island\TCC\75kVA.tcc

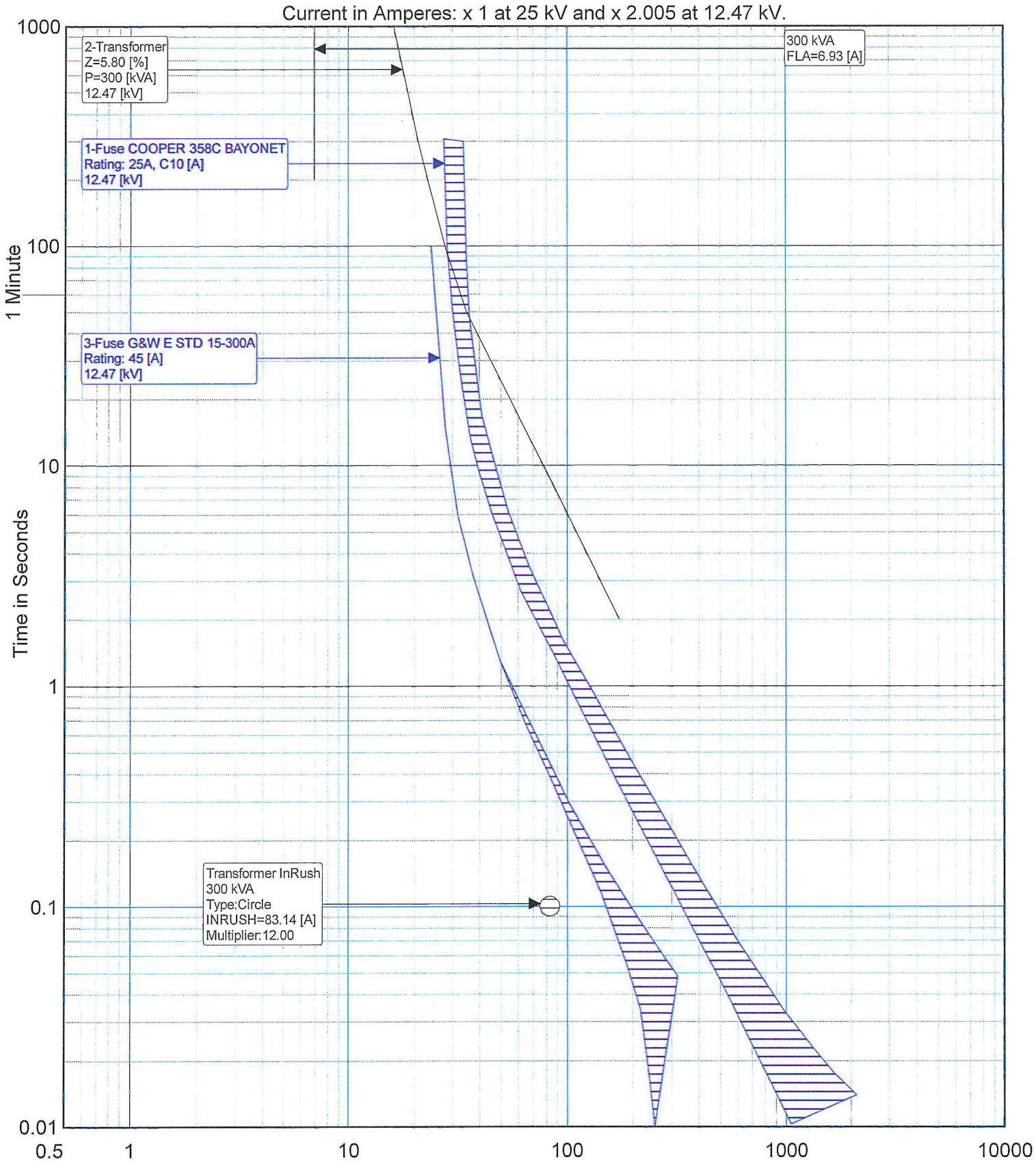


Wallops Island
VFI Coordination
225 kVA Transformer

PLOTTING VOLTAGE:25 kV
BY:

NO:
DATE: 6/9/2013

Study: V:\Clients\Wallops Island\TCC\150kVA.tcc



PLOTTING VOLTAGE:25 kV

BY:

NO:

DATE:

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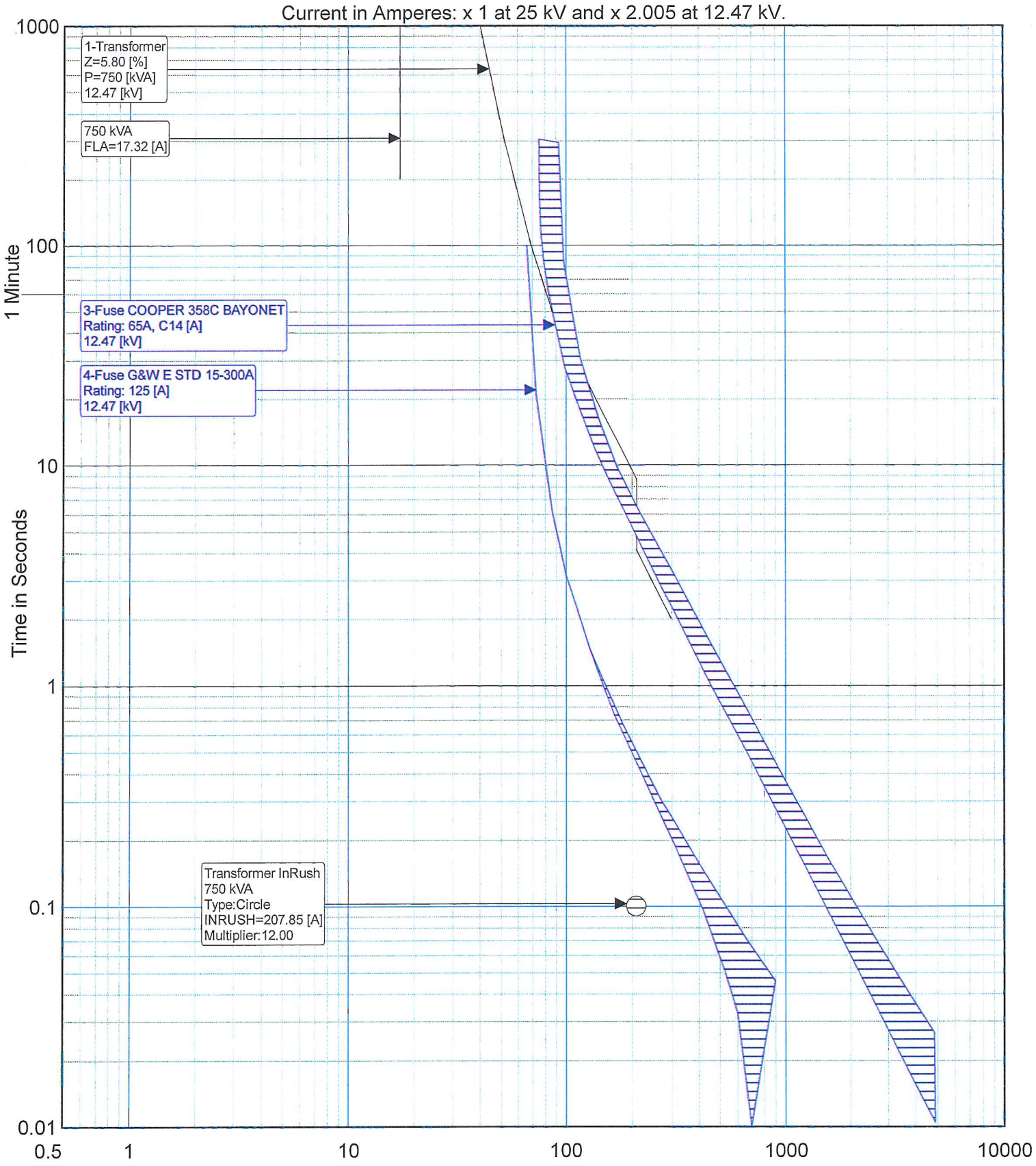

Wallops Island	PLOTTING VOLTAGE:25 kV
VFI Coordination	BY:
750 kVA Transformer	NO:
	DATE: 6/9/2013

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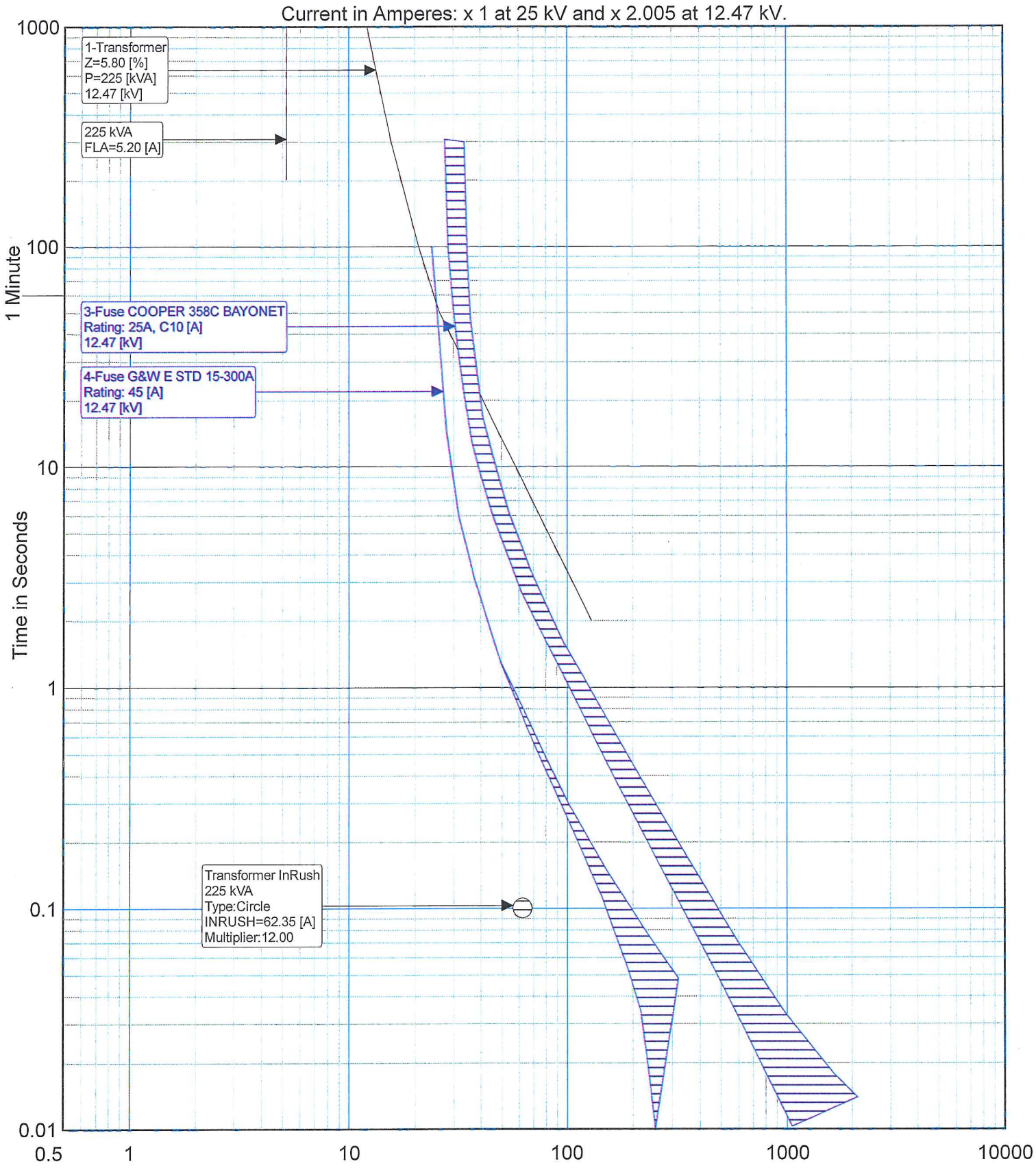
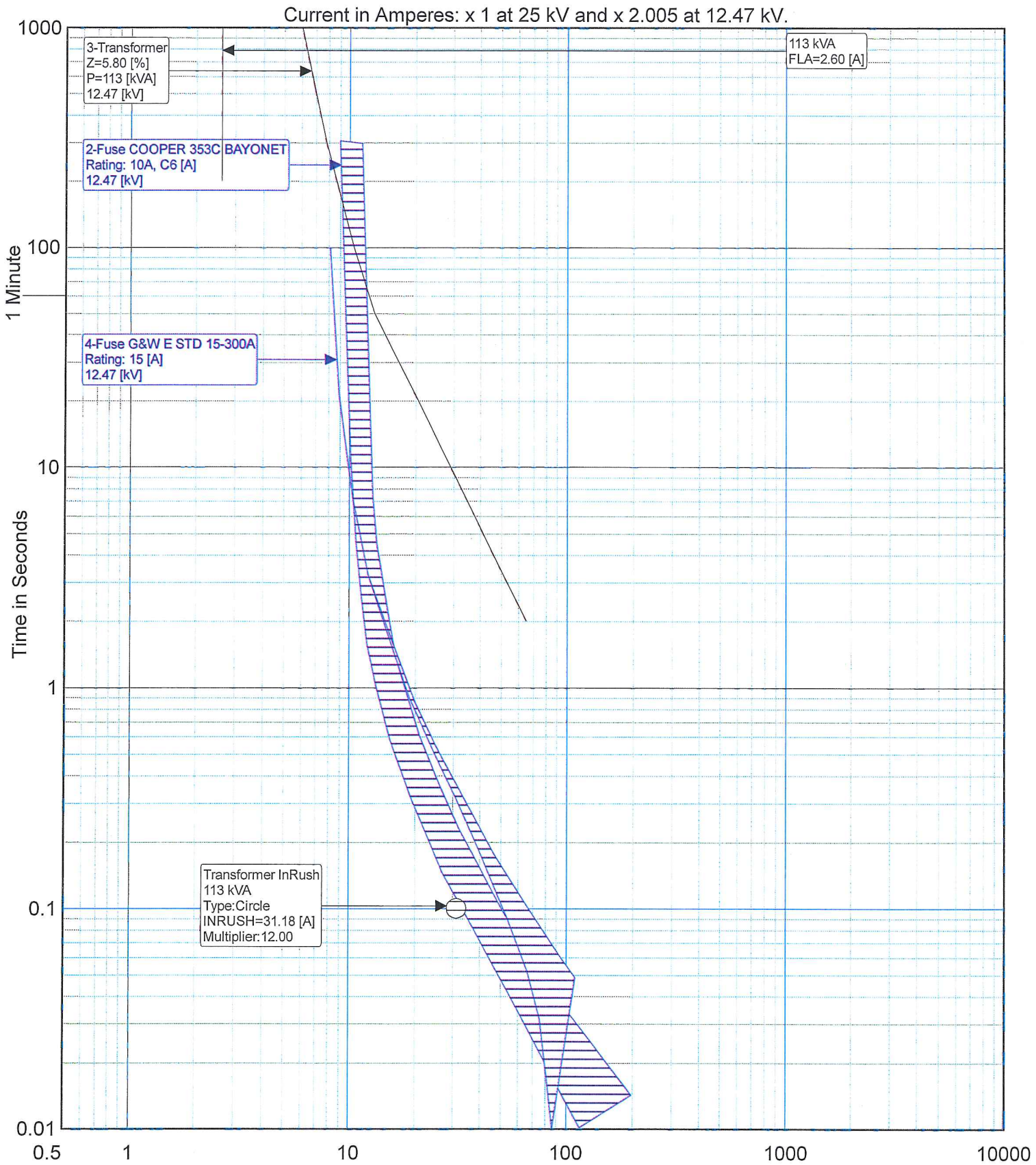


Wallops Island	PLOTTING VOLTAGE:25 kV
VFI Coordination	BY:
225kVA Transformer	NO:
	DATE: 6/9/2013

Study: untitled.dat



Wallops Island	PLOTTING VOLTAGE:25 kV
VFI Coordination	BY:
112.5 kVA Transformer	NO:
	DATE: 6/9/2013

Study: untitled.dat

12.0 Cost Estimate

Cost estimates and options for development of bid schedules are provided with in Section 8.

13.0 Schedule

A proposed schedule for full project completion is provided in Section 8.

UNDERGROUND DISTRIBUTION LINE DESIGN DATA SUMMARY

3 UNDERGROUND DISTRIBUTION LINE DESIGN DATA SUMMARY

UNDERGROUND DISTRIBUTION LINE DESIGN DATA SUMMARY

Client: **NASA –Wallops Flight Facility** **Date:** **01-14-2012**

Project: **North Island Distribution Upgrades**

Note: Preliminary project parameters - all for review and subject to revision

	Voltage		Insulation	
Distribution	12.47/7.2	kV	15	kV
			175	mils

Conductor Data:

	Size	Stranding	Material	Type
Distribution (Main)	4/0		Copper	MV-105
Distribution (Tap)	1/0		Copper	MV-105
Distribution (Tap)				
Neutral – Circuit	4/0, 1/0	19 Class B	Copper	Bare

Distribution Construction:

Number of Circuits	2
Neutral	2
Different Utility Involved (_____)	No
Type of Construction	Directional Bore

Conduit Data:

	Size	Cables/Conduit	Material	Name
Distribution (Main)	4"	4"	HDPE	
Distribution (Tap)	4"	4	HDPE	
Distribution (Tap)				
Neutral – Circuit	N/A			

3 UNDERGROUND DISTRIBUTION LINE DESIGN DATA SUMMARY

Design Criteria:

NESC Loading District (Check One)	Medium	X		Heavy		Light	
Spans - Distribution	Avg.	500	ft.	Max.		Ruling	ft.
Max. Pulling Tension	4/0 = 3386 1/0 = 1690	lbs.					
	21.6	% Rated Breaking Strength		41.3	% Rated Breaking Strength		

Minimum Clearances:

PER 2012 NESC Unless Noted Otherwise

	Railroad	Highway	Streets	Water	Other
Primary	N/A ft.	4 ft.	4 ft.	N/A ft.	ft.
Secondary	N/A ft.	N/A ft.	N/A ft.	N/A	ft.

Grounding:

Type: 4/0 Bare CU Ground

Installation: NEC 250.4(A)(5) NESC 314, 342, 374, 384,

Communication Cable Data:

	Type	Stranding	Material	Name
Main	Loose Tube	288	Fiber Optic	

Conduit Data:

	Size	Cables/Conduit	Material	Name
Main	4"	1	HDPE	

Distribution Construction:

Number of Circuits	2
Neutral	2

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3 UNDERGROUND DISTRIBUTION LINE DESIGN DATA SUMMARY

Different Utility Involved (_____)	No
Type of Construction	Directional Bore

Lightning Protection:

	Class	Duty Cycle	MCOV	Type
Surge Arresters	15kV	10kV	8.4kV	Elbow

Right-of-Way Requirements Responsibilities: (Check One)

	Responsibility
Courthouse Research	N/A
Survey	N/A
Preparation of Plats	N/A
Flagging	N/A
Clearing (By Contractor)	N/A

Construction:

Energization Date

_____

Materials Responsibility:

	Materials
All	TBD
Conduit	Contractor
Manholes/Vaults	Contractor
Conductors/Cables	Contractor
Switchgear	Government | Contractor
Relay and Controls	Contractor
Other Material (Describe)	
Major Items	Contractor
Communication Handholes	Contractor

SPECIFICATIONS

SECTION 01 33 00

SUBMITTAL PROCEDURES
05/11

PART 1 GENERAL

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to issuance of contract notice to proceed.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction Progress Schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices

Health and safety plan

Work plan

Quality Control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material

attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

Interim "DD Form 1354" with cost breakout for all assets 30 days prior to facility turnover.

1.2.2 Approving Authority

Office or designated person authorized to approve submittal.

1.2.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register

1.4 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.6 PREPARATION

1.6.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to office of approving authority. Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled, "Identifying Submittals," of this section. Process transmittal forms to record actions regarding sample[s] installations.

1.6.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.

e. Section number of the specification section by which submittal is required.

f. Submittal description (SD) number of each component of submittal.

g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

h. Product identification and location in project.

1.6.3 Format for SD-02 Shop Drawings

Shop drawings are not to be less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

Present 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled, "Identifying Submittals," of this section.

Number drawings in a logical sequence. Contractors may use their own number system. Each drawing is to bear the number of the submittal in a uniform location adjacent to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

Reserve a blank space, no smaller than 2 inches on the right hand side of each sheet for the Government disposition stamp.

Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Include the nameplate data, size and capacity on drawings. Also include applicable federal, military, industry and technical society publication references.

1.6.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

Supplement product data with material prepared for project to satisfy

submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of SD-07 Certificates.

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of construction effort.

Submit manufacturer's instructions prior to installation.

1.6.5 Format of SD-04 Samples

Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.

c. Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

e. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard

unit.

g. Sample Panel: 4 by 4 feet.

h. Sample Installation: 100 square feet.

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at time of use.

Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.

When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.6.6 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

1.6.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.

Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.6.8 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.6.9 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.

1.7 QUANTITY OF SUBMITTALS

1.7.1 Number of Copies of SD-02 Shop Drawings

Submit three copies of submittals of shop drawings requiring review and approval only by QC organization and five copies of shop drawings requiring review and approval by Contracting Officer.

1.7.2 Number of Copies of SD-03 Product Data and SD-08 Manufacturer's Instructions

Submit in compliance with quantity requirements specified for shop drawings.

1.7.3 Number of Samples SD-04 Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.7.4 Number of Copies SD-05 Design Data and SD-07 Certificates

Submit in compliance with quantity requirements specified for shop drawings.

1.7.5 Number of Copies SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC reports.

1.7.6 Number of Copies of SD-10 Operation and Maintenance Data

Submit three copies of O&M Data to the Contracting Officer for review and approval.

1.7.7 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit two sets of administrative submittals.

1.9 VARIATIONS

Variations from contract requirements require both Designer of Record (DOR) and Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.9.1 Considering Variations

Discussion with Contracting Officer prior to submission, after consulting with the DOR, will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the

Government.

1.9.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government, including the DOR's written analysis and approval. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.9.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record, warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.9.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.10 SUBMITTAL REGISTER AND DATABASE

Prepare and maintain submittal register, as the work progresses. Use electronic submittal register program furnished by the Government or any other format. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all inclusive and additional submittals may be required. The Government will provide the initial submittal register in electronic formatwith the following fields completed, to the extent that will be required by the Government during subsequent usage.]

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

The database and submittal management program will be furnished to Contractor on a Writable Compact Disk (CD-R), for operation on Windows based personal computer.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on

which submittals are received and returned by the Government.

1.10.1 Use of Submittal Register

Submit submittal register as an electronic database, using submittals management program furnished to Contractor. Submit with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register database submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.10.2 Contractor Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.10.3 Approving Authority Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.10.4 Action Codes

Entries for columns (j) and (o), are to be used are as follows (others may be prescribed by Transmittal Form):

1.10.5 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request. Deliver in electronic format, unless a paper copy is requested by Contracting Officer.

1.11 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.

d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

At the Preconstruction conference, provide, for approval by the Contracting Officer, the following schedule of submittals:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

1.12 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

a. Note date on which submittal was received.

b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals. Three copies of the approved submittal will be retained by the Contracting Officer and two copies of the submittal will be returned to the Contractor.

1.12.1 Review Notations

Contracting Officer review will be completed within seven calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" "or approved except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.13 DISAPPROVED OR REJECTED SUBMITTALS

Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes," is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.14 APPROVED/ACCEPTED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.15 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

1.17 PROGRESS SCHEDULE

1.17.1 Bar Chart

a. Submit the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference in one reproducible and 4 copies.

b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

c. Include no less than the following information on the progress chart:

(1) Break out by major headings for primary work activity.

(2) A line item break out under each major heading sufficient to track the progress of the work.

(3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.

(4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.

(5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.

(6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)

d. Update the progress schedule in one reproduction and 4 copies every 30 calendar days throughout the contract performance period.

1.17.2 Project Network Analysis

Submit the initial progress schedule within 21 calendar days of notice to proceed. Schedule is to be updated and resubmitted monthly beginning 7 calendar days after return of the approved initial schedule. Updating to entail complete revision of the graphic and data displays incorporating changes in scheduled dates and performance periods. Redlined updates will only be acceptable for use as weekly status reviews.

Contractor to provide a single point contact from his on-site organization as his Schedule Specialist. Schedule Specialist is to have the responsibility of updating and coordinating the schedule with actual job conditions. Schedule Specialist to participate in weekly status meetings and present current information on the status of purchase orders, shop drawings, off-site fabrication, materials deliveries, Subcontractor activities, anticipated needs for Government furnished equipment, and any problem which may impact the contract performance period.

Include the following in the project network analysis:

a. Graphically display with the standard network or arrow diagram capable of illustrating the required data. Drafting to be computer generated on standard 24 by 36 inch (nominal size) drafting sheets or on small 11 by 17 inch minimum sheets with separate overview and detail breakouts. Provide a project network analysis that is legible with a clear, consistent method for continuations and detail referencing. Clearly delineate the critical path on the display. Clearly indicate the contract milestone date on the project network analysis graphic display.

b. Data is to be presented as a separate printout on paper or, where feasible, may be printed on the same sheet as the graphic display. Data is to be organized in a logical coherent display capable of periodic updating.

c. Include within the data verbal activity descriptions with a numerical ordering system cross referenced to the graphic display. Additionally, costs (broken down into separate materials and costs), duration, early start date, early finish date, late start date, late finish date, and float are to be detailed for each activity. A running total of the percent completion based on completed activity costs versus total contract cost is to be indicated. A system for indicating scheduled versus actual activity dates and durations is also to be provided.

d. Sufficient detail to facilitate the Contractor's control of the job and to allow the Contracting Officer to readily follow progress for portions of the work should be shown within the schedule.]

1.18 STATUS REPORT ON MATERIALS ORDERS

Within forty five calendar days after notice to proceed, submit, for approval by the Contracting Officer, an initial material status report on all materials orders. This report will be updated and re-submitted every thirty calendar days as the status on material orders changes.

Report to include list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

a. Material name, supplier, and invoice number.

b. Bar chart line item or CPM activity number affected by the order.

c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.

d. Current delivery date agreed on by supplier.

e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.

f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS
02/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	(2004) Fall Protection
ASSE/SAFE A10.34	(2001; R 2005) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	(2010) Articulating Boom Cranes
ASME B30.3	(2009) Tower Cranes
ASME B30.5	(2011) Mobile and Locomotive Cranes
ASME B30.8	(2010) Floating Cranes and Floating Derricks

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA NPG 8621.1	(2004a) NASA Mishap Reporting, Investigating and Record Keeping Policy
NASA NPG 8715.3	(2004) NASA Safety Manual
NASA-STD 8719.12	(2010) Safety Standard for Explosives, Propellants, and Pyrotechnics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2010; Errata 2012) Standard for Portable Fire Extinguishers
NFPA 241	(2009) Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 306	(2009) Standard for Control of Gas Hazards on Vessels

NFPA 51B	(2009; TIA 09-1) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 70E	(2012; Errata 1) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 20	Standards for Protection Against Radiation
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1919	Gear Certification
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes & Derricks in Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.450	Scaffolds
29 CFR 1926.500	Fall Protection
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NAVFAC P-307	(2009; Change 1 Mar 2011; Change 2 Aug 2011)Management of Weight Handling Equipment

1.2 DEFINITIONS

b. High Visibility Accident. Any mishap which may generate publicity or high visibility.

c. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

e. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work (any time lost after day of injury/illness onset);

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G, A

Activity Hazard Analysis (AHA); G, A

Crane Critical Lift Plan; G, A

Proof of qualification for Crane Operators; G, A

SD-06 Test Reports

Notifications and Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph, "Notifications and Reports."

Accident Reports

Crane Reports

Gas Protection for NASA projects

SD-07 Certificates

Confined Space Entry Permit

Hot work permit

License Certificates

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent addition of USACE NPR 8715.3C, and the following federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.6 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

The SSHO must meet the requirements of NPR 8715.3C and ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Designated Representative/alternate shall be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan.

A Competent Person shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the the Contracting Officer for acceptance in consultation with the Safety Office.

1.6.1.1.1 Contractor Quality Control (QC) Person:

The Contractor Quality Control Person can be the SSHO on this project.

1.6.1.4 Crane Operators

Meet the crane operators requirements in NASA NASA-STD-8719.9. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification.

1.6.2 Personnel Duties

1.6.2.1 Site Safety and Health Officer (SSHO)

The SSHO shall:

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

h. Maintain a list of hazardous chemicals on site and their material safety data sheets.

Failure to perform the above duties will result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any

other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.7 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan" and show compliance with NASA NPG 8715.3. Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor Quality control Manager, and any designated CSP or CIH.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the

hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the Contracting Officer's office and at the job site.
Continuously review and ammend the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.7.1 EM 385-1-1 Contents

In addition to the requirements outlined in Appendix A of USACE EM 385-1-1, the following is required:

c. Confined Space Entry Plan. Develop a confined and/or enclosed space entry plan in accordance with NASA NPG 8715.3, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

d. Crane Critical Lift Plan.
Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. Submit 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.H. and the following:

(1) For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400.

k. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION AND DECONSTRUCTION and referenced sources. Include engineering survey as applicable.

l. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK.

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

1.9 DISPLAY OF SAFETY INFORMATION

Within one calendar day(s) after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by NASA NPG 8715.3, section 01.A.06. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.12 NOTIFICATIONS and REPORTS

1.12.1 Accident Notification

Notify the Contracting Officer as soon as practical, but no more than four hours after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident in accordance with NASA NPG 8621.1. Within notification include contractor name; contract

title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.12.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, property damage accidents resulting in at least $20,000 in damages, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable USACE Accident Report Form 3394, and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

1.12.3 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix I and as specified herein with Daily Reports of Inspections.

1.12.4 Certificate of Compliance

Provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926 and USACE EM 385-1-1 Section 16 and Appendix I. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used.[For cranes at DOD activities in foreign countries, certify that the crane and rigging gear conform to the appropriate host country safety standards.] Also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). Post certifications on the crane.

1.13 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Fire Division. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

1.15 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

1.17 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive-actuated devices) shall be scheduled for weekends. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

1.18 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.19 CONFINED SPACE ENTRY REQUIREMENTS.

Contractors entering and working in confined spaces while performing general industry work are required to follow the requirements of OSHA 29 CFR 1926 and comply with the requirements in Section 3.17 of NPR 8715.3C, OSHA 29 CFR 1910, and OSHA 29 CFR 1910.146.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK
3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are

prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Apply for utility outages at least 14 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Ensure that each employee is familiar with and complies with these procedures and NASA NPR 8715.3C, Section 3.4, Control of Hazardous Energy.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with NASA NPR 8715.3C1, Section 3.18.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraphs 21.N through 21.N.04. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.4 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.6 Rescue and Evacuation Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.7 EQUIPMENT

3.7.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless

specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.7.2 Weight Handling Equipment

a. Equip cranes and derricks as specified in EM 385-1-1, section 16.

c. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

e. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.

g. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

h. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

i. All employees must keep clear of loads about to be lifted and of suspended loads.

j. Use cribbing when performing lifts on outriggers.

k. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

l. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

m. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

n. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

o. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

3.7.4 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

Explosive work shall be performed in accordance with NASA-STD 8719.12. This document is available at:

http://www.hq.nasa.gov/office/codeq/doctree/871912.htm

3.8 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.8.1 Utility Locations

All underground utilities in the work area must be positively identified by a third party, independent, private utility locating company in addition to any station locating service and coordinated with the station utility department.

3.8.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system.

3.8.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company shall locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.9 ELECTRICAL

3.9.1 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of EM 385-1-1, NFPA 70E, and OSHA electrical standards.

3.10 WORK IN CONFINED SPACES

Comply with the requirements in Section 34 of NASA NPR 8715.3C, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, OSHA Directive CPL 2.100 and OSHA 29 CFR 1926. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 34 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space

shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
08/10

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: http://www.concrete.org

ACOUSTICAL SOCIETY OF AMERICA (ASA)
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
E-mail: asa@aip.org
Internet: http://asa.aip.org

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)
2800 Shirlington Road, Suite 300
Arlington, VA 22206
Ph: 703-575-4477
Fax: 703-575-4449
E-mail: info@acca.org
Internet: http://www.acca.org

AIR DIFFUSION COUNCIL (ADC)
1901 N. Roselle Road, suite 800
Schaumburg, IL 60195
Ph: 847-706-6750
Fax: 847-706-6751

E-mail: info@flexibleduct.org
Internet: http://www.flexibleduct.org

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: http://www.amca.org

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph: 703-524-8800
Fax: 703-528-3816
E-mail: fdietz@ahrinet.org
Internet: http://www.ahrinet.org

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)
1200 G Street, NW, Suite 500
Washington, D.C. 20005
Ph: 202-628-6380
Fax: 202-393-5453
E-mail: doccenter@atis.org
Internet: http://www.atis.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209
Ph: 703-358-2960
Fax: 703-358-2961
Internet: http://www.aluminum.org

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Office Square
Suite 550
Schaumburg, IL 60173-5774
Ph: 847-303-5664
Fax: 847-303-5774
E-mail: webmaster@aamanet.org
Internet: http://www.aamanet.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
1 Davis Drive
P.O. Box 12215
Research Triangle Park, NC 27709
Ph: 919-549-8141

Fax: 919-549-8933
E-mail: leonardc@aatcc.org
Internet: http://www.aatcc.org

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-367-1155
Fax: 202-367-2155
E-mail: info@americanbearings.org
Internet: http://www.abma-dc.org

AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA)
8221 Old Courthouse Road Suite 207
Vienna, VA 22182
Ph: 703-356-7171
Fax: 703-356-4543
Internet: http://www.abma.com

AMERICAN BUREAU OF SHIPPING (ABS)
16855 Northcase Drive
Houston, TX 77060 USA
Ph: 1-282-877-5800
Internet: http://www.eagle.org

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
1303 W. Walnut Hill Lane, Suite 305
Irving, TX 75038-3008
Ph: 972-506-7216
Fax: 972-506-7682
E-mail: info@concrete-pipe.org
Internet: http://www.concrete-pipe.org

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020 or 513-742-6163
Fax: 513-742-3355
E-mail: mail@acgih.org
Internet: http://www.acgih.org

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)
American Wood Council
ATTN: Publications Department
1111 Nineteenth Street NW, Suite 800
Washington, DC 20036
Ph: 800-890-7732 or 202-463-2766
Fax: 202-463-2791
E-mail: awcpubs@afandpa.org
Internet: http://www.awc.org/

AMERICAN GAS ASSOCIATION (AGA)
400 North Capitol Street N.W.
Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Fax: 202-824-7115
E-mail: website@aga.org

Internet: http://www.aga.org

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)
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PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00.00 40

QUALITY CONTROL
05/12

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Quality Control Data; G

Quality Control Coordinating Actions; G

Quality Control Training; G

Inspection Records; G

Letters of Authority or Delegation; G

Field Tests; G

Factory Tests; G

SD-07 Certificates

Contractor's Quality Representative Qualifications; G

Special Certifications; G

1.2.1 Quality Assurance (QA) Plan

Address the following within the QA Plan:

a. Description of the authority, responsibilities and coordinating procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.

b. List personnel designated by the Contractor to accomplish the work required by the contract.

c. Provide an appendix with a copy of each form, report format, or similar record to be used in the QA program.

d. Contractor's organization that handles construction contract activities.

e. Contractor's operational plan for accomplishing and reviewing work controls, fabrication controls, certifications, and documentation of quality control operations, inspections, and test records, including those for subcontractors.

f. Include within these provisions the methods to be used during the procurement cycle (order to delivery) for those materials or equipment that require source inspections, shop fabrications, or similar operations located separately from the work site.

g. Description of on-site personnel training.

h. Certification(s) of personnel, procedures, processes, and equipment.

i. Non-Destructive Testing (NDT) requirements.

j. Identification of independent certifying and testing laboratories.

1.2.2 Records

Include all quality control data; factory tests or manufacturer's certifications, quality control coordinating actions; records of quality control training/certifications as well as routine hydrostatic, electrical continuity, grounding, welding, line cleaning, field tests and similar tests. Ensure Quality records are available for examination by the Contracting Officer.

Furnish legible copies of the test and inspection records to the Contracting Officer. Ensure records cover work placement traceable to the contract schedule, specifications and drawings, and are verifiable.

1.2.2.1 Narrative Description

Submit for approval, the narrative description of an inspection system which provides for compliance with the quality requirements and technical criteria of the contract within 7 calendar days after notice to proceed.

1.2.2.2 Monthly Performance Report

Submit a monthly performance report that summarizes the quality operations. Identify inspections made, tests performed, nonconformances, corrective actions taken, status of plans/procedures being developed, and status of open items/problems in work.

1.2.2.3 Letters of Authority or Delegation

Submit Letters of Authority or Delegation outlining the authority and responsibilities of quality control personnel along with a copy of the letter of delegation to the Contracting Officer that defines delegated duties and responsibilities.

1.3 QUALITY ASSURANCE

1.3.2 Quality Control Requirements

Provide a quality control program encompassing: selection of construction materials and sources; suppliers; subcontractors; on-site and off-site fabrication of Contractor-furnished assemblies; on-site and off-site assembly; erection; work procedures; workmanship; inspection; and testing.

Provide document systems ensuring that quality provisions of contract schedule, specifications, and drawings have been performed.

1.3.2.1 Management and Organization

Designate an individual within the on-site organization whose sole responsibility is the day-to-day on-site management and direction of the Quality Program.

The Quality Program Manager will report to the Contractor's management and have the necessary authority to discharge contractual responsibilities.

1.3.2.2 Identification and Data Retrieval

Provide an identification and data retrieval system.

Identify all records, drawings, submittals, and equipment by referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System.

1.3.2.3 Procurement

Contractor is responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality requirements.

1.3.2.4 Receiving Inspection System

Maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Ensure receiving inspection records accompany each procurement delivery to the construction site. Maintain records of site receiving inspections.

Show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection within the records.

1.3.2.5 Nonconforming Articles and Material Control

Control nonconformances discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to correct deficient operations.

a. Prepare a "nonconformance" report for each instance comprising:

(1) A unique and traceable number.

(2) Identification of the nonconforming article or material.

(3) A description of the nonconformance and the applicable requirement.

(4) Cause or reason for the nonconformance.

(5) Remedial actions taken or recommended.

(6) Disposition of the nonconforming article or material.

b. Identify and mark each nonconforming article for removal from the work area.

c. Monitor and correct deficient operations.

1.3.2.6 Fabrication, Process, and Work Control

Ensure compliance of requirements in contract specifications and drawings with procedures and controls.

Establish in-process inspections, to ensure compliance with quality requirements.

1.3.2.7 Quality Control Records

Maintain Quality Control records at a central on-site location.

Maintenance of quality control records do not relieve the Contractor from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification.

Ensure each record is identified and traceable to specific requirements in the specifications and drawings.

1.3.2.8 Drawings and Change Control

Maintain drawing-control system to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Control changes involving interface with other work areas, or affecting materials controlled by others. Integrate this system with the document requirements of the contract.

Clearly annotate and identify drawing changes and associated drawings for implementation ion that are to be revised accordingly. Use for fabrication and inspection drawings that have been approved, or approved as noted, by the Contracting Officer.

1.3.3 Quality Inspections

1.3.3.1 Government Inspections

Work performed under this contract will be subject to inspection by the Contracting Officer. Changes to the specifications or drawings will not be allowed without written authorization of the Contracting Officer.

When the Contracting Officer determines that inspected work needs to be corrected, the Contracting Officer will be allowed 24hours to complete reinspection of the corrected work.

Notify Contracting Officer in writing before backfilling or encasing any underground utility so that work may be inspected. Failure to notify the Contracting Officer before backfill or encasement occurs will require the work be uncovered at no additional cost to the Government.

Contractor's program is subject to continuous evaluation, review, and verification by the Contracting Officer. Contractor will be notified in writing of any noncompliance and will be given 7 calendar days to correct identified deficiencies.

1.3.3.2 Contractor's Quality Inspections

Implement an inspection system that Documents and indicates quality control through records of inspections, tests, and procedures.

Include the following within the Contractor's Quality Assurance System:

a. Single Contractor's representative responsible for on-site communication and operation of the inspection program.

b. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.

c. Receiving inspection system documenting inspections for each procurement.

d. Documentation for handling and disposing of nonconforming components and materials.

e. Inspection records for each specific section of the specification and drawings.

f. Identification of test(s) to be performed, test procedures, records, and independent organizations used.

g. Documenting and maintaining certification or re-certification of procedures.

h. Management of government-furnished equipment, components, and materials.

i. Calibration of gages, tools, measuring instruments, and independent laboratories used.

Establish a system of scheduled or random audits to ensure task completion.

1.3.4 Field Services

1.3.4.1 Responsibility for Inspection and Testing

Contractor is responsible for all inspections and tests, and the accompanying documentation for each inspection and test. Contractor may utilize independent inspection and testing laboratories or services as approved by the Contracting Officer.

Contractor is also be responsible for tests of construction materials utilizing the services of an approved independent testing laboratory.

1.3.4.2 Inspection and Test Records

Provide on-site records of each inspection and test performed throughout the life of the contract including, but not be limited to, factual evidence that the required inspections or tests have been performed, including type

and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Ensure all inspection records, test procedures, test results, and associated forms are verified by and provided to the Contracting Officer. Submit final test data with a cover letter/sheet clearly marked with the system name, date, and the words "Final Test Data.

1.4 HANDLING AND STORAGE

Provide controls, procedures and documentation with each shipment, that meet requirements of each section of the specifications.

Include documentation with each shipment that consist of documentation required by the contract along with specifications required to identify, store, preserve, operate, and maintain the items shipped.

1.5 SEQUENCING AND SCHEDULING

Notify the Government at least 48 hours prior to scheduled inspections and tests.

Provide 24 hour notice to the Government of the date when the contract work will begin at the site.

When Contractor suspends work for 5 calendar days or longer prior to completion notify the Contracting Officer. Do not resume work without notification of the Contracting Officer.

Notify the Contracting Officer at least 24 hours in advance of backfilling or encasing any underground utility.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

<SEC><MTA NAME=SUBFORMAT CONTENT=NEW/>

<SCN>SECTION 01 50 00</SCN>

<STL>TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS</STL>
<DTE>08/09</DTE>

<PRT =1><TTL>PART 1 GENERAL</TTL>

<SPT =1.1><TTL>1.1 SUMMARY</TTL>

<TXT>Requirements of this Section apply to, and are a component of, each section of the specifications.</TXT>

<SPT =1.2><TTL>1.2 REFERENCES</TTL>

<TXT>The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.</TXT>

<REF> <ORG>AMERICAN WATER WORKS ASSOCIATION (AWWA)</ORG>

<RID>AWWA C511</RID> <RTL>(2007) Standard for Reduced-Pressure Principle Backflow Prevention Assembly</RTL>

<REF>> <ORG>FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)</ORG>

<RID>FCCCHR List</RID> <RTL>(continuously updated) List of Approved Backflow Prevention Assemblies</RTL>

<RID>FCCCHR Manual</RID> <RTL>(1988e9) Manual of Cross-Connection Control</RTL>

<REF>> <ORG>NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)</ORG>

<RID>NFPA 241</RID> <RTL>(2009) Standard for Safeguarding Construction,Alteration, and Demolition Operations</RTL>

<RID>NFPA 70</RID> <RTL>(2011; Errata 2 2012) National Electrical Code</RTL>

<REF>> <ORG>U.S. FEDERAL AVIATION ADMINISTRATION (FAA)</ORG>

<RID>FAA AC 70/7460-1</RID> <RTL>(2007; Rev K) Obstruction Marking and Lighting</RTL>

<REF>> <ORG>U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)</ORG>

<RID>MUTCD</RID> <RTL>(2009) Manual of Uniform Traffic Control Devices</RTL>

<SPT =1.3><TTL>1.3 SUBMITTALS</TTL>

<TXT>Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submitted the following in accordance with Section <SRF>01 33 00</SRF> SUBMITTAL PROCEDURES:</TXT>

<LST>_{SD-01 Preconstruction Submittals}</LST>

<ITM>_{Construction site plan}; _G</ITM>]
<ITM>_{Traffic control plan}; _G</ITM>]

<SPT =1.4><TTL>1.4 _{CONSTRUCTION SITE PLAN}</TTL>

<TXT>Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.</TXT>

</SPT =1.4></PRT =1><PRT =2><TTL>PART 2 PRODUCTS</TTL>

<SPT =2.1><TTL>2.1 TEMPORARY SIGNAGE</TTL>

<SPT =2.1.1><TTL>2.1.1 Bulletin Board</TTL>

<TXT>Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than<ENG> 36 by 48 inches</ENG> in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.</TXT>

<SPT =2.1.2><TTL>2.1.2 Project and Safety Signs</TTL>

<TXT>The requirements for the signs, their content, and location are as specified in Section <SRF>01 58 00</SRF> PROJECT IDENTIFICATION.. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.</TXT>

<SPT =2.2><TTL>2.2 TEMPORARY TRAFFIC CONTROL</TTL>

<SPT =2.2.1><TTL>2.2.1 Haul Roads</TTL>

<TXT>At contractors expense construct access and haul roads necessary for proper prosecution of the work under this contract. Construct with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic are be avoided. Provide necessary lighting, signs,

barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. </TXT>

<SPT =2.2.2><TTL>2.2.2 Barricades</TTL>

<TXT>Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.</TXT>

<SPT =2.2.3><TTL>2.2.4 Temporary Wiring</TTL>

<TXT>Provide temporary wiring in accordance with <RID>NFPA 241</RID> and <RID>NFPA 70</RID>, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.</TXT>

</SPT =2.2.3></SPT =2.2></PRT =2><PRT =3><TTL>PART 3 EXECUTION</TTL>

<SPT =3.1><TTL>3.1 EMPLOYEE PARKING</TTL>

<TXT>Contractor employees will park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.</TXT>

<SPT =3.2><TTL>3.2 AVAILABILITY AND USE OF UTILITY SERVICES</TTL>

<SPT =3.2.1><TTL>3.2.1 Temporary Utilities</TTL>

<TXT>Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.</TXT>

<SPT =3.2.2><TTL>3.2.10 Electricity</TTL>

<TXT>Provide connections, sized to provide service required for power and lighting. Locate feeder and branch wiring with area distribution boxes so that power is available throughout the project site by use of power cords. 120/240 and 480 electrical volt feeder service is available. Provide lighting as required for safe and secure operations. Electricity used will be furnished by the Government. </TXT>

<SPT =3.2.3><TTL>3.2.11 Water</TTL>

<TXT>Make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government. </TXT>

<SPT =3.2.4><TTL>3.2.12 Sanitation</TTL>

<LST>a. Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and / or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.</LST>

<SPT =3.2.5><TTL>3.2.13 Telephone</TTL>

<TXT>Make arrangements and pay all costs for telephone facilities desired.
</TXT>

<SPT =3.2.6><TTL>3.2.15 Fire Protection</TTL>

<TXT>Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.</TXT>

<SPT =3.3><TTL>3.3 TRAFFIC PROVISIONS</TTL>

<SPT =3.3.1><TTL>3.3.1 Maintenance of Traffic</TTL>

<LST INDENT=-0.33>a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a _{Traffic Control Plan} detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the <RID>MUTCD</RID>, Part VI. Make all notifications and obtain any permits required for modification to traffic movements outside Station's jurisdiction.. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.</LST>

<LST INDENT=-0.33>b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.</LST>

<LST INDENT=-0.33>c. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.</LST>

<SPT =3.3.2><TTL>3.3.2 Protection of Traffic</TTL>

<TXT>Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.</TXT>

<SPT =3.3.3><TTL>3.3.4 Dust Control</TTL>

<TXT>Dust control methods and procedures must be approved by the Contracting Officer. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.</TXT>

<SPT =3.4><TTL>3.4 CONTRACTOR'S TEMPORARY FACILITIES</TTL>
<TAI OPT=NASA></TAI>
<TXT>Contractor-owned or -leased trailers must be identified by Government assigned numbers. Size and location of the number will comply with . Apply the number to the trailer within 14 calendar days of notification, or sooner, if directed by the Government.</TXT>

<SPT =3.4.1><TTL>3.4.1 Safety</TTL>

<TXT>Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.</TXT>

<SPT =3.4.2><TTL>3.4.2 Administrative Field Offices</TTL>

<TXT>Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.</TXT>

<SPT =3.4.3><TTL>3.4.3 Storage Area</TTL>

<TXT>Construct a temporary<ENG> 6 foot</ENG> high chain link fence around trailers and materials. Include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store Trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment,

cranes, trucks, and like equipment within the fenced area at the end of each work day.</TXT>

<SPT =3.4.4><TTL>3.4.4 Supplemental Storage Area</TTL>

<TXT>Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor is responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.</TXT>

<SPT =3.4.5><TTL>3.4.5 Appearance of Trailers</TTL>

<LST INDENT=-0.33>a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on installation property. </LST>

<LST INDENT=-0.33>b. <ADD>M</ADD>aintain the temporary facilities. Failure to do so will be sufficient reason to require their removal. </LST>

<SPT =3.4.6><TTL>3.4.7 Maintenance of Storage Area</TTL>

<LST INDENT=-0.33>a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.</LST>

<SPT =3.4.7><TTL>3.4.9 Security Provisions</TTL>

<TXT>Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.</TXT>

<SPT =3.4.8><TTL>3.4.12 Weather Protection of Temporary Facilities and Stored Materials</TTL>

<TXT>Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental

weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.</TXT>

<SPT =3.4.8.1><TTL>3.4.12.1 Building and Site Storm Protection</TTL>

<TXT>When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.</TXT>

<SPT =3.4.8.2><TTL>3.4.12.2 Hurricane Condition of Readiness</TTL>

<TXT>Unless directed otherwise, comply with:</TXT>

<LST INDENT=-0.33>a. Condition FOUR (Sustained winds of<ENG> 50 knots</ENG> or greater expected within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than<ENG> 4 feet</ENG> high. Remove all debris, trash, or objects that could become missile hazards. Contact Contracting Officer for Condition Requirements updates and completion of required actions.</LST>

<LST INDENT=-0.33>b. Condition THREE (Sustained winds of<ENG> 50 knots </ENG> or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness. Contact Contracting Officer for weather and COR updates and completion of required actions.</LST>

<LST INDENT=-0.33>c. Condition TWO (Sustained winds of<ENG> 50 knots</ENG> or greater expected within 24 hours): Curtail or cease routine activities until securing operation is complete. Reinforce or remove form work and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact Contracting Officer for weather and Condition of Readiness (COR) updates and completion of required actions.</LST>

<LST INDENT=-0.33>d. Condition ONE. (Sustained winds of<ENG> 50 knots </ENG> or greater expected within 12 hours): Secure the jobsite, and leave Government premises.</LST>

<SPT =3.5><TTL>3.5 GOVERNMENT FIELD OFFICE</TTL>

<SPT =3.5.1><TTL>3.5.2 Quality Control Manager Records and Field Office </TTL>

<TXT>Provide on the jobsite an office with approximately<ENG> 200 square feet</ENG> of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a<ENG> 4 by 8 foot</ENG> plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide either a 1,500 watt radiant heater and a window-mounted air conditioner rated at<ENG> 9,000 Btus</ENG> minimum or a window-mounted heat pump of the same minimum heating and cooling ratings. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate as directed]. File quality control records in the office and make available at all times to the Government. After completion of the work, remove the entire structure from the site. </TXT>

<SPT =3.5.2><TTL>3.5.3 Trailer-Type Mobile Office</TTL>

<TXT>The Contractor may, at its option, furnish and maintain a trailer-type mobile office acceptable to the Contracting Officer and providing as a minimum the facilities specified above. Securely anchor the trailer to the ground at all four corners to guard against movement during high winds. </TXT>

<SPT =3.6><TTL>3.6 PLANT COMMUNICATION</TTL>

<TXT>Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor must install a satisfactory means of communication, such as telephone or other suitable devices and made available for use by Government personnel.</TXT>

<SPT =3.7><TTL>3.7 TEMPORARY PROJECT SAFETY FENCING</TTL>

<TXT>As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. The safety fencing must be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of<ENG> 42 inches</ENG> high, supported and tightly secured to steel posts located on maximum<ENG> 10 foot</ENG> centers, constructed at the approved location. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.</TXT>

<SPT =3.8><TTL>3.8 CLEANUP</TTL>

<TXT>Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stacked stored materials not in trailers, whether new or salvaged.</TXT>

<SPT =3.9><TTL>3.9 RESTORATION OF STORAGE AREA</TTL>

<TXT>Upon completion of the project remove the bulletinboard, signs, barricades, haulroads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor.

Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.</TXT>

</SPT =3.9></PRT =3> <END/>
</SEC>

SECTION 01 58 00

PROJECT IDENTIFICATION
08/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

U.S. ARMY CORPS OF ENGINEERS (USACE)

EP 310-1-6a	(2006) Sign Standards Manual, VOL 1
EP 310-1-6b	(2006) Sign Standards Manual, VOL 2, Appendices

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

preliminary drawing indicating layout and text content

Sign Legend Orders

SD-04 Samples

Final rendering sample

Final framed rendering and copies

Facility Recognition Plaque

1.3 QUALITY ASSURANCE

1.3.1 Rendering

Provide the project rendering in accordance with the following drawing stages as required in paragraph entitled "Submittals". The following submittal data is required to properly identify the appropriate view and approve the final rendering of the facility. The final painted rendering will be used to produce the image for the signboard and framed photographic copies provided to the Contracting Officer.

1.3.1.1 Preliminary One Line Drawings

Provide three different views of the facility in a preliminary single line drawing (black and white) format. These three views will represent the best angles at which to view the proposed facility showing the best design features and the three dimensional character of the facility.

1.3.1.2 Final Rendering Sample

Provide a photographic copy (8 by 10 inches minimum size) of final rendering for approval of color, landscaping, and foreground/background development prior to final submittal.

1.3.1.3 Final Framed Rendering and Copies

Provide final full color rendering of the proposed facility as specified.

1.4 PROJECT SIGN

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

Many products listed in 40 CFR 247 have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 TITLE

Not Used

PART 3 TITLE

Not Used

-- End of Section --

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED GBDC	(2009) LEED Reference Guide for Green Building Design and Construction
LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill.

1.3 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan

SD-11 Closeout Submittals

Records;

1.5 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

a. Pre-bid meeting.

b. Preconstruction meeting.

c. Regular QC meetings.

d. Work safety meetings.

1.6 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the pre-demolition meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.7 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.9 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly

and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION+-. Separate materials by one of the following methods:

1.9.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

(1) Ferrous.

(2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

(1) Bond.

(2) Newsprint.

(3) Cardboard and paper packaging materials.

i. Plastic.

(1) Type 1: Polyethylene Terephthalate (PET, PETE).

(2) Type 2: High Density Polyethylene (HDPE).

(3) Type 3: Vinyl (Polyvinyl Chloride or PVC).

(4) Type 4: Low Density Polyethylene (LDPE).

(5) Type 5: Polypropylene (PP).

(6) Type 6: Polystyrene (PS).

(7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.9.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.9.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.10 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.10.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.10.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.10.4 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.10.5 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1971	(2005; R 2011) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors must compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor must compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections must use Data Package 5. Commissioned items with a Data Package 1 or 2 requirement must use instead Data Package 5.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data must be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of

submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 Review and Approval

The Government's Commissioning Authority (CA) must review the commissioned systems and equipment submittals for completeness and applicability. The Government must verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CA must communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA must recommend approval and acceptance of these O&M manuals to the Contracting Officer. This work is in addition to the normal review procedures for O&M data.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.3.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.3.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.3.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.3.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of

wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.3.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.3.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.3.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.3.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.3.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.3.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.3.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.3.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.3.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.3.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.3.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.3.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.4 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply all functions,

features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).

1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.5.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Testing and performance data

s. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 86 26.07 40

RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS
02/12

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

This specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G

Material, Equipment, and Fixture Lists

SD-02 Shop Drawings

Connection Diagrams

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data

Equipment Foundation Data

Specific Equipment Data; G

Spare Parts List

Warranty

SD-05 Design Data

Design Analysis and Calculations; G

SD-06 Test Reports

SF6 Gas Test

SF6 Gas Leakage Test

Vacuum Bottle Integrity Test

Visual Inspection

SD-07 Certificates

Certificates; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals

SD-11 Closeout Submittals

Acceptance Documentation

Record Drawings

Baseline Data Report]

1.4 DESIGN DATA

Submit applicable design analysis and calculations for the equipment listed below as instructed to by the project specification.

d. Breakers:

(1) General

(5) SF6 Gas

][e. Cables:

][(1) General

][(2) Low Voltage (600V Maximum)

][(3) Medium Voltage (600V-33,000V)

j. Electric Buss

m. Electrical Grounding Grid

n. Electrical Lightning Protection

r. Electrical Relays

t. Electric Switches:

(6) Medium Voltage, SF6

u. Electrical Transformer Load Tap Changer

w. Switchgear

x. Transformers

1.5 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.6 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory. Show connection diagrams and assemblies in switchgear fabrication drawings

Submit for all equipment listed. Include manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to

demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for each specified component.

Submit manufacturer's catalog data and equipment foundation data (as applicable) for the following equipment:

Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

d. Breakers:

(1) General

(5) SF6 Gas

][e. Cables:

][(1) General

][(2) Low Voltage (600V Maximum)

][(3) Medium Voltage (600V-33,000V)

][j. Electric Buss

][m. Electrical Grounding Grid

][n. Electrical Lightning Protection

][r. Electrical Relays

][t. Electric Switches:

(6) Medium Voltage, SF6

u. Electrical Transformer Load Tap Change

w. Switchgear

x. Transformers

2.1.2 Certification Data

Submit applicable certificates for the equipment listed below showing conformance with test requirements, laboratory certifications, etc. as instructed by the project specification.

d. Breakers:

(5) SF6 Gas

][e. Cables:

][(1) General

][(2) Low Voltage (600V Maximum)

][(3) Medium Voltage (600V-33,000V)]

j. Electric Buss

m. Electrical Grounding Grid

n. Electrical Lightning Protection

][r. Electrical Relays

][t. Electric Switches:

(6) Medium Voltage, SF6

w. Switchgear

x. Transformers

2.1.3 Specific Equipment Data

Submit the following information for all equipment listed below: location of installation, NASA Identification number, date of installation (required or actual acceptance date), and applicable NASA reference drawing number. Unless explicitly stated in submitted manufacturer's literature, provide and submit the following specific equipment data:

][d. Breakers- General, Air Blast, Air Magnetic, Oil, SF6 Gas, and Vacuum Types

][(1) Breaker type

][(2) Breaker Specifications (including current transformer ratios)

][e. Cables- Low, Medium, and High Voltage

][(1) Power cable type

][g. Electrical Automatic Transfer Switch (ATS)

][(1) ATS Identification (Type)

][h. Electric Buss

][(1) Buss Type

][(2) Buss Specifications (including current and load capacity)

][k. Electrical Grounding Grid

][(1) Grid Identification (Type)

][l. Electrical Lightning Protection

][p. Electrical Relays

][(1) Electrical relay type (NEMA enclosure type)

][(2) Voltage configuration

][(3) Time over current curves (time delay curves)

][(4) Phase and ground operating curves (shapes)

][(5) Dimensions, Weight

][(6) UL certification, EMI levels (if applicable)

][(7) Number and types of output relays

][(8) Current loading

][r. Electric Switch, All Types

][(1) Switch type

][(2) Switch specifications

u. Switchgear

(1) Switchgear type

(2) Switchgear specification data (voltage rating)

v. Transformers

(1) Transformer Type

(3) Current transformer ratios

(4) Transformer impedance

(5) Load loss at rated voltage and current

(6) Current loading

2.1.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 12 months operation, and a list of the parts recommended by the manufacturer to be replaced after 1and5 year(s) of service.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, conduit and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function within the electrical system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for electrical equipment, panels, conduit, and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update electrical system drawings to reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on the equipment listed below. Correct all abnormalities or defects as directed by the Contracting Officer.

][d. Breakers:

][(5) SF6 gas

][e. Cables:

][(1) General

][(2) Low voltage (600V Maximum)

][(3) Medium voltage (600V-33,000V)

j. Electric Buss

m. Electrical Grounding Grid

n. Electrical Lightning Protection

r. Electrical Relays

t. Electric Switches:

][w. Switchgear

][x. Transformers

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. Ensure all equipment is free of latent manufacturing and installation defects, and acceptance criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection Tests

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report Data - Forward to the Systems Engineer for inclusion in the Maintenance Information Database.

[a. Perform SF6 Gas Test for:

][(1) Breakers- SF6 Gas

][(2) Electric Switch, Medium Voltage, SF6

][b. Perform SF6 Gas Leakage Test for:

][(1) Breakers- SF6 Gas

][c. Perform Air Compressor Performance Test for:

][(1) Breakers- SF6 Gas

][d. Perform Automatic Transfer Test for:

][(1) Electrical Automatic Transfer Switch

][f. Perform Breaker Timing Test for:

][(1) Breakers- General [optional]

][(2) Breakers- Air Blast [optional]

][(3) Breakers- Air Magnetic [optional]

][(4) Breakers- Oil [optional]

][(5) Breakers- SF6 Gas [optional]

][(6) Breakers- Vacuum [optional]

][i. Perform Contact Resistance Test for:

][(3) Breakers- General

][(4) Breakers- Air Blast

][(5) Breakers- Air Magnetic

][(6) Breakers- Oil

][(7) Breakers- SF6 Gas

][(8) Breakers- Vacuum

][(9) Electrical Automatic Transfer Switch

][(10) Electric Buss

][(21) Electric Switch, Medium Voltage, SF6

][(24) Electrical Relays [optional]

][(26) Switchgear [optional]

][(27) Transformers [optional]

][j. Perform Continuity Test for:

][(1) Electrical Lightning Protection

][k. Perform Fall of Potential Test for:

][(1) Electrical Grounding Grid

][n. Perform High Voltage Test for:

][(1) Breakers- General [optional]

][(2) Breakers- Air Blast [optional]

][(3) Breakers- Air Magnetic [optional]

][(4) Breakers- Oil [optional]

][(5) Breakers- SF6 Gas [optional]

][(6) Breakers- Vacuum [optional]

][(7) Cables (General) [optional]

][(8) Cables- Low Voltage (600V Maximum) [optional]

][(9) Cables- Medium Voltage (600V-33,000V) [optional]

][(18) Electric Switch, Medium Voltage, SF6 [optional]

][(21) Switchgear [optional]

][(22) Transformers [optional]

][p. Perform Insulation Oil Test for:

][(1) Breakers- Oil

][(3) Electric Switch, Medium Voltage, Oil

][(4) Electric Switch, Medium Voltage, Vacuum

][(5) Transformers

][(6) Breakers- General [optional]

][q. Perform Insulation Resistance Test for:

][(1) Breakers- General

][(5) Breakers- SF6 Gas

][(7) Cables (General)

][(8) Cables- Low Voltage (600V Maximum)

][(9) Cables- Medium Voltage (600V-33,000V)

][(14) Electric Buss

][(16) Electrical Relays

][(22) Electric Switch, Medium Voltage, SF6

][(25) Switchgear

][(28) Electrical Lightning Protection [optional]

][(33) Transformers [optional]

][r. Perform Overpotential Test for:

][(2) Electric Buss

][s. Perform Point to Point Test for:

][(1) Electrical Grounding Grid

][u. Perform Turns Ratio Test for:

][(4) Transformers

w. Perform Vacuum Bottle Integrity Test for:

(1) Breakers- SF6 Gas

(2) Electric Switch, Medium Voltage, Vacuum

3.3.2 Baseline Data from Verification Testing

Upon completion of all PT&I tests submit baseline data report to the Contracting Officer. Include a summary of all performance data, set points, operating parameters and PT&I test results obtained for equipment and building systems.

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for the following equipment:

][d. Breakers:

][(1) General

(5) SF6 Gas

][e. Cables:

][(1) General

][(2) Low Voltage (600V Maximum)

][(3) Medium Voltage (600V-33,000V)

][i. Electrical Automatic Transfer Switches

][j. Electric Buss

][m. Electrical Grounding Grid

][n. Electrical Lightning Protection

][r. Electrical Relays

][t. Electric Switches:

][(4) Medium Voltage Air, Metal Enclosed

][(6) Medium Voltage, SF6

][(7) Medium Voltage, Vacuum

][w. Switchgear

][x. Transformers

] Submit six complete copies of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When electronic format publications are provided, only two copies of the document are required. Submit operations and maintenance manuals 30 calendar days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing the Contracting

Officer will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the Contracting Officer for processing and approval.

-- End of Section --

SECTION 03 40 00.00 10

PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION
08/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2011; Errata 2011) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(2011) Building Code Requirements for Structural Concrete & Commentary

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(2000) Concrete Pipe Handbook
ACPA 01-110	(1984) Design Manual for Sulfide and Corrosion Prediction and Control
ACPA QPC	(2005; Ver 3.0) QCast Plant Certification Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A496/A496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A497/A497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A615/A615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2009b) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2009) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A884/A884M	(2006) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM C1064/C1064M	(2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1107/C1107M	(2011) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	(2010a) Standard Specification for Fiber-Reinforced Concrete
ASTM C1240	(2011) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1244	(2005ae1) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

ASTM C1244M	(2005ae1) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill (Metric)
ASTM C138/C138M	(2010b) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2010a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C1478	(2008) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
ASTM C1478M	(2008a) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals (Metric)
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C173/C173M	(2010b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C330/C330M	(2009) Standard Specification for Lightweight Aggregates for Structural Concrete

ASTM C39/C39M	(2011) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C443	(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C443M	(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C494/C494M	(2011) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2011) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C877M	(2002; R 2009) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections (Metric)
ASTM C891	(2011) Installation of Underground Precast Concrete Utility Structures
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C923M	(2008b) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C989/C989M	(2011) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C990M	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)

CSA STANDARDS (CSA)

CSA A23.4	(2009; Update 2010) Precast Concrete - Materials and Construction

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual	(2005; R 2006) Quality Control Manual for Precast Plants

1.2 SYSTEM DESCRIPTION

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least 3 years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades.

1.2.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards . Design shall also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings. Submit drawings for standard precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. These drawings shall demonstrate that the applicable industry design standards have been met. Include installation and construction information on shop drawings. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings. Submit cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.

1.2.2 Custom-Made Precast Units

Submit design calculations for custom-made precast units, prepared and sealed by a registered professional engineer, for approval prior to fabrication. Include in the calculations the analysis of units for lifting stresses and the sizing of lifting devices. Submit drawings furnished by the precast concrete producer for approval by the Contracting Officer. Show on these drawings complete design, installation, and construction information in such detail as to enable the Contracting Officer to determine the adequacy of the proposed units for the intended purpose. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

1.2.3 Proprietary Precast Units

Products manufactured under franchise arrangements shall conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, shall conform to the requirements in this specification. Submit standard plans or informative literature, for proprietary precast concrete units. Make

available supporting calculations and design details upon request. Provide sufficient information as to demonstrate that such products will perform the intended task.

1.2.4 Joints and Sealants

Provide joints and sealants between adjacent units of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

1.2.5 Concrete Mix Design

1.2.5.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportions using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. At a minimum of thirty days prior to precast concrete unit manufacturing, the precast concrete producer will submit a mix design and proportions for each strength and type of concrete that will be used. Furnish a complete list of materials, including quantity, type, brand and applicable data sheets for all mix design constituents as well as applicable reference specifications. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

1.2.5.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'c) of [_____] psi.

1.2.5.3 Water-to-Cement Ratio

Furnish concrete, that will be exposed to freezing and thawing, containing entrained air and with water-cement ratios of 0.45 or less. Furnish concrete which will not be exposed to freezing, but which is required to be watertight, with a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. Furnish reinforced concrete exposed to deicer salts, brackish water or seawater with a water-cement ratio of 0.40 or less for corrosion protection.

1.2.5.4 Air Content

The air content of concrete that will be exposed to freezing conditions shall be within the limits given below.

	AIR CONTENT PERCENT	
NOMINAL MAXIMUM AGGREGATE SIZE	SEVERE EXPOSURE	MODERATE EXPOSURE
3/8 inch	6.0 to 9.0	4.5 to 7.5

	AIR CONTENT PERCENT	
NOMINAL MAXIMUM AGGREGATE SIZE	SEVERE EXPOSURE	MODERATE EXPOSURE
1/2 inch	5.5 to 8.5	4.0 to 7.0
3/4 inch	4.5 to 7.5	3.5 to 6.5
1.0 inch	4.5 to 7.5	3.0 to 6.0
1.5 inch	4.5 to 7.0	3.0 to 6.0
Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1 percent		

1.2.5.5 Corrosion Control for Sanitary Sewer Systems

Follow design recommendations outlined in Chapter 7 of ACPA 01-102 or the ACPA 01-110 when hydrogen sulfide is indicated as a potential problem.

1.3 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Procedures

SD-02 Shop Drawings

Standard Precast Units
Custom-Made Precast Units

SD-03 Product Data

Standard Precast Units
Proprietary Precast Units
Embedded Items
Accessories

SD-05 Design Data

Design Calculations
Concrete Mix Proportions

SD-06 Test Reports

Test Reports

SD-07 Certificates

Quality Control Procedures

1.4 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in NPCA QC Manual and/or ACPA QPC. Meet requirements written in the subparagraphs below.

1.4.1 NPCA and ACPA Plant Certification

The precast concrete producer shall be certified by the National Precast Concrete Association's and/or the American Concrete Pipe Association's Plant Certification Program prior to and during production of the products for this project.

1.4.2 Qualifications, Quality Control and Inspection

1.4.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.4.2.2 Quality Control Procedures

Submit quality control procedures established by the precast manufacturer in accordance with NPCA QC Manual and/or ACPA QPC. Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

a. Slump: Perform a slump test for each 150 cu yd of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with ASTM C143/C143M.

b. Temperature: Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C1064/C1064M.

c. Compressive Strength: Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: ASTM C31/C31M, ASTM C192/C192M, ASTM C39/C39M.

d. Air Content: Perform tests for air content on air-entrained, wet-cast concrete for each 150 cu yd of concrete, but not less often than once each day when air-entrained concrete is used. Determine the air content in accordance with either ASTM C231/C231M or ASTM C173/C173M for normal weight aggregates and ASTM C173/C173M for lightweight aggregates.

e. Unit Weight: Perform tests for unit weight a minimum of once per week to verify the yield of batch mixes. Perform unit weight tests for each 100 cu yd of lightweight concrete in accordance with ASTM C138/C138M.

1.4.2.3 Inspection

The Contracting Officer may place an inspector in the plant when the units

covered by this specification are being manufactured. The burden of payment for plant inspection will be clearly detailed in the specification. The precast concrete producer shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.4.2.4 Test Reports

Submit the following as specified in paragraph SUBMITTALS:

a. Material certifications and/or laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

b. Test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

c. Sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

d. In-plant QA/QC inspection reports, upon the request of the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Contracting Officer for quality and final acceptance.

1.5.2 Storage

Store units off the ground or in a manner that will minimize potential damage.

1.5.3 Handling

Handle, transport, and store products in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

Except as otherwise specified in the following paragraphs, conform material to Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE and Section 03 20 00.00 10 CONCRETE REINFORCING.

2.1.1 Cement

Furnish cement conforming to ASTM C150/C150M, Type I, II, III or V. Furnish blended cements that conform to ASTM C595/C595M.

2.1.2 Silica Fume

Provide silica fume conforming to ASTM C1240. Provide available alkalies conforming to the optimal limit given in Table 2 of ASTM C1240. Silica fume may be furnished as a dry, densified material or as a slurry. When necessary, coordinate the services of a technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

2.1.3 Fly Ash and Pozzolans

Fly ash is [required] [used] as a supplementary cementitious material (SCM) conforming to ASTM C618, Class [C or F] with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.

2.1.4 Ground Granulated Blast-Furnace Slag

Ground granulated blast furnace slag is [required] [used] as a supplementary cementitious material conforming to ASTM C989/C989M, Grade [120] with between 25 to 50 percent maximum cement replacement by weight.

2.1.5 Water

Furnish water potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

2.1.6 Aggregates

2.1.6.1 Selection

Furnish aggregates conforming to ASTM C33/C33M. Provide aggregates not containing any substance, which may be deleteriously reactive with the alkalies in the cement.

2.1.6.2 Aggregates for Lightweight Concrete

ASTM C330/C330M

2.1.7 Admixtures

2.1.7.1 Air-Entraining

ASTM C260/C260M

2.1.7.2 Accelerating, Retarding, Water Reducing [Moderate to High]

ASTM C494/C494M

2.1.7.3 Pigments

Non-fading and lime-resistant

2.1.8 Reinforcement

2.1.8.1 Reinforcing Bars

a. Deformed Billet-steel: ASTM A615/A615M
b. Deformed Low-alloy steel: ASTM A706/A706M

2.1.8.2 Reinforcing Wire

a. Plain Wire: ASTM A82/A82M
b. Deformed Wire: ASTM A496/A496M

2.1.8.3 Welded Wire Fabric

a. Plain Wire: ASTM A185/A185M
b. Deformed Wire: ASTM A497/A497M

2.1.8.4 Epoxy Coated Reinforcement

a. Reinforcing Bars: ASTM A775/A775M
b. Wires and Fabric: ASTM A884/A884M

2.1.8.5 Galvanized Reinforcement

Provide galvanized reinforcement conforming to ASTM A767/A767M.

2.1.9 Synthetic Fiber Reinforcement

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inch.

2.1.10 Inserts and Embedded Metal

All items embedded in concrete shall be of the type required for the intended task, and meet the following standards.

a. Structural Steel Plates, Angles, etc.: ASTM A36/A36M
b. Hot-dipped Galvanized: ASTM A153/A153M
c. Proprietary Items: In accordance with manufacturers published literature

2.1.11 Accessories

Submit proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.

a. Rubber Gaskets for Circular Concrete Sewer Pipe and Culvert Pipe: ASTM C443.

b. External Sealing Bands for Noncircular Sewer, Storm Drain and Culvert

Pipe: ASTM C877.

c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: ASTM C990.

d. Elastomeric Joint Sealants: ASTM C920

2.1.12 Pipe Entry Connectors

Pipe entry connectors shall conform to ASTM C923 or ASTM C1478.

2.1.13 Grout

Nonshrink Grout shall conform to ASTM C1107/C1107M. Cementitious grout shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. [Provide air entrainment for grout exposed to the weather.]

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with NPCA QC Manual and/or ACPA QPC unless specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4/D1.4M. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1/D1.1M when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations. Submit product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.

3.1.4 Synthetic Fiber Reinforced Concrete

Add fiber reinforcement to the concrete mix in accordance with the applicable sections of ASTM C1116/C1116M and the recommendations of the manufacturer, and in an amount of [0.1] [_____] percent by volume.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with ACI 306.1.

a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.

b. Free from frost all concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact.

c. Do not use frozen materials or materials containing ice.

d. In cold weather the temperature of concrete at the time of placing shall not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Recommendations for hot weather concreting are given in detail in ACI 305R. During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance

with ASTM C171.

b. Cover with burlap or other absorptive material and keep continually moist.

c. Use of a membrane-curing compound applied at a rate not to exceed 200 square ft/gallon, or in accordance with manufacturers' recommendations according to ASTM C309.

3.2.3.2 Curing with Heat and Moisture

Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Apply steam, if used, within a suitable enclosure, which permits free circulation of the steam in accordance with CSA A23.4. If hot air is used for curing, take precautions to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 150 degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted but no major imperfections, honeycombs, or other major defects shall be permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes shall be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for approval when required by the project documents. The sample finishes shall be approved prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

3.2.6.1 Repairing Minor Defects

Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas

When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects

Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7 Shipping Products

Do not ship products until they are at least 5 days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION

3.3.1 Site Access

It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 General Requirements

a. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.

b. Lift products by suitable lifting devices at points provided by the precast concrete producer.

c. Install products in accordance with the precast concrete producer's instructions. In the absence of such instructions, install underground utility structures in accordance with ASTM C891. Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.

d. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.

3.3.3 Water Tightness

Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Tests

When water tightness testing is required for an underground product, use one of the following methods:

3.4.2 Vacuum Testing

Prior to backfill vacuum test system according to ASTM C1244.

3.4.3 Water Testing

Perform water testing according to the contract documents and precast concrete producer's recommendations.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012) National Electrical Safety Code
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 12 19.10 THREE-PHASE PAD MOUNTED TRANSFORMERS

Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION
Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 15 kV primary, three phase, four wire, 60 Hz, and 120/208, 480/277volts secondary, three phase, four wire. Final connections to the power distribution system at the existing manhole shall be made by the Contractor as directed by the Contracting Officer.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 IEEE C2unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's

name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers[and pad-mounted SF6 switches], provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the

equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test[and the additional requirements specified in the technical sections].

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two

sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL
11/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480	(1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	(2009) Accessible and Usable Buildings and Facilities

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1	(2006; R 2011) American National Standard for Safety--Color Code
ANSI/NEMA OS 1	(2008; Amd 2010) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
ANSI/NEMA OS 2	(2008; AMD 2010) Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	(2008) Enclosures for Electrical Equipment

(1000 Volts Maximum)

NEMA FB 1	(2012) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA KS 1	(2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA PB 1	(2011) Panelboards
NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	(2009) Standard for Metal Cable Tray Systems
NEMA WD 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2002; R 2008) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2007) Standard for Flexible Metal Conduit
UL 1242	(2006; Reprint Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 506	(2008; Reprint Mar 2010) Specialty Transformers
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel

UL 797	(2007) Electrical Metallic Tubing -- Steel
UL 870	(2008) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

Spare Parts

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.5 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.6 GENERAL REQUIREMENTS

Submit material, equipment, and fixture lists for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit certification required to install equipment components and system packages.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.10 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 15 kilo-volt type EPR.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 6 and larger with [indentor crimp-type connectors and compression tools] [bolted clamp-type connectors]. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise,provide a floor box set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70.

3.10 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00 PAINTS AND COATINGS or Section 09 96 00 HIGH-PERFORMANCE COATINGS.

3.11 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to

end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

SECTION 26 05 13.00 40

MEDIUM-VOLTAGE CABLES
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS1	(1990e11) Impregnated-Paper-Insulated, Metallic Sheathed Cable, Solid Type

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM D746	(2007) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383	(2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004
IEEE 400.2	(2004) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659	(1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 2	(1980; Rev 1 1989; R 1998; R 2005) Standard for Steel Armor and Associated Coverings for Impregnated Paper Insulated Cables (ICEA S-67-401 5th Edition)

NEMA WC 27500	(2005) Standard for Aerospace and Industrial Electrical Cable
NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658
NEMA WC 74/ICEA S-93-639	(2006) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-228	(2000; Notices 1-5) Cable and Wire, Insulated; Methods of Testing

1.2 DEFINITIONS

Medium voltage power cables includes all cables rated above 600 to 35,000 volts.

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Provide Certificates for the following showing that the cable manufacturer has made factory-conducted tests on each shipping length of cable. Provide certified copies of test data that shows conformance with the referenced standards and is approved prior to delivery of cable.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Provide equipment and performance data and manufacturer's catalog data for the following items:

Multiple-Conductor Shielded Cables

Single-Conductor Shielded Cables

Nonmetallic Jacket

SD-06 Test Reports

Provide test reports for the following in accordance with the paragraph entitled, "Field Testing," of this section.

Dielectric Absorption Tests

High-Voltage Tests

SD-07 Certificates

Provide listing of products installed showing qualifications of Cable Splicers to the Contracting Officer prior to specified work.

Provide Certificates for the following:

Flammability

Minimum Bending Radius

High-Voltage Tests

Dielectric Absorption Tests

Cable Splicers

SD-08 Manufacturer's Instructions

Provide manufacturer's instructions showing the recommended sequence and method of installation for the following:

Medium-Voltage Power Cables

High-Voltage Power Cables

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section

01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 QUALIFICATIONS

Cable splicers performing splicing are required to have 5 years experience in cable splicing and terminations. Once a termination or splice has been started by a worker, the same person completes that particular splice. Start and complete each termination and splice in one continuous work period.

1.7 CABLE VOLTAGE RATINGS

Provide Medium-voltage power cables including multiple- and single-conductor cables rated as follows, phase-to-phase, for grounded and ungrounded neutral systems:

Use cables rated 15,000 volts, ungrounded neutral, on 12,470-volt, three-phase, 60-hertz distribution systems.

1.8 SHIPMENT

Ship cables on reels such that the cable is protected from mechanical injury. Hermetically seal and securely attach each end of each length of cable to the reel.

Make minimum reel drum diameter 14 times the overall diameter of the cable. Provide a pulling eye that is installed by the manufacturer for each length of cable supplied for installation in ducts, manholes, and utility tunnels.

PART 2 PRODUCTS

2.1 CONDUCTORS

Provide conductors that are solid copper conforming to ASTM B3.

2.2 CABLE IDENTIFICATION

Provide cables that have a tape placed immediately under the lead sheath or outer jacket showing the name of the manufacturer, the year in which the cable was manufactured, and a unique number for identification purposes. Closely group information on the tape at 1-foot intervals to permit complete identification.

2.3 FLAMMABILITY

Test cables not to be enclosed in metallic conduit for flammability in accordance with FED-STD-228, Method 5221 verticalIEEE 383, 70,000 Btu per hour per hour vertical tray flame test.

2.4 MULTIPLE-CONDUCTOR SHIELDED CABLES

2.5 MULTIPLE-CONDUCTOR, NONSHIELDED CABLES

2.5.4 Ethylene-Propylene with PVC Jacket

Provide multiple-conductor, ethylene-propylene-insulated,

polyvinylchloride-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.6 SINGLE-CONDUCTOR SHIELDED CABLES

2.6.4 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor 15 KV cable assemblies that consist of: Class B stranded copper conductors, an extruded semiconducting shield over the conductors, 220 mils of ethylene propylene rubber insulation, an extruded or other approved semiconducting shield, a 5 mil minimum copper tape shield wrapped helically with a minimum 12.5 percent overlap and a PVC jacket.

Provide single-conductor, ethylene-propylene-insulated, polyvinylchloride-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.7 SINGLE-CONDUCTOR NONSHIELDED CABLES

2.7.1 Butyl Rubber with Neoprene Jacket

Provide single-conductor, butyl-rubber-insulated, neoprene-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639.

2.7.2 Cross-Linked Polyethylene

Provide single-conductor, cross-linked polyethylene-insulated, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.7.3 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor, ethylene-propylene-rubber-insulated, polyvinylchloride-jacketed, nonshielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.10 CABLE SUPPORTS AND FITTINGS

Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes and utility tunnels, with a factory applied coating of polyvinylchloride of at least 20 mils thick. Provide polyvinylchloride (PVC) coated items that have a uniform thickness and be free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D746.

[Provide cable racks, cable tray supports and related fittings that are UL listed heavy-duty nonmetallic polycarbonate.

PART 3 EXECUTION

3.1 INSTALLATION

Install medium-voltage cables in accordance with NFPA 70.

Install cable in underground duct banks; in conduit above and below grade; inside buildings; by open wire method; on insulator hooks; on racks; in

wall and ceiling mounted cable trays in utility tunnels and manholes; and by direct burial.

Secure cables with heavy duty cable ties in existing or new trays mounted horizontally, where cable rests on tray bottom. Install cable ties at minimum of 10 foot intervals.

Secure cables with PVC coated cable clamps, straps, hangers, or other approved supporting devices to tunnel walls, ceilings, and in new or existing cable trays mounted vertically, where tray bottom is in a vertical plane.

When field cuts or other damage occurs to the PVC coating, apply a liquid PVC patch to maintain the integrity of the coating. After the installation is complete, perform an inspection to ensure the absence of voids, pinholes, or cuts.

Ensure that all cable tray is properly secured and supported prior to installing new armored cable. Add new permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.

Cable or conductors of a primary distribution system will be rejected when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with ac/dc control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.

3.1.1 Moisture-Testing Before Pulling

Moisture-test cable that has paper insulation before before pulling it into underground ducts. Ensure that radii of bends, potheads, fittings, cable risers, and other conditions are suitable for the cable and conform with the recommendations of the cable manufacturer.

3.1.2 Protection During Splicing Operations

Provide blower to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Make waterproof protective coverings available on the work site to provide protection against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Never make a splice or termination with the interior of a cable exposed to moisture. Moisture-test conductor insulation paper before the splice is made. Use a manhole ring at least 6 -inches above ground around the manhole entrance to keep surface water from entering the manhole. Plug unused ducts and stop water seepage through ducts in use before the splice is started.

3.1.3 Duct Cleaning

Thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth, sand, or foreign material in the line. Provide not less than 12 -inches long mandrel with a diameter 1/2 inch less than the inside diameter of the duct. Then pull a brush with stiff bristles through each duct to remove the loosened particles. Provide brush diameter that is the same as or slightly larger than the diameter of the duct.

3.1.4 Pulling Cables in Ducts, Manholes and Utility Tunnels

Pull medium-voltage cables into ducts and utility tunnels with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure the careful and proper installation of the cable.

Set up cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install flexible tube guide through the opening in a manner that prevents the cable from rubbing on the edges of any structural member.

Allow for a pulling force for a cable grip on lead-sheathed cable that does not exceed 1,500 pounds per square inch of sheath cross-sectional area. Use a dynamometer in the pulling line to ensure that the pulling force is not exceeded. Allow for a pulling force for a nonmetallic-sheathed cable that does not exceed the smaller of 2,600 pounds or a value computed from the following equation:

TM = 0.008 X N X CM

Where: TM = maximum allowable pulling tension in pounds

N = number of conductors in the cable

CM = cross-sectional area of each conductor in circular mils

Unreel cable from the top of the reel. Carefully control payout. Make cable to be pulled be attached through a swivel to the main pulling wire by means of a pulling eye.

Use woven-wire cable grips to grip the cable end when pulling small cables and short straight lengths of heavier cables.

Attach pulling eyes to the cable conductors to prevent damage to the cable structure.

Use pulling eyes and cable grips together for nonmetallic sheathed cables to prevent damage to the cable structure.

Provide a minimum bending radius in accordance with the following:

CABLE TYPE	MINIMUM BENDING RADIUS MULTIPLIER TIMES CABLE DIAMETER
RUBBER- AND PLASTIC-INSULATED CABLE WITH OR WITHOUT INTERLOCKED ARMOR	
Shielded cables with shielding tape	12

CABLE TYPE	MINIMUM BENDING RADIUS MULTIPLIER TIMES CABLE DIAMETER

Liberally coat cables with a suitable cable-pulling lubricant as it enters the tube guide or duct. Use grease and oil lubricants only on lead-sheathed cables. Cover nonmetallic sheathed cables with wire-pulling compounds when required which have no deleterious effects on the cable. Provide rollers, sheaves, or tube guides around which the cable is pulled that conform to the minimum bending radius of the cable.

Pull cables into ducts at a speed not to exceed 50 feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle is not permitted. Stop pulling operations immediately with any indication of binding or obstruction and do not resume until such difficulty is corrected. Provide sufficient slack for free movement of cable due to expansion or contraction.

Make cable splices made up in manholes or utility tunnels that are firmly supported on cable racks as indicated. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Make cables to be spliced in manholes or utility tunnels overlap the centerline of the proposed joint by not less than 2 feet.

Provide cables cut in the field that have the cut ends immediately sealed to prevent entrance of moisture. Seal nonleaded cables with rubber tape wrapped down to 3inches from the cable end. Cover-wrap rubber tape with polyvinylchloride tape. Seal lead-covered cables with wiping metal making a firm bond with the end of the sheath or with a disk of lead fitted over the end and wiped to the sheath.

3.1.5 Splices and Terminations

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables to minimize exposure and cable deterioration.

Terminate cables in potheads. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones are allowed for terminating cables. Provide potheads with adequate means for making external connections to the cable conductors of single- conductor cables; protecting the cable insulation against moisture, oil, or other contaminant; physically protecting and supporting cables, and maintaining the insulation level of the cable.

Field-fabricate Pothead terminations from termination kits supplied by and in accordance with the pothead manufacturer's recommendations for the type, size, and electrical characteristics of the cable.

Installation includes built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above, ungrounded.

Field fabricate cable splices from splicing kits supplied by and in accordance with the cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Locate cable splices in manholes midway between cable racks on walls of manholes and supported with cable arms at approximately the same elevation as the enclosing duct.

Cable splices in the tunnel which are not installed in cable trays, install on cable racks or by other approved methods which minimize physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

Support all universal demountable splices in such manner so as to minimize physical stress on the splice connections. Support each cable end termination using a pair of saddle type supports under the cable end termination and/or cable with a minimum 12 inches and a maximum 30 inches separation between the supports. Secure cable end termination and cable to the supports in such a manner as to prevent movement of termination or cable at the support. Install saddle type supports on galvanized steel framing channel anchored to the wall or securely fastened to the cable tray or installed by other approved methods.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Subject each to dielectric-absorption tests and high-voltage tests after the installation of high-voltage power cables has been completed, including splices, joints, and terminations, and before the cable is energized.

Provide test equipment, labor, and technical personnel as necessary to perform the electrical acceptance tests.

Make arrangements to have tests witnessed and approved by the Contracting Officer.

Completely isolate each power-cable installation from extraneous electrical connections at cable terminations and joints. Observe safety precautions.

First give each power cable a full dielectric-absorption test with 5000-volt insulation-resistance test set. Apply test for a long enough time to fully charge the cable. Record readings every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Continue test until three equal readings, 1 minute apart, are obtained. Minimum reading is 200 megohms at an ambient temperature of 68 degrees F. Correct readings taken at other than 68 degrees F ambient temperatures.

Upon successful completion of the dielectric absorption tests, subject the cable to a direct-current high-potential test for 5 minutes with test voltages applied in accordance with AEIC CS1 and IEEE 400.2 for paper-impregnated, lead-covered cable; AEIC C8 and IEEE 400.2 for cross-linked, polyethylene-insulated cable; and AEIC C8 and IEEE 400.2 for ethylene propylene rubber-insulated cable.

Record leakage current readings every 30 seconds during the first 2 minutes

and every minute thereafter for the remainder of the test. When the leakage current continues to increase after the first minute, immediately terminate the test and take steps to find and correct the fault. When a second test becomes necessary, repeat this test procedure.

Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test as before.

Provide results of the second dielectric-absorption test that agree with the first test and that indicate no evidence of permanent injury to the cable caused by the high-potential test.

Record test data and include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

Final acceptance depends upon the satisfactory performance of the cable under test. Do not energize cable until recorded test data has been approved by the Contracting Officer Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 26 05 19.00 10

INSULATED WIRE AND CABLE
11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383	(2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation Instructions

SD-06 Test Reports

Tests, Inspections, and Verifications

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel

number. Each coil or reel of cable shall contain only one continuous cable without splices. Cables for exclusively dc applications, as specified in paragraph HIGH VOLTAGE TEST SOURCE, shall be identified as such. Shielded cables rated 2,001 volts and above shall be reeled and marked in accordance with Section I of AEIC C8 or AEIC CS8, as applicable. Reels shall remain the property of the Contractor.

1.4 PROJECT/SITE CONDITIONS

[_____]

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

Furnish wire and cable in accordance with the requirements of the wire table appended to these specifications, conforming to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with NEMA WC 70.

2.1.3 Conductors

2.1.3.1 Material for Conductors

Conductors shall conform to all the applicable requirements of NEMA WC 70, as applicable, and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

2.1.3.2 Size

Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in NEMA WC 70, as applicable.

2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in NEMA WC 70, as applicable. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding.

2.1.3.4 Conductor Shielding

Use conductor shielding conforming to NEMA WC 70, as applicable, on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC C8 or AEIC CS8. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently applied insulation.

2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

2.1.4.1 Insulation Material

Provide insulation which is an ethylene-propylene rubber (EPR) type meeting the requirements of NEMA WC 70. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

b. Insulation shall be chemically bonded to conductor shielding.

c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC C8 or AEIC CS8, as applicable.

d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable .

2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by NEMA WC 70, as applicable. Some thicknesses of NEMA WC 70 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 70 ethylene-propylene rubber-insulated conductors shall have a jacket.

b. Power Cables, Rated 2,001 Volts and Above - Thickness of insulation for power cables rated 2,001 volts and above shall be in accordance with the following:

(1) Non-shielded cables, 2,001 to 5,000 volts, shall comply with NEMA WC 70, as applicable.

(2) Shielded cables rated 2,001 volts and above shall comply with Column B of Table B1, of AEIC C8 or AEIC CS8, as applicable.

c. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by NEMA WC 70, as applicable.

2.1.4.3 Insulation Shielding

Unless otherwise specified, provide insulation shielding for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in NEMA WC 70, as applicable. The material, if thermosetting, shall meet the wafer boil test requirements as described in Section D of AEIC C8 or AEIC CS8, as applicable. The method of shielding shall be in accordance with the current practice of the industry; however, the application process shall include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield shall not exceed the maximum allowances specified in Section C of AEIC C8 or AEIC CS8, as applicable. The cable shall be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system shall remain tightly applied to the components they enclose after handling and installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove will not be permitted unless specifically approved.

2.1.5 Jackets

All cables shall have jackets meeting the requirements of NEMA WC 70, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. General Use

(1) Heavy-duty black neoprene (NEMA WC 70).

(2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 70).

(3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 70).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one

of the following:

(1) General-purpose neoprene (NEMA WC 70).

(2) Black polyethylene (NEMA WC 70).

(3) Thermoplastic chlorinated polyethylene (NEMA WC 70).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by NEMA WC 70, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by NEMA WC 70.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in NEMA WC 70. If shielded, the jacket thickness shall be in accordance with the requirements of NEMA WC 70.

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with NEMA WC 70, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with NEMA WC 70. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included. Other individual conductors shall be color-coded as indicated on the contract drawings but such color-coding may be accomplished by applying colored plastic tapes or sleeving at terminations.

2.2.2 Shielded Cables Rated 2,001 Volts and Above

Marking shall be in accordance with Section H of AEIC C8 or AEIC CS8, as applicable.

2.2.3 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to NEMA WC 70, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the

cable and shall be lapped at least 10 percent of its width.

2.2.4 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit cable manufacturing data . The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.

b. Pulling tension and sidewall pressure limits, in pounds.

c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.

d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

3.2 TESTS, INSPECTIONS, AND VERIFICATIONS

3.2.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer. The Government may perform further tests before or after installation. Testing in general shall comply with NEMA WC 70. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below. Submit 3 certified copies of test reports.

3.2.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for

cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

3.2.2.2 Shielded Cables Rated 2,001 Volts or Greater

The following tests shall be performed in addition to those specified above. Section or paragraph references are to AEIC C8 or AEIC CS8 as applicable, unless otherwise stated.

a. High potential test voltages shall be as required by Table B1 of AEIC C8 or AEIC CS8 as applicable, rather than by NEMA WC 70.

b. If high potential testing is done with an ac test voltage as specified in paragraph HIGH-VOLTAGE TEST SOURCE, an additional test shall be made using a dc test voltage rated at 75 percent of the specified full dc test voltage, for 5 consecutive minutes.

c. Production sampling tests shall be performed in accordance with Section D. Sampling frequency and failure contingencies shall be in accordance with paragraph G.3. Unless otherwise approved, samples shall not be taken from the middle of extruder runs of insulation or shielding made only for one continuous shipping length of cable, if such sampling will result in the need to repair the sampled area.

d. Partial discharge tests shall be performed in accordance with Section E, paragraph E.2, and Section F.

3.2.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 70. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

3.2.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

3.2.2.5 Reports

Furnish results of tests made. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

WIRE TABLE

Item No.	Size, AWG or kcmil	No. of Conds.	Rated Circuit Voltage	Stranding	Comments	Quantity lin ft.

Class ___ stranding may be substituted for ___ where indicated by "*".

-- End of Section --

SECTION 26 05 70.00 40

HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments

ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM D3487	(2009) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 443	(1979) NARM Standard for Solid State Relays Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.09	(1999; AMD 1 2005; Corr 1 2007; R 2007; Errata 2007; Amendment B 2011) Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.121	(1989; R 2006) American National Standard for Switchgear-Unit Substations - Requirements
IEEE C37.13	(2008; INT 1 2009) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE C37.16	(2009) Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC 3200 V and below) Power Circuit Breakers
IEEE C37.17	(1997) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C57.13	(2008) Standard Requirements for Instrument Transformers
IEEE C63.2	(2009) Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications
IEEE C63.4	(2009) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
ANSI C78.23	(1995; R 2003) American National Standard for Incandescent Lamps - Miscellaneous Types
NEMA 107	(1987; R 1993) Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus (inactive)
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2006) Molded Case Circuit Breakers and Their Application
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements

NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA SG 2	(1993) Standard for High-Voltage Fuses

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 50	(2007) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 508	(1999; Reprint Apr 2010) Industrial Control Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Fuses]

Sample Warranty

SD-02 Shop Drawings

Connection Diagrams

Fabrication Drawings

Control Devices

Protective Devices

SD-03 Product Data

Instrument Transformers

Current Transformers

Potential Transformers

Enclosures

Control Devices

Protective Relays

Indicating Instruments

Indicating Lights

SD-06 Test Reports

Dielectric Tests

Timing Test

Insulation Power Factor Test

Final Test Reports

SD-07 Certificates

Circuit Tests

Warranty

SD-08 Manufacturer's Instructions

Control Devices

Protective Devices

SD-10 Operation and Maintenance Data

Circuit Breakers

Protective Relays

Indicating Instruments

1.3 ADMINISTRATIVE REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Prior to the beginning of construction submit manufacturer's equipment and

performance data for the following items including use life, system functional flows, safety features, and mechanical automated details:

a. Fuses

c. Instrument transformers

d. Enclosures

e. Circuit breakers

f. Control devices

g. Protective relays

h. Indicating instruments

i. Indicating lights

j. Submit connection diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

k. Submit fabrication drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

l. Submit manufacturer's sample warranty for review and acceptance to the Contracting Officer

1.4 QUALITY ASSURANCE

1.4.1 Predictive Testing And Inspection Technology Requirements

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS

PART 2 PRODUCTS

2.2 INSTRUMENT TRANSFORMERS

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2, IEEE C63.4, and NEMA 107 for Instrument transformers.

Influence		Preferred			Radio	
Insulation Class, kV	Basic Insulation Level, kV	Nominal System Voltage, kV	Test Voltage for Potential Transformers, kV	Test Voltage for Current Transformers, kV	Voltage Level, Microvolts Dry Type	Oil Filled
0.6	10	.....	.....	0.76	250	250
1.2	30	0.208 0.416 0.832 1.04	0.132 0.264 0.528 0.66	0.76	250	250
2.5	45	2.40	1.52	1.67	250	250
5.0	60	4.16 4.80	2.64 3.04	3.34	250	250
8.7	75	7.20 8.32	4.57 5.28	5.77	250	250
15L or 15H	95-110	12.00 12.47 14.40	7.62 7.92 9.14	9.41	1000	250
25	150	23.00	14.60	15.70	2500	650
34.5	200	34.50	21.90	23.0	....	650
46	250	46.00	29.20	29.30	....	1250
69	350	69.00	43.80	44.00	....	1250
92	450	92.00	58.40	58.40	....	2500
115	550	115.00	73.40	73.40	....	2500
138	650	138.00	88.00	88.00	....	2500

2.2.1 Current Transformers

Provide current transformers conforming to IEEE C57.13 for installation in metal-clad switchgear. Use standard 3-A secondary transformer.

Provide wound type transformers.

Provide transformers that have single secondary winding.

Provide transformers that are complete with secondary short-circuiting device.

For window-type current transformers, provide indoor dry type construction with secondary current ratings as indicated with specified burden, frequency, and accuracy.

2.2.2 Potential Transformers

Provide potential transformers conforming to IEEE C57.13 for installation in metal-clad switchgear. Use standard 120-volt secondary transformers.

Provide transformers with single secondary.

Provide burden, frequency, and accuracy as required.

For disconnecting potential transformers with integral fuse mountings and current-limiting fuses, provide indoor dry type two-winding construction with primary and secondary voltage ratings as required.

2.3 ENCLOSURES

2.3.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

b. Contain equipment installed in wet locations in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

c. Contain equipment installed in industrial locations in a NEMA Type 12 industrial use, sheet-steel enclosure constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

f. Fabricate sheet-steel enclosures from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

][g. Fabricate steel enclosures from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A167 Type 300 series with ASM No. 4 general-purpose polished finish, with box dimensions and thickness of sheet steel in accordance with UL 50.

2.3.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

b. Contain remote-control stations installed in wet locations in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosures constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and

NEMA 250 for Type 4 enclosures.

2.4 CIRCUIT BREAKERS

Provide circuit breakers conforming to UL 489, UL 489, and NEMA AB 3.

2.4.1 Power Circuit Breakers

Comply with IEEE C37.16 and IEEE C37.13 for power circuit breakers.

Equip power circuit breakers with static trip (solid-state) devices with long-time/short-time instantaneous elements.Provide breakers that are electrically and mechanically trip-free in any position of the closing stroke. Include ground fault protection in either type trip device. Provide silver-plated main contacts and sintered tungsten alloy arcing contacts. Accomplish tripping by a [shunt-trip] [series-trip] device. Provide manual electrical closing operation.

Supply alarms, auxiliary switches, interlocks, and similar devices as required.

Provide breakers with a removable operating handle, provision for padlocking, and position indicator.

Submit certification of factory testing of Power Circuit Breakers in accordance with IEEE C37.09.

2.4.2 Air Circuit Breakers

Provide circuit breakers that include a ground-fault system or ground-sensing relays.

2.4.2.1 Stored-Energy-Operated Type

Provide circuit breakers that have mechanically trip-free mechanisms with direct-current potential trip coils of the voltage indicated, auxiliary switches, latch-checking switches, control relays, and operation counters.

2.4.2.2 Solenoid-Operated Type

Rate mechanism closing coils for 125 volts and operable at voltages as low as 90 volts. Rate mechanism trip coils for 125 volts and operable at voltages as low as 70 volts. Provide operating mechanism for ac control circuits by the manufacturer for [_____] voltage.

Provide circuit breakers with mechanically trip-free mechanisms including auxiliary switches, latch-checking switches, control relays, and operation counters. The use of solid-state tripping devices is acceptable.

2.5 FUSES

Provide a complete set of fuses for all switches and switchgear. Provide fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Provide power fuses on ac systems above 600 volts in accordance with NEMA SG 2.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

2.6 PROTECTIVE RELAYS

2.6.1 Overcurrent Relays

Conform to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults provide single-phase nondirectional removable induction type overcurrent relays with built-in testing facilities designed for operation on the dc or ac control circuit indicated.

Provide ground-fault overcurrent relays with short-time inverse time characteristics with adjustable current tap range as required.

Provide phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range as required and indicating instantaneous-trip attachments with adjustable current range as required.

Semiflush-mount case with matching cover to the hinged instrument panel.

Provide solid-state static-type trips for low-voltage power circuit breakers in accordance with EIA 443 and IEEE C37.17.

Provide a trip unit that employs a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system.

Provide complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker including: overload; short circuit; and ground fault.

Wire trip unit to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground fault circuits using a small hand-held test kit.

2.6.2 Directional Overcurrent Relays

Provide directional overcurrent relays in accordance with IEEE C37.90.

For directional overcurrent relays for protection against reverse-power faults provide single-phase induction type with adjustable time-delay and instantaneous trip attachments. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.6.3 Reclosing Relays

For reclosing relays, conform to IEEE C37.90.

Design reclosing relays to reclose circuit breakers that have tripped from overcurrent. Provide device that automatically recloses the breaker at adjustable time intervals between reclosures and then locks out the breaker in the open position if the fault persists. Provide circuit breaker that remains closed and the reclosing relay resets automatically and is ready to start a new sequence of operation if the fault disappears after any reclosure.

Provide removable reclosing relays with built-in testing facilities and consisting of a timing unit rated at 120/240 volts, single-phase, ac and solenoid and contactor units with dc rating as indicated. Arrange contacts

for one instantaneous reclosure and two subsequent reclosures at 15 and 45 seconds, respectively. Set time dial for 60-second drum speed.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.6.4 Undervoltage Relays

For undervoltage relays, conform to IEEE C37.90.

Provide three-phase induction type undervoltage relays including inverse timing with adjustable high- and low-voltage contacts and calibrated scale for protection against loss of voltage, undervoltage, and overvoltage. Equip relays with indicating contactor and voltage switches to provide electrically separate contact circuits. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120-volt ac circuits with contacts that are suitable for operation on dc or ac control circuits.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.7 INDICATING INSTRUMENTS

2.7.1 Ammeters

For ammeters, conform to ANSI C39.1.

Provide switchboard indicating ammeters of approximately 4-1/2 inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 5-ampere type meter for a zero to full-scale normal movement, 60 hertz.

2.9 INDICATING LIGHTS

2.9.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with ANSI C78.23. Provide indicating lights color coded in accordance with NEMA ICS 6.

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

2.10 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

Install control devices and protective devices that are not factory installed in equipment in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to NFPA 70, NEMA ICS 1, NEMA ICS 2, and NEMA ICS 3 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Give circuit breakers rated 15KV and above a timing test to verify proper contact speed, travel, bounce, and wipe.

Give oil and high-voltage circuit breakers and their bushings an insulation power factor test to establish condition monitoring baselines.

Perform and submit dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Submit final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

3.3 OPERATION AND MAINTENANCE MANUALS

No less than 30 days prior to final testing and inspection, submit Operation and Maintenance Manuals to the Contracting Officer for the following equipment:

d. Circuit breakers

e. Protective relays

f. Indicating instruments

3.4 WARRANTY

No less than 30 days prior to project completion, submit warranty to the Contracting Officer for final review.

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections

SD-07 Certificates

Qualifications of organization, and lead engineering technician

Acceptance test and inspections procedure

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall

have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

b. Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS

e. Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION

f. Section 26 13 00.00 20 SF6/HIGH-FIREPOINT FLUID INSULATED PAD-MOUNTED SWITCHGEAR

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 12 19.00 40

PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318M	(2011) Building Code Requirements for Structural Concrete & Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D117	(2010) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D1535	(2012) Specifying Color by the Munsell System
ASTM D3487	(2009) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D92	(2011) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2011) Pour Point of Petroleum Products

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2006; INT 1 2011) Standard for Separable

	Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012; Errata 2012; INT 1-4 2012) National Electrical Safety Code
IEEE C37.47	(2011) Standard for High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.25	(1990) Standard for Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers With Separable Insulated High-Voltage Connectors; High Voltage, 34,500 Grdy/ 19,920 Volts and Below; Low Voltage, 240/120 Volts; 167 kVa and Smaller Requirements
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.34	(2009) Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2010) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(2008) Standard Requirements for Instrument Transformers
IEEE C57.98	(1993; Errata 1998; R 1999) Guide for Transformer Impulse Tests
IEEE C62.11	(2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing

	Specifications for Electrical Power Equipment and Systems

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
ANSI C12.7	(2005) Requirements for Watthour Meter Sockets
NEMA LI 1	(1998; R 2011) Industrial Laminating Thermosetting Products
NEMA/ANSI C12.10	(2011) Physical Aspects of Watthour Meters - Safety Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-90/027F	(1993) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms
EPA 712-C-98-075	(1996) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the entire submittal package requirements of this contract. Instead, submit the following items:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).

d. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses (paragraph entitled "Pad-Mounted Transformer Drawings", item e).

e. Routine and other tests (in PART 2, see paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government (in Part 2, see paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

f. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

g. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

SD-02 Shop Drawings

Pad-Mounted Transformer Drawings

SD-03 Product Data

Pad-Mounted Transformers

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance Checks And Tests; G]

SD-07 Certificates

Transformer Losses; G

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

SD-09 Manufacturer's Field Reports

Pad-mounted transformer Design Tests; G

Pad-mounted transformer Routine And Other Tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Transformer Test Schedule

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 and or IEEE C2unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal

material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.5.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on watthour demand meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION, andSection 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein.

2.2.1 Compartments

Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, feed-thru inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts and feed-thru inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-thru inserts as indicated.

c. Load-break switch

(1) Radial-feed oil-immersed type rated at 15kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

d. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse

links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Conspicuously display warning within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

(1) Bayonet fuse assembly: 150 kV BIL.

f. Surge arresters: IEEE C62.11, rated 9 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide three arresters for radial feed circuits.

g. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

h. Protective caps: IEEE 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts and insulated standoff bushings.

2.2.1.3 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

2.2.2 Compartment Construction

b. Two compartment: Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.3 Transformer

a. Oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated 112.5 kVA, 95 kV BIL.

c. Transformer voltage ratings: 12,470_ V - 480/277 V.

d. Tap changer shall be externally operated, manual type for changing tap

setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than [_____] percent at 85 degrees C on Three-Phase transformers [and [_____] at 85 degrees C on Single-Phase transformers].

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole.[Transformer shall have its kVA rating conspicuously displayed on its enclosure.] The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.3.1 Specified Transformer Losses

2.2.4 Insulating Liquid

a. Mineral oil: ASTM D3487, Type II, tested in accordance with ASTM D117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.2.4.1 Liquid-Filled Transformer Nameplates

Provide distribution transformers with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.5 Corrosion Protection

Entire transformer assembly, including tank and radiator, base, enclosure, and metering enclosure shall be fabricated of stainless steel conforming to ASTM A167, Type 304 or 304L. Form enclosure of stainless steel sheets. Paint entire transformer assembly Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.28. The Munsell color notation is specified in ASTM D1535.

2.3 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

2.4 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

[2.5 PADLOCKS

Provide padlocks for pad-mounted equipment . Padlocks shall be keyed as directed by the Contracting Officer. Padlocks shall comply with Section 08 71 00 DOOR HARDWARE.

2.6 CAST-IN-PLACE CONCRETE

Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section[03 30 00 CAST-IN-PLACE CONCRETE][03 30 00.00 10 CAST-IN-PLACE CONCRETE][03 35 00.00 10 CONCRETE FINISHING][03 39 00.00 10 CONCRETE CURING] for other projects.
]
Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16 inch to 1 inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. Slump shall not exceed 4 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C260/C260M. Air content shall be between 4 and 6 percent.

2.7 SOURCE QUALITY CONTROL

2.7.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify

Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.7.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for[each of] the specified transformer(s). Perform design tests prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include the primary windings only of that transformer.

(1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.7.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

(1) Impulse

(2) Applied voltage

(3) Induced voltage

g. Leak

h. Dissolved gas analysis (DGA)

2.7.4 PREDICTIVE & ACCEPTANCE TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION]. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.4 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.5 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.6 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.7 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab

shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Place the slab on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.7.1 Cast-In-Place Concrete

Cast-in-place concrete work shall conform to the requirements of Section[03 30 00 CAST-IN-PLACE CONCRETE][03 30 00.00 10 CAST-IN-PLACE CONCRETE][03 35 00.00 10 CONCRETE FINISHING][03 39 00.00 10 CONCRETE CURING][ACI 318M].

3.7.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.8 FIELD QUALITY CONTROL

3.8.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.8.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(4) Verify correct liquid level in tanks.

(5) Perform specific inspections and mechanical tests as recommended by manufacturer.

(6) Verify correct equipment grounding.

(7) Verify the presence of transformer surge arresters.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Verify that the tap-changer is set at specified ratio.

(3) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.8.1.2 Current Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance test.

(3) Perform a polarity test.

(4) Perform a ratio-verification test.

3.8.1.4 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather,

not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. Equip the instrument with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.8.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 12 19.10

THREE-PHASE PAD-MOUNTED TRANSFORMERS
02/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318M	(2011) Building Code Requirements for Structural Concrete & Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2011b) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D117	(2010) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D1535	(2012) Specifying Color by the Munsell System
ASTM D3487	(2009) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D92	(2011) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2011) Pour Point of Petroleum Products

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative

	Dictionary of IEEE Standards Terms
IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012) National Electrical Safety Code
IEEE C37.47	(2011) Standard for High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C57.12.34	(2009) Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.90	(2010) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(2008) Standard Requirements for Instrument Transformers
IEEE C57.98	(1993; Errata 1998; R 1999) Guide for Transformer Impulse Tests
IEEE C62.11	(2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
ANSI C12.7	(2005) Requirements for Watthour Meter

	Sockets
NEMA LI 1	(1998; R 2011) Industrial Laminating Thermosetting Products
NEMA/ANSI C12.10	(2011) Physical Aspects of Watthour Meters - Safety Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075	(1996) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"
EPA 821-R-02-012	(2002) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431	Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pad-mounted transformer drawings

SD-03 Product Data

Pad-mounted transformers

Submittal shall include manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance checks and tests

Submittal shall include acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

SD-07 Certificates

Transformer Efficiencies

Submit certification, including supporting calculations, from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Efficiencies."

SD-09 Manufacturer's Field Reports

Pad-mounted transformer design tests

Pad-mounted transformerroutine and other tests

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Transformer test schedule

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.4.1 Government Submittal Review

Contracting Officer will review and approve all submittals in this section requiring Government approval.

1.4.2 Reduced Submittal Requirements

Transformers designed and manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the entire submittal package requirements of this contract. Instead, the following items shall

be submitted:

a. A certification, signed by the manufacturer, stating that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).

d. Manufacturer's published time-current curves (properly overlaid on one full size logarithmic paper) of the transformer high side fuses (paragraph entitled "Pad-Mounted Transformer Drawings", item e) with transformer damage curve, inrush curve, and thru fault current indicated.

e. Routine and other tests (in PART 2, see paragraph entitled "Source Quality Control", subparagraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government. Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

f. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

g. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams [with terminals identified of watthour meter and current transformers].

d. One-line diagram, including switch(es)[, current transformers, meters, and fuses].

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and

advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

g. Actual nameplate diagram

h. Date of purchase

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis

during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION,] and Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein.

2.2.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed bayonet fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

c. Bushing well inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-thru inserts as indicated.

d. One-piece bushings: IEEE 386, 200 amperes, 15 kV Class.

e. Load-break switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200] amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

[f. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or

minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

h. Surge arresters: IEEE C62.11, rated 9 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap. Provide three arresters for radial feed circuits. Provide three arresters for loop feed circuits.]

i. Parking stands: Provide a parking stand near each bushing. Provide insulated standoff bushings for parking of energized high-voltage connectors on parking stands.

j. Protective caps: IEEE 386, 200] amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushings.

2.2.1.3 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator. [Provide a removable 600V Volt rated secondary NEMA spade terminal insulating system to completely insulate and cover these exposed live parts within the secondary compartment.]

2.2.2 Transformer

a. Less-flammable liquid-insulated or oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated 112.5_ kVA.

c. Transformer voltage ratings: [_____] V [Delta][_____] - [_____] V [GrdY][_____].[For GrdY - GrdY transformers, provide transformer with five-legged core design for third harmonic suppression.]

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested percent impedance at 85 degrees C shall not be less than the following values:

2.50 for units rated 75kVA and below
2.87 for units rated 112.5kVA to 300kVA
4.03 for 500kVA rated units

5.32 for units rated 750kVA and above

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60
2000	61
2500	62

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed [using 3 inch high yellow letters] on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.2.1 Specified Transformer Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. No-load losses (NLL) shall be referenced at 20 degrees C. Load losses (LL) shall be referenced at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. That table is based on requirements contained within 10 CFR 431, Subpart K.

kVA	EFFICIENCY (percent)
15	98.36

30	98.62
45	98.76
75	98.91
112.5	99.01
150	99.08
225	99.17
300	99.23
500	99.25
750	99.32
1000	99.36
1500	99.42
2000	99.46
2500	99.49
above 2500	99.50

2.2.3 Insulating Liquid

a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

The fluid shall be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid shall meet the following fluid properties:

1. Pour point: ASTM D97, less than -15 degree C

2. Aquatic biodegradation: EPA 712-C-98-075, 100 percent

3. Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012, pass

b. Mineral oil: ASTM D3487, Type II, tested in accordance with ASTM D117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.2.3.1 Liquid-Filled Transformer Nameplates

Distribution transformers shall be provided with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.4 Corrosion Protection

Entire transformer assembly, including tank and radiator, base, enclosure, and metering enclosure shall be fabricated of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Form enclosure of stainless steel sheets. The optional use of aluminum is permitted for the metering enclosure.

Paint entire transformer assembly Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.28 [and IEEE C57.12.29]regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D1535.

2.3 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

[[b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.]

2.4 Arc Flash Warning Label

Provide warning label for the enclosure of pad-mounted transformers. Locate this self-adhesive warning label on the outside of the high voltage compartment door warning of potential electrical arc flash hazards and appropriate PPE required. The label format shall be as indicated.

2.5 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.6 PADLOCKS

Padlocks shall be provided for pad-mounted equipment . Padlocks shall be keyed as directed by the Contracting Officer. Padlocks shall comply with Section 08 71 00 DOOR HARDWARE.

2.7 CAST-IN-PLACE CONCRETE

Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section[03 30 00 CAST-IN-PLACE CONCRETE][03 30 00.00 10 CAST-IN-PLACE CONCRETE].

Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16 inch to 1 inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. Slump shall not exceed 4 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C260/C260M. Air content shall be between 4 and 6 percent.

2.8 SOURCE QUALITY CONTROL

2.8.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

4. Dated calibration labels shall be visible on all test equipment.

5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party

calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.8.2 Design Tests

IEEE C57.12.00 states that "design tests are made only on representative apparatus to substantiate the ratings assigned to all other apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s). Design tests shall have been performed in accordance with IEEE C57.12.90 prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include the primary windings only of that transformer.

   1. IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

   2. State test voltage levels.

   3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.8.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed in accordance with IEEE C57.12.90 by the manufacturer on[each of] the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Phase relation

b. Ratio

c. No-load losses (NLL) and excitation current

d. Load losses (LL) and impedance voltage

e. Dielectric

    1. Impulse

    2. Applied voltage

    3. Induced voltage

f. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL

DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.6 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.6.1 Cast-In-Place Concrete

Cast-in-place concrete work shall conform to the requirements of[Section[03 30 00 CAST-IN-PLACE CONCRETE][03 30 00.00 10 CAST-IN-PLACE CONCRETE]][ACI 318M].

3.6.2 Sealing

When the installation is complete, the Contractor shall seal all entries into the equipment enclosure with an approved sealing method. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7 FIELD QUALITY CONTROL

3.7.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.7.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

3. Inspect anchorage, alignment, and grounding.

4. Verify the presence of PCB content labeling.

5. Verify the bushings and transformer interiors are clean.

6. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

7. Verify correct liquid level in tanks and bushings.

8. Verify that positive pressure is maintained on gas-blanketed transformers.

9. Perform specific inspections and mechanical tests as recommended by manufacturer.

10. Verify de-energized tap changer position is left as specified.

11. Verify the presence of transformer surge arresters.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

2. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.7.1.4 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to

test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

2. Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.7.1.5 Surge Arresters, Medium- and High-Voltage

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Inspect anchorage, alignment, grounding, and clearances.

4. Verify the arresters are clean.

5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

6. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform an insulation-resistance test on each arrester, phase terminal-to-ground.

3. Test grounding connection.

3.7.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 13 00.00 20

SF6/HIGH-FIREPOINT FLUIDS INSULATED PAD-MOUNTED SWITCHGEAR
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D1535	(2012) Specifying Color by the Munsell System
ASTM D2472	(2000; R 2006) Standard Specification for Sulphur Hexafluoride
ASTM D6871	(2003; R 2008) Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012) National Electrical Safety Code
IEEE C37.60	(2003; CORR 1 2004) Standard Requirements for Overhead, Pad Mounted, Dry Vault and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems Up to 38 kV
IEEE C37.74	(2003; Int 1 2004) Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

IEEE C62.11	(2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60265-1	(1998; Corrigendum 2000) High Voltage Switches - Part 1: Switches for Rated Voltages Above 1 kV and Less Than 52 kV
IEC 61099	(2010) Insulating Liquids - Specifications for Unused Synthetic Organic Esters for Electrical Purposes; Ed 2.0
IEC 62271-111	(2005) High Voltage Switchgear And Controlgear - Part 111: Overhead, Pad-Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters For Alternating Current Systems Up To 38 kV; Ed 1.0

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 70B	(2010) Recommended Practice for Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS and Section 26 08 00 APPARATUS INSPECTION AND TESTING, apply to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Switched Way

A switched way is considered a three-phase circuit entrance to the bus through a switch. For single-phase switches, it is a single-phase entrance to the bus through a switch.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings

SD-03 Product Data

Electronic Overcurrent Control Curves

SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear

Insulated High-Voltage Connectors

Surge Arresters

Each submittal shall include data on switches and associated accessories. Each submittal shall include manufacturer's information for each component, device and accessory provided with the equipment.

SD-06 Test Reports

Acceptance Checks and Tests

SD-07 Certificates

Paint Coating System

SD-09 Manufacturer's Field Reports

Switchgear design and production tests

SD-10 Operation and Maintenance Data

SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear Operation and Maintenance, Data Package 5

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Switchgear Drawings

Furnish drawings that include, but are not limited to, the following:

a. Overall dimensions, weights, plan view, and front view

b. Ratings

c. Single-line diagram.

1.5.2 Paint Coating System

Submit IEEE C57.12.29 paint coating system performance requirement tests.

1.5.3 Electronic Overcurrent Control Curves

Provide time-current characteristic curves (in electronic format suitable for import into computer programs EasyPower and SKM PowerTools for Windows) and instruction manuals for the electronic overcurrent control.

1.6 MAINTENANCE

1.6.1 SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 SF6/HIGH-FIREPOINT FLUID INSULATED PAD-MOUNTED SWITCHGEAR

IEEE C37.74

2.1.1 Ratings and Test Requirements

The voltage rating of the switchgear shall be 15.5 kVas indicated. The corresponding ratings associated with the required switchgear voltage rating shall be as follows:

Rated Maximum Voltage, kV	15.5
Rated Withstand Impulse Voltage, kV BIL	95
Continuous and Load Interrupting Current, A	[600][600][600]
Short-Time Current, kA rms Sym	12.5
[Short-Circuit interrupting Current,kA rms Sym	12.5

2.1.2 Switchgear Construction

Switch contacts and cable entrance terminations shall be contained in a sealed, dielectric-filled stainless steel tank. Switchgear shall be shipped factory filled with appropriate levels of SF6 gas conforming to ASTM D2472 or less-flammable, high-firepoint biodegradable fluid conforming to ASTM D6871 and IEC 61099. Switchgear shall be configured with load interrupting and fault interrupting switched ways as indicated. Switchgear shall have front accessible terminations suitable for cables entering from below with the manual operating provisions either mounted on the rear or

capable of hookstick operation. Switch contact positions for switched ways shall be visible through viewing windows in the switchgear tank located adjacent to the manual operating provisions. Provide internal gas pressure gage or fluid level gage in viewable location from switch operating handle. Each switched way shall have three position switch; Open, Closed, Ground and provisions for grounding.

2.1.2.1 Pad-mounting Provisions

Provide enclosed switchgear suitable for installation on a concrete pad. Switchgear enclosure shall be fabricated of ASTM A167 type 304 or 304L stainless steel. Paintenclosure including base ASTM D1535 Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.29 regardless of equipment material.

2.1.3 Load Interrupting Switched Ways

Load interrupter switched ways shall provide three-pole group operated switching as indicated.

2.1.4 Fault Interrupting Switched Ways

IEEE C37.60, IEC 62271-111. Provide non-fused, non-reclosing, manual reset, vacuum interrupters consisting of vacuum interrupter and a spring assisted operating mechanism. Each fault interrupting switched way shall utilize internally mounted current transformers and an electronic overcurrent control to provide three-pole ganged tripping as indicated for single-phase and three-phase faults. The electronic overcurrent control shall have provisions for a wide variety of field changeable time-current characteristic curves with ten field changeable trip levels through a current range of0-600 amperes. The electronic overcurrent control shall have an EIA-RS-485 communications port that supports Modbus and DNP 3.0 Level 2 protocals. Fault interrupting switched ways shall have provisions for remote tripping via an external dry contact device as indicated. Remote trip control power shall be 120 Vac.

[2.1.5 Automatic Switch Controls

Provide an automatic switch control system to execute Manual, Automatic Source-Transfer, and SCADA operation of the load interrupting switch ways. The automatic switch control shall accept 120 Vac control power and shall be powered from an integral battery-charger DC supply system. Switch way operation shall be via motor operators and associated motor operator controllers. The motor operator controllers shall have "Close," "Open," and "Ground" pushbuttons for manual operation. The Source-Transfer controls shall effect opening of an incoming switch way where voltage is lost and close the other incoming switch way if voltage is present. The Source-Transfer controls shall include an overcurrent-lockout feature that prevents automatic closing of a switch way into a system fault. The automatic switch control system shall execute remote commands received from a SCADA master station and transmit switchgear operation information to a SCADA master station via DNP 3.0 communications. Execution of remote commands shall include enabling of the Source-Transfer controls and transfer of switch ways to "Close," "Open," and "Ground" positions. Transmission of switchgear information shall include switch way positions, voltage and current readings, and DC supply system status. The control shall have communication port provisions for connection to a multi-mode serial fiber link.

[2.1.6 Low Voltage Test Pins

Load interrupting switch ways shall have internal load side voltage sensors and external test pins that allow for low voltage checks to confirm energized and in-phase conditions using a standard high-impedance voltmeter.

2.1.8 Dead-Front High-Voltage Bushings

IEEE 386. 15 kV, 95 kV BIL. Provide 600 ampere one-piece deadbreak apparatus bushingsfor each switched way.

[a. Parking stands: Provide a parking stand near each dead-front bushing. Provide insulated standoff bushings for parking of energized load-break connectors on each parking stands.

2.2 Insulated High-Voltage Connectors

IEEE 386. Provide corresponding connector for each switched way. Connectors shall have a grounding eye and test point.

a. 600 Ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 25,000 rms symmetrical amperes. Connectors shall have 200 ampere bushing interface for surge arrestersas indicated]

b. Provideone set of three grounding elbows.

[2.3 Surge Arresters

IEEE C62.11, rated 9 kV as indicated, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide arresters on switched ways as indicated.

2.4 SF6 Refill Cylinders

Provide two SF6 refill cylinders, minimum size of 6 pounds of SF6; include regulator, valves, and hose for connection to the fill valve of the switch.

2.5 SOURCE QUALITY CONTROL

2.5.1 Switchgear Design and Production Tests

Furnish reports which include results of design and production tests performed according to IEEE C37.74, IEC 60265-1 and IEC 62271-111. Production tests shall be performed by the manufacturer on each switchgear assembly to ensure that design performance is maintained in production.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms. When work, in addition to that indicated or specified, is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION at each corner of switchgear pad as indicated.

3.2.2 Switchgear Grounding

Connect #4/0 bare copper conductor ground loop, not less than 24 inches below grade, to the upper end of the ground rods by exothermic welds or compression connectors. Provide #4/0 bare copper conductors connecting the switchgear grounding provisions to two different ground rods.

3.2.3 Connections

Make joints in grounding conductors and ground loop by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount switch on concrete slab. Slab shall be at least 12 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with switch cable training areas. Concrete work shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.4 FIELD QUALITY CONTROL

3.4.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS and referenced ANSI standards.

Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 Switchgear

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Check for proper anchorage, alignment, required area clearances, and grounding.

(4) Perform mechanical operator tests in accordance with manufacturer's instructions.

(5) Verify that insulating SF6 gas pressure or dielectric fluid level is correct.

(6) Inspect all indicating devices for proper operation.

[(7) Test interlock systems for proper operation and sequencing.]

b. Electrical Tests

(1) Perform contact-resistance tests.

[(2) Trip fault interrupters by operation of overcurrent control[and remote trip].]

(3) Perform insulation-resistance tests.

(4) Perform an over-potential test on each switched way pole with the switched way in the open position in accordance with the manufacturer's instructions.

[(5) Set fault interrupter overcurrent control in accordance with government provided settings. Request settings from government, in writing, a minimum of 30 days prior to scheduling electrical tests.]

3.4.1.2 Grounding System

a. Visual and Mechanical Inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.4.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that devices are in good operating condition and properly performing the intended function. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times for checks and tests.

-- End of Section --

SECTION 26 18 23.00 40

MEDIUM-VOLTAGE SURGE ARRESTERS
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012) National Electrical Safety Code
IEEE C62.11	(2005; Amd 1 2008) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LA 1	(2009) Standard for Surge Arresters

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Provide the following shop drawings according to requirements set forth in this section:

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Submit Manufacturer's product data for the following items:

Surge Arresters

Mounting Brackets

SD-08 Manufacturer's Instructions

Installation Instructions

Surge Arresters

SD-10 Operation and Maintenance Data

O & M Manuals

Surge Arresters

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 EQUIPMENT

Provide design, fabrication, testing, and performance of arresters that complies with IEEE C62.11, NEMA LA 1.

Provide arresters that utilize metal oxide varistor and gapped arrester technologies.

Provide arresters that are contained within a polymer housing. Provide arrester that is designed to be non-fragmenting to provide extra safety to personnel and equipment. For arresters utilizing a hanger frame type mounting bracket, provide a frame that is non-corrosive track resistant glass filled polyester or other suitable non-corrosive/non-conductive material providing high mechanical strength. Provide arrester mounting hardware that is designed for installation in severe salt-spray atmosphere and that is of a corrosion-resistant metal or zinc-coated in accordance with ASTM A153/A153M.

The arrester housing is molded of EPDM insulating rubber which provides deadfront safety and overvoltage system protection in an insulated, fully shielded, submersible, deadfront device that conforms to IEEE 386.

2.2 FABRICATION DRAWINGS

Submit fabrication drawings in accordance with paragraph entitled, "Equipment," of this section. Provide drawings that show assembly and fabrication details performed in the factory.

2.3 SURGE ARRESTERS

2.3.1 O & M Manuals, Surge Arresters

Provide O & M Manuals for surge arresters specified within these plans and specifications.

2.3.2 Distribution

Provide combination spark gap and metal oxide varistor type distribution arresters. Provide corrosion resistant mounting hardware.

2.3.2.1 Distribution - Riser-Pole Class

Distribution - Provide combination spark gap and metal oxide varistor type riser-pole class. Provide corrosion resistant mounting hardware.

2.3.2.2 Distribution - Underground

Provide arresters that are combination spark gap and metal oxide varistor type technology in a premolded rubber elbow.

2.3.3 Intermediate

Provide single-phase, single-pole, self-supporting type arresters for pedestal, platform, or bracket mounting.

2.3.4 Station

Provide single-phase, single-pole, self-supporting type arresters for pedestal, platform, or bracket mounting.

2.4 SURGE PROTECTION FOR ROTATING AC MACHINES

Provide arresters installed on rotating alternating current equipment that are the type and rating as recommended by the manufacturer of the equipment.

2.5 MOUNTING BRACKETS

Provide arresters that are equipped with suitable mounting brackets for the applicable method of mounting.

PART 3 EXECUTION

3.1 INSTALLATION

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Install and connect arresters in accordance with the manufacturer's installation instructions.

Make ground connection to a driven ground rod, counterpoise, or station grounding system and meet the intent of the National Electrical Code, NFPA 70 and/or IEEE C2.

Connect lightning arresters as close as practicable to the apparatus being protected. When connecting arresters to overhead conductors, use a hot line clamp. Provide a hot line clamp that is designed to be compatible to the type of conductor material being used, i.e. aluminum or copper.

3.1.1 Installation Instructions, Surge Arresters

Submit Manufacturer's instructions for surge arresters including special provisions required to install equipment components and system packages. Provide special notices that detail impedances, hazards and safety precautions.

3.1.2 Installation Drawings

Submit installation drawings in accordance with paragraph entitled, "Installation," of this section.

3.2 ARRESTERS

3.2.1 Distribution Type

Install distribution class arresters on all overhead lines, riser poles, pad mounted transformers and where applicable installed on distribution load break switches, sectionalizers and fault interrupters.

3.2.1.1 Distribution - Riser-Pole Class

Distribution - Install riser-pole class arrestors on all riser poles.

3.2.2 Intermediate Type

Install intermediate type arrestors on grounded support brackets/structures suitable to adequately support the weight of the arrestor.

3.2.3 Station Type

Install station type arrestors on grounded structures suitable to adequately support the weight of the arrestor.

-- End of Section --

SECTION 27 13 23.00 40

COMMUNICATIONS OPTICAL BACKBONE CABLING
11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C338	(1993; R 2008) Standard Test Method Softening Point of Glass
ASTM D4976	(2012) Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

ANSI/TIA-455-80C	(2003) FOTP-80 - IEC 60793-1-144 Optical fibres Part 1-44: Measurement Methods and Test Procedures - Cut-off Wavelength
TIA/EIA 455-41-A	(1993a; R 2001) FOTP-41 - Compressive Loading Resistance of Fiber Optic Cables

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-87-640	(2011) Optical Fiber Outside Plant Communications Cable; 4th Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing

NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

EIA/TIA 455-165A	(1993) Standard for Mode-Field Diameter Measurement by Near-Field Scanning Technique
TIA-455-104	(1993a; R 2000; R 2005) Standard for FOTP-104 Fiber Optic Cable Cyclic Flexing Test
TIA-455-175	(2003b) FOTP-175 IEC-60793-1-42: Measurement Methods and Test Procedures - Chromatic Dispersion
TIA-455-177	(2003b) FOTP-177 IEC-60793-1-43: Measurement Methods and Test Procedures - Numerical Aperture
TIA-455-33	(2005b) Optical Cable Tensile Loading and Bending Test
TIA-455-78-B	(2002) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation
TIA-455-82	(1992b) FOTP-82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
TIA-472D000	(2007b) Fiber Optic Communications Cable for Outside Plant Use
TIA-526-14	(2010b) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-526-7	(2002; R 2008) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-568-C.3	(2008; Corrections 2008) Optical Fiber

	Cabling Components Standard
TIA-590	(1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA-758	(2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-455-25	(2002c) FOTP-25 Impact Testing of Optical Fiber Cables
TIA/EIA-455-81	(2000b) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
TIA/EIA-472DAAA	(1993) Detail Specification for All Dielectric Fiber Optic Communications Cable for Outside Plant Use Containing Class 1a 62.5 Um Core Diameter/125 um Cladding Diameter/250 um Coating Diameter Fiber(s).
TIA/EIA-4750000-C	(1996) Generic Specifications for Fiber Optic Connectors (ANSI)
TIA/EIA-569-A	(1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces
TIA/EIA-598	(2005c) Optical Fiber Cable Color Coding
TIA/EIA-604-3	(2000b) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1753F-601	(1994) Specifications for Filled Fiber Optic Cables (PE-90)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-188-176	(1996; Notice 1) Standardized Profile for Asynchronous Transfer Mode (ATM)
MIL-STD-2042	(2002; Rev B; Notice 1 2007) Fiber Optic Cable Topology Installation Standard Methods for Naval Ships

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C; Notice 1) Colors Used in

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Fiber optic cable shall consist of optical fibers, strength member[s], and jacketing. Associated components shall include optical fiber connectors, optical patch panels, terminal bay cabinets, and splice closures as indicated. Install fiber optic cables in inner duct in the existing cable duct and manhole system and/or directly buried to the facility. Locate fiber optic terminal in existing facility buildings.

References in this section to cable shall refer to fiber optic cable.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit the following preconstruction submittals to the Contracting Officer for approval and approved 30 calendar days prior to installation.

Qualifications

Quality Assurance Plan

SD-02 Shop Drawings

Fiber Optic System

SD-03 Product Data

Submit manufacturer's product data for the following items. Data shall include a complete list of parts, special tools, and supplies with current unit prices and source of supply.

Optical Fibers

Fiber Optic Cable Design

Splice Organizers

Pre-Connected Cable Assembly

Fiber Optic Terminal Cabinets

Optical Patch Panel Assemblies

Fiber Optic Media Types

Fiber Optic Terminations and Connectors Material Data

Fiber Optic Enclosures

SD-06 Test Reports

Submit contractor test reports for approval to the Technical Representative not later than 14 calendar days after the completion of each test.

Factory Test Certificates

Single and Multi-mode OTDR Test

End-to-End Attenuation Tests

End-to-End Bandwidth Tests

Fiber Optic Factory Test Plan

Fiber Optic Field Tests Plan

SD-07 Certificates

Fiber Optic Cable Installer and Splicer Qualifications; G

Manufacturer's qualifications

SD-08 Manufacturer's Instructions

Fiber optic system instructions

1.4 QUALIFICATIONS

Cable construction work shall be performed by construction personnel who have had at least 3years experience in placing cables in conduit, cable trays, and underground duct systems.

Fiber optic cable splices, terminations and testing shall be made by journeymen cable splicers who have had a minimum of 1 year experience in splicing and terminating fiber optic cables. Personnel working pursuant to this section, may at the Contracting Officer's option, be required to demonstrate technical competence by performing sample work [and/or by displaying their state qualifications/certificates], at no additional cost to the Government.

Each person who is to perform fiber optic cable splicing shall perform a minimum of one acceptable sample splice and termination. Do not incorporate sample splices and terminations in the job.

Submit a Quality Assurance Plan for fiber optic cable systems consisting of detailed procedures defining methods to ensure compliance to contract drawings and specifications by drawing control, inspection and procurement records, test plan showing when and how each system will be tested, material testing, and certification records. Submit test plan to the Technical Representative for approval at least 30 calendar days prior to the start of testing.

1.5 QUALITY ASSURANCE PLAN

Contractor shall prepare a quality assurance plan which provides a detailed outline of all testing to be accomplished. Quality assurance plan shall address whether cladding modes have been stripped prior to testing, source wavelength (peak), spectral width full width/half maximum (FWHM), mode structure, fiber end preparation, and bandwidth measurements of fiber links both greater and less than 1 kilometer. Quality assurance plan shall include, as a minimum, a schedule of when tests will be performed relative to installation milestones, specific test procedure that will be used, a list of test equipment that will be used including manufacturer, model number, range, resolution accuracy and shall conform to the specified requirements.

1.5.1 Fiber Optic System

Provide drawings for the fiber optic cable and pathway system. Provide single line schematic details of the fiber optic and pathway media, splices, and associated construction materials. Drawings shall be in AUTOCAD.DXF or compatible format. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the fiber optic system. Include drawing details of fiber optic terminations in equipment rooms. System drawings shall show final configuration, including location, fiber pair count, pathway innerduct arrangement, and pathway assignment of outside plant. FO system shall be compatible with MIL-STD-188-176. Design Pier FO systems for compatibility with MIL-STD-2042 and NAVSEA drawings.

1.5.2 Fiber Optic Cable Installer and Splicer Qualifications

Technicians installing FO media, splices and performing system tests shall be certified and trained in accordance with an approved manufacturers training program. Technicians shall have a minimum of 3 years FO experience in installing equivalent FO systems. Submit data for approval to the Contracting Officer. Submit FO technician qualifications for approval 30 days before splices are to be made on the cable. Certification shall include the training, and experience of the individual on specific type and classification of FO media to be provided under this contract.

1.5.3 Fiber Optic System Instructions

Provide installation methods and procedures for installing the FO media and pathway system. Include methods and procedures for installing FO media, pathway, splices, and associated hardware. Submit installation procedures and equipment list to the Contracting Officer.

1.5.4 Manufacturer's Qualifications

The FO media manufacturer shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of FO media which comply with RUS Bull 1753F-601. Manufacturer must provide a list of customers with 3 years of maintenance logs documenting experience with government customers.

1.5.5 Fiber Optic Factory Test Plan

Prepare and provide the government for review a test plan for factory and field tests of the FO media. Provide factory OTDR test data as part of the test report. Provide a list of factory test equipment. Include a FO link

performance test plan. Submit the plan at least 30] days prior to tests for government approval. Refer to TIA/EIA-569-A for performance measurement criteria. Conduct tests at all operating bandwidths. Provide calculations for optical power budget and bandwidth as required by RUS Bull 1753F-601 using test method TIA-455-78-B or TIA/EIA-455. Submit test plans and reports to the government for review and approval.

1.5.6 Fiber Optic Field Tests Plan

Prepare and provide technicians and test equipment for field tests of FO media. Conduct OTDR reel tests at the job site prior to installation. Perform OTDR and end to end tests of all installed media. Conduct tests on single mode fiber in accordance with TIA-526-7 for single mode fiber and EIA TIA/EIA-526-14A for multi mode fiber.

1.6 DELIVERY, STORAGE, AND HANDLING

Ship media to job site on factory reels or in factory cartons. Radius of the reel drum shall not be smaller than the minimum bend radius recommended by the manufacturer for the media. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at each end of the reel must be readily accessible for testing. Provide a permanent label on each reel showing length, media, identification number, and date of manufacture. Provide water resistant label and ink on the labels. Apply end seals to each end of the media after testing and before terminating to prevent moisture from entering the cable while stored at the job site. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from zero to 100 percent. Equipment, other than FO media, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants.

Exercise care in handling materials during construction. Contractor shall ensure that the buried cable is fed through the plow into the ground at zero tension. Do not allow tension to develop in the cable.

Whenever the plow is stopped, sufficient cable shall be unreeled to guard against sudden jerks when the plow is started.

Exercise caution to ensure that the plow is not backed up while the blade is in the ground. Cable can be severely damaged by the plow backing up even a slight amount. During the plowing operation, the plow may strike a buried object or rock that would stop the equipment and necessitate removal of the plow from the ground. When this occurs, remove the plow carefully without backing up. When it is necessary to back the plow, uncover the cable a sufficient distance back from the plow for inspection by the Contracting Officer to determine if there is any damage. Immediately report any damage to the Contracting Officer. Repair or replace damages as directed by the Contracting Officer.

1.7 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

PART 2 PRODUCTS

2.1 FIBER OPTIC CABLE DESIGN

2.1.1 Fiber Optic Media Types

FO media shall meet all performance requirements of TIA-568-C.1, TIA-568-C.3 and the physical requirements of ICEA S-87-640 and TIA/EIA-598.

2.1.1.1 Multi Mode Fiber Media

Provide FO media with outer sheath jacket, strength member, ripcords, water blocking material,optional steel shield, core tube, and core fibers as installed in a permanent underground pathway system as shown on the construction drawings. FO media shall have an all glass, graded index material with a nominal core diameter of 62.5 microns. Provide a cladding material for the fiber which is compatible with the core. Media transmission window shall be centered at 850 and 1300 nanometer wavelengths, attenuation at 1300 nanometers shall be less than 2.0 dB per kilometer. Minimum bandwidth shall be 500 mHz-Km.

2.1.2 Cable Length

Cable shall be manufactured continuous with no factory splices.

2.1.3 Materials and Construction

Materials used within a given cable shall be compatible with all other materials used in the same cable when such materials come into intimate contact. All cable components used shall have no adverse affect on optical transmission or on the mechanical integrity characteristics of the fiber placed in the cable. All materials used shall be non-toxic, non-corrosive, and present no dermal hazard.

Minimum required material components applied to fiber optic cable construction shall be central core member, color-coded optical fiber, color-coded loose tube buffer with gel-filling, gel-filling around loose tube, inner jacket, pulling strength members, and outer jacket. Variations in sequence and construction structural components will be considered when necessary.

2.1.3.1 Central Core Member

Include a central core member to serve as a cable core foundation to reduce strain on the fibers but not to serve as a pulling strength member. Material of the central core member shall be non-metallic.

2.1.3.2 Optical Fibers

Two types of optical fibers, single-mode fiber and multi-mode fiber, shall be contained in the cable and shall be as follows:

Multi-Mode (MM) fiber shall be the graded index optical glass. Core diameter of the fiber shall be 50 plus or minus 3 micrometer. Cladding diameter shall be 125 plus or minus 3 micrometer. Core-cladding offset shall be less than 3 micrometer. Minimum tensile strength of the fiber after primary protective coating shall be greater than 50,000 psi.

Softening point of the clad material of the optical fiber shall be 1630 degrees C plus or minus 50 degrees C in accordance with ASTM C338, or the optical fiber shall meet the requirements in paragraph entitled, "Splice Compatibility Test."

2.1.3.3 Fiber Primary Protective Coating

Coat optical fiber with suitable material to preserve the intrinsic high tensile strength of the glass fiber. Outside diameter of the coated optical fiber shall be 250 plus or minus 15 micrometer. Coating material shall be readily removable, mechanically or chemically, without damaging the optical fibers when the removal is desired.

2.1.3.4 Optical Fiber Color-Code Coating

Primary protective coated SM and MM fibers shall be coated with a color-code coating for individual fiber identification. Maximum outside diameter of color-code coated fiber shall be less than 300 micrometer.

2.1.3.5 Loose Tube Buffering

Surround color-code coated fiber[s] with a loose tube buffering for protection from external mechanical and environmental influences. Fill interior of the tube with a suitable gel-fitting compound to prevent water migration. Color code loose tube buffering for the tube identification. Material of the buffering tube shall be PVC.

2.1.3.6 Colorants

Color concentrates or inks used to color code the optical fibers and the loose buffer tube shall not be susceptible to migration and chemical reaction with gel filling compound.

2.1.3.7 Number of Fibers Per Tube Per Cable

36-fiber cable and 72-fiber cable are required and shall be as follows:

36-fiber cable shall contain multimode and single mode fibers. Cable core configuration shall be comprised of six loose buffer tubes, each containing six fibers. Six fibers in each loose buffer tube shall be color coded using the first colors of the standard Munsell color code, Blue, Orange, Green, Brown, Slate, and White. Loose buffer tubes shall be color coded using the standard Munsell color code, Blue, Orange, Green, Brown and Slate. Sixth buffer tube shall be Pink. Consider single mode fibers last in configuration.

72-fiber cable shall contain multimode and single mode fibers. Cable core configuration shall be comprised of 12 loose buffer tubes, each containing six fibers. Six fibers in each loose buffer tube shall be color coded using the first colors of the standard Munsell color code, Blue, Orange, Green, Brown, Slate and White. Color code loose buffer tubes using the standard Munsell color code, Blue, Orange, Green, Brown, Slate, Red, Black, Yellow, and Violet. Eleventh and twelfth buffer tubes shall be Blue/White and Orange/White, respectively. Consider single mode fibers last in configuration.

2.1.3.8 Inner Jacket

Locate buffer tubes concentrically around the cable central core member and covered with a polyethylene inner jacket. Polyethylene inner jacket shall be [high] [medium] density polyethylene in accordance with ASTM D4976. Space between the buffer tubes and inner jacket shall be filled with a gel compound to prevent air, moisture, or water intrusion in the inner jacket.

2.1.3.9 Filling Compound

Inner jacket interior and loose tube buffer cavity shall contain a gel-type filling compound. Filling compound shall be of suitable viscosity so that it will protect the optical fibers against the ingress of water and/or soluble chemicals and shall not flow at the temperature of up to 65 degrees C. Gel filling compound shall be electrically non-conducting, inert gel-type, waterproof compound, non-toxic, with no dermal hazards, and compatible chemically and mechanically with all cable components and associated splice hardware materials to which it may make contact. Gel filling compound shall be removable, as required, using commercially available products under field-type conditions.

2.1.3.10 Pulling Strength Member

Use a ramid type material as pulling strength members in the cable to provide pulling strength of at least 400 pounds for the cable during installation.

2.1.3.11 Cable Outer Jacket

Black high density, high-molecular weight, polyethylene materials in accordance with ASTM D4976 shall be applied longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket. Outer jacket shall be smooth, concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections. Overall outside cable diameter shall not exceed 0.75 inch.

2.1.3.12 Metallic Armor

Provide a metallic armor shield for direct buried cable for additional tensile strength, rodent protection, and high crush and moisture resistance. Material of the metallic armoring shall be metallic tube or steel corrugation-coated with anti-corrosion material, sealed at the longitudinal overlap.

2.2 CABLE IDENTIFICATION SYMBOL

First of three lines on the ID symbol employ 5 characters.

First and second characters, from left to right, shall denote the number of active optical fibers in the cable.

Third character shall be a slash.

Fourth and fifth characters shall denote optical transmission windows which the optical fiber can support. These windows are defined herein as follows:

Fourth character shall be an "A" or an "O." The "A" denotes a window at a wavelength of 850 nanometers (nm) with an attenuation of 4 dB/kilometer (km) and a bandwidth of 800 MHz-km. Character shall be an

"O" if these requirements are not met.

Fifth character shall be a "B" or an "O." The "B" denotes a window at a wavelength of 1,300 nanometer (nm) with an attenuation of 1.0 dB/km and a bandwidth of 1,000 MHz-km. Character shall be an "O" if these requirements are not met.

Two lower lines of the cable ID symbol indicate multi-mode or single mode fibers, the cable number and the fiber count:

Example: 72/OB	Identifies the number of optical fibers (72) and the optical transmission window (OB - See preceding paragraph).
FM05 : 61-120	Identifies Multi-Mode Fiber Cable 05 with MM Fibers 61 through 120.
and FS05 : 13-24	Identifies Single Mode Fiber Cable 05 with SM Fibers 13 through 24.

2.3 REPLACEMENT CABLE

In addition to the cable sections indicated, a reel of each size and type of the manufacturer's furnished cable, provide not less than 0.5 kilometers.

2.4 SPLICE ORGANIZERS

Single mode or multi-mode fibers shall be fusion spliced with a protective sleeve covering and stored in an organizer with a minimum of 18 inches spare coiled buffer tubing. Single mode fibers shall be spliced last in the splice tray.

Complete a 72 fiber splice in an outer closure. Organizer assembly, with one tray containing 12 fusion splices each requires five extra trays, to form the section complete in the inner closure.

Fill space between the inner and outer closures with encapsulating fluid. Factory drill end plates to fit the cable(s) outer diameter.

2.5 PRE-CONNECTED CABLE ASSEMBLY

Contractor shall supply factory assembled pre-connectorized cable assembly to interface with the patch panel bulkhead feed-through receptacle. Contractor shall supply and install dust caps for all terminated fibers.

Multi-mode fiber optic cable assembly shall be comprised of a single fiber connector, terminated on three (3) meter length of single fiber, multi-mode cable. Single fiber cable shall contain a buffered optical fiber and be the same as that provided in the multi-fiber cable.

Single fiber optic cable assembly shall be comprised of a single fiber connector terminated on the three (3) meter length of single fiber, single mode cable. Single fiber cable shall contain a buffered optical fiber and be the same as that provided in the multi-fiber cable. Return loss for single mode connectors shall be a minimum of minus 30dB.

Connector/cable interface on both the single and multi-mode cable assemblies shall be able to withstand a tensile force of 25 pounds without detrimental affects on the connector loss characteristics.

Each connectorized cable assembly shall have a loss of less than or equal to 0.5 dB.

2.6 OPTICAL PATCH PANEL ASSEMBLIES

Make all cable terminations in optical patch panel assemblies. Patch panel assemblies shall be of the pre-assembled chassis type with associated rack-mounting hardware.

To facilitate the transition between outside plant cable and the preconnectorized cable assemblies, the fibers shall be [fusion] [mechanical] spliced and housed in a splice tray. Position splice tray in the optical patch panel assembly as indicated. Splice attenuation shall not exceed 0.2 db. Cover splice with a protective sleeve.

2.7 FIBER OPTIC TERMINAL CABINETS

FOT cabinets shall be front recess only. Cabinet's frame shall consist of vertical and horizontal tubular aluminum extrusions with a minimum wall thickness of .150 inches. Front to rear aluminum extruded corners shall be at least .125 inches thick. Rear door, top panel, and side panels shall be a minimum of 18-gage steel. Provide cabinet with 14 gage steel, .281 inches punched panel/chassis mounting rails permitting recessed installation of equipment. Place cable entry and exit holes as indicated. Dimensions of cabinet and associated cabinet hardware shall be as indicated.

Cabinet shall be gray in color in accordance with FED-STD-595.

2.8 FACTORY TEST CERTIFICATES

Fiber optical cable shall comply with the following optical and mechanical test requirements.

2.8.1 Optical Performance

2.8.1.1 Multi-Mode Fibers in the Cable

Optical attenuation of each optical fiber in the cable (reeled) shall be no greater than 1.0 dB/Km at 1300 plus or minus 50 nm optical spectrum window. Measure attenuation on completed cable reel length, and normalized linearly to 1 Km.

Bandwidth at minus 3 dB optical power of each optical fiber in the cable (reeled) shall be a bandwidth length product, gamma equals 1, greater than 1 GHz-Km at 1300 plus or minus 50 nm optical spectrum window.

Numerical aperture of each optical fiber shall be 0.2 plus or minus 0.015 at 1300 nm optical spectrum window. Method of numerical aperture measurement shall be in accordance with TIA-455-177, at central wavelength 1300 nm nominal. When this requirement is not met, apply the fusion splice compatibility test.

2.8.1.2 Single-Mode Fibers in the Cable

Optical attenuation of each optical fiber in the cable (reeled) shall be no greater than 0.5 dB/Km at 1300 plus or minus 50 nm optical spectrum window. Measure attenuation on completed cable reel length, and normalized linearly to 1 Km. Measurement method shall be in accordance with TIA-455-78-B, at central wavelength 1300 nm nominal.

Pulse dispersion of each optical fiber in the cable (reeled) shall be no greater than 3.5 picosecond/nm-Km within the emissive region of 1285-1330 nm. Measurement method shall be in accordance with TIA-455-175.

Mode field diameter at 1300 nm optical spectrum window shall be within 10 plus or minus 1 micrometer. Measurement method shall be in accordance with EIA/TIA 455-165A at central wavelength 1300 nm nominal. When this requirement is not met, apply the fusion splice compatibility test.

Cut-off wavelength for 1300 nm optical spectrum window shall be within 1200 plus or minus 70 nm. Measurement method shall be in accordance with ANSI/TIA-455-80C.

2.8.2 Mechanical Performance

2.8.2.1 Minimum Bend Radius

Cable shall be able to withstand bending to a minimum radius of 10 times the cable outer diameter without tensile load applied, and of 20 times the cable outer diameter with maximum tensile load applied (during installation), without damage to cable components or degradation of the optical fiber performance at room temperature.

2.8.2.2 Tensile Strength

Fiber optical cable shall withstand a pull force of at least (400 pounds) to be applied to the pulling strength member during the installation, and a tensile load of at least 300 newtons during operation without incurring any damage or detriment to fiber optical cable and optical performance. Tensile strength test shall be in accordance with TIA-455-33.

2.8.2.3 Flexing or Bending Cycles

Fiber optical cable shall withstand at least 20 bending cycles at minimum bend radius without damage to the fiber optic cable components or degrading optical performance. Cyclic flexing test shall be in accordance with TIA-455-104.

2.8.2.4 Crush Resistance

Minimum crush resistance of the fiber optical cable shall be greater than 650 newton/centimeter (cm) without damage to cable components or degrading optical performance. Crush resistance test shall be in accordance with TIA/EIA 455-41-A.

2.8.2.5 Impact Resistance

Fiber optical cable shall be capable of withstanding 20 impacts, at five newton-meters force, without damage to cable components, or degradation of optical performance. Impact resistance test shall be in accordance with TIA/EIA-455-25.

2.8.2.6 Gel Filling Compound Drip Test

Test optical cable for the ability of the gel filling compound in the interior of the inner jacket and loose tube buffer to resist flow at the temperature range of minus 40 degrees C to 60 degrees C in accordance with TIA/EIA-455-81.

2.8.2.7 Fluid Penetration

Optical cable shall be capable of preventing the entry and axial migration of pressurized water when subjected to fluid penetration testing in accordance with TIA-455-82.

2.9 TEMPERATURE ENVIRONMENT

Fiber optical cable shall comply with the mechanical performance requirements herein while used in duct applications where the temperature varies from minus 8 degrees C to plus 38 degrees C. Optical performance degradation shall be less than fivepercent of the optical performance requirements in the temperature range of minus 20 degrees C to plus 60 degrees C. Do not damage fiber optical cable in storage where the temperature may vary from minus 40 degrees C to plus 65 degrees C.

2.10 SPLICE COMPATIBILITY TEST

When the material of the optic fiber is different from Cornings' Class Code No. 1517 for multi-mode graded index fiber and No. 1528 for single-mode fiber, perform and document the Splice Compatibility Test as follows:

Vendor shall select fiber samples from a minimum of 3 different production lots of the fiber type proposed for the job.

Vendor shall fabricate and measure a minimum of 10 fusion splices using fiber from the different production lots and a sample of Corning fiber, Class Code No. 1517 and No. 1528, supplied by the Government.

Measure fusion splices using an Optical Time Domain Reflectometer (OTDR) operating in the region of 1250 through 1350 nm. The insertion loss of the fusion splice shall be the average of two OTDR measurements, one taken with the OTDR installed on the Corning fiber, and the other with the OTDR installed on the vendor's fiber. Vendor's fiber and the Corning fiber shall each be a minimum of 1 Km in length throughout the testing.

Consider vendor's fiber compatible with the Corning fiber if the maximum splice insertion loss of each of 10 fusion splices tested measures less than 0.2 dB.

Vendor shall be allowed a maximum of three retries on any one splice to obtain a loss of 0.2 dB or less.

Perform these tests under Government supervision.

2.11 FIBER OPTIC ENCLOSURES

Provide metallic enclosures for fiber optic data transmission equipment. NEMA 250, type 4 enclosure. Enclosures shall protect the spliced fibers

from moisture and physical damage. Splice closure shall provide strain relief for the cable and the fibers at splice points. Provide full documentation citing conformance to structural parameters.

2.12 FIBER OPTIC TERMINATIONS AND CONNECTORS

FO connectors shall comply with TIA/EIA-4750000-C and TIA/EIA-604-3.

2.13 FIBER OPTIC PATHWAY SYSTEM

Provide an FO pathway system including raceway conduit, duct system, and maintenance manholes and handholes as shown on the drawings. Pathway materials shall comply with TIA/EIA-569-A, and the following commercial standards for construction materials, NEMA RN 1 (PVC), NEMA TC 2 (PVC), NEMA TC 3 (PVC), NEMA TC 6 & 8, and NEMA TC 9.

2.13.1 Conduit

Conduit as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.14 FACTORY FO QUALITY CONTROL

Conduct factory quality tests of FO media as required by TIA-472D000.

2.15 PREPARATION FOR DELIVERY

Ship media on reels in [____] ft lengths. Provide 6 1/2 feet pigtails on each end of media accessible for testing. Reel drum shall comply with manufacturers recommended bend radius for the media. Wind media on reel so that unreeling can be done without kinking the media. Attach a permanent waterproof label with indelible text on reel showing the length, media type, bandwidth, attenuation, and date of manufacture.

2.16 FACTORY REEL TEST

Test 100 percent OTDR test of FO media at the factory prior to shipment in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single mode fiber and EIA TIA/EIA-526-14A Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Provide digitized or photographic traces to the Contracting Officer.

2.17 MISCELLANEOUS ITEMS

2.17.1 FO Media Tags

Provide stainless steel, 1 5/8 inches in diameter 1/16 inchthick, and circular in shape.

2.17.2 Buried Warning and Identification Tape

Provide color, type and depth of tape as specified in paragraph "Buried Warning and Identification Tape" in Section 31 00 00 EARTHWORK, FO media must be marked and protected as required by TIA-590.

2.17.3 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. Make braid from flat tin-plated copper.

PART 3 EXECUTION

3.1 FIBER SPLICES

Outside plant fiber splices shall be [fusion] [mechanical] type and made along the fiber route. Splices shall exhibit an insertion loss not greater than 0.2 dB. Make all splice measurements at 1300 nm, plus or minus 5 nm. Mount all splices in trays. Do not increase number of splices.

Cover completed splice with a protective sleeve heat shrink type to restore the protective properties of the fiber coating and buffering. Deviations to the splice, location and pulling plan will be permitted, upon approval by the Contracting Officer, and shall be provided at no additional cost to the Government.

All fiber colors shall be continuous from end to end. No switching or staggering of color scheme within the cable at splice points shall be allowed. Splice fibers in order with multi-mode fibers identified first and single mode fibers at the end.

Bring cables out of the manhole in a controlled environment to perform the fiber fusion splice operation. Complete splice by returning the cable to the manhole such that the excess cable does not impede future entrance and utilization. Secure cable at regular intervals.

3.2 INSTALLATION

Install and test the FO media in accordance with contract drawings, specifications, IEEE C2, NFPA 70, and TIA-590. Provide all necessary power, utility services, technicians, test equipment, calibration equipment as required to perform reel and final acceptance tests of the media. All media which fail the factory or reel tests or final acceptance field tests shall be replaced and re-tested at the contractors expense. Splices are not permitted unless shown on the construction drawings. Field test splices within 24 hours after splice installation. Test splices to demonstrate a maximum 0.2 dB loss. Provide a splice box for each field splice. Provide a minimum of 2 meters for routing and testing media. Protect media ends of unspliced FO media during splicing operations.

3.2.1 Contractor Damage

Promptly repair indicated utility and communications lines or systems damaged during site preparation and construction. Damage to lines or systems not indicated, which are caused by contractor operations, shall be treated as "Changes" under the terms of the Contract clauses. When Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.3 BURIED CABLE INSTALLATION

3.3.1 Location

Location of the cable splice overlaps shall be as indicated. Contractor shall ensure that all cable ends are sufficiently long before cutting.

3.3.2 Field Staking

When staking the cable plow or trench line, place stakes at least every 100 feet in level country and more frequently in rolling country or in dense vegetation, so that the construction force can sight at least two successive stakes at all times. Stakes should be placed at changes in direction, the beginning and end of all turns should be staked clearly. Where existing buried cable is encountered within 2 feet of the proposed line, decrease the distance between stakes to a minimum of 10 feet. When possible, stakes should project above the vegetation along the line. When a road or other crossings are involved, stakes should be placed at both extremes of the right-of-way.

A stake, with the appropriate number or explanation noted on it, should be used to show the location of each caution point, such as underground utility crossings and culverts; miscellaneous points, such as physical cable protection; and buried cable warning sign locations.

3.3.3 Method of Cable Placement

All direct buried cable shall have a warning tape placed above it as indicated.

Depth of buried cable in soil measured from the top of the cable to the surface of the ground shall be a minimum of 30 inches, when existing utilities are crossed, use hand excavation at a distance of no less than four feet on each side of the utility.

3.4 UNDERGROUND CABLE INSTALLATION

Inner duct assignment of individual cables shall be as indicated. Do not place cables in ducts other than those specified.

Exercise adequate care when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed.

3.4.1 Securing Cable

Immediately after cable placement, a permanent identification tag as indicated shall be attached to visible cable sections. Check cables to ensure that the markings are intact.

Support and secure cables and equipment as indicated. Where the specific method of support is not shown, supports and fasteners shall be used to secure cables and equipment in position. Metallic supports and fasteners shall have a corrosion resistant finish. Rout all cables along the interior sides of manholes.

Two or more cable hooks shall be required per manhole.

Use clamps and straps as necessary to properly secure the cable.

3.4.2 Bending

Use caution when bending cable to avoid kinks or other damage to the sheath. Bend radius shall be as large as possible with a minimum of 10 inches. Increase minimum radius when necessary to meet cable manufacturer's recommendation. Do not rest cables against any sharp edges.

Pull and splice cable in the manner and at the locations shown.

3.4.3 Pulling

Attach pulling lines to both cable ends when cable is destined for bi-directional pull, and fitted with factory-installed pulling eyes. Cables not equipped with a pulling eye shall have the pulling line attached to the cable end by means of a cable grip. Do not use core hitches.

Locate and align cable reels so that the cable is paid out from the top of the reel into the duct or conduit in a long, smooth bend without twisting. Do not pull cable from the bottom of the reel. Use a cable feeder guide of proper dimensions at the mouth to guide the cable into the duct or conduit.

Rigging shall be set up at the pulling end so that the pulling line and cable exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Do not pull cable ends around sheave wheels. When the sheave or pulley cannot be positioned to obtain sufficient cable end slack for proper racking and splicing with the pulling line attached to the end of the cable, a split cable grip may be used to obtain the necessary slack.

3.4.4 Lubricant

Pulling lubricant, shall be used to minimize pulling tension and prevent sheath damage when pulling cables into ducts and conduits. Apply lubricant to the cable sheath with a lubricator. When pulling has been completed, the exposed cable ends shall be wiped clean of lubricant.

Lubricants shall be compatible with and intended for use with plastic-sheathed cables. Do not allow soap and grease type lubricants.

All equipment and the pulling set shall be checked to minimize interruptions once pulling begins. Pull cable without stopping until the required amount of the cable has been placed. When the pulling operation is halted before the pull is completed, the tension of the pulling line shall not be released. When pulling is resumed, the inertia of the cable shall be overcome by increasing the tension in small steps a few seconds apart until the cable is in motion. Cable shall be paid from the top of the reel by rotating the reel in the feed direction at the rate of pull. Cable shall not be stripped off the reel by pulling.

3.4.5 Damage and Defects

Contractor shall use a tension monitoring device to ensure that the maximum pulling tension that may be applied to the cable to be pulled into a conduit section is not exceeded. Any damage to the cable due to exceeding the maximum tension will require a new cable furnished by the Contractor.

Carefully inspect cable for sheath defects or other irregularities as it is paid out form the reel. When defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the

discretion of the Contracting Officer. Maintain a system of communications between pulling and feed locations so that pulling can be stopped instantly, when required.

Hand guide cable through intermediate manholes and into the next duct section when making pull-throughs. Use proper rigging in the intermediate manhole to keep the pulling line and cable aligned with the exit duct to prevent the line or cable from rubbing against the edge of the duct. Cables in pull-through manholes shall be set up and racked before the cable ends in adjacent manholes are set up and racked.

Cable ends pulled into manholes, vaults, or terminal locations that are not to be racked or otherwise permanently positioned immediately shall be tied in fixed positions to prevent damage to the cables and provide adequate working space.

3.4.6 Seal

Ducts or innerduct in which cable is placed shall be sealed with urethane foam duct seal. Insert this material between the cable and the duct or innerduct of which it is in, between the innerduct and the duct, and in all unused innerduct, in order to prevent damage to the cable sheath and to prevent the entrance of dirt or water into the manhole or vault.

Provide cables in continuous lengths as required to accomplish the required installation without splices from termination to termination, except where field splices are specifically shown.

3.6 GROUNDING SYSTEMS

Ground cables at each termination point or as indicated.

3.7 DIRECT BURIAL SYSTEM INSTALLATION

Installation shall be in accordance with TIA-590. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 24 inches below finished grade. Trenches shall be not less than 6 inches wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, space laterally at least 3 inches apart. When rock is encountered, remove it to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Do not unreel and pull cables into the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.7.1 Media Placement

a. Separate FO media crossing other cables or metal piping from the other cables or pipe by not less than3 inches of well tamped earth. Do not install FO media under or above traffic signal loops.

b. Media shall be in one continuous length without splices except where splices are shown on the drawings.

c. Do not allow bends in media which exceed the manufacturers minimum recommended radii. Do not bend media to a radius less than 10 times the outside diameter of the media.

d. Leave a horizontal slack of approximately 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections.

3.7.2 Identification Slabs (Markers)

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 20 inches square by 150 mm 6 inches thick and stake mounted warnings meeting the requirements of REA.

3.8 UNDERGROUND DUCT INSTALLATION

Construct underground duct as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION. Encase in concrete any ducts under roads, paved areas, or railroad tracks.

3.8.1 Connections to Existing Maintenance Holes [and Handholes]

For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and the duct line envelope.

3.8.2 Connections to Concrete Pads

For duct line connections to concrete pads, break an opening in the pad out to the dimensions required and preserve the steel in the pad. Cut the steel and extend it out to tie into the reinforcing of the duct line envelope. Chip out the opening in the pad to form a key for the duct line envelope.

3.8.3 Connections to Existing Ducts

Where connections to existing duct lines are indicated, excavate the lines to the maximum depth required. Cut off lines and remove loose concrete from the conduits before new concrete encased ducts are installed. Provide reinforced concrete collar, poured monolithically with the new duct line to take the shear at the joint of the duct lines.

3.9 RECONDITIONING OF SURFACES INSTALLATION

3.9.1 Unpaved Surface Treatment

Restore unpaved surfaces disturbed during the installation of duct or direct burial cable to their original elevation and condition. Carefully preserve existing sod and topsoil and replace after the back-filling is completed. Replace damaged sod with sod of quality equal to that removed.

Where the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.10 CABLE PULLING

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of FO media. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on media when entering or leaving the maintenance holes. Do not place media in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up media reels on the same side of the maintenance hole as the pathway section in which the media is to be placed. Level the reel and bring into proper alignment with the pathway section so that the media pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the media be paid off from the bottom of the reel. Check the equipment set up prior to beginning the media cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between media reel and face of duct to protect media and guide cable into the duct as it is paid off the reel. As media is paid off the reel, lubricate and inspect media for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Stop media pulling if reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide media lubricants recommended by the cable manufacturer. Provide 3.3 feet of spare media in all manholes and enclosures for final termination and testing.

3.10.1 FO Media Tensions

Install FO media as shown on construction drawings. Provide devices to monitor media tension during installation. Do not exceed manufacturers recommended maximum FO tensions and bending radii during installation.

3.10.2 Pulling Eyes

Equip media 1-1/4 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide media with diameter smaller than 1-1/4 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Do not beat rings to prevent grip from slipping into the cable sheath. Use a swivel grip of 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.10.3 Installation of Media in Maintenance Manholes, Handholes, and Vaults

Do not install media utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support media on brackets and cable insulators at a maximum of 4 feet. In existing maintenance manholes, handholes, and vaults where new ducts are to be terminated, or where new media are to be installed, modify the existing installation of media, cable supports, and grounding as required with cables arranged and supported as specified for new media.

3.11 AERIAL MEDIA INSTALLATION

Pole installation shall be as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Where physical obstructions make it necessary to pull distribution wire along the line from a stationary reel, use cable stringing blocks to support wire during placing and tensioning operations. Do not place ladders, cable coils, and other equipment on or against the distribution wire. Wire shall be sagged in accordance with the data shown.

3.11.1 Aerial FO Media

Keep media ends sealed at all times using cable end caps. Take media from reel only as it is placed. During placing operations, do not bend in a radius less than 10 times the outside diameter of media. Place temporary supports sufficiently close together, and properly tension the media where necessary, to prevent excessive bending. In those instances where spiraling of media is involved, accomplish mounting of enclosures for purposes of loading, splicing, and distribution after the spiraling operation has been completed.

3.12 Grounding

Ground exposed non current carrying metallic parts of telephone equipment, media sheaths, media splices, and terminals.

3.13 Housekeeping

The Contractor shall be responsible for cleaning up work area and maintaining the work area in orderly condition.

3.14 CABLE DELIVERY

Deliver replacement cable reels to the Government as directed by the Contracting Officer.

3.15 TESTING

As a minimum, the Contractor shall test each fiber cable before and after installation for any faults or attenuations using an Optical Time Domain Reflectometer (OTDR). End-to-end attenuation tests shall also be conducted after complete installation.

All test equipment, test procedures, and testing techniques shall be specified in the quality assurance plan and will require approval prior to execution. Tests shall be conducted by the Contractor in accordance with the approved Quality Assurance Plan. Field tests shall be witnessed by the Contracting Officer. Contracting Officer shall be given at least 20 calendar days notice prior to performing each test.

Each test sheet shall have a sign-off blank for the Contractor as well as the Contracting Officer. Deliver copies of the completed test forms and test results as indicated.

Sequential cable markings along the cable, prior to and after each end of splice point, shall be recorded on the sequential cable form and submitted for approval.

Submit test results on all installed fiber cabling before and after each

pre-connectorized cable assembly splice is completed.

Contractor shall maintain an accurate test record during all field tests.

3.15.1 Field Reel Tests

Perform the following tests on FO media at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, perform these tests at the factory and certified test results shall accompany the media. Perform OTDR tests with media on reels and compare factory and field test data.

3.15.1.1 Reel Test Results

Provide results of reel tests to the Contracting Officer at least 5 working days before installation is to commence. Results shall indicate reel number of the media, manufacturer, type and number of fiber tested, and recorded readings. When reel tests indicate that the media does not comply with factory reel test results remove the media from the job site and replace with compliant media.

3.15.2 Final Acceptance Tests

Perform end-to-end tests including power meter light source and OTDR tests. Perform OTDR measurements as required by TIA-568-C.1 and TIA-568-C.3. Test single mode fiber in accordance with TIA-526-7 (Optical Power Loss). Test multi mode fiber in accordance with TIA-526-14(Optical Power Loss).

3.15.2.1 Test Results

Provide results of final acceptance tests (attenuation tests, OTDR traces, etc.), to the Contracting Officer at least 5 working days after completion of tests.

3.16 TEST REQUIREMENTS

Test equipment used for verifying installation testing shall be calibrated by a certified testing company within 3 weeks of use.

3.16.1 Single and Multi-mode OTDR Test

The Optical Time Domain Reflectometer (OTDR) shall conform to the following minimum requirements:

Operating wavelengths: 1,300 plus or minus 20 nanometers

Attenuation Range (one way): minimum 15 dB at 1,300 nm

Attenuation Resolution: 0.01 dB

Accuracy: plus 0.5 dB.

OTDRs shall have digital readout capability and shall have a means of providing a permanent record in the form of a [strip chart] [photograph] [_____].

3.16.2 End-to-End Attenuation Tests

An attenuation measurement test set shall consist of an optical power meter and an optical power source. Attenuation measurement test set shall be in accordance with the applicable National Bureau of Standards (NBS) standards for a stable optical source. Meter may be analog or digital. Include end-to-end attenuation test reading on the test reference loss. Measurement test set shall conform to the following minimum requirements:

Operating wavelengths: 1,300 plus or minus 10 nanometers

Attenuation Range: at least 30 dB at 1,300 nm

Attenuation Resolution: 0.01 dB

Accuracy: The accuracy of the attenuation measurement test set shall be plus or minus 5 percent.

Optical source shall be capable of coupling sufficient power into the fiber so that the light received at the meter is within the meter delectability limits.

3.16.3 End-to-End Bandwidth Tests

Bandwidth test shall conform to the following minimum requirements:

Operating wavelengths: 1,300 plus or minus 10 nanometers

Bandwidth range: minimum 1000 megahertz

Bandwidth Resolution: 1 megahertz

Accuracy: plus or minus 0.5 megahertz

Measurement Method: Swept Frequency]

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING
08/08

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Nonsaleable Materials

SD-04 Samples

Tree wound paint
Herbicide

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Submit samples in cans with manufacturer's label of bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work. Submit samples in cans with manufacturer's label.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Apply herbicide in accordance with the manufacturer's label to the top surface of stumps designated not to be removed.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

[Prune] [Trim] trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with

suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Saleable Timber

4. All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be removed from the project site and disposed of off stations.

3.6.2 Nonsaleable Materials

Written permission to dispose of such products on private property shall be filed with the Contracting Officer. Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	(2009) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	(2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM D1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of

	Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1883	(2007e2) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2216	(2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3786/D3786M	(2009) Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D4533	(2011) Trapezoid Tearing Strength of Geotextiles
ASTM D4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011) Determining the Specification Conformance of Geosynthetics
ASTM D4833	(2007) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

ASTM D698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-203	(Rev C; Notice 3) Paper, Kraft, Untreated

1.2 DEFINITIONS

1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557, for general soil types, abbreviated as percent laboratory maximum density.

1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan

Dewatering work plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Fill and backfill test

Density tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH,

BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

1.7 QUALITY ASSURANCE

1.7.1 Shoring and Sheeting Plan

The Contractor shall comply with OSHA sloping and shoring requirements for all excavations. In lieu of a shoring plan, all excavation exceeding depth limits set by OSHA shall be done using an engineered shoring system or

1.7.2 Dewatering Work Plannce with OSHA regulations.

Submit procedures for accomplishing dewatering work.

1.7.3 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer.] Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and [frozen,] deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and

SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.6 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.7 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D4318 liquid limit of 35, maximum ASTM D4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.1.9 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.3.1 Sand

Clean, coarse-grained sand classified as by ASTM D2487 for beddingand backfill[as indicated.

[2.3.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof [identified as or having a classification of GW in accordance with ASTM D2487 for bedding andbackfillas indicated. [Maximum particle size shall not exceed 3 inches.]

2.8 MATERIAL FOR PIPE CASING

2.8.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Casing size shall be of the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

2.9.1 Bedding Material

Consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Material shall be composed of tough, durable particles. Fines passing the No. 200 standard sieve shall have a plasticity index less than six.

2.9.2 Grout

Composed of cement, water, an air-entraining admixture, and sand mixed in proportions of one part portland cement to two parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air to produce durable grout, as determined by the Contracting Officer. Mix grout in a concrete mixer. Mixing time shall be

sufficient to produce a mixture having a consistency permitting gravity flow into the interstices of the rip-rap with limited spading and brooming.

2.10 BURIED WARNING AND IDENTIFICATION TAPE

metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes	
[Yellow:]	[Electric]
[Yellow:]	[Gas, Oil; Dangerous Materials]
[Orange:]	[Telephone and Other Communications]
[Blue:]	[Water Systems]
[Green:]	[Sewer Systems]
[White:]	[Steam Systems]
[Gray:]	[Compressed Air]

[2.10.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.10.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.11 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring bracingcribbingtrench boxesunderpinningand sheeting where indicated. In addition to Section 25 A and B of EM 385-1-1 [and other requirements set forth in this contract], include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

c. Allow for the abandonment of shoring and sheeting materials in place in critical areas as the work is completed. In these areas, backfill the excavation to within 3 feet of the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the

existing utilities indicated prior to starting construction. The Contractor shall contact the Public Works Department for assistance in locating existing utilities.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with backfill and fill material . Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material . Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

[3.3.4 Hard Material and Rock Excavation

Remove hard material [and rock] to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material and rock beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the Contracting Officer. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

3.3.5 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory

material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.6 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.6.1 Common Fill Placement

Use satisfactory materials. Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.6.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.6.3 Select Material Placement

Provide under porous fill of structures not pile supported. Place in 6 inch lifts. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.6.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade [and shall include backfill for outside grease interceptors and underground fuel tanks]. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.6.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4

inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.6.6 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.8 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.10 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required.

3.10.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 85 percent of ASTM D698.

3.10.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D698. Compact common fill95 percent of ASTM D698.

3.10.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D698.

3.10.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D698. Compact fill and backfill materials to 95 percent of ASTM D698.

3.15 FINISH OPERATIONS

3.15.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.15.2 Topsoil and Seed

Provide as specified in Section 32 92 19 SEEDING.

3.15.3 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.16 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.17 FIELD QUALITY CONTROL

3.17.1 Sampling

Take the number and size of samples required to perform the following tests.

3.17.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.17.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.17.2.2 Select Material Testing

Test select material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.17.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136 for conformance to gradation specified in ASTM C33/C33M.

3.17.2.4 Density Tests

Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations every [2000] [_____] square feet of existing grade in fills for structures and concrete slabs, and every [2500] [_____] square feet for other fill areas and every [2000] [_____] square feet of subgrade in cut. Include density test results in daily report.

[Bedding and backfill in trenches: One test per [50] [_____] linear feet in each lift.]

[3.17.2.5 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D2216. Include moisture content test results in daily report.

] -- End of Section --

SECTION 32 11 23

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
08/08

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurement

1.1.1.1 Area

Measure the quantity of ABC completed and accepted, as determined by the Contracting Officer, in square yards.

1.1.1.2 Volume

Measure the quantity of ABC completed and accepted, as determined by the Contracting Officer, in cubic yards. The volume of material in-place and accepted will be determined by the average job thickness obtained in accordance with paragraph THICKNESS CONTROL and the dimensions shown.

1.1.1.3 Weight

The tonnage of ABC material will be the number of tons of aggregate, placed and accepted in the completed course, as determined by the Contracting Officer. Deductions shall be made for any material wasted, unused, rejected, or used for convenience of the Contractor, and for water exceeding specified amount at time of weighing.

1.1.2 Payment for Quantities

Quantities of ABC, determined as specified above, will be paid for at the respective contract unit prices, which shall constitute full compensation for the construction and completion of the [ABC] [and] [GCA].

1.1.3 Payment for Stabilization of Underlying Course

Stabilization of cohesionless subgrade or subbase courses, as specified in paragraph PREPARATION OF UNDERLYING COURSE, will be paid for as a special item on a tonnage basis. This tonnage price will include the price of extra manipulation as required.

1.1.4 Waybills and Delivery Tickets

Before the final statement is allowed, file certified waybills and certified delivery tickets for all aggregates actually used, as specified in the Submittals paragraph.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C29/C29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D422	(1963; R 2007) Particle-Size Analysis of

	Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D5821	(2001; R 2006) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates
ASTM E11	(2009e1) Wire Cloth and Sieves for Testing Purposes

1.3 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.3.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.3.2 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.3.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve are expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.4 SYSTEM DESCRIPTION

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Provide adequate equipment having the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools
Waybills and Delivery Tickets

SD-06 Test Reports

Sampling and Testing[; G][; G, [_____]]
Field Density Tests[; G][; G, [_____]]

1.6 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor and performed by a testing laboratory approved in accordance with Section 01 45 00.00 40 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements; perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.6.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.6.2 Tests

Perform the following tests in conformance with the applicable standards listed.

1.6.2.1 Sieve Analysis

Make sieve analysis in conformance with ASTM C117 and ASTM C136. Sieves shall conform to ASTM E11.

1.6.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.6.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with ASTM D1557.

1.6.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556, ASTM D2167 or ASTM D6938. For the method presented in ASTM D6938 check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D6938 result in a wet unit weight of soil, and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D6938. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals as directed.

a. Submit certified copies of test results for approval not less than 30 days before material is required for the work.

b. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

c. Submit copies of field test results within 24 hours after the tests are performed.

1.6.2.5 Wear Test

Perform wear tests on ABC course material in conformance with ASTM C131.

1.6.2.6 Soundness

Perform soundness tests on GCA in accordance with ASTM C88.

1.6.2.7 Weight of Slag

Determine weight per cubic foot of slag in accordance with ASTM C29/C29M on the ABC course material.

1.6.3 Testing Frequency

1.6.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

a. Sieve Analysis [including the No. 635 sieve].

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

e. [Soundness].

f. [Weight per cubic foot of Slag].

g. [_____].

1.6.3.2 In Place Tests

Perform each of the following tests on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated. [Perform sampling and testing of recycled concrete aggregate at twice the specified frequency until the material uniformity is established.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.

b. Perform sieve analysis [including the No. 635 sieve] on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the total thickness of the base course at intervals, in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

1.6.4 Approval of Material

Select the source of the material 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s).

1.7 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide ABC consisting of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve is known as coarse aggregate; that portion passing the No. 4 sieve is known as fine aggregate.

2.1.1 Coarse Aggregate

Provide coarse aggregates with angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled

separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.

c. Crushed Recycled Concrete: Provide crushed recycled concrete consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Reject recycled concrete aggregate exceeding this value. Crushed recycled concrete shall meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 70 pcf as determined by ASTM C29/C29M, and shall meet all the requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D5821. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.1.2 Graded-Crushed Aggregate Base Course

GCA coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131. GCA coarse aggregate shall not exhibit a loss greater than 18 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate, or 12 percent weighted average, at five cycles, when tested in sodium sulfate in accordance with ASTM C88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 1/2 inch sieve nor 20 percent for the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D5821. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.2.2 Graded-Crushed Aggregate Base Course

Provide GCA fine aggregate consisting of angular particles produced by crushing stone, slag, [recycled concrete,] or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. [Fine aggregate shall be produced by crushing only particles larger than No. 4 sieve in size. The fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the No. 4 sieve and retained on the No. 10 sieve, and in the portion passing the No. 10 sieve and retained on the No. 40 sieve.] [Fine aggregate shall be manufactured from gravel particles 95 percent of which by weight are retained on the 1/2 inch sieve.]

2.1.3 Gradation Requirements

Apply the specified gradation requirements to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E11.

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than No. 635 shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C127 and ASTM C128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be

corrected as directed by the Contracting Officer.

2.2 LIQUID LIMIT AND PLASTICITY INDEX

Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area. Provide line and grade stakes as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating are the responsibility of the Contractor. Operate the aggregate sources to produce the quantity and quality of materials meeting the specified requirements in the specified time limit. [Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and shall be left in a satisfactory condition.] Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.3 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the base course(s), the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to [Section 31 00 00 EARTHWORK] [Section 32 11 16 SUBBASE COURSES]. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the base

course(s). Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the base course is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

Mix the coarse and fine aggregates in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. Make adjustments in mixing procedures or in equipment, as directed, to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification.

3.5.2 Placing

Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, place the material in a single layer. When a compacted layer in excess of 6 inches is required, place the material in layers of equal thickness. No layer shall be thicker than 6 inches or thinner than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.5.3 Grade Control

The finished and completed base course shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The base course(s) shall be placed so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Additionally, place approved fill material along the outer edges of the base course in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Continue compaction until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. Make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Construct the compacted thickness of the base course as indicated. No individual layer shall be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5.8 Finishing

The surface of the top layer of base course shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in [and compacted] [, compacted and proof rolled] to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Take measurements in successive

positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

[Do not allow traffic on the completed base course]. [Completed portions of the base course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.]

3.7 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of [outside the limits of Government-controlled land] [as directed] [in waste disposal areas indicated]. No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION 33 05 23.13

UTILITY HORIZONTAL DIRECTIONAL DRILLING
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.652	Safety and Health Regulations for Construction; Subpart P, Excavations; Requirements for Protective Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Statement of Qualifications and Records or previous similar jobs.

Submit Soil Test Data prior to commencement of drilling/excavation work.

SD-02 Shop Drawings

Record Drawings

SD-03 Product Data

Submit Manufacturer's Catalog Data for the polyethylene pipe.

SD-07 Certificates

Drill Rod

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-11 Closeout Submittals

Work Complete Logs of Guided Directional Drill Operations

1.3 COMMENCEMENT, DELIVERY, STORAGE, AND HANDLING OF MATERIALS

Prior to commencement of the work, submit the following to the Engineer of Record for review and approval:

Manufacturer's Catalog Data

Material Safety Data Sheets

Statement of Qualifications and Records

Soil Test Data

Provide written documentation of conformance with AASHTO T 180. Submit a complete list of all drilling fluids, additives, and mixtures to be used along with Material Safety Data Sheets.

Inspect materials delivered to the site for damage. All materials found during inspection or during the progress of work to have cracks, flaws, surface abrasions, or other defects will be rejected. Remove defective materials from the job site.

Disposal of fluids is the responsibility of the Contractor. Dispose of fluids in a manner that is in compliance with all permits and applicable federal, state, and local regulations. The Contractor may dispose of the drilling fluids on approved land owned by the Government subject to written approval from the Contracting Officer. Spread the drilling slurry over the Government-approved disposal area and plow into the soil.

1.4 QUALIFICATIONS

Ensure that Contractor and his field supervisor assigned to this project are experienced in work of this nature and have successfully completed similar projects of similar length, pipe type, pipe size, and soil type using directional drilling in the last three (3) years. As part of the bid submission, submit a description of such project(s) which include, at a minimum, a listing of the location(s), date of project(s), owner, pipe type, size installed, length of installation, type, and manufacturer of equipment used, and other information relevant to the successful completion of the project.

1.5 SAFETY

Include in directional drilling equipment machine safety requirements a common grounding system to prevent electrical shock in the event of underground electrical cable strike. Ensure the grounding system connects all pieces of interconnecting machinery; the drill, mud mixing system, drill power unit, drill rod trailer, operators booth, worker grounding mats, and any other interconnected equipment to a common ground. Equip the drill with an "electrical strike" audible and visual warning system that notifies the system operators of an electrical strike.

PART 2 PRODUCTS

2.1 DRILL ROD

Select the appropriate drill rod to be used. Submit certified statement that the drill rod has been inspected and is in satisfactory condition for its intended use.

2.2 PRODUCT

2.3 DRILLING FLUIDS

Use a high quality bentonite drilling fluid to ensure hole stability, cuttings transport, bit and electronics cooling, and hole lubrication to reduce drag on the drill pipe and the product pipe. Use only fluid with a composition which complies with all federal, state, and local environmental regulations.

Mix the bentonite drilling fluid with potable water (of proper pH) to ensure no contamination is introduced into the soil during the drilling, reaming, or pipe installation process. The Contractor is responsible for any required pH adjustments.

Disposal of the drilling fluids is the responsibility of the Contractor. Conduct disposal in compliance with all relative environmental regulations, right-of-way and work space agreements, and permit requirements.

Collect drilling fluid returns in the entrance pit, exit pit, or spoils recovery pit. Immediately clean up any drilling fluid spills or overflows from these pits.

PART 3 EXECUTION

3.1 DRILL SET-UP AREA

The Contractor is responsible for design and construction of the drill entrance and exit pits.

3.2 DRILL ENTRANCE AND EXIT PITS

Drill entrance and exit pits are required. Maintain at minimum size to allow only the minimum amount of drilling fluid storage prior to transfer to mud recycling or processing system or removal from the site.

Do not allow drilling mud to flow freely on the site or around the entrance or exit pits. Remove spilled mud and restore ground to original condition. Provide shore pits in compliance with OSHA Standards, 29 CFR 1926.652.

When drilling near wetlands or water courses, provide secondary containment to prevent drilling fluids from entering the wetlands, and secure written approval of secondary containment plan from the Contracting Officer .

3.3 DRILL ENTRANCE AND EXIT ANGLE

Ensure entrance and exit angles and elevation profile maintains adequate

cover to reduce risk of drilling fluid breakouts and ground exit occurs as specified herein. Ensure that entrance and exit angles ensure pullback forces do not exceed 5 percent strain on the polyethylene pipe.

3.4 PILOT HOLE

The type and size of the pilot string cutting head and the diameter of the drill pipe is at the Contractor's discretion.

Drill the pilot hole along the path shown on the plan and profile drawings. Pilot hole tolerances are as follows:

a. Vertical Tolerance: Provide minimum cover below channel bottom as specified on the plans. The Contractor may go deeper if necessary to prevent breakout.

b. Horizontal Tolerance: plus/minus - 60 inches] from the centerline of the product pipe.

c. Curve Radius: No curve is acceptable with a radius less than 1,000 feet.

d. Entry Point Location: Make pilot hole entry point within plus/minus - 60 inches of the location shown on the drawings or as directed by the Contracting Officer in the field.

e. Exit Point Location: Make the exit point location within plus/minus - 60 inches of the location shown on the drawings or as directed by the Contracting Officer] in the field.

f. The installed pipeline cover requirements as shown on the drawings or as specified is mandatory.

3.5 REAMING

Conduct reaming operations at the Contractor's discretion. Determine the type of back reamer to be utilized by the type of subsurface soil conditions that are encountered during the pilot hole drilling operation. The reamer type is at the Contractor's discretion.

3.6 PULL BACK

Fully assemble the entire pipeline to be installed via direction drill prior to commencement of pull back operations.

Support the pipeline during pullback operations in a manner to enable it to move freely and prevent damage. Install the pipeline in one continuous pull.

Minimize torsion stress by using a swivel to connect the pull section to the reaming assembly.

Maximum allowable tensile force imposed on the pull section is not to exceed 90 percent of the pipe manufacturer's safe pull (or tensile) strength. If the pull section is made up of multiple pipe size or materials, the lowest safe pull strength value governs and the maximum allowable tensile force is not to exceed 90 percent of this value.

Minimize external pressure during installation of the pullback section in the reamed hole. Replace damaged pipe resulting from external pressure at no cost to the Government. Buoyancy modification is at the discretion of the Contractor.

3.7 CONNECTION OF PRODUCT PIPE TO WATER LINE

After the product pipe has been successfully installed, allow the product pipe to recover for 24 hours prior to connection of the water line. The Contractor is responsible for ensuring that a sufficient length of the product pipe has been pulled through the hole so that the pull-nose is not pulled back into bore hole due to stretch recovery of the product pipe.

3.8 GUIDANCE SYSTEMS

Walkover guidance systems are not acceptable for this project; use a magnetic survey tool locator installed behind the pilot string cutting head and an electric grid (tru-tracker) system for this project.

3.9 DOCUMENTATION

Maintain drilling logs that accurately provide drill bit location (both horizontally and vertically) at least every 2 inches along the drill path. In addition, keep logs that record, as a minimum the following, every 15 minutes throughout each drill pass, back ream pass, or pipe installation pass:

a. Drilling Fluid Pressure

b. Drilling Fluid Flow Rate

c. Drill Thrust Pressure

d. Drill Pullback Pressure

e. Drill Head Torque

Make all instrumentation, readings, and logs available to the Contracting Officer] at all times during operation.

3.10 UTILITY LOCATING AND MARKING

Locate and clearly mark all utilities prior to start of excavation or drilling. The Contractor is responsible for damage to utilities, and repairs for such damages, at no cost to the Government.

3.11 CLEANUP AND FINAL CLOSEOUT

Immediately upon completion of work of this section, remove all rubbish and debris from the job site. Remove all construction equipment and implements of service leaving the entire area involved in a neat condition acceptable of the Contracting Officer.

Immediately clean "blow holes" or "breakouts" of drilling fluid to the surface and return the surface area to its original condition. Dispose of all drilling fluids, soils, and separated materials in compliance with federal, state, and local environmental regulations.

Submit an electronic copy and three hard copies of the record drawings to the Contracting Officer within five days after completing the pull back. Include in the record drawings a plan, profile, and all information recorded during the progress of the work. Clearly tie the record drawings to the project's survey control. Maintain and submit upon completion signed final work complete logs of guided directional drill operations.

-- End of Section --

SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1	(2008) Wood Poles -- Specifications & Dimensions

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B231/B231M	(2011) Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B400	(2008) Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductor
ASTM B496	(2004e1; R 2010) Standard Specification for Compact Round Concentric-Lay-Stranded

	Copper Conductors
ASTM B609/B609M	(1999; R 2010) Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical purposes
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B800	(2005; R 2011) Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers
ASTM B801	(2007) Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
ASTM C478	(2012) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C478M	(2012) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D2472	(2000; R 2006) Standard Specification for Sulphur Hexafluoride
ASTM D4059	(2000; R 2010) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D923	(2007) Standard Practice for Sampling Electrical Insulating Liquids

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 242	(2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V

IEEE 399	(1997) Brown Book IEEE Recommended Practice for Power Systems Analysis
IEEE 404	(2006) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C135.30	(1988) Standard for Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code
IEEE C37.1	(2007) Standard for Supervisory Control, Data Acquisition (SCADA) and Automatic Systems
IEEE C37.121	(1989; R 2006) American National Standard for Switchgear-Unit Substations - Requirements
IEEE C37.13	(2008; INT 1 2009) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	(2009) Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC 3200 V and below) Power Circuit Breakers
IEEE C37.2	(2008) Standard for Electrical Power System Device Function Numbers, Acronyms and Contact Designations
IEEE C37.20.1	(2002; INT 1 2005; AMD A 2005; AMD B 2006; R 2007) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1999; Corr 2000; R 2005) Standard for Metal-Clad Switchgear
IEEE C37.20.3	(2001; R 2006) Standard for Metal-Enclosed Interrupter Switchgear

IEEE C37.23	(2003; R 2008) Standard for Metal-Enclosed Bus
IEEE C37.30	(1997) Standard Requirements for High-Voltage Switches
IEEE C37.34	(1994) Standard Test Code for High-Voltage Air Switches
IEEE C37.41	(2008; Errata 2009) Standard Design Tests for High-Voltage (>1000 V) Fuses, Fuse and Disconnecting Cutouts, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories Used with These Devices
IEEE C37.46	(2010) Standard for High Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches
IEEE C37.63	(2005) Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems
IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C37.90.1	(2002; Errata 2003; Errata 2004) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.21	(1992) Pad-Mounted, Compartmental-Type Self-Cooled, Single-Phase Distribution Transformers With High Voltage Bushings; High-voltage, 34,500 GRYD/19,920 Volts
IEEE C57.12.26	(1992) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.13	(2008) Standard Requirements for Instrument Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2005; Amd 1 2008) Standard for

	Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60255-21-3	(1993) Electrical Relays - Part 21: Vibration, Shock, Bump And Seismic Tests On Measuring Relays And Protection Equipment - Section 3: Seismic Tests; Ed 1.0

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C29.1	(1988; R 2002) American National Standard for Electrical Power Insulators--Test Methods
ANSI C37.50	(1989; R 1995; R 2000; R 2010) American National Standard for Switchgear--Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures
ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA BU 1.1	(2010) General Instructions for Proper Handling, Installation, Operation and Maintenance of Busway Rated 600 V or Less
NEMA C12.4	(1984; R 2011) Registers - Mechanical Demand
NEMA FB 1	(2012) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA LA 1	(2009) Standard for Surge Arresters
NEMA PB 1	(2011) Panelboards
NEMA PB 2	(2011) Deadfront Distribution Switchboards
NEMA SG 2	(1993) Standard for High-Voltage Fuses
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 7	(2005) Standard for Smooth-Wall Coilable Electrical Polyethylene Conduit

NEMA/ANSI C12.10	(2011) Physical Aspects of Watthour Meters - Safety Standards
NEMA/ANSI C12.11	(2007) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1072	(2006; Reprint Aug 2011) Medium-Voltage Power Cables
UL 1242	(2006; Reprint Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1684	(2000; Reprint Aug 2009) Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
UL 198M	(2003; Reprint Oct 2007) Standard for Mine-Duty Fuses
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 510	(2005; Reprint Apr 2008) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2004; Reprint Apr 2010) Metallic Outlet Boxes
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 651	(2011; Reprint Mar 2012) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 854	(2004; Reprint Sep 2011) Standard for Service-Entrance Cables

UL 857 (2009; Reprint Dec 2011) Busways

1.2 SYSTEM DESCRIPTION

Items provided under this section shall be specifically suitable for the following service conditions.

c. Ambient Temperature [_____] degrees F.

d. Frequency [_____]

e. Ventilation [_____]

f. Seismic Parameters [_____]

h. Corrosive Areas

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G
As-Built Drawings; G

SD-03 Product Data

Fault Current Analysis
Protective Device
Coordination Study
Nameplates
Material and Equipment
Installation Requirements

SD-06 Test Reports

Factory Tests
Field Testing
Operating Tests
Cable Installation

SD-07 Certificates

Material and Equipment
Cable Joints

Installation Engineer

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

(1) Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

(2) Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

(3) Detail drawings shall as a minimum depict the installation of the following items:

(a) Medium-voltage cables and accessories including cable installation plan.

(b) Transformers.

(c) Substations.

(d) Switchgear.

(e) Pad-mounted loadbreak switches.

(f) Busways.

(g) Surge arresters.

1.4.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. Correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS ANSI O5.1. Handle wood poles in accordance with ATIS ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.6 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Provide material and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

a. Submit a complete itemized listing of equipment and materials

proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

b. Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms.

c. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

2.2 NAMEPLATES

Submit catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 2 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A153/A153M and ASTM A123/A123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072 . Cables shall be manufactured for use in duct or direct burial applications as indicated.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of15 kV as indicated.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of AEIC CS8. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase. The shield tapeshall be sized to meet IEEE C2 requirements for a ground fault availability of 12000_____] amperes.

2.4.1.6 Neutrals

Neutral conductors of shall be copper. employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.4.1.7 Jackets

Cables shall be provided with a polyethylene jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B3 and ASTM B8. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 Direct Buried

Single and multi-conductor cables shall of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE 404. Medium-voltage cable terminations shall comply with IEEE 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE 386 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE 48 for the next higher Basic Insulation Level (BIL) level.

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 12-1/2 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Duct lines shall be nonencased direct-burial, thick-wall type.[Low-voltage lines orCommunication lines run elsewhere may be direct-burial, thick-wall type.Where concrete encasement is not required, low-voltage circuits may utilize factory-installed cable in coilable plastic duct.

2.6.2 Nonmetallic Ducts

2.6.2.3 Direct Burial

UL 651 Schedule 40andSchedule 80[as indicated, or NEMA TC 6 & 8 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C478, ASTM C478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A48/A48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox

and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.9.1.1 Incoming Section

Metal-enclosed interrupter switchgear consisting of fused, SF6-insulated, interrupters in series with automatic, visible blade disconnects shall be provided for protection of incoming circuits. SF6 gas shall conform to ASTM D2472. Metal-enclosed interrupter switchgear shall comply with IEEE C37.30 for load-interrupter switches, NEMA SG 2 for power fuses, and shall be of the outdoor no-aisle type that meets or exceeds the requirements of applicable publications listed. Switch construction shall be of the manually-operated, "OPEN-CLOSED," SF6-insulated, load interrupter type equipped with a stored energy operator for quick-make quick-break to make operating speeds independent of manual switch operations. Where indicated, suitable bus or lug connections shall be provided to mount field-installed, slip-on, medium-voltage cable terminations for cable entering via conduit from below and a flanged throat suitable for direct connection to the associated transformer. Surge protection shall be provided in accordance with paragraph SURGE ARRESTERS. Switches shall be of the 2-position type, open-closed.

a. Ratings. Fuse continuous current ratings shall be as indicated for the transformer for an incoming line unit and for the line tie unit. Unless otherwise indicated, fuses shall be of the current limiting type. Switch ratings at 60 Hz shall be:

Nominal voltage	12,470
Rated maximum voltage	13,200
Maximum symmetrical interrupting capacity	25kA
Maximum asymmetrical interrupting capacity	25kA
3-Second short time current carrying capacity	12.5kA
Rated continuous current	600
BIL	95

b. Basic Requirements. The electrical devices listed below shall be rated for the application and voltage and current indicated. Unless otherwise noted, manufacturer's standard devices shall be provided and shall include the following:

(1) A switch-operating handle with provisions for locking in either the open or closed position.

(2) A switch mechanical position indicator.

(7) An interface terminal block wired for required exterior connections.

2.9.1.2 Transformer Section

Transformers shall have two separate windings per phase and shall be of the mineral oil-insulated type with high molecular-weight hydrocarbon liquid. Transformers shall be suitable for outdoor use. Liquid-insulated transformers shall comply with IEEE C57.12.00, and shall have two 2-1/2 percent full capacity taps above and two 2-1/2 percent full capacity taps below rated voltage. Transformers shall be of the sealed tank type construction with welded-on cover. High-voltage terminals shall be provided in an air terminal chamber for incoming bottom entry cablesfor direct connection to the incoming line sectionas shown on the drawings. Low-voltage terminals shall be provided in an air terminal chamber for incoming bottom entry cablesfor direct connection to the outgoing switchgear sectionas shown on the drawings. Low-voltage terminals shall be on the rightas shown on the drawings when facing the front, accessory side of the transformer.

Accessories:

1. drain and filter connection.

2. filling and top filter press connection.

3. pressure-vacuum gauge.

4. dial type thermometer with alarm contacts.

5. magnetic liquid level indicator with high and low level alarm contacts.

6. pressure relief device with alarm contacts.

7. ground connection pad.

8. provision for jacking, lifting, and towing.

9. diagram and rating nameplate.

2.9.1.4 Nonintegral (Cable Compartment) Outgoing Section

A cable compartment shall be provided on the transformer for cable connections as shown. Clamp type terminations for cables entering from below shall be provided for connection to the transformer bushings. Clamp type cable terminations, suitable for copper conductors, shall be provided for the circuit sizes shown.

2.9.2 Pad-Mounted Transformers

Pad-mounted transformers shall comply with IEEE C57.12.26 and shall be of the loop feed type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of IEEE C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.9.2.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, oil-immersed, bayonet-type fuses , medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stenciled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on a second set of high voltage bushings.

2.9.2.2 Load-Break Switch

a. Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

2.9.2.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00 and IEEE C57.12.21 and shall be of the mineral oil-insulated type. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage

compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity	112.5 kVA
Impedance	[_____]
Temperature Rise	149 degrees F
High-voltage winding	15,000] volts
High-voltage winding connections	Delta/Wye
Low-voltage winding	[_____] volts
Low-voltage winding connections	[_____]

2.9.2.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.9.2.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.9.3 Busways

Busways shall comply with NEMA BU 1.1 and UL 857 and shall be of the voltage, phase, and continuous current ratings indicated. Neutrals shall be full size. Busways shall have short-circuit ratings not less than the maximum short-circuit currents of associated transformers, assuming primary sources of infinite capacity. Busways shall be feeder-low-impedance type and of outdoor or indoor service construction as suitable to the location. Busways shall be complete with elbows, fittings, flanges, end-closures, tees, crosses, cable-tap boxes, accessories, and other devices required for the indicated installation, and shall be coordinated for connection to the indicated equipment. For wet/damp locations, bus duct shall be heated, nonventilated enclosure, nonsegregated phase type in accordance with IEEE C37.23. Detail drawings for busway supports and bracing shall be submitted in accordance with the detail drawings portion of paragraph SUBMITTALS and shall indicate that busways are adequately supported for the

seismic forces specified in paragraph GENERAL REQUIREMENTS (sub-paragraph Service Conditions).

2.9.4 Pad-Mounted, Metal-Enclosed, Switchgear

The switchgear shall be configured with 2 incoming compartments for loop-feed arrangement, equipped with SF6-insulated, load-interrupter switches, as indicated. The outgoing compartments shall be provided with non-reclosing vacuum-type interrupters or circuit breakers, as indicated.

2.9.4.1 Ratings at 60 Hz shall be:

Nominal voltage (kV)	12.47
Rated maximum voltage (kV)	15
Rated continuous current (A)	600
Maximum symmetrical interrupting capacity (kA)	25
Maximum asymmetrical interrupting capacity (kA)	25
Three-second short-time current-carrying capacity (kA)	12.5
BIL (kV)	95

2.9.4.2 Operators, Devices, and Controls

Operators and controls shall be provided for the switchgear as follows:

a. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy (spring-driven) mechanism to simultaneously open or close all phases. The switchgear shall be configured so that the switch actuator is padlockable, but may be accessed without opening the switch compartment doors.

b. Fused disconnects shall be hook-stick operated.

c. Switches shall be provided with an automatic switch operator configured for local and remote opening and closing. An actuator charging motor shall be provide which operates at 120 V ac. Switches shall be provided with remote telemetry units (RTUs) for remote operation and integration with supervisory, control, and data acquisition systems. Systems, components, and equipment shall conform to the requirements and recommendations of IEEE C37.1.

d. Vacuum type interrupters shall be provided with an electronic controller for trip initiation. Manual trip initiation shall be provided by a push button or switch. Automatic trip shall be initiated by detection of excessive current. The electronic controller shall provide trip current selection capability according to present time-current response curves, as indicated. Each interrupter shall be

provided with a 3 phase, gang-operated handle mechanism for trip and reset.

2.9.4.3 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of IEEE C57.12.28 and IEEE C37.20.3, Category A.

2.9.5.2 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of IEEE C57.12.28 and IEEE C37.20.3, Category A.

2.9.6 Cable Terminating Cabinets

Cable terminating cabinets shall be hook-stick operable, deadfront construction conforming to the requirements of IEEE C37.20.3, Category A. Cabinets shall be provided with with 600 A. dead-break junctions and elbow-type separable dead-break connectors, cable parking stands, and grounding lugs. The cable terminating equipments shall conform to IEEE 386.

Ratings at 60 Hz shall be:

Nominal voltage (kV)	12.47
Rated maximum voltage (kV	15
Rated continuous current (A)	600
Three-second short-time current-carrying capacity (kA)	25
BIL (kV)	95

2.10.2 Fuses, Medium-Voltage, Including Current-Limiting

2.10.2.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.10.2.2 Ratings

[Expulsion-type] [Current-limiting] power fuses shall have ratings in accordance with IEEE C37.46 and as follows:

Nominal voltage (kV)	12.47
Rated maximum voltage (kV	15
Rated continuous current (A)	600
Maximum symmetrical interrupting capacity (kA)	12.5
BIL (kV)	95

2.10.2.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to IEEE C37.46.

2.10.2.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.10.4 Instrument Transformers

2.10.4.1 General

Instrument transformers shall comply with NEMA/ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.10.4.4 Current Transformers for Metal-Enclosed Switchgear

Single-ratio units, used only for relaying, shall have a relaying accuracy class rating of [_____] for either a C or T classification.

2.10.4.6 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of . Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.10.6 Protective Relaying

2.10.6.1 General

Solid-stateMicroprocessor-based protective relays shall be provided as shown and shall be of a type specifically designed for use on power switchgear or associated electric power apparatus. Protective relays shall conform to IEEE C37.90. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.10.6.2 Construction

Relays shall be dustproof and moisture resistant. Necessary test devices shall be incorporated within each relay and shall provide a means for testing either from an external source of electric power or from associated instrument transformers. Each relay shall be provided with an operation indicator and an external target reset device. Relays shall have necessary auxiliaries for proper operation. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.10.6.3 Ratings

Relays shall be the manufacturer's standard items of equipment with appropriate ranges for time dial, tap, and other settings. Relay device numbers shall correspond to the function names and descriptions of IEEE C37.2.

2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters for use at elevations in excess of 6000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than [5/8 inch[3/4 inch in diameter by 10 feet in length. Sectional type rods may be used.

2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Concrete reinforcing shall be as specified in Section 03 20 00.00 10 CONCRETE REINFORCING.

2.14 PADLOCKS

Padlocks shall comply with Section 08 71 00 DOOR HARDWARE.

2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM APP GUIDE as a

fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

2.16 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 2 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D923 and have tests performed in accordance with ASTM D4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 2 ppm shall be replaced.

2.17 FACTORY TESTS

Submit certified factory test reports when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included. Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard [routine] [design] [and] [other]

tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

d. Protective Relays: Seismic tests in accordance with IEC 60255-21-3. Surge withstand tests in accordance with IEEE C37.90.1.

e. Relaying Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

i. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

2.19 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. Provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.19.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extended through the secondary side of transformers for medium voltage distribution feeders.

2.19.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented.

2.19.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram

or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.19.4 Fault Current Analysis

2.19.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE 242, and IEEE 399.

2.19.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.19.5 Coordination Study

Submit the study with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government will not be responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study. The study shall demonstrate that the maximum possible degree of selectively has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION REQUIREMENTS

As a minimum, submit installation procedures for transformers, substations, switchgear, and splices. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment. Equipment and devices shall

be installed and energized in accordance with the manufacturer's published instructions. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE.

3.2.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.2.2 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. Furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.3 CABLE AND BUSWAY INSTALLATION

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. And then [prepare a checklist of significant requirements] [perform pulling calculations and prepare a pulling plan] which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.3.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.3.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.3.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.3.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.3.1.4 Cable Installation

Provide a cable feeding truck and a cable pulling winch as required. Provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manila rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. Do not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation. Submit 6 copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

3.3.1.5 Cable Installation Plan

Submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.3.2 Duct Line

[Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.3.3.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.3.3.4 Cable Joints or Splices

Cable joints or splices for Medium-Voltage Cable Joints or Low-Voltage Cable Splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.3.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.4 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted with a certification that contains the names of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.5 FIREPROOFING

Fire-stops shall be installed in each conduit entering or leaving a manhole.

3.5.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.5.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM APP GUIDE. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.6 DUCT LINES

3.6.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of 12_____] inches, but not less than [36_____] inches below finished grade and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.6.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.6.5.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct as shown. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due

to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 32 degrees F.

3.6.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.7 MANHOLES, HANDHOLES, AND PULLBOXES

3.7.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.7.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.7.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the

telephone and communication systems will be installed by others.

3.7.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 4/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.8 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.8.1 Concrete Pads

3.8.1.1 Construction

Concrete pads for pad-mounted electrical equipment [may be either pre-fabricated or] [shall be] poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished [floor] [paving or grade] and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.8.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03 20 00.00 10 CONCRETE REINFORCING.

3.8.1.3 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.8.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

3.11 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed under pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer,a switchgear ground bus, to the ground mat. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.11.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.

c. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed not less than 30 inches below finished top of soil grade. Ground ring conductors shall be sized as shown .

d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be a single extension-type rod, 5/8 inch diameter, up to 30 feet long, driven perpendicular to grade . In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.11.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.11.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is

necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.11.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.11.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.11.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.12 FIELD TESTING

Submit a proposed field test plan, 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

3.12.1 General

Field testing shall be performed in the presence of the Contracting Officer. Notify the Contracting Officer 30 days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. Maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.12.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity.

Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.12.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Multiple rod electrodes - 25 ohms.

3.12.5 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC C8 or AEIC CS8 as applicable, and shall not exceed the recommendations of IEEE 404 for cable joints and IEEE 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.12.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired

cable shall be retested until failures have been eliminated.

3.12.7 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.12.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.12.12 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

b. Pad-mounted transformers

g. Switches

3.12.13 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. Submit 6 copies of the tests report in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. The operating test report shall include the following:

a. A list of equipment used, with calibration certifications.
b. A copy of measurements taken.
c. The dates of testing.
d. The equipment and values to be verified.
e. The condition specified for the test.
f. The test results, signed and dated.
g. A description of adjustments made.

3.13 MANUFACTURER'S FIELD SERVICE

3.13.1 Onsite Training

b. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included.

c. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

3.13.2 Installation Engineer

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers. After delivery of the equipment, furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.14 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 33 77 19.00 40

MEDIUM-VOLTAGE GAS SWITCH
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.72	(1987) Standard for Manually-Operated Dead-Front Pad Mounted Switchgear with Load Interrupting Switches and Separable Connections for Alternating-Current Systems

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM D2472	(2000; R 2006) Standard Specification for Sulphur Hexafluoride

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

1.2 GENERAL REQUIREMENTS

Sections 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS and 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES and Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES apply to work specified in this section.

Permanently mark Connection Diagrams for heater connections on drawings and shipping covers.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Connection Diagrams for heater connections in accordance with paragraph entitled, "General Requirements," of this section.

Provide detail drawings that show mounting details and configuration for the following:

Load- Break Switches

SD-03 Product Data

Provide Equipment and performance data for the following items:

SF6 Load-Break Switches

Mounting Frames

Accessories

SD-06 Test Reports

Provide Test reports for the following in accordance with ANSI C37.72.

Basic Impulse Insulation Level (BIL)

Withstand Voltage Rating

Momentary RMS Asymmetrical Rating

Leak Tests

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Switches

1.4 SHIPPING

Prior to shipment, perform leak tests and certify the completed switch assembly to have leak rate less than 10-7cubic (.0000001) centimeters per

second by a helium mass spectrometer test. Seal and fill switches with SF6 to a nominal 10 psig positive pressure at 75 degrees F.

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 SWITCHES

Provide gas insulated load-break switches of the pad-mounted type in accordance with ANSI C37.72 and IEEE 386.

Provide Sulphur hexafluoride (SF6) gas in accordance with ASTM D2472.

Provide manually operated, load-interrupting type SF6 load-break switches, rated 15 kV 600 amperes, minimum, continuous and load break for operation on a 12.47 kV, 3-phase, 4-wire system. Provide switch that has momentary rms asymmetrical rating of 22.5 kA and a close rms symmetrical rating of 12.5 kA for 1 minute 60 Hz withstand voltage rating of 35 kV and basic impulse insulation level (BIL) of 95 kV. Provide the type of switch indicated, designed to show the internal wiring, indicating each switch position. Provide each switching way with 600A dead break bushings.

Provide switch enclosures in accordance with IEEE C57.12.28 equipped with ground bus capable of carrying the rated fault current for one second for each way.

Provide each switch with pressure gage, position viewing window and fill plug.

Provide lockable incoming line position of switches to prevent unauthorized grounding.

Provide cable and cable terminations in accordance with Section 26 05 13.00 40 MEDIUM-VOLTAGE CABLES. Equip switches with 600 amperes and bushings with inserts to accept load break elbows, as indicated.

Provide cable terminations from the fuse compartment that are preformed stress-cones or have deep-well apparatus bushings in accordance with IEEE 386.

Provide provisions for padlocking each handle in any position.

Provide switch tanks that are constructed of stainless steel plate, fully

TTG welded.

Provide operating mechanisms that are equipped with handles for manual operation and are operated by a non-teasible, snap-action, quick-make, quick-break. Make opening and closing of the main contacts totally independent of the speed or position of the operating handle. Secure operating handle to the shaft in a manner that ensures tightness and alignment.

2.2 ACCESSORIES

Provide fittings, lifting eyes, insulators, and other required accessories with the switch as necessary.

Provide all corrosion-resistant metal operating parts of switch assemblies.

Provide switches with suitable attachments to permit closing and opening under full rated load current, without damage.

Provide fuses located in a separate compartment on the outgoing feeders as indicated and per Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES . Interlock fuse-compartment doors with switch mechanisms.

Provide switches with a visible break option that allows direct viewing of the switch contacts in the open and closed positions within the switch tank.

2.4 COORDINATION

Coordinate power fuses with the circuit breaker settings in the substation and with the transformer rating. Provide time-current characteristics, minimum melt and total clear times as required.

2.5 MOUNTING FRAMES

Furnish mounting frames that are of angle-iron construction, for all pad -mounted switches and are hot-dipped galvanized after fabrication in accordance with ASTM A123/A123M.

After fabrication, clean and paint all exposed ferrous metal surfaces of the pad mount enclosure.

Paint mounting frames in accordance with ANSI C37.72.

2.6 FACTORY FINISH

Provide switches with the manufacturer's standard paint finish when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

Install switches in accordance with the manufacturer's instructions. Include in the installation all necessary hardware, insulators, and

connections to line wire or bus.

3.2 GROUNDING

Solidly bond tanks, mounting frames, and operating mechanisms to the station ground counterpoise in accordance with ANSI C37.72 and Section 28 05 26.00 40 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

Provide incoming line position with a warning tag that states "CAUTION: INCOMING LINE, DO NOT GROUND."

3.3 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Operate switch assembly in the presence of the Contracting Officer. Provide final test reports to the Contracting Officer. Provide a cover letter/sheet with the reports clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 33 77 36.00 40

MEDIUM-VOLTAGE UTILITY FUSES
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 242	(2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE 399	(1997) Brown Book IEEE Recommended Practice for Power Systems Analysis
IEEE C37.40	(2003; Errata 2003; R 2009) Service Conditions & Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, & Accessories
IEEE C37.41	(2008; Errata 2009) Standard Design Tests for High-Voltage (>1000 V) Fuses, Fuse and Disconnecting Cutouts, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories Used with These Devices
IEEE C37.42	(2009) Standard Specifications for High-Voltage (> 1000 V) Expulsion-Type Distribution-Class Fuses, Fuse and Disconnecting Cutouts, Fuse Disconnecting Switches, and Fuse Links, and Accessories Used with These Devices
IEEE C37.46	(2010) Standard for High Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches
IEEE C37.47	(2011) Standard for High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC

NEMA ICS 6	(1993; R 2011) Enclosures
NEMA SG 2	(1993) Standard for High-Voltage Fuses

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Equipment and Performance Data

Distribution Fuse Cutouts

SD-07 Certificates

Testing

SD-08 Manufacturer's Instructions

Fuse Cutouts

Manufacturer's Installation Instructions

1.3 SYSTEM REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit fabrication drawings for fuse cutouts consisting of fabrication and assembly details to be performed in the factory.

Submit equipment and performance data for distribution fuse cutouts including life, testing certificates verifying conformance to referenced standards, system functional flows, safety features, and mechanical automated details.

PART 2 PRODUCTS

2.1 EQUIPMENT STANDARDS

Ensure distribution fuse cutouts conform to the following requirements:

IEEE C37.40

IEEE C37.41

IEEE C37.42

IEEE C37.46

IEEE C37.47

IEEE 242

IEEE 399

NEMA ICS 3

NEMA ICS 6

NEMA SG 2

NFPA 70

2.2 FUSE CUTOUTS

Submit manufacturer's instructions for fuse cutouts including special provisions required to install equipment components and system packages. Include special notices detailing impedances, hazards and safety precautions.

Ensure distribution fuse cutouts are self-contained, enclosed, dropout type, or open type when required for higher voltage or interrupting rating. Install loadbreak cutouts only if specifically indicated.

Ensure the interrupting capacity is sufficient to break the maximum system fault current to which the cutout will be subjected. The minimum interrupting capacity is 16,000 amperes root mean square asymmetric.

Provide heavy-duty or extra-heavy-duty classification cutouts. Ensure cutouts installed on three-phase, 13.2-kilovolt (kV) or 13.8-kV systems are rated at 15 kV. The installation of cutouts rated at 7.8 kV on these systems is not allowed.

Provide fuse links with a continuous rating equal to approximately 150 percent of the full-load line current when used for transformer protection, and approximately 110 percent of the conductor rated capacity when used for circuit protection. Ensure the 15-kV cutout has a wet withstand, 10-second voltage rating of 37 kV, with a 95-kV basic impulse level (BIL). Provide with a continuous current rating of 100 amperes unless otherwise indicated. Provide fuse disconnects rated not less than 100 amperes, having attachments to permit manual operation of the disconnect under load without external arcing.

Where indicated,combine lightning arresters and fuse cutouts.

PART 3 EXECUTION

3.1 INSTALLATION

Install distribution fuse cutouts in accordance installation drawings with the manufacturer's installation instructions.

-- End of Section --

MANUFACTURER & VENDOR MATERIAL DATA SHEETS

Okoguard®-Okoseal® Type MV-105

15kV Shielded Power Cable

One Okopact® (Compact Stranded) Copper Conductor/105°C Rating
100% and 133% Insulation Level
For Cable Tray Use-Sunlight Resistant

A. Uncoated, Okopact (Compact Stranded) Copper Conductor
B. Strand Screen-Extruded Semiconducting EPR
C. Insulation-Okoguard EPR
D. Insulation Screen-Extruded Semiconducting EPR
E. Shield- Copper Tape
F. Jacket-Okoseal

Insulation

Okoguard is Okonite's registered trade name for its exclusive ethylene-propylene rubber (EPR) based, thermosetting compound, whose optimum balance of electrical and physical properties is unequaled in other solid dielectrics. Okoguard insulation, with the distinctive red color and a totally integrated EPR system, provides the optimum balance of electrical and physical properties for long, problem free service.

The triple tandem extrusion of the screens with the insulation provides optimum electrical characteristics.

Jacket

The Okoseal (PVC) jacket supplied with this cable is mechanically rugged and has excellent resistance to flame, oil, acids and most chemicals.

Applications

Okoguard shielded Okoseal Type MV-105 power cables are recommended for use as feeder circuits, in electric utility generating stations, for distribution circuits, and for feeders or branch circuits in industrial and commercial installations.

Type MV cables may be installed in wet or dry locations, indoors or outdoors (exposed to sunlight), in any raceway or underground duct, directly buried if installed in a system with a grounding conductor in close proximity that conforms with NEC Section 250.4(A)(5), or messenger supported in industrial establishments and electric utilities. Sizes 1/0 AWG and larger may also be installed in cable tray.

Specifications

Conductor: Annealed uncoated copper compact stranded per ASTM B-496.

Strand Screen: Extruded EPR semiconducting strand screen. Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, AEIC CS8, CSA C68.3 and UL 1072.

Insulation: Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, AEIC CS8, CSA C68.3 and UL 1072.

Insulation Screen: Extruded EPR semiconducting insulation screen applied directly over the insulation. Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, AEIC CS8, CSA C68.3 and UL 1072.

Shield: 5 mil bare copper tape helically applied with 25% nominal overlap.

Jacket: Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, CSA C68.3 and UL 1072 for polyvinyl chloride jackets.

UL listed as Type MV-105, sunlight resistant and for use in cable tray in accordance with UL 1072.

CSA C68.3 listed and rated FT4 and -25°C.

Product Features

- Triple tandem extruded, all EPR system.
- Okoguard cables meet or exceed all recognized industry standards (UL, CSA, AEIC, NEMA/ICEA, IEEE).
- 105°C continuous operating temperature.
- 140°C emergency rating.
- 250°C short circuit rating.
- Passes the Vertical Tray Flame Test requirements of UL 1072 and IEEE 383 and 1202.
- Excellent corona resistance.
- Screens are clean stripping.
- Exceptional resistance to "treeing".
- Exceptional resistance to moisture.
- Resistant to most oils, acids, and alkalies.
- Sunlight resistant.
- For Cable Tray Use.
- CSA FT4 and -25°C.
- Improved Temperature Rating.

Okoguard-Okoseal Type MV-105

15kV Shielded Power Cable

One Okopact (Compact Stranded)
Copper Conductor/105°C Rating
100% and 133% Insulation Level
For Cable Tray Use-Sunlight Resistant

Product Data
Section 2 Sheet 3

Catalog Number (1)	Conductor Size AWG or kcmil	Conductor Size -mm²	Approx. Dia. over Insulation (in.)	Approx. Dia. over Screen (in.)	Jacket Thickness - mils	Jacket Thickness - mm	Approx. O.D. - Inches	Approx. O.D. - mm	Approx. Net Weight lbs./1000'	Approx. Ship Weight lbs./1000'	Ampacities (2) Conduit in Air	Ampacities (3) Underground Duct	Ampacities (4) Cable Tray	Conduit Size Inches (5)*
Okoguard Insulation: 175 mils (4.45mm), 100% Insulation Level														
115-23-3064	1/0	53.5	0.74	0.80	80	2.03	0.98	24.8	760	825	215	215	220	3
115-23-3066	2/0	67.4	0.78	0.84	80	2.03	1.02	25.8	870	935	255	245	250	3
115-23-3067	3/0	85.0	0.83	0.89	80	2.03	1.07	27.1	1005	1070	290	275	290	3
115-23-3069	4/0	107.0	0.88	0.94	80	2.03	1.12	28.4	1160	1240	330	315	335	3
115-23-3074	250	127.0	0.93	0.98	80	2.03	1.17	29.7	1330	1415	365	345	370	3½
115-23-3076	350	177.0	1.03	1.07	80	2.03	1.26	32.0	1700	1800	440	415	460	3½
115-23-3090	500	253.0	1.14	1.19	80	2.03	1.38	35.1	2230	2275	535	500	575	4
115-23-3091	750	380.0	1.32	1.37	80	2.03	1.55	39.4	3105	3340	655	610	745	5
115-23-3092	1000	507.0	1.47	1.52	80	2.03	1.71	43.4	3960	4215	755	690	890	5
Okoguard Insulation: 220 mils (5.59mm), 133% Insulation Level														
▲ 115-23-3230	1/0	53.5	0.83	0.88	80	2.03	1.07	27.2	850	920	215	215	220	3
▲ 115-23-3232	2/0	67.4	0.87	0.92	80	2.03	1.11	28.2	970	1030	255	245	250	3
115-23-3234	3/0	85.0	0.92	0.98	80	2.03	1.16	29.4	1100	1185	290	275	290	3½
▲ 115-23-3236	4/0	107.0	0.96	1.02	80	2.03	1.21	30.7	1280	1370	330	315	335	3½
▲ 115-23-3238	250	127.0	1.01	1.07	80	2.03	1.26	32.0	1435	1520	365	345	370	3½
▲ 115-23-3240	350	177.0	1.11	1.17	80	2.03	1.35	34.3	1810	1940	440	415	460	4
▲ 115-23-3242	500	253.0	1.22	1.28	80	2.03	1.47	37.3	2350	2535	535	500	575	4
▲ 115-23-3243	750	380.0	1.40	1.46	80	2.03	1.65	41.9	3240	3480	655	610	745	5
▲ 115-23-3244	1000	507.0	1.55	1.60	110	2.79	1.86	47.1	4220	4490	755	690	890	6

Visit Okonite's web site, www.okonite.com for the most up to date dimensions.

▲ **Authorized Stock Item.** Available from our Customer Service Centers. Minimum Manufacturing Quantity for non-stock items is 5000'.

Aluminum Conductors

(1) Aluminum conductors are available on special order. To order aluminum conductors, change the first three digits of the catalog number from 115 to 135.

Ampacities

(2) Ampacities are in accordance with Table 310.60(C)(73)of the NEC for three single Type MV-105 conductors, or single conductors twisted together (triplexed) and installed in an isolated conduit in air at an ambient temperature of 40°C and a conductor temperature of 105°C.

(3) Ampacities are in accordance with Table 310.60(C)(77)of the NEC for three single conductors or triplexed cable in one underground raceway, three feet deep with a conductor temperature of 105°C, 100% Load Factor, an ambient earth temperature of 20°C, and thermal resistance (RHO) of 90.

Refer to the NEC, IEEE/ICEA S-135 Power Cable Ampacities, or the Okonite Engineering Data Bulletin EHB for installation in duct banks, multiple point ground shields, other ambient temperatures, circuit configurations or installation requirements.

(4) Ampacities based on single Type MV-105 conductors, or single conductors twisted together (triplexed, quadruplexed, etc.) size 1/0 AWG and larger, installed in uncovered cable tray in accordance with Section 392.80(B) of the NEC at an ambient temperature of 40°C and a conductor temperate rating of 105°C. In accordance with NEC Section 392.80(B)(2)(a) (copper conductors), the values are 75% of the values given in table 310.69. Where the cable tray is covered for more than six feet with solid unventilated covers, the ampacities shall not exceed 93% of the values shown above.

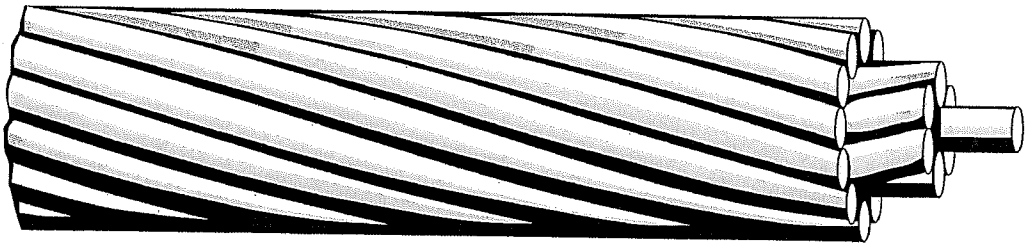
(5) Recommended size of rigid or nonmetallic conduit for three conductors based on 40% maximum fill.

*The jam ratio, conduit I.D. to cable O.D. should be checked to avoid possible jamming.

THE OKONITE COMPANY
Ramsey, New Jersey 07446

Bare Copper Wire and Cable

Bare Copper Conductor. Solid and Stranded .



APPLICATIONS

Solid and stranded (classes AA and A) bare copper are suitable for overhead transmission and distribution applications. Stranded conductor of greater flexibility (classes B and C) are suitable for uninsulated hook up, jumpers, and grounds in electrical construction. Soft Drawn copper is unilay construction.

SPECIFICATIONS

Southwire's bare copper wire and cable meets or exceeds the following ASTM specifications:

- B-1 Hard-Drawn Copper Wire.
- B-2 Medium-Hard Copper Wire.
- B-3 Soft or Annealed Copper Wire.
- B-8 Concentric-Lay-Stranded Hard, Medium-Hard or Soft Copper Conductor.
- B-33 Tinned Conductors
- B-787 19 Wire Combination Unilay-Stranded Soft copper wire.

CONSTRUCTION

Bare copper, solid or stranded. Available in tempers hard, medium-hard, or soft. Stranded conductors are concentrically stranded in hard and medium-hard tempers and are Combination Unilay stranded in the soft-drawn temper.

Southwire
One Southwire Drive
Carrollton, Ga. 30119 USA

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Bare Copper

Size (AWG)	Weight (lbs/1000 ft)	Diameter (mils)	Circular Mil Area (mils)	Hard Drawn		Medium-Hard Drawn		Soft-Drawn (Annealed)		Allowable Ampacity+
				Rated Strength> (lbs)	DC Resistance (ohms/1000 ft) @20°C	Rated Strength (lbs)	DC Resistance (ohms/1000 ft) @20°C	Rated Strength (lbs)	DC Resistance (ohms/1000 ft) @20°C	
SOLID										
14	12.4	64.1	4110	213.5	2.626	166.6	2.613	124.2	2.525	--
13	15.7	72	5180	268.0	2.083	208.8	2.072	156.6	2.003	--
12	19.8	80.8	6530	336.9	1.652	261.2	1.643	197.5	1.588	--
11	24.9	90.7	8230	422.9	1.310	327.6	1.303	249.0	1.260	--
10	31.4	101.9	10380	529.2	1.039	410.4	1.033	314.0	.999	--
9	39.6	114.4	13090	661.2	.824	514.2	.820	380.5	.792	--
8	50	128.5	16510	826.0	.653	643.9	.650	479.8	.628	95
7	63	144.3	20820	1030.0	.518	806.6	.515	605.0	.498	105
6	79.4	162	26240	1280.0	.411	1010.0	.409	762.9	.395	125
5	100.2	181.9	33090	1591.0	.326	1265.0	.324	961.9	.313	145
4	126.3	204.3	41740	1970.0	.258	1584.0	.257	1213.0	.249	170
3	159.3	229.4	52620	2439.0	.205	1984.0	.204	1530.0	.197	195
2	200.9	257.6	66360	3003.0	.163	2450.0	.162	1929.0	.156	225
1	253.3	289.3	83690	3688.0	.129	3024.0	.128	2432.0	.124	260

+Ampacity based on 75°C conductor temperature; 25°C ambient temperature; 2 ft./sec. wind in sun.

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Bare Copper

Size (AWG)	Stranding	Stranding Class	Weight (lbs/1000 ft)	Diameter (mils)		Hard Drawn		Medium-Hard Drawn		Soft-Drawn (Annealed)		Allowable Ampacity+
				Individual Wires	Complete Conductor	Rated Strength (lbs)	DC Resistance (ohms/1000 ft) @20°C	Rated Strength (lbs)	DC Resistance (ohms/1000 ft) @20°C	Rated Strength (lbs)	DC Resistance (ohms/1000 ft) @20°C	
STRANDED												
8	7	B	51	49	146	777	.6663	610	.6629	499	.6408	95
6	7	B	81	61	184	1228	.4191	959	.4169	794	.4030	130
4	7	A, B	128.9	77	232	1938	.2636	1505	.2622	1320	.2534	170
3	7	A, B	162.5	87	260	2433	.2090	1885	.2079	1670	.2010	200
2	7	A, B	204.9	97	292	3050	.1660	2360	.1650	2110	.1578	230
1	7	A	258.4	109	328	3801	.1316	2955	.1309	2552	.1252	265
1/0	7	A, AA	326.1	123	368	4752	.1042	3705	.1037	3221	.1002	310
2/0	7	A, AA	410.9	138	414	5926	.08267	4640	.08224	4062	.07949	355
2/0	19	B	410.9	84	418	6690	.08267	4765	.08224	4024	.07949	355
3/0	7	A, AA	518.1	155	464	7366	.06556	5812	.06522	5118	.06304	410
4/0	7	A, AA	653.3	174	522	9154	.05199	7278	.05172	6459	.04999	480
4/0	19	B	653.3	106	528	9617	.05199	7479	.05172	6453	.04999	480
250	19	A	771.9	115	574	11360	.04400	8836	.04378	7627	.04231	530
250	37	B	771.9	82	575	11600	.04400	8952	.04378	7940	.04231	530
300	19	A	926.2	126	628	13510	.03667	10530	.03648	9160	.03526	590
350	19	A	1080.6	136	679	15590	.03143	12200	.03127	10680	.03022	650
500	37	A, B	1543.8	116	814	22510	.02200	17550	.02189	15240	.02116	810
600	37	A, AA	1852.5	127	891	27020	.01834	21060	.01825	18300	.01763	910
750	61	A, B	2315.6	111	998	34090	.01467	26510	.01459	22890	.01410	1040
1000	61	A, B	3087.5	128	1152	45030	.01100	35100	.01094	30500	.01058	1240

+Ampacity based on 75°C conductor temperature; 25°C ambient temperature; 2 ft./sec. wind in sun.

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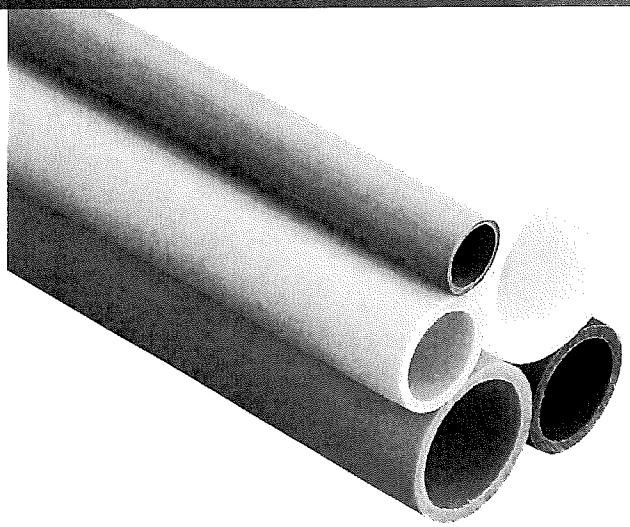
Smoothwall



Applications: Underground or innerduct

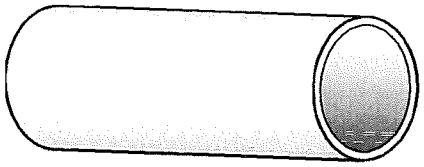
Installation methods: Plowing, open trench, directional boring or pulled through existing conduit

Smoothwall HDPE is a nonmetallic flexible raceway manufactured from High Density Polyethylene (HDPE) for use in underground and innerduct applications.

Smoothwall offers superior protection, increases pathways of existing duct systems, allows extra channels for future cabling needs, and is ideal for jetting cable. Available in a wide range of sizes, colors, and options, Carlon HDPE is the only cable management system you need.

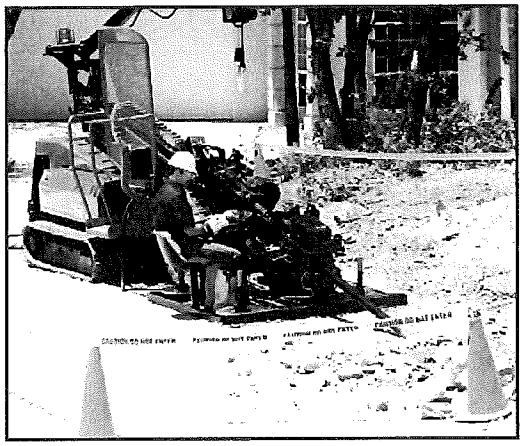
Smooth Interior Wall

Smoothwall is ideal for jetting cable



Smoothwall Options

- Sizes 1/2" - 16"
- Multiple colors and stripes
- Factory installed pull lines
- Sequentially marked footage
- Up to four colors of equal lengths paralleled or segmented on one reel
- Pre-lubricated
- Toneable Duct – copper conductor within the wall of duct. Used to locate buried conduit. (see page 6)



Directional Boring

Open Trench

Custom Orders

Custom Orders are not returnable
Custom lengths are available in minimum order quantities specified on page 25

How to Build a Part Number:

Product	Size	Type	Wall	Options	Splits	Color	Stripes	Tape	Length
A = HDPE	2 = 1/2"	C = Smooth/Smooth	4 = SCH 40	N = None	1 = 1 Way Single	A = Black	NN = None	A = Empty	1500
	3 = 3/4"		5 = SCH 80	D = Lube Duct	2 = 2 Way Segmented	B = Blue	3A = Black Stripes	B = 1130 lbs. Polyester Tape	(Equals 1500 Feet)
	5 = 1"		6 = SDR 11		3 = 3 Way Segmented	C = Brown	3B = Blue Stripes	C = 1250 lbs. Polyester Tape	
	6 = 1-1/4"		9 = SDR 13.5		4 = 4 Way Segmented	D = Buff	3C = Brown Stripes	D = 1500 lbs. Polyester Tape	
	9 = 1-1/2"		13 = SDR 15.5		5 = 2 Way Parallel	E = Gray	3D = Buff Stripes	E = 1800 lbs. Polyester Tape	
	13 = 2"		14 = SDR 17		6 = 3 Way Parallel	F = Green	3E = Gray Stripes	G = 200 lbs. Polyester Tape	
	14 = 2-1/2"		16 = SDR 21		7 = 4 Way Parallel	G = Lilac	3F = Green Stripes	J = 2500 lbs. Polyester Tape	
	15 = 3"		22 = SDR 7		12 = 2 Way Compart	H = Lt. Green	3G = Lilac Stripes	K = 400 lbs. Detect. Polyester Tape	
	16 = 4"		24 = SDR 9		13 = 3 Way Compart	J = Orange	3H = Lt. Green Stripes	T = 1250 lbs. Poly Metric Tape	
	17 = 4.75"		26 = SIDR 11.5		14 = 4 Way Compart	K = Red	3J = Orange Stripes	V = 1250 lbs. Detectable 22G Poly Tape	
	18 = 5"		27 = SIDR 11.5 True			L = Terra Cotta	3K = Red Stripes		
	22 = 6"		29 = SIDR 15			M = White	3L = Terra Cotta Stripes		
	23 = 7"		34 = SIDR 7			N = Yellow	3M = White Stripes		
	24 = 8"		36 = SIDR 9				3N = Yellow Stripes		
	25 = 10"		37 = SIDR 9 True						
	26 = 12"		42 = TC-7A						
	27 = 14"		45 = True 11						
	28 = 16"		46 = True 9						

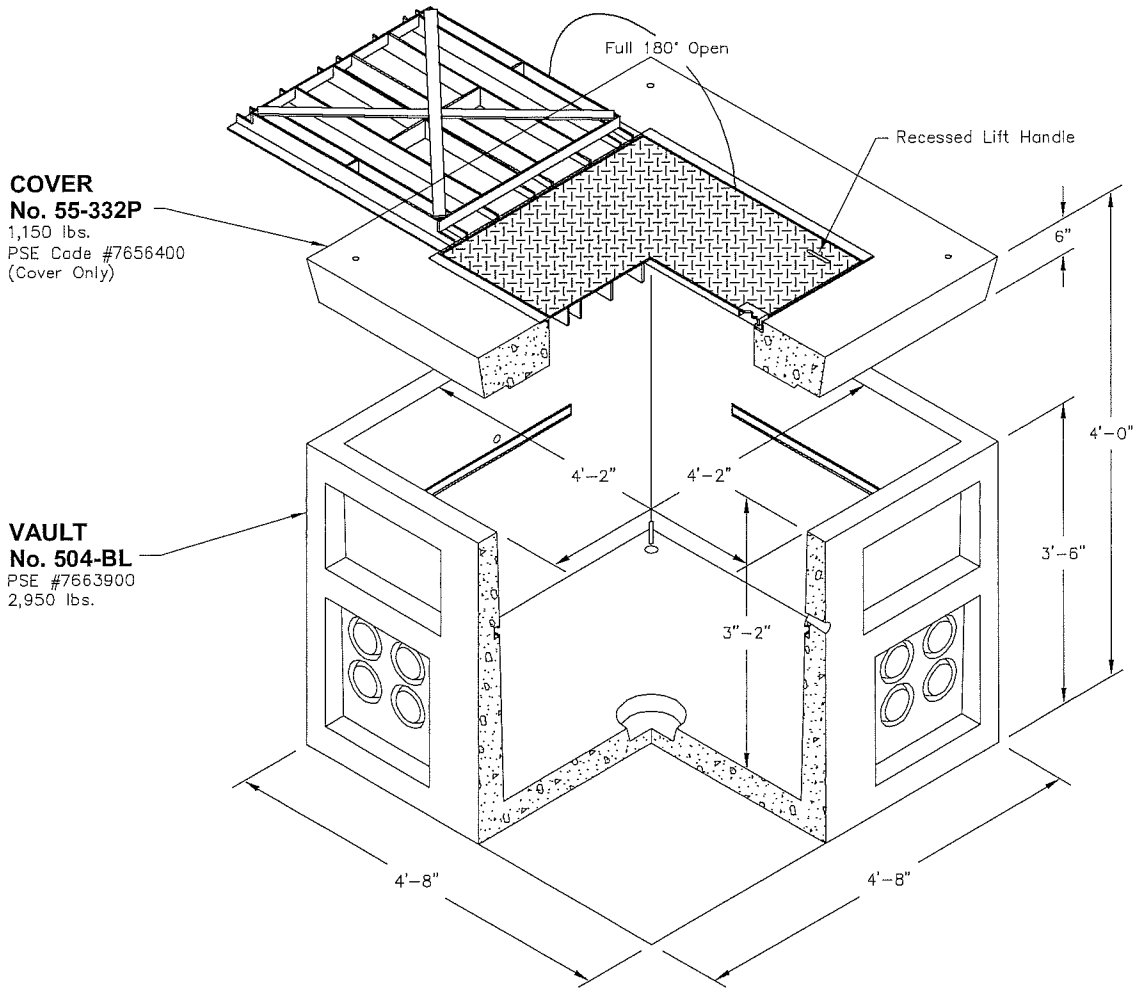
Standard Length – Reels and Coils

	Color	Part No.	Type	Wall	Pull Tape Polyester Woven	Reel Size	Reel Length (ft.)	Wt./Ea. (lbs.)
1"	Orange	A5C6N1JNNA7000	S/S	SDR 11	Empty	72x45x24	7000	1517
	Orange	A5C6N1JNNB7000	S/S	SDR 11	1130 lb.	72x45x24	7000	1576
	Orange	A5C9N1JNNB250	S/S	SDR 13.5	1130 lb.	Coil	250	42
	Orange	A5C9N1JNNB500	S/S	SDR 13.5	1130 lb.	Coil	500	84
	Orange	A5C9N1JNNB1800	S/S	SDR 13.5	1130 lb.	48x30x24	1800	382
	Orange	A5C9N1JNNA7000	S/S	SDR 13.5	Empty	72x45x24	7000	1278
	Orange	A5C9N1JNNB7000	S/S	SDR 13.5	1130 lb.	72x45x24	7000	1337
1 1/4"	Orange	A6C6N1JNNA5000	S/S	SDR 11	Empty	82x45x30	5000	1742
	Orange	A6C6N1JNNB5000	S/S	SDR 11	1130 lb.	82x45x30	5000	1784
	Orange	A6C9N1JNNB250	S/S	SDR 13.5	1130 lb.	Coil	250	66
	Orange	A6C9N1JNNB500	S/S	SDR 13.5	1130 lb.	Coil	500	132
	Orange	A6C9N1JNNC2500	S/S	SDR 13.5	1250 lb.	66x45x30	2500	793
	Orange	A6C9N1JNNA5000	S/S	SDR 13.5	Empty	82x45x30	5000	1481
	Orange	A6C9N1JNNB5000	S/S	SDR 13.5	1130 lb.	82x45x30	5000	1523
	Orange	A6C9N1JNNA8000	S/S	SDR 13.5	Empty	96x45x32	8000	2271
	Orange	A6C9N1JNNB8000	S/S	SDR 13.5	1130 lb.	96x45x32	8000	2338
1 1/2"	Orange	A9C6N1JNNA5000	S/S	SDR 11	Empty	96x45x32	5000	2246
	Orange	A9C9N1JNNA5000	S/S	SDR 13.5	Empty	96x45x32	5000	1904
	Orange	A9C9N1JNNB5000	S/S	SDR 13.5	1130 lb.	96x45x32	5000	1946
	Orange	A9C26N1JNNC2500	S/S	SIDR 11.5	1250 lb.	66x45x30	2500	1190

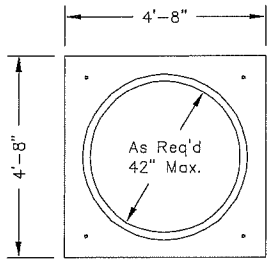
Standard Length – Reels and Coils

	Color	Part No.	Type	Wall	Pull Tape Polyester Woven	Reel Size	Reel Length (ft.)	Wt./Ea. (lbs.)
2"	Orange	A13C4N1JNNC2500	S/S	Sch 40	1250 lb.	82x45x40	2500	1410
	T Cotta	A13C5N1LNNC2500	S/S	Sch 80	1250 lb.	82x45x40	2500	1816
	Grey	A13C6N1ENNA4000	S/S	SDR 11	Empty	96x45x32	4000	2747
	Black	A13C6N1ANNA4000	S/S	SDR 11	Empty	96x45x32	4000	2747
	Orange	A13C6N1JNNA4000	S/S	SDR 11	Empty	96x45x32	4000	2747
	Black 3 RD	A13C9N1A3KA4000	S/S	SDR 13.5	Empty	96x45x32	4000	2319
	Black	A13C9N1ANNA4000	S/S	SDR 13.5	Empty	96x45x32	4000	2319
	Orange	A13C9N1JNNA4000	S/S	SDR 13.5	Empty	96x45x32	4000	2319
3"	Black	A15C9N1ANNA1000	S/S	SDR 13.5	Empty	96x45x68	1000	1364
	Orange	A15C9N1JNNA1000	S/S	SDR 13.5	Empty	96x45x68	1000	1364
4"	Black	A16C6N1ANNA766	S/S	SDR 11	Empty	102x45x68	766	2022
	Orange	A16C6N1JNNA766	S/S	SDR 11	Empty	102x45x68	766	2022
	Black	A16C9N1ANNA766	S/S	SDR 13.5	Empty	102x45x68	766	1727
	Orange	A16C9N1JNNA766	S/S	SDR 13.5	Empty	102x45x68	766	1727
	Orange	A16C26N1JNNC700	S/S	SIDR 11.5	1250 lb.	102x45x68	700	1746
4 3/4"	Grey	A17C9N1ENNA700	S/S	SDR 13.5	Empty	102x45x68	700	2171
	Orange	A17C9N1JNNA700	S/S	SDR 13.5	Empty	102x45x68	700	2171
5"	Grey	A18C9N1ENNA480	S/S	SDR 13.5	Empty	114x45x85	480	1842
	Black	A18C9N1ANNA480	S/S	SDR 13.5	Empty	114x45x85	480	1842
6"	Grey	A22C9N1ENNA450	S/S	SDR 13.5	Empty	120x45x85	450	2296
	Black	A22C6N1ANNA450	S/S	SDR 11	Empty	120x45x85	450	2669
	Black	A22C9N1ANNA450	S/S	SDR 13.5	Empty	120x45x85	450	2296

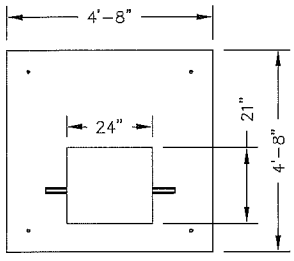
504-LA



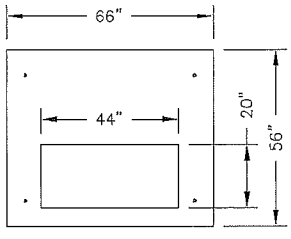
OPTIONAL TOP SECTIONS



ROUND ACCESS
No. 55-42C (Shown)
766 lbs.



PADMOUNT
No. 55-2124
1,500 lbs.
PSE Code #7658500



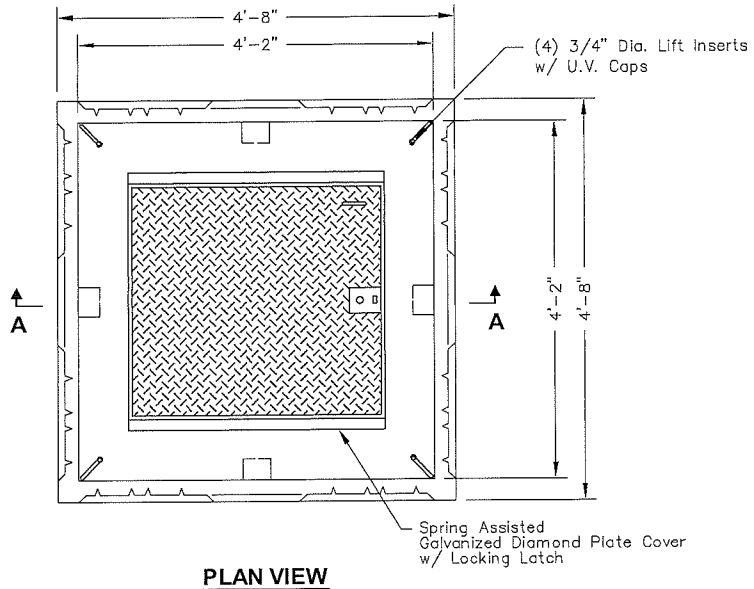
PADMOUNT
No. 56-2044
1,550 lbs.
PSE Code #7655200

Non Skid Covers Available

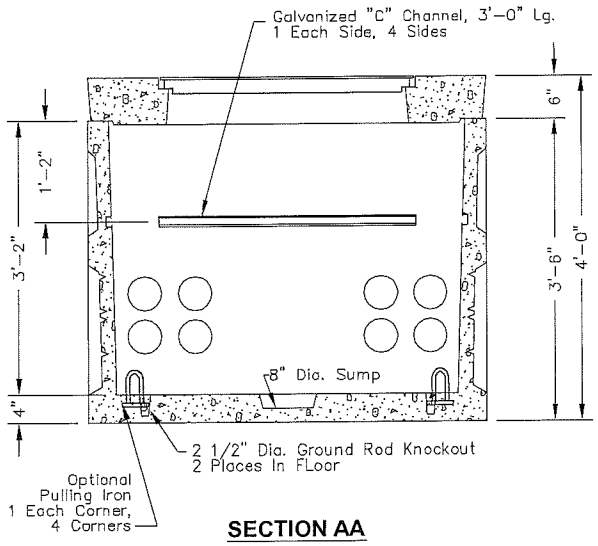
SCALE: 1/2" = 1'-0"

Oldcastle Precast® Utility Vault PO Box 588, Auburn, Washington 98071-0588 Tel: (253) 839-3500 Fax: (253) 735-4201	**504-LA** File Name: 010-504LA Issue Date: 2010 www.uvauburn.com	**504-LA** **4'-2" x 4'-2" x 3'-2"** **ELECTRIC / WATER / GAS** ©1970-2010 Oldcastle Precast, Inc.

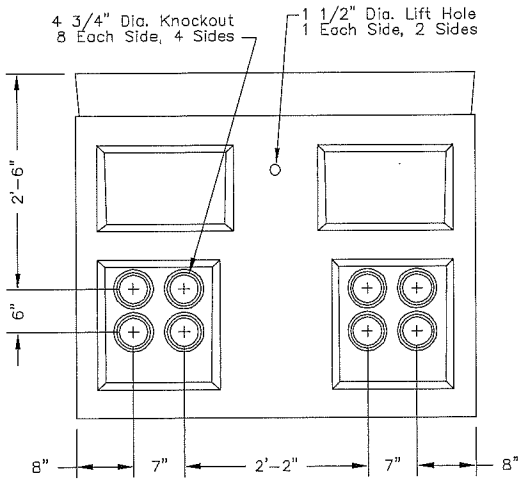
504-LA



PLAN VIEW



SECTION AA



END VIEW
Typical All Sides

SCALE: 1/2" = 1'-0"

Oldcastle Precast®
Utility Vault
PO Box 588, Auburn, Washington 98071-0588
Tel: (253) 839-3500 Fax: (253) 735-4201

504-LA	504-LA 4'-2" x 4'-2" x 3'-2" ELECTRIC / WATER / GAS
File Name: 010-504LA	
Issue Date: 2010	
www.uvauburn.com	

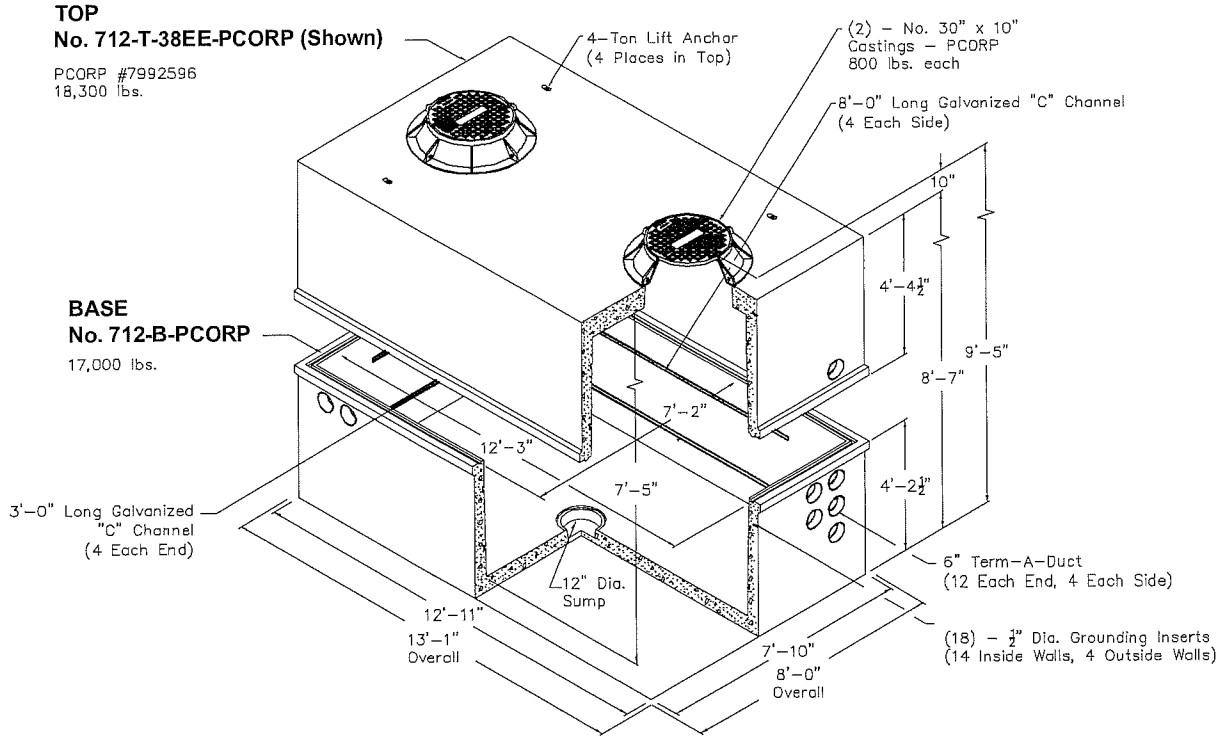
©1970–2010 Oldcastle Precast, Inc.

712-PCORP

7' x 12' Manhole
- **Full Traffic Vault, Stock Item 7992596**
- **Incidental Traffic Vault, Stock Item 7992597**
- **15 kV, 600 Amps, Air Insulated Switchgear Padvault, Stock Item 7992598**
- **25 kV, 600 Amps, Air Insulated Switchgear Padvault, Stock Item 7992599**

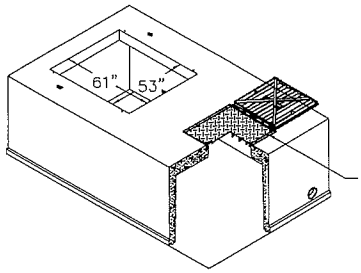
TOP
No. 712-T-38EE-PCORP (Shown)
PCORP #7992596
18,300 lbs.

BASE
No. 712-B-PCORP
17,000 lbs.



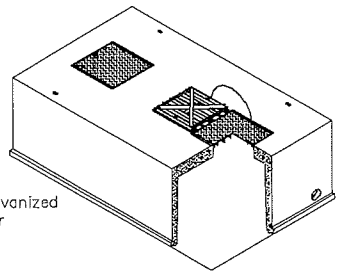
OPTIONAL TOPS

15 kV, 600 AMPS, AIR INSULATED SWITCHGEAR PADVAULT



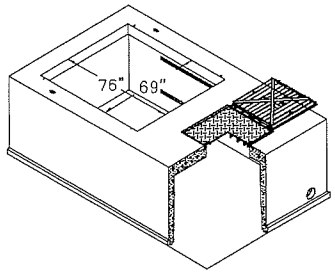
No. 712-T-332P-5361-PCORP
PCORP #7992598
14,520 lbs.

INCIDENTAL TRAFFIC VAULT



No. 712-T-2-332P-PCORP
PCORP #7992597
18,100 lbs.

25 kV, 600 AMPS, AIR INSULATED SWITCHGEAR PADVAULT



No. 712-T-332P-6976-PCORP
PCORP #7992599
13,120 lbs.

SCALE: 3/16" = 1'-0"

Oldcastle Precast®
Utility Vault
PO Box 588, Auburn, Washington 98071-0588
Tel: (253) 839-3500 Fax: (253) 735-4201

712-PCORP	712-PCORP 12'-3" x 7'-2" x 7'-5" ELECTRIC / WATER / GAS
File Name: 010-712PCORP	
Issue Date: 2010	
www.uvauburn.com	

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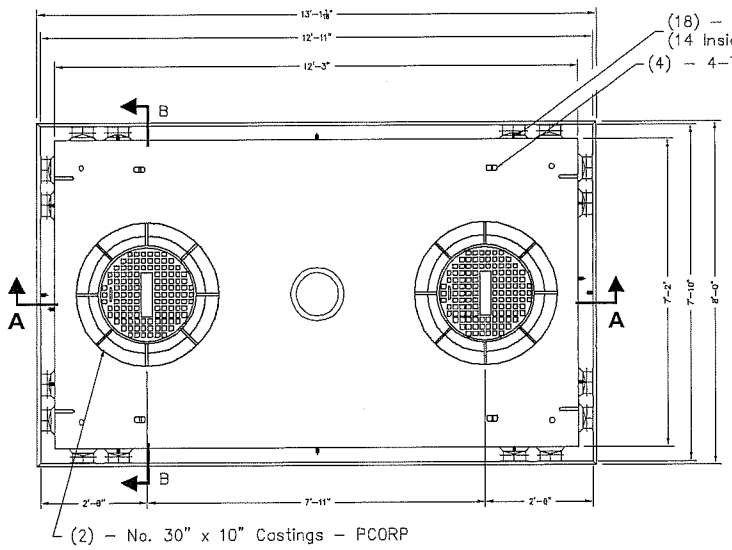
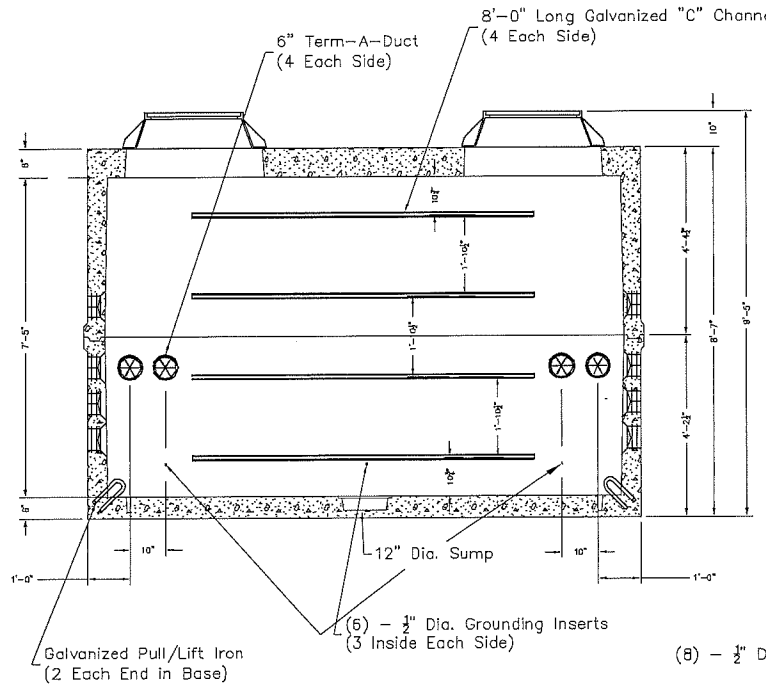
712-PCORP

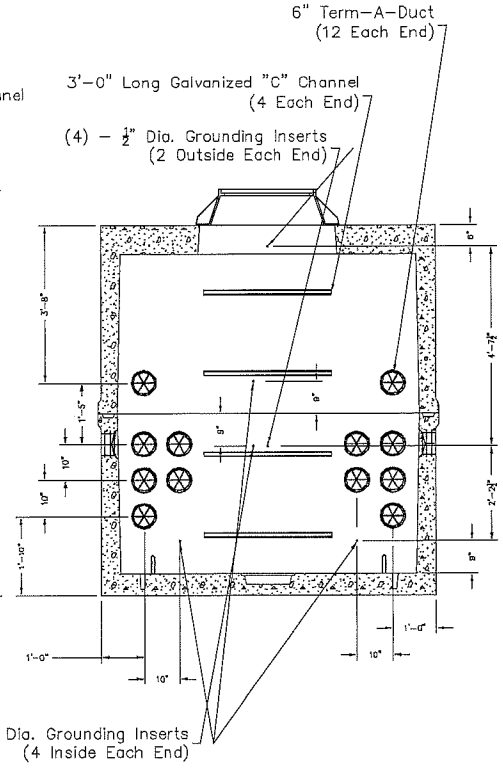


PLAN VIEW

No. 712–T–38EE–PCORP (FULL TRAFFIC VAULT)
PCORP #7992596



SECTION AA



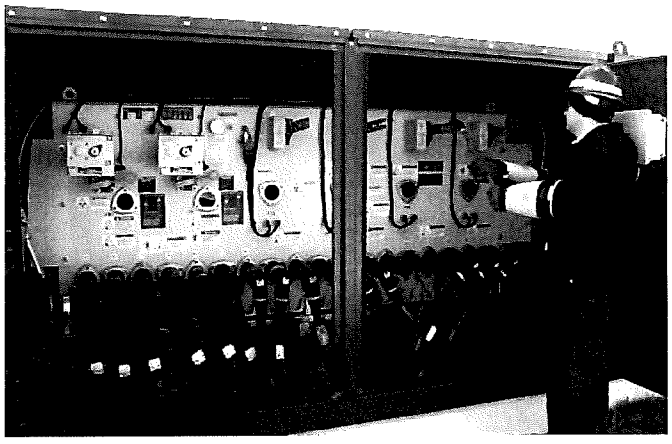
SECTION BB

SCALE: 1/4" = 1'–0"

Oldcastle Precast® Utility Vault PO Box 588, Auburn, Washington 98071-0588 Tel: (253) 839-3500 Fax: (253) 735-4201	**712-PCORP** File Name: 010-712PCORP Issue Date: 2010 **www.uvauburn.com**	**712-PCORP** **12'-3" x 7'-2" x 7'-5"** **PACIFICORP** ©2001–2010 Oldcastle Precast, Inc.

Automatic Transfer Control Package

Model ATC 451



- Factory integrated Auto Transfer Package based on the SEL-451 relay
- User friendly programming template for quick and easy setup
- SCADA and Lazer® ready
- Available on SF6 and Trident® solid dielectric switches
- Variety of transfer speeds, from 10 seconds to 10 cycles
- Quality supplier since 1905

G&W Engineered to order. Built to last.

Catalog ATC12

ATC 451

G&W ATC 451 automatic transfer controls are available for G&W SF6 gas or Trident® solid dielectric switchgear. Switches can be padmount style or installed in dry or wet vault environments. The two source ways can be located in one switch, or in two separate switches.

Features

Uses SEL-451 relay

G&W'S ATC 451 control utilizes the field proven SEL-451 relay. G&W integrates the relay into a NEMA rated enclosure and includes a power supply, optional battery back-up with automated battery load test for AC powered units, pre-programmed Auto Transfer Logic, pre-labeled front panel pushbuttons and display and a programming template to quickly and easily program the control.

Available with Built-In Overcurrent Protection

The ATC 451 package can be used to provide overcurrent protection for up to two load side ways. For switches with more than two load side ways, additional relays can be incorporated. G&W installs and tests all the necessary logic prior to shipment. The control comes with a programming template to quickly and easily set the transfer and overcurrent settings. Overcurrent protection is available for both three-phase and single-phase loads.

SCADA ready

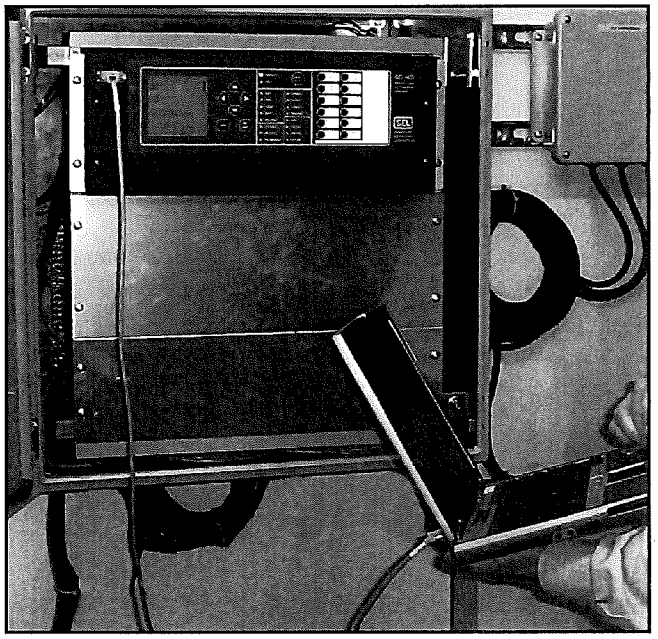
The ATC 451 comes standard with a DNP point map to control and monitor the switch using SCADA. Multiple protocols are available including DNP3.0 (standard), Mirrored Bits (standard), DNP IP (option) and IEC 61850 (option). Ethernet or fiber optic ports for communications are also available.

Lazer® Automation ready

The Lazer ready capability of the ATC 451 simplifies the requirements for communication to other intelligent field devices for automatic power restoration schemes. The ATC 451 is pre-engineered to work with G&W's Lazer automation systems.

Generator source capability

The Common Bus style ATC 451 can be configured for use when a generator is the alternate source of power.



▲ *System parameters are laptop programmable.*

Bus-tie configurations

The ATC 451 can be incorporated on a bus-tie switch permitting automatic transfer on systems where the load is normally balanced between two sources.

User friendly controls

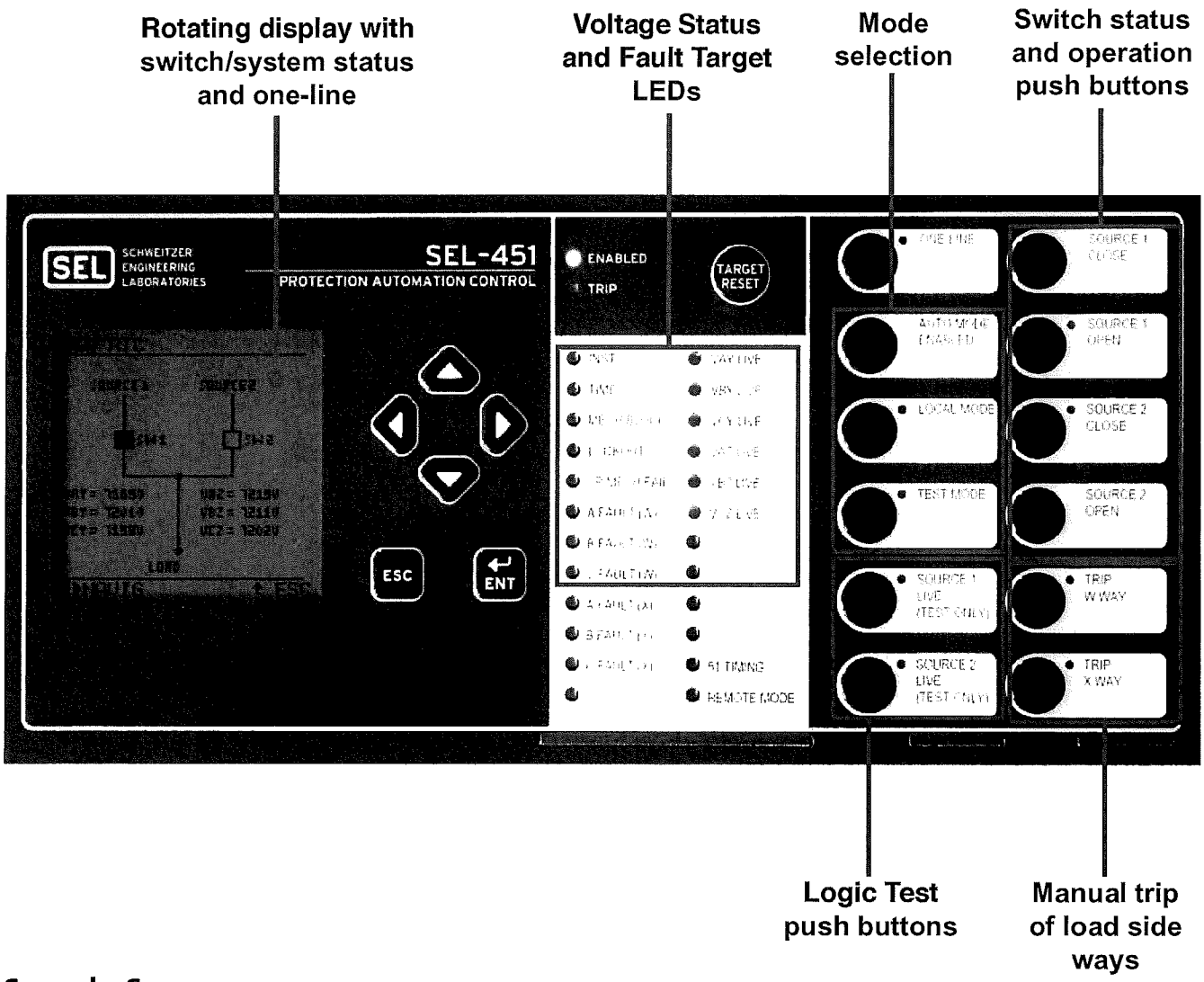
Large, easy to read, push buttons for the most commonly used functions gives quick access on the front panel of the control.

Sequence of event recorder

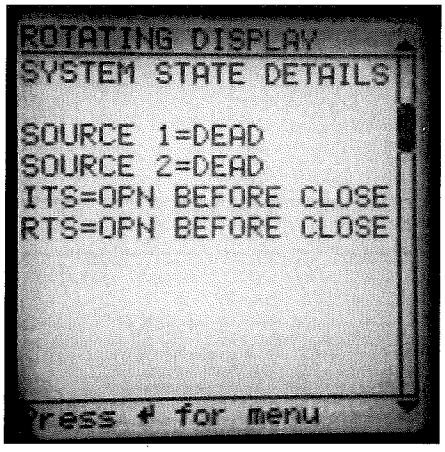
Each ATC 451 includes a Sequence of Events Recorder (SER) which will record the last 1,000 entries, including setting changes, powerups, and selectable logic elements.

Flexible voltage sensing options

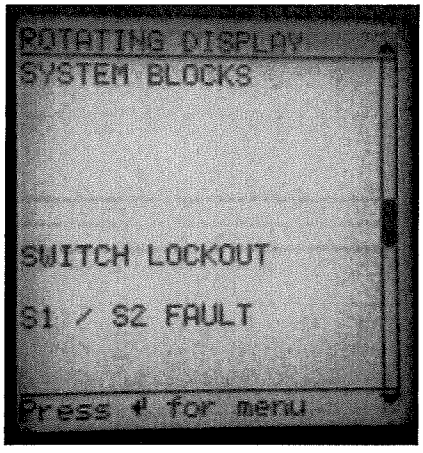
G&W offers factory integrated capacitively coupled voltage sensors molded into the bushings of the switch for monitoring the status of each source. These sensors are sealed from the surrounding environment and are more cost effective and compact when compared to potential transformers.



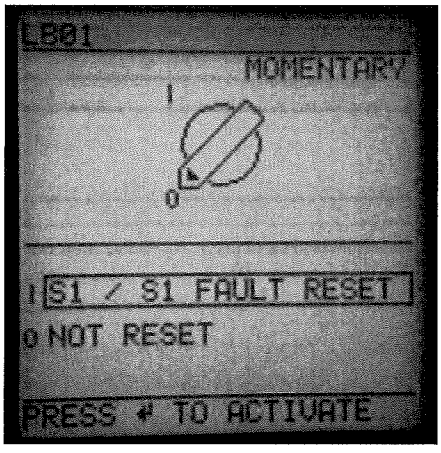
Sample Screens



▲ *Current system status and settings*



▲ *System lockout status*



▲ *Faulted circuit indicator reset*

ATC 451 Options

Transfer Speed Options

The G&W ATC 451 has two different transfer speed options. Transfer time is measured from the confirmed loss of the primary source until the alternate source is feeding the load.

8 – 10 Seconds

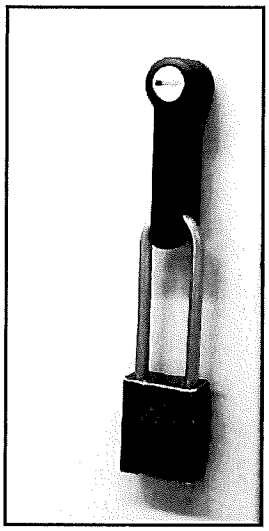
Motor Operated Auto Transfer Packages are available on all G&W SF6 and spring-assisted Trident® solid dielectric switches. Once the source health has been confirmed as dead, the total transfer time for these switches is approximately 8-10 seconds.

8 – 10 Cycles

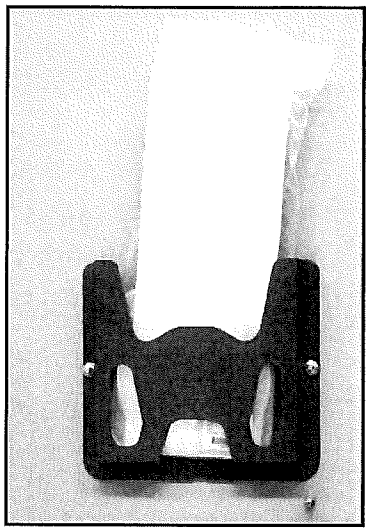
G&W Trident®-SR solid dielectric switches are equipped with magnetic actuators providing extremely fast switching. The magnetic actuator is completely sealed within a stainless steel housing, eliminating the need for an external linkage or motors. It is charged and ready to operate immediately upon a control command. The ATC 451 can open the primary switch and close the alternate switch in less than 10 cycles.

Enclosure Options

There are a wide variety of ATC applications. For this reason G&W offers five standard control enclosure options. For padmount and dry vault applications, the control can be supplied in either a mild steel NEMA 4 cabinet or a stainless steel NEMA 4X cabinet. Both of these enclosures can be supplied in a compact size (24" tall by 24" wide) or in a larger size (30" tall by 24" wide) to accommodate additional equipment such as communication devices.



▲ *Padlockable handle*

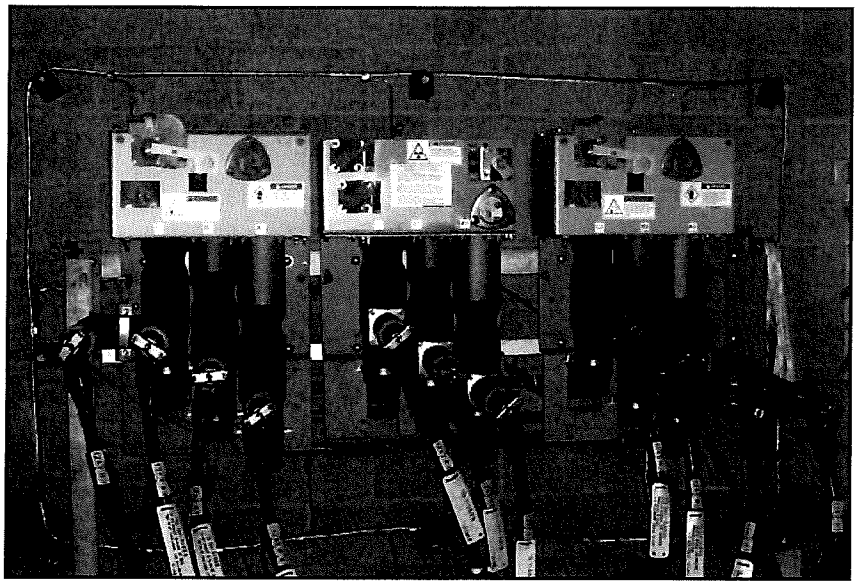


▲ *Document holder*

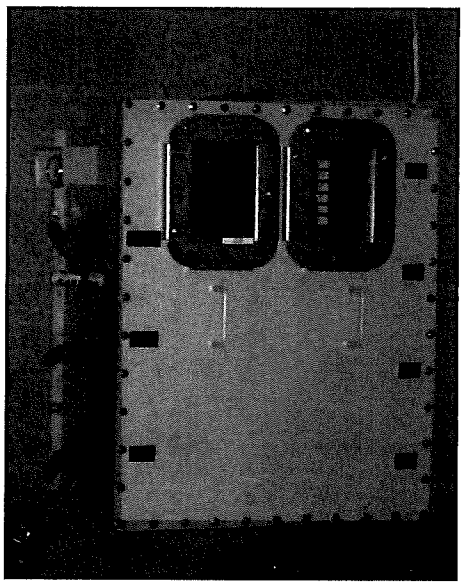
The NEMA 4 and NEMA 4X cabinets have several options including a padlocking handle, convenience outlet, and a document packet.

For submersible applications, the control can be supplied in an IP68 stainless steel cabinet. This cabinet design has been tested to successfully withstand 20 days beneath a 20 foot head of water. The IP68 cabinet can be supplied with several options including

1. Windows to see the front of the relay and any system status points
2. External handles for manual operation via hotstick or rope
3. A submersible DNP3.0 port for communications, and battery back-up in a NEMA 6P enclosure.



▲ *Magnetic Actuated Trident-SR multi-way in a submersible vault installation.*



▲ *IP68 submersible stainless steel cabinet.*

Test Switch Option

ATC 451 controls that include load side overcurrent protection can be supplied with a variety of optional test switches, including ABB FT1-F. The test switch provides the user with the ability to:

- Block tripping by opening the trip circuit
- Short the current transformer leads when working inside of the control cabinet
- Test the relay using a secondary current injection method

SCADA Options

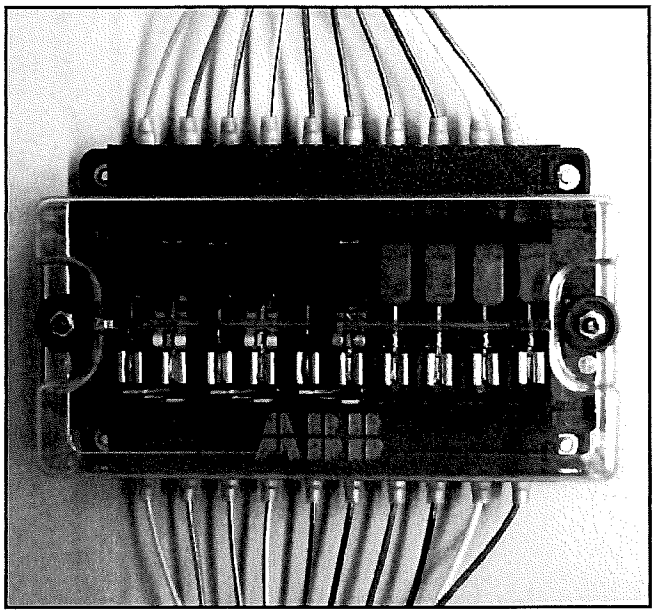
The ATC 451 can be supplied with a number of SCADA communication options:

1. Connection to RS-232 Port using serial DNP3.0. The user may select either standard copper or fiber-optic cable connections. The map includes commonly used status and command functions such as: Source Health, Source Closed/Open Status, Mode Enabled, Lockout Condition, Overcurrent Trip and Cause, Power Status, Other switch/control status, Enable Automatic Mode, Enable Remote operations, Open/Close the Sources, and Trip Load Ways.

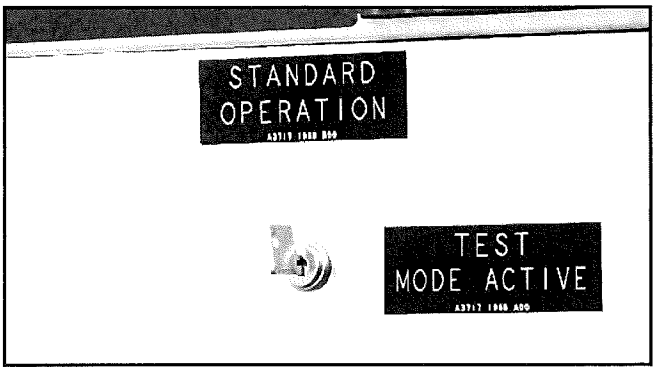
2. Provisions for a user selected and installed radio or cellular modem. Provisions would include appropriate power supply and connections, serial or Ethernet data cable between relay and radio, internal antenna cable, and antenna surge protector with enclosure feedthru. The ATC 451 can be supplied with the Sensus Telemetric DNP-RTMII-GSM cellular modem factory installed.

Optional Live System Test Mode

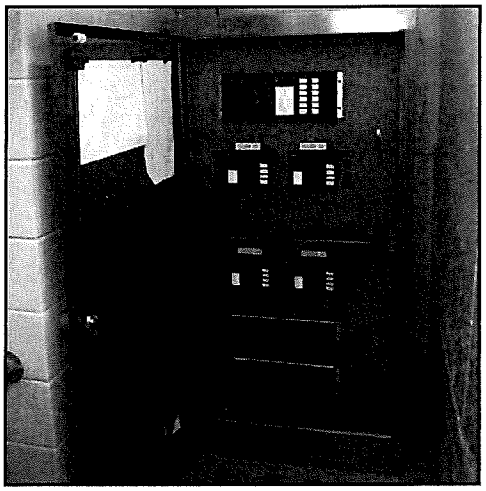
The ATC 451 includes a system test option which will allow the user to turn a key and cause the control to operate as if the preferred source has been lost. It's designed to fully test the automatic transfer logic and switch under live conditions.



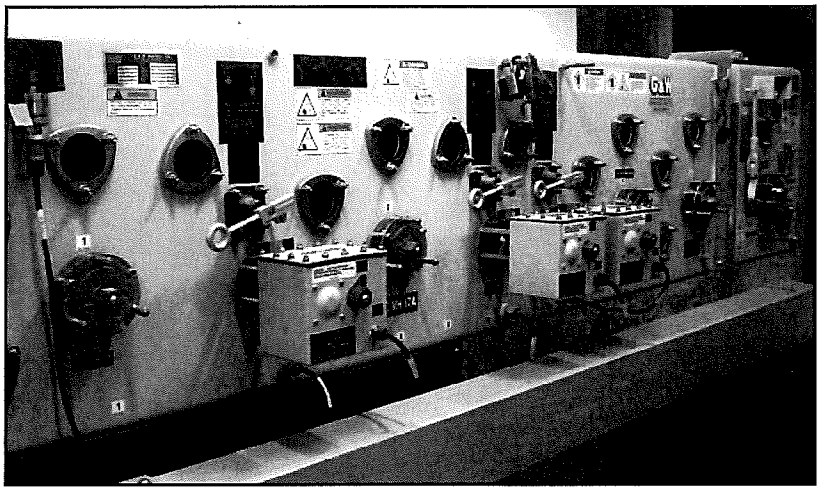
▲ *ABB FT1-F test switch*



▲ *Live system test mode*



▲ *ATC 451 in freestanding enclosure*



▲ *SF6 Bus Tie Switch*

ATC 451 Options

Setting Options
Each ATC 451 comes with multiple setting options including source preference, timing, transition sequences, operational oversight, and overcurrent protection.

Source Settings:

- The Common Bus version of the ATC 451 allows the user to select between two utility sources or one utility source and a standby generator. When utilizing a generator, the control offers the ability to customize the duration of the generator cool down and stop contact closure.

- The Common Bus version of the ATC 451 also provides the user complete flexibility for source preference. Each ATC 451 can be set for either source 1 or source 2 to be preferred, in which case the control will always attempt to feed the load from the preferred source. In some cases, neither utility source is preferred, so the control should not automatically return the load to the original source once power is restored. In this case, the ATC 451 can be set in a non-preferred mode ensuring that transitions between the sources will only take place when a source is lost.

- Regardless of source preference, each ATC 451 is designed for customer selection of the style of transition:
  - Open Before Close/ Break Before Make
  - Close Before Open/ Make Before Break
  - Manual return (no automatic return to normal)

In addition, the presence and absence of voltage timers can be set from 0 seconds to 10 hours.

Operational Oversight
The ATC 451 program also allows for oversight of operational commands to match the user's standard operating procedures.

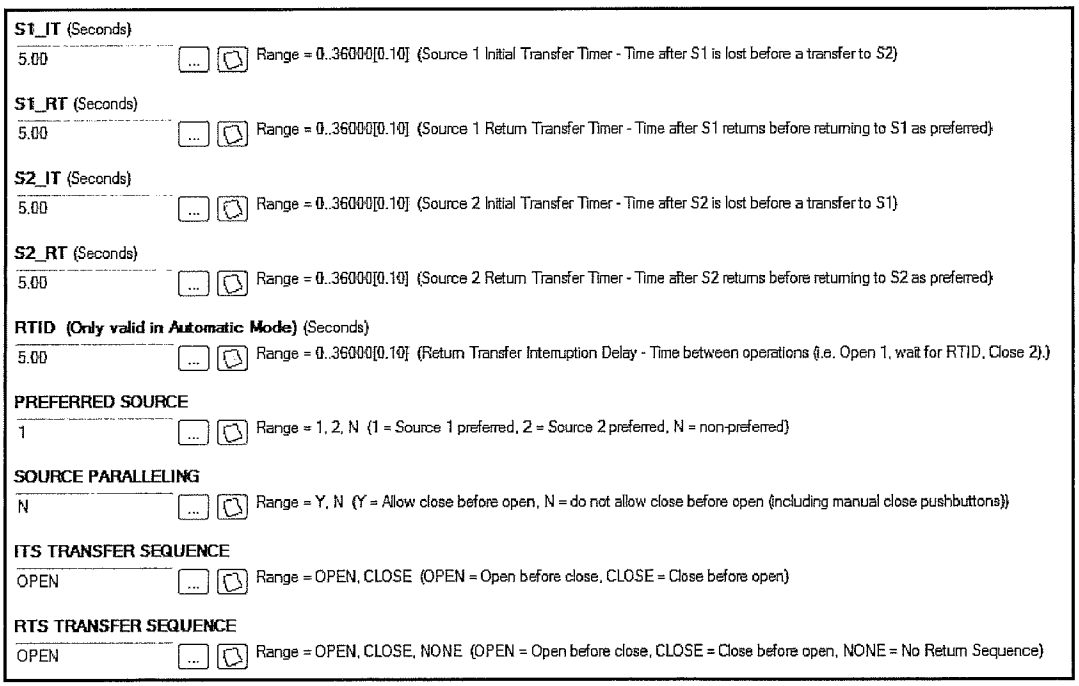
- The user may elect to Block Source Paralleling which will prevent Close Before Open/ Make Before Break Transitions and manual or SCADA based Close commands if one of the sources is already closed.

- Each ATC 451 comes with multiple testing options which can be limited within the logic, or hardware, including Logic Only (no switch operations); Live System Test (full system operations including generator start-up if applicable); and Logic with Switch Operations for incoming and maintenance requirements.

- For controls supplied with battery back-up, the ATC 451 can be programmed to automatically test the load capability of the battery on a user defined schedule of every 4, 8, 12, or 24 hours.

Overcurrent Protection
If factory ordered, each control can provide overcurrent protection for up to two load side tap ways. This includes the ability to select protection settings for Time Overcurrent (51P and 51G), Instantaneous (50P and 50G) in two settings groups – Protection and Maintenance. The maintenance group allows for lower settings when personnel are working around the switch.

In addition, each ATC 451 is equipped with two Digital Fault Circuit Indicator inputs which will block all operations when either indicator has been activated. The user may select to manually reset the control once the indicator has been reset or to use the Automatic Reset function built into the program.



Settings template ▶ simplifies programming of the ATC.

ATC 451 Selection Guide:

Switch Style:	☐ Common (Tied) Bus	☐ Bus-Tie
Transfer Speed:	☐ 8 – 10 Seconds	☐ 8 – 10 Cycles
Voltage Sensing:	☐ Digital Elbow Mounted Sensors	☐ PTs or Integral Voltage Sensing Bushings
System Type:	☐ 4 Wire Grounded Wye	☐ 3 Wire Wye or Delta

ENCLOSURE OPTIONS:

Type:

☐ Mild Steel (NEMA 4) ☐ Stainless Steel (NEMA 4X)

☐ IP68 (Without batteries) ☐ IP68 (With NEMA 6P Battery Option)

NEMA 4/4X Enclosure Options:

☐ Document Holder ☐ Padlockable Handle

IP68 Enclosure Options:

☐ Viewing Windows ☐ Submersible Serial DNP Port ☐ Manual Operating Handles

ADDITIONAL OPTIONS:

Power:

☐ 120VAC without battery backup ☐ 120VAC with battery backup

☐ 240VAC without battery backup ☐ 240VAC with battery backup

☐ 24VDC ☐ 125VDC

Other:

☐ Laptop Power Outlet

☐ System Test Key

☐ Fiber Optic Communication Accessories

☐ Single Mode Fiber ☐ Multi Mode Fiber

If cabinet entrances are to be provided, select from the following options

☐ 0.138 – 0.315" Cable Diameter ☐ 0.197 – 0.472" Cable Diameter

☐ 0.512 – 0.709" Cable Diameter ☐ 0.748 – 1.0" Cable Diameter

☐ Provisions for Radio Radio Manufacturer and Part Number _____

☐ Provisions for Sensus RTM II

☐ Sensus RTM II

Faulted Circuit Indicators:

☐ None ☐ One ☐ Two ☐ Customer Supplied

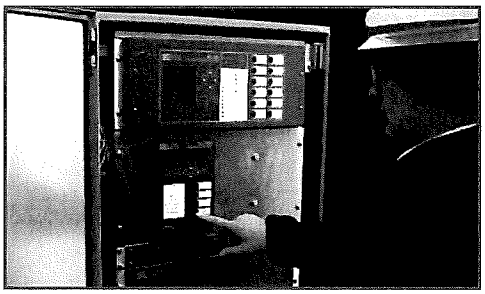
Overcurrent Load Protection:

☐ One Load Way ☐ Two Load Ways (Select One)

☐ Single Phase Tripping* ☐ Three Phase Tripping (Select One)

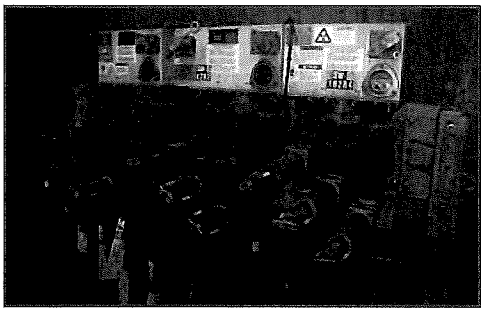
*Single Phase Tripping is available for Common Bus applications if the switch is similarly equipped.

G&W offers a complete line of **smart distribution voltage equipment** including:



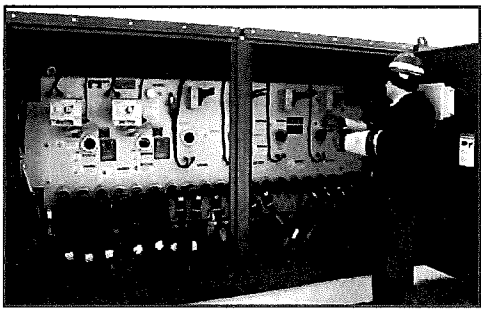
Lazer® Automation

- Multiple levels of protection
- Open, flexible communication
- Pre-engineered, factory tested
- Transfer, loop, and network applications



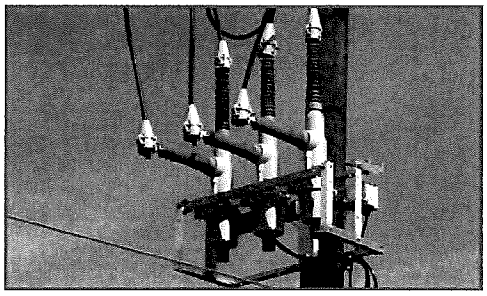
Solid Dielectric Switchgear

- To 38kV, 16kA interrupting
- Submersible vault and padmount
- Smart Grid / Lazer® solutions
- Single phase and three phase



SF6 Insulated Switchgear

- To 38kV, 25kA interrupting
- Submersible vault and padmount
- Smart Grid / Lazer® solutions
- Load and Fault Interrupting



Solid Dielectric Reclosers

- To 38kV, 12.5kA interrupting
- To 27kV, 16kA interrupting
- Overhead, substation and padmount
- Smart Grid / Lazer® solutions
- Single phase and three phase
- Six voltage sensing available

G&W Engineered to order. Built to last.

G&W Electric Company
305 W. Crossroads Pkwy
Bolingbrook, IL 60440-4938 USA
Tel 708.388.5010 Fax 708.388.0755

www.gwelec.com
ISO 9001:2008 Certified
ISO 14001:2004 Certified

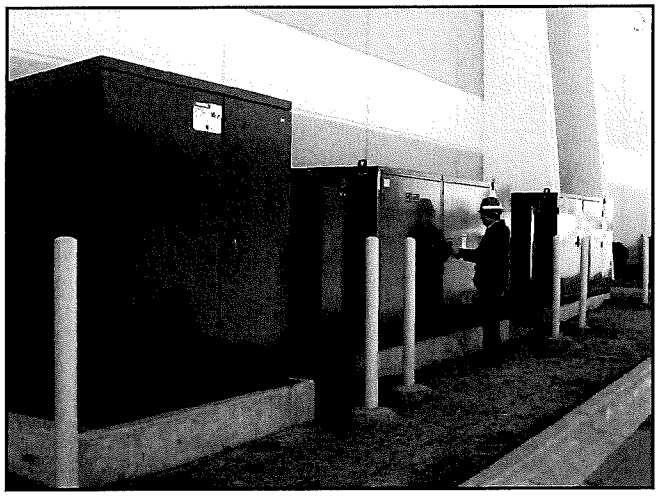
Catalog ATC12
February, 2012

Industrial Feeder Restoration

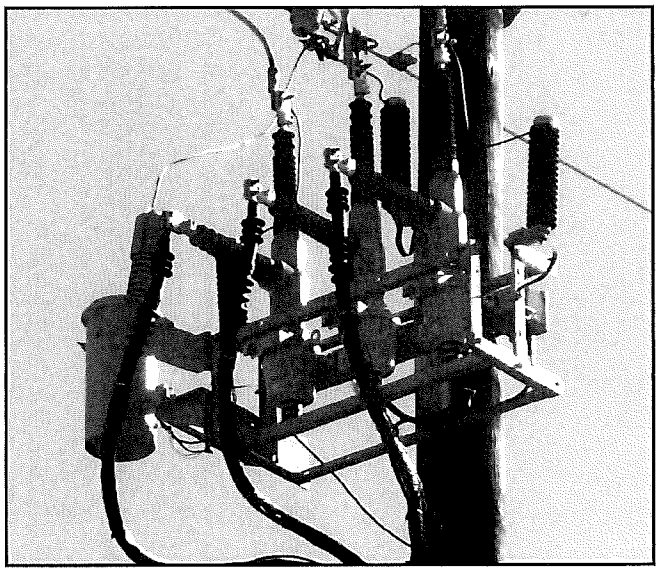
G&W PRODUCTS: Lazer™ automation solution comprised of two overhead reclosers and four padmount switches, all with SEL controls.

ISSUE: A major midwest manufacturer of raw material used in making LCD chips needed to expand their manufacturing operation to accommodate a substantial increase in business. They already had two plants that were filled to capacity so they decided to build a new facility that would more than double the output of their existing operations. Besides the need for a new facility, the industrial customer had several critical power requirements. One requirement was for maximum service reliability because of the estimated millions of dollars of lost revenue if any significant downtime were to occur. The other requirement was an unusually short lead time to research, design, procure, test and commission the best power distribution system for the application. After a thorough investigation, the industrial customer found a location near their existing sites and a municipal utility willing to take on the short lead time challenge.

SOLUTION: The municipal utility soon determined they needed a feeder restoration system which could automatically sense and isolate an electrical problem without the need for dispatching a crew. The utility researched some of the industry's better known suppliers of distribution automation equipment. After numerous proposals, G&W was chosen because they offered a field proven solution and were willing to work closely with the utility's engineers to accommodate their specific requirements. G&W's "Lazer" Distribution Automation system offered a pre-engineered package of both the field switching devices and the complete control package, providing a single source solution.



▲ *Figure 2: G&W padmount switches and transformers were installed on opposite sides of the building.*



▲ *Figure 1: G&W style Viper-ST recloser with SEL-651R controls were installed on the two overhead lines.*

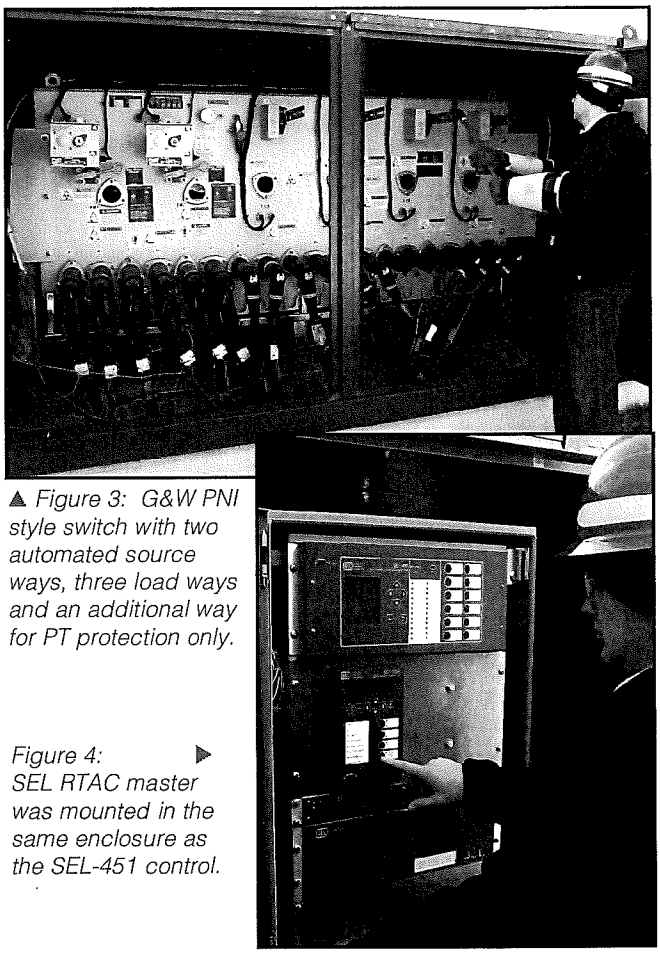
SYSTEM CONFIGURATION: The new industrial site already had two 35kV overhead distribution lines nearby. The municipal decided to tap off these lines and feed the new industrial plant underground through four padmount switches. The new plant was divided into 12 separate loads, with three loads being fed through each switch. Reclosers (G&W Viper-ST style with SEL-651R controls) were installed on the two overhead lines, one feeding two switches and the other feeding the remaining two switches (Figure 1). One of the switches had a normally open point which would automatically switch from one source to another if a problem occurred.

The switches (G&W PNI style) incorporated two automated source (line) ways and three, 3-phase load ways (Figure 3). Each source way switch was controlled with an SEL-451 relay and incorporated a stored energy mechnism for high speed switching, An SEL RTAC, located in one of the padmount switch control enclosures, served as the master control for reconfiguration after a fault occurrence (Figure 4). Each switch had an additional way to protect the potential transformers which were located in a side enclosure. These PTs provided real-time voltage values and power for the controls. A battery backup system was provided in the event of a widespread, extended power outage.

OPERATION: The automated system operated as an open loop with fault interruption occurring at the feeder reclosers. When a fault or voltage loss was detected, the line recloser would open to clear it. Fault indicators on the line ways of the switches were tied through the relays and back to the RTAC controller. The controller would then determine the location of the fault by which fault sensors had been activated. Once the fault was located, the controller would open the closest switches very quickly to isolate the faulted section and close the midpoint switch, if necessary, to allow power flow to all of the loads. Finally the recloser would close back into the re-configured circuit to restore power. This allowed all of the loads to be re-energized while the faulted line section was isolated. See the diagram below for a system layout.

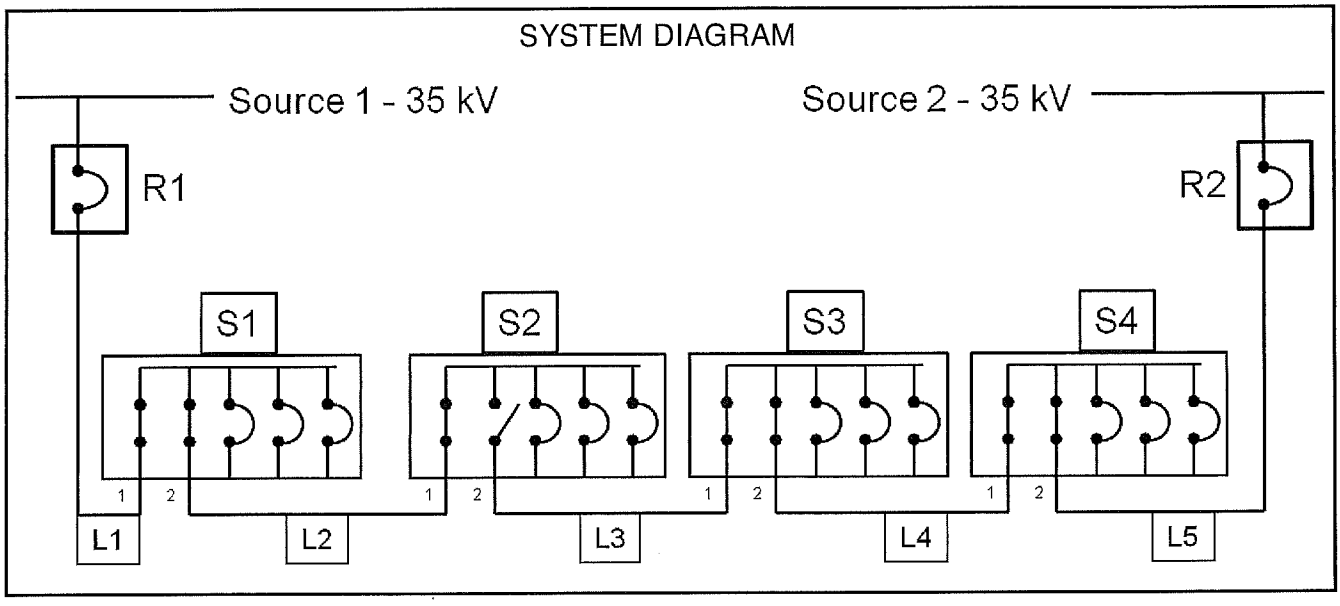
The RTAC controller based design offered excellent flexibility for future modifications and allowed all system currents, voltages, and power to be compiled into a single device. The system was programmed and tested to oprate on its own with the ability to integrate to a future SCADA system.

SOLUTION RESULTS: The system was programmed and fully tested at G&W prior to shipment. All re-configuration scenarios were confirmed and the reconfiguration time was verified as less than one second. The switches and reclosers were installed on site and are fully operational.



▲ *Figure 3: G&W PNI style switch with two automated source ways, three load ways and an additional way for PT protection only.*

Figure 4: ▶
SEL RTAC master was mounted in the same enclosure as the SEL-451 control.



Optional RTD Elements (Models Compatible With SEL-2600 Series RTD Module)

12 RTD Inputs via SEL-2600 Series RTD Module and SEL-2800 Fiber-Optic Transceiver

Monitor Ambient or Other Temperatures

PT 100, NI 100, NI 120, and CU 10 RTD-Types Supported, Field Selectable

Up to 500 m Fiber-Optic Cable to SEL-2600 Series RTD Module

Breaker Failure Instantaneous Overcurrent

Setting Range

5 A Model:	0.50–50.0 A, 0.01 A steps
1 A Model:	0.10–10.0 A, 0.01 A steps

Accuracy

5 A Model:	±0.05 A plus ±3% of setting
1 A Model:	±0.01 A plus ±3% of setting
Transient Overreach:	< 5% of setting
Maximum Pickup Time:	1.5 cycles
Maximum Reset Time:	1 cycle
Timers Setting Range:	0–6000 cycles, 0.125 cycle steps (All but BFIDO*n*, BFISP*n*) 0–1000 cycles, 0.125 cycle steps (BFIDO*n*, BFISP*n*)
Time Delay Accuracy:	0.125 cycle plus ±0.1% of setting

Synchronism-Check Elements

Slip Frequency Pickup Range:	0.005–0.500 Hz, 0.001 Hz steps
Slip Frequency Pickup Accuracy:	±0.0025 Hz plus ±2% of setting
Close Angle Range:	3–80°, 1° steps
Close Angle Accuracy:	± 3°

Load-Encroachment Detection

Setting Range

5 A Model:	0.05–64 Ω secondary, 0.01 Ω steps
1 A Model:	0.25–320 Ω secondary, 0.01 Ω steps
Forward Load Angle:	–90° to +90°
Reverse Load Angle:	+90° to +270°

Accuracy

Impedance Measurement:	±3%
Angle Measurement:	±2°

Timer Specifications

Setting Ranges

Breaker Failure:	0–6000 cycles, 0.125 cycle steps (All but BFIDO*n*, BFISP*n*) 0–1000 cycles, 0.125 cycle steps (BFIDO*n*, BFISP*n*)
Communications-Assisted Tripping Schemes:	0.000–16000 cycles, 0.125 cycle steps
Pole Open Timer:	0.000–60 cycles, 0.125 cycle steps
Recloser:	1–999999 cycles, 1 cycle steps

Switch-Onto-Fault

CLOEND, 52AEND:	OFF, 0.000–16000 cycles, 0.125 cycle steps
SOTFD:	0.500–16000 cycles, 0.125 cycle steps

Synchronism Check Timers

TCLSBK1, TCLSBK2:	1.00–30.00 cycles, 0.25 cycle steps

Station DC Battery System Monitor Specifications

Operating Range:	0–350 Vdc
Input Sampling Rate:	2 kHz
Processing Rate:	1/8 cycle
Maximum Operating Time:	≤ 1.5 cycles

Setting Range

DC settings:	15–300 Vdc, 1 Vdc steps
AC ripple setting:	1–300 Vac, 1 Vac steps

Accuracy

Pickup Accuracy:	±3% plus ±2 Vdc (all elements but DC1RP and DC2RP) ±10% plus ±2 Vac (DC1RP and DC2RP)

Metering Accuracy

All metering accuracy is at 20°C, and nominal frequency unless otherwise noted.

Currents

Phase Current Magnitude

5 A Model:	±0.2% plus ± 4 mA (2.5–15 A sec)
1 A Model:	±0.2% plus ± 0.8 mA (0.5–3 A sec)

Phase Current Angle

All Models	±0.2° in the current range 0.5 • I_{nom} to 3.0 • I_{nom}

Sequence Currents Magnitude

5 A Model:	±0.3% plus ± 4 mA (2.5–15 A sec)
1 A Model:	±0.3% plus ± 0.8 mA (0.5–3 A sec)

Sequence Current Angle

All Models:	±0.3° in the current range 0.5 • I_{nom} to 3.0 • I_{nom}

Voltages

Phase and Phase-to-Phase Voltage Magnitude:	± 0.1% (33.5–200 V_{L-N})
Phase and Phase-to-Phase Angle:	± 0.05° (33.5–200 V_{L-N})
Sequence Voltage Magnitude:	± 0.15% (33.5–200 V_{L-N})
Sequence Voltage Angle:	± 0.1° (33.5–200 V_{L-N})

Frequency (Input 40–65 Hz)

Accuracy:	±0.01 Hz

Power and Energy

Real Power, P (MW), Three Phase

At 0.1 • I_{NOM}

Power factor unity:	±0.4%
Power factor 0.5 lag, 0.5 lead:	±0.7%

At 1.0 • I_{NOM}

Power factor unity:	±0.4%
Power factor 0.5 lag, 0.5 lead:	±0.4%

Reactive Power, Q (MVAR), Three Phase

At 0.1 • I_{nom}

Power factor 0.5 lag, 0.5 lead: ±0.5%

At 1.0 • I_{nom}

Power factor 0.5 lag, 0.5 lead: ±0.4%

Energy (MWh), Three Phase

At 0.1 • I_{nom}

Power factor unity: ±0.5%

Power factor 0.5 lag, 0.5 lead: ±0.7%

At 1.0 • I_{nom}

Power factor unity: ±0.4%

Power factor 0.5 lag, 0.5 lead: ±0.4%

Synchrophasors

See *Accuracy* in the instruction manual for test exclusions and details

TVE (total vector error): ≤ 1%

Frequency Range: ±5 Hz of nominal (50 or 60 Hz)

Voltage Range: 30 V–150 V

Current Range: (0.1–2) • I_{nom} (I_{nom} = 1A or 5A)

Phase Angle Range: –179.99° to 180°

Notes

Notes

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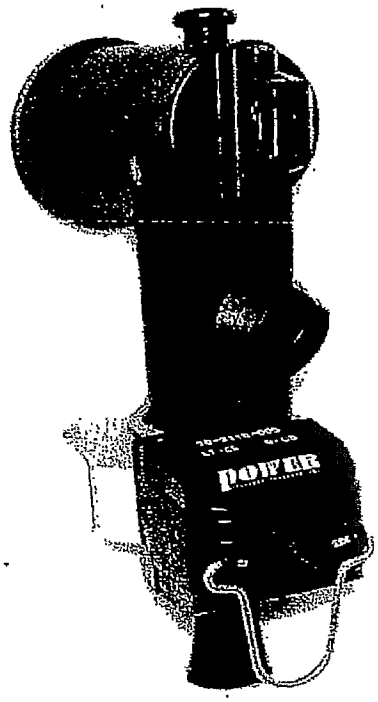
PDS451-01

POWER DELIVERY PRODUCTS INC.

FCI LOAD TRACKER

UNDERGROUND SELF ADJUSTING TRIP

- *One size for all circuits*
- *Self adjusting to load current*
- *Proximity immunity to 2.3" at 10KA*
- *Automatic reset on time and current*
- *Local or remote LED indication*
- *Automatic In-Rush Restraint*
- *Load Tracking above 40 Amps*
- *900 flashing hours*
- *SCADA ready*
- *Elbow or Cable Mounted*
- *Lightweight = 10 ounces*
- *Closed Core CT Design*
- *Armed and Ready*
- *Self Powered*
- *Manual Test and Reset*
- *Hot stick applied*
- *1 minute installation time*

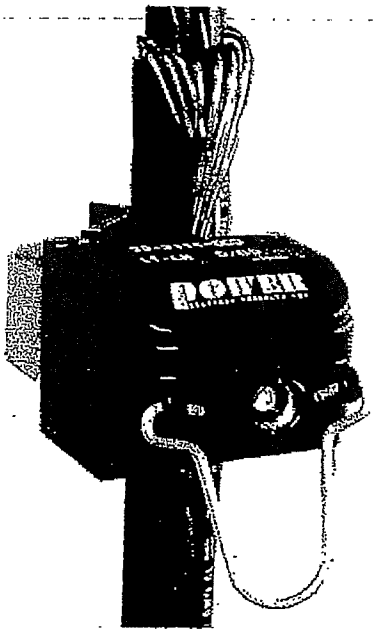


Cable or Elbow Mounting

ANSI/IEEE 495-1986 Compliant
ISO 9001 Certified Factory

Load tracking capability allows utilities to use one fault indicator for all requirements without concern for coordination studies. The Load Tracker Faulted Circuit Indicator represents state of the art closed core design technology. The Load Tracker offers the highest degree of proximity immunity available. Underground circuits that require automatic reset type fault indicators have cable spacing constraints that require a high degree of immunity from adjacent cable circuits. In many cases false trip or false reset conditions can occur that will adversely affect faulted circuit indicators that are sensitive to and dependent on load current for their reset. The Load Tracker Faulted Circuit Indicator offers the highest degree of immunity, while still being able to sense and reset on current and/or time.

Hotstick applied, one size fits all, close proximity immunity, the ultimate answer to FCI requirements.



2658 Holcomb Bridge Rd. Suite 100 Alpharetta, GA 30022
Phone: 770-587-9044 Fax: 770-587-4497

POWER DELIVERY PRODUCTS INC.

FCI LOAD TRACKER
TECHNICAL DATA

Electrical Data	MEETS OR EXCEEDS ANSI/IEEE STD. 495-1986
Trip Current Range	200A Min. to 3 to 5 Times Load (200A DEFAULT)
Temperature Range	-40 to +85 Degrees C
Accuracy	±10% @ 20 Degrees C
Load Tracking	Initiated after Load = 40 A or greater
Auto Reset Time	4 Hours Standard, 8 to 24 Hour Optional
Current Reset	5 Amps Small Core / 10 Amps Large Core
Power Source	1.2 AH Lithium Oxide Cell, non-replaceable, 15 to 20 year life
Indication	Bright LED, Local or Remote optic
Total Indicating Time	>900 Hours
Flashing Frequency	30 per minute
Maximum Operating Voltage	46 KV
Current Withstand	25,000 amps sym. RMS / 170 msec.
Adjacent Cable Immunity	2.3 inches @ 10KA
Cable Diameter Range	.85 inches to 2.37 inches
Casing Material	UV stable polycarbonate
Current Transformer	Closed Core, corrosion protected galvanized and powder coated steel
Weight	10 oz.

Catalog Number Selection

29	– 3	X Select Reset Option	XX Select Cable Diameter	– 000	– Trip	– Reset Time
29= Closed CoreUG	3= Load Tracker	0= 56 Second Current Reset 1= Full Time Current Reset 2= Time Reset only	14= .85 to 1.57 15= 1.57 to 2.37	000	Automatic 200 A Min. to 3 to 5 X Load	4 Hour 8 Hour

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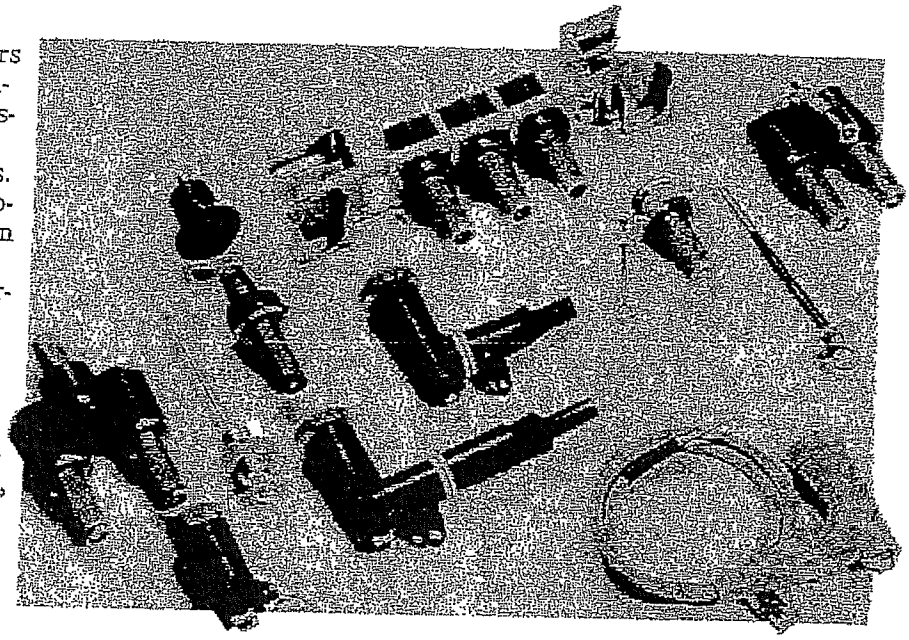
200 Amp loadbreak connectors and accessories provide a convenient method to connect/disconnect cable and equipment on power distribution systems. Loadbreak elbows include provisions for energized operation using standard hotstick tools, allowing loadmake/break operation and a visible disconnect. Components can be isolated with insulated caps, plugs and parking bushings.

Optional accessories allow system grounding, testing, bypass, lightning surge protection and current limiting fusing. Additional connecting points and taps can be provided by use of junctions or feed-thrus.



RATINGS OVERVIEW

See page 2 for complete information including switching and fault close ratings.

CURRENT RATINGS
200A Continuous
10kA sym. 10 Cycles

VOLTAGE RATINGS
15kV Class
8.3kV Phase-to-Ground
14.4kV Phase-to-Phase
95kV BIL
34kV AC Withstand
53kV DC Withstand
11kV Corona Extinction

25kV Class
15.2kV Phase-to-Ground
26.3kV Phase-to-Phase
125kV BIL
40kV AC Withstand
78kV DC Withstand
19kV Corona Extinction

35kV Class
21.1kV Phase-to-Ground
36.6kV Phase-to-Phase
150kV BIL
50kV AC Withstand
103kV DC Withstand
26kV Corona Extinction

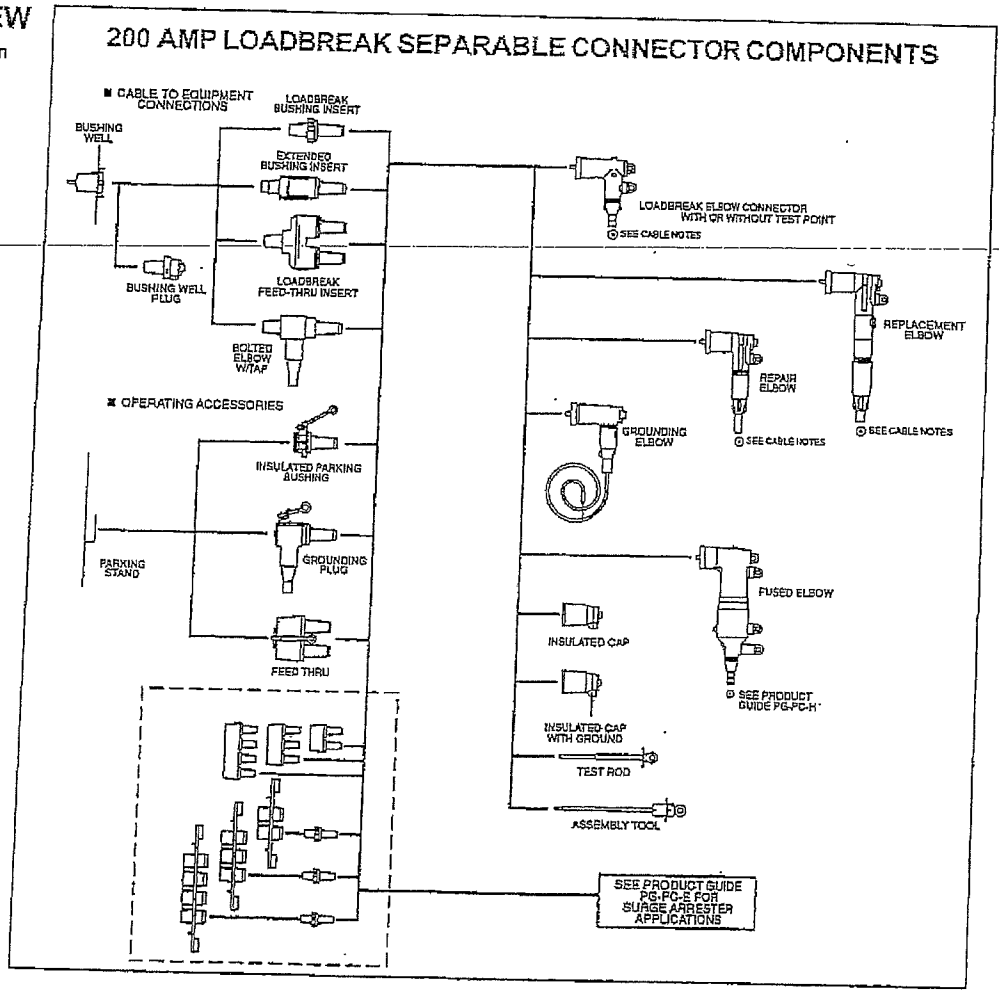


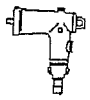
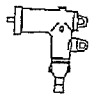
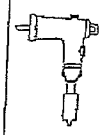
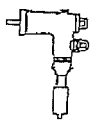
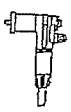
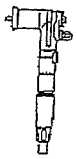
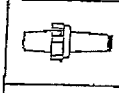
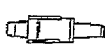
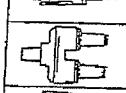
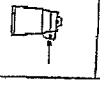
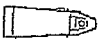
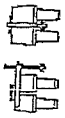
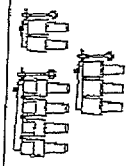
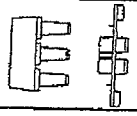
Illustration (not to scale)	Description	Voltage Class	ELASTIMOLD Part Number	Notes
	Elbow Connector	15kV	165LR-W5X Use Tables W1 and X1	N2,3,4,5
		25kV	275LR-W5X Use Tables W16 and X1	N2,3,4,5
		35kV	375LR-W5X Use Tables W3 and X2	N2,3,5
	Elbow Connector w/ Test Point	15kV	166LR-W5X Use Tables W1 and X1	N2,3,4,5
		25kV	276LR-W5X Use Tables W16 and X1	N2,3,4,5
		35kV	376LR-W5X Use Tables W3 and X2	N2,3,5
	Jacket Seal Elbow Connector	15kV	165LRJS-W5X Use Table W1 (B&C sizes only) and Table X1	N2,19
		25kV	275LRJS-W5X Use Tables W16 and X1	N2,19
	Jacket Seal Elbow Connector w/ Test Point	15kV	166LRJS-W5X Use Tables W1 (B&C sizes only) and Table X1	N2,19
		25kV	276LRJS-W5X Use Tables W16 and X1	N2,19
	Repair Elbow Connector	15kV	167ELR-W5X Use Tables W5 and X1	N5,10,18
		25kV	273ELR-W5X Use Tables W5 and X1	N5,10,18
	Repair Elbow Connector w/ Test Point	15kV	168ELR-W5X Use Tables W5 and X1	N5,10,18
		25kV	274ELR-W5X Use Tables W5 and X1	N5,10,18
	Replacement Elbow	15kV	167RLR-W5X Use Tables W4 and X1	N5,11,13
		25kV	273RLR-W5X Use Tables W2 and X1	N5,11,13
	Replacement Elbow w/ Test Point	15kV	168RLR-W5X Use Tables W4 and X1	N5,11,13
		25kV	274RLR-W5X Use Tables W2 and X1	N5,11,13
	Direct Test Elbow Connector	15kV	167DLR-W5X	N2,5,22
		25kV	273DLR-W5X	N2,5,22
	Direct Test Repair Elbow Connector	15kV	167DELR-W5X	N5,10,18,22
		25kV	273DELR-W5X	N5,10,18,22
	Direct Test Repair Elbow Connector w/Test Point	15kV	168DELR-W5X	N5,10,18,22
		25kV	274DELR-W5X	N5,10,18,22
	Fused Elbow (Full Range Current Limiting)	15kV 25kV	168FLR H-W0X 274FLR H-W0X *See Product Guide PG-PC-H*	
	Bolted Elbow w/ Tap	15kV	167LRT-W5X Use Tables W4 and X1	N17
	Bushing Insert	15kV 25kV 35kV 35kV	1601A4 2701A4 3701A4 3701A3	N4,8,20 N4,8,20 N6,21 N8,21
	Extended Bushing Insert	15kV 25kV	1601EA4 2701EA4	N8,20 N8,20
	Feed-Thru Insert	15kV 25kV 35kV	1602A3R 2702A1 3702A1	N16 N16 N6,16
	Insulated Cap	15kV	160DR	N9
	Insulated Cap w/ Ground	15kV 15kV 25kV 35kV	160DRG 167DRG 273DRG 375DRG	N9 N7,9 N7,9 N7,9

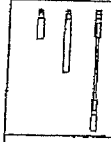
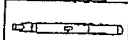
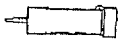
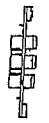
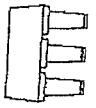
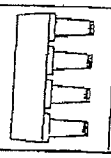
Illustration (not to scale)	Description	Voltage Class	ELASTIMOLD Part Number	Notes
	Insulated Cap w/ Ground and Test Point	15kV 25kV 35kV	168DRG 274DRG 376DRG	N7 N7 N7
	Grounding Plug (1/0 AWG x 6' Ground Lead)	15kV 25kV	161GP 272GP	
	Grounding Elbow (1/0 AWG x 6' Ground Lead)	15kV 25/35kV	160GLR 370GLR	N12
	Feed-Thru	15kV 25kV 35kV 35kV	164FT 274FT 371FT 373FT	N6
	Feed-Thru Vertical	15kV 25kV 35kV	164FTV 274FTV 373FTV	
	Adjustable Bracket 2-point Feed-Thru	15kV 25kV	164FT2-AB 274FT2-AB	N23 N23
	Adjustable Bracket 3-point Feed-Thru	15kV 25kV	164FT3-AB 274FT3-AB	N23 N23
	Adjustable Bracket 4-point Feed-Thru	15kV 25kV	164FT4-AB 274FT4-AB	N23 N23
	Feed-Thru Well	15/25kV	K1601WFT	
	Feed-Thru Well Vertical	15/25kV	K1601WFTV	
	Insulated Parking Bushing	15kV 25kV 35kV	161SOP 272SOP 372SOP	N20 N20 N21
		15kV 25kV	164SOP 274SOP	N20,23 N20,23
	Test Rod	ALL	370TR	
	Bushing Well Plug	15/25kV 35kV	276BWP M276BWP	
	Assembly Tool	ALL	200AT	N8

N1. Copper lug for use on COPPER CONDUCTOR ONLY.
N2. W5X indicates that the part number includes 02500X long bi-metal compression lug as standard. For an all-copper lug, replace W5X with W2X in Table X1 to specify the all-copper 02702X lug.
N3. Also available as housing only. Specify: 165BLR-W; 275BLR-W; 375BLR-W; 166BLR-W; 276BLR-W; 376BLR-W.
N4. Also available as elbow/insert combination. Specify: 165A4-WX; 275A4-WX; 165A4-WX; 276A4-WX.
N5. Also available with 200ECS jacket seal included. Add - "S" suffix to part number.
N6. Rated for single-phase applications only.
N7. Equipped with insulated cuff.
N8. Includes internal torquing feature using 200AT Assembly Tool.
N9. Also available without probe. Specify "A" suffix - Example: 273DRGA.
N10. Repair elbow has extended length contact and elbow housing resulting in a net gain of 3-1/4" in length.
N11. Replacement elbow has extended length contact and elbow housing resulting in a net gain of 8-7/8" in length.
N12. Rated for 25kV thru 35kV applications.
N13. Includes long bi-metal contact 00400X.
N14. 160CA Cable Size Adapter can only be used with elbow part numbers 165LR/166LR C size only.
N16. Fully rotatable for 360° positioning. Includes ball assembly to secure feed-thru insert to bushing well.
N17. Includes 02800X bi-metal contact.
N18. Includes 02509X long bi-metal contact.
N19. Includes built-in jacket seal. Also available as housing only — specify: 165BLRJS-W, 166BLRJS-W, 275BLRJS-W or 276LRJS-W. Also available as elbow/insert combination — specify: 165JSA4-W5X, 166JSA4-W5X, 275JSA4-W5X or 276JSA4-W5X.
N20. Includes a yellow seating indicator and vent ring.
N21. Includes a black vent ring.
N22. Direct Test Connectors, along with a 200TC-X series meter adapter, a properly rated voltage meter and Hot-line Stick provides a means for direct conductor voltage testing.
N23. With stainless steel bracket.



CONTACTS, PROBES, PLUGS, CABLE ADAPTERS AND JUNCTIONS
CONTINUED ON PAGE 7.

Refer to the W and X tables on pages 38 and 39 for sizing to cable insulation diameter and conductor size.
For cable shield adapters and jacket seals, see page 28.

Illustration (not to scale)	Description	Voltage Class	ELASTIMOLD Part Number	Notes
	Contacts:		Use Table X1	
	Long Bi-Metal	ALL	02500X	
	ELR Bi-Metal	15/25kV	02509X	N1
	Copper	ALL	02702X	N2
	LRT Contact	15kV	02800X	
	RLR Contact	15/25kV	00400X	N3
	Elbow Probe	15kV	166LRF	
		25kV	274LRF	
		35kV	375LRF	
	Elbow Cable Entrance Insulating Plug	ALL	10EPW Use Table W6	
	Cable Size Adapter	15kV	160CA-W Use Table W6 EB-FA Only	N4
	Direct Voltage Test Meter Adapter for:			
	HD Electric Meters	ALL	200TC-1	N14
	Ross Meters		200TC-2	N14
	Chance Meters		200TC-4	N14
	2-Way Well Junction w/ s.s. Bracket	15/25kV	K1601WJ2	N6
	2-Way Well Junction w/ "U" Straps	15/25kV	K1601WJ2-5	N5, 6, 11
	3-Way Well Junction w/ s.s. Bracket	15/25kV	K1601WJ3	N6
	3-Way Well Junction w/ "U" Straps	15/25kV	K1601WJ3-5	N5, 6, 12
	4-Way Well Junction w/ s.s. Bracket	15/25kV	K1601WJ4	N6
	4-Way Well Junction w/ "U" Straps	15/25kV	K1601WJ4-5	N5, 6, 13
	2-Point Junction with/stainless steel bracket	15kV 25kV 35kV	164J2 274J2 373J2	N7 N7 N7
	2-Point Junction w/"U"-straps	15kV 25kV 35kV	164J2-5 274J2-5 373J2-5	N5, 8 N5, 11 N5, 11
	3-Point Junction with/stainless steel bracket	15kV 25kV 35kV	164J3 274J3 373J3	N7 N7 N7
	3-Point Junction w/"U"-straps	15kV 25kV 35kV	164J3-5 274J3-5 373J3-5	N5, 9 N5, 12 N5, 12
	4-Point Junction with/stainless steel bracket	15kV 25kV 35kV	164J4 274J4 373J4	N7 N7 N7
	4-Point Junction w/"U"-straps	15kV 25kV 35kV	164J4-5 274J4-5 373J4-5	N5, 10 N5, 13 N5, 13

N1. Repair elbow has extended length contact and elbow housing resulting in a net gain of 3-1/4" in length.

N2. Copper lug for use on COPPER CONDUCTOR ONLY.

N3. Replacement elbow has extended length contact and elbow housing resulting in a net gain of 8-7/8" in length.

N4. 160CA Cable Size Adapter can only be used with elbow part numbers 165LR/166LR C size only.

N5. Also available as rubber only, without straps. Specify suffix "-4" in place of "-5" in the part number.

N6. Supplied with replaceable stud. Replacement stud available separately. Specify 1601RS.

N7. Hardware packages, consisting of brackets & straps only, may be ordered separately by specifying "-6" in the part number. Example 164J4-6

N8. Hardware package, consists of "U"-straps and back plate only, may be ordered separately by specifying 1601US-J2.

N9. Hardware package, consists of "U"-straps and back plate only, may be ordered separately by specifying 1601US-J3.

N10. Hardware package, consists of "U"-straps and back plate only, may be ordered separately by specifying 1601US-J4.

N11. Hardware package, consists of "U"-straps and back plate only, may be ordered separately by specifying 271-68.

N12. Hardware package, consists of "U"-straps and back plate only, may be ordered separately by specifying 271-61.

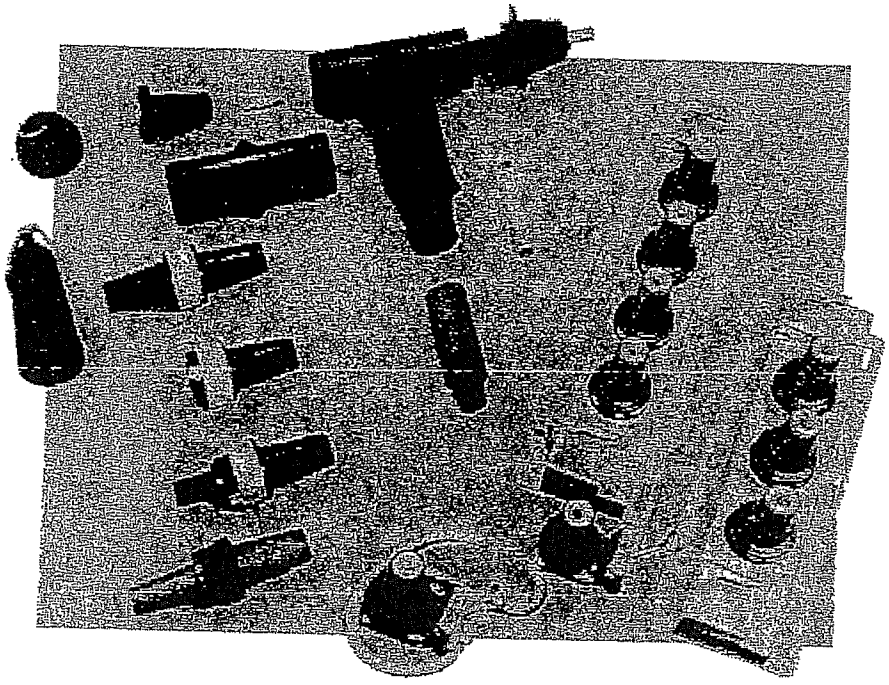
N13. Hardware package, consists of "U"-straps and back plate only, may be ordered separately by specifying 271-70.

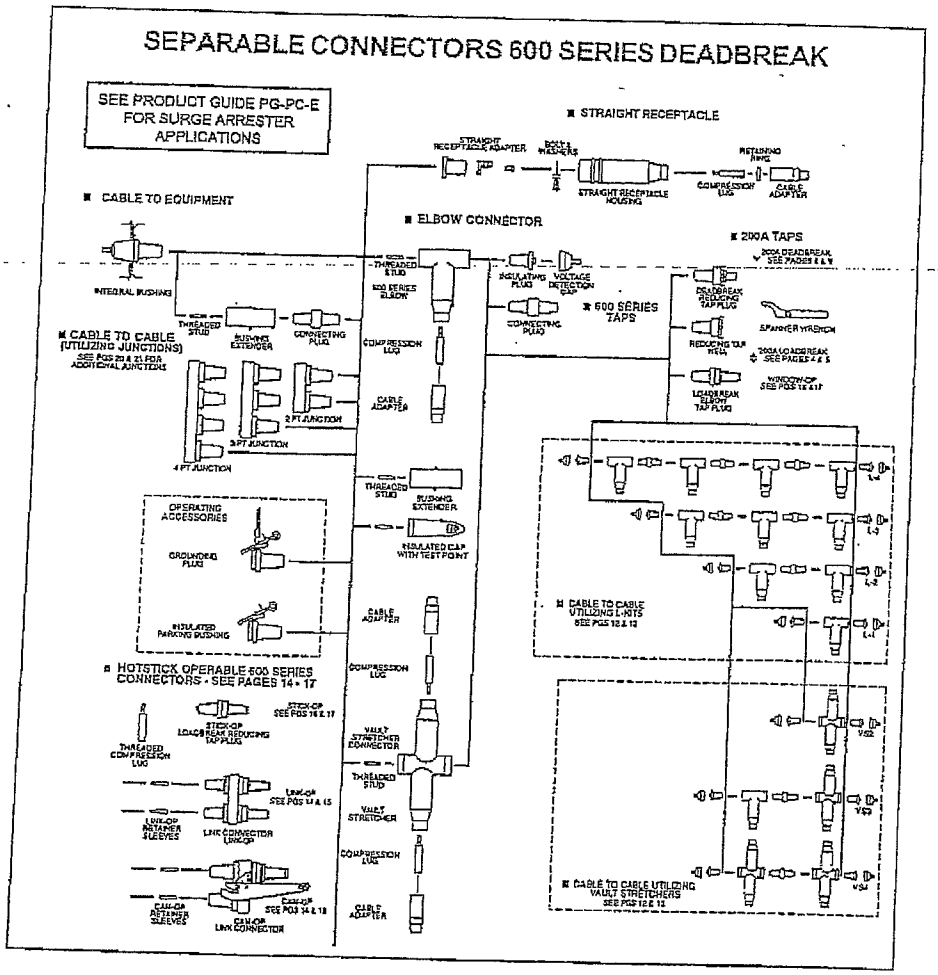
N14. For use with Direct Test Connectors.

600 Series deadbreak elbows, straight receptacles, junctions, vault stretchers and accessories are used to connect equipment and cable on primary feeder and network circuits. Designs accommodate large conductors and feature bolted connections and deadfront modular construction for maximum reliability, performance and versatility.

DE-ENERGIZED connectors can be quickly and easily connected and disconnected using standard hand tools and equipment in accordance with accepted operating practices. Optional accessories allow visible external separation, by-pass, isolation, dead-ending, grounding, and testing as well as adding taps, surge arresters and circuit protection.

Hotstick operable and separable joint systems are shown on pages 14 thru 19.





Separable Connectors 600 Series Deadbreak

RATINGS OVERVIEW

See page 2 for complete information.

CURRENT RATINGS
(Prefixes: 650, K650, K655, K656, 750, 755, 756 & 03700)
600 Amp Continuous
25kA sym., 10 cycles
(Prefixes 675, K675, K676, 775, 776 & 03702)
900 Amp Continuous
25kA sym., 10 cycles

NOTE: 900 Amp ratings require copper cable and copper current-carrying components.

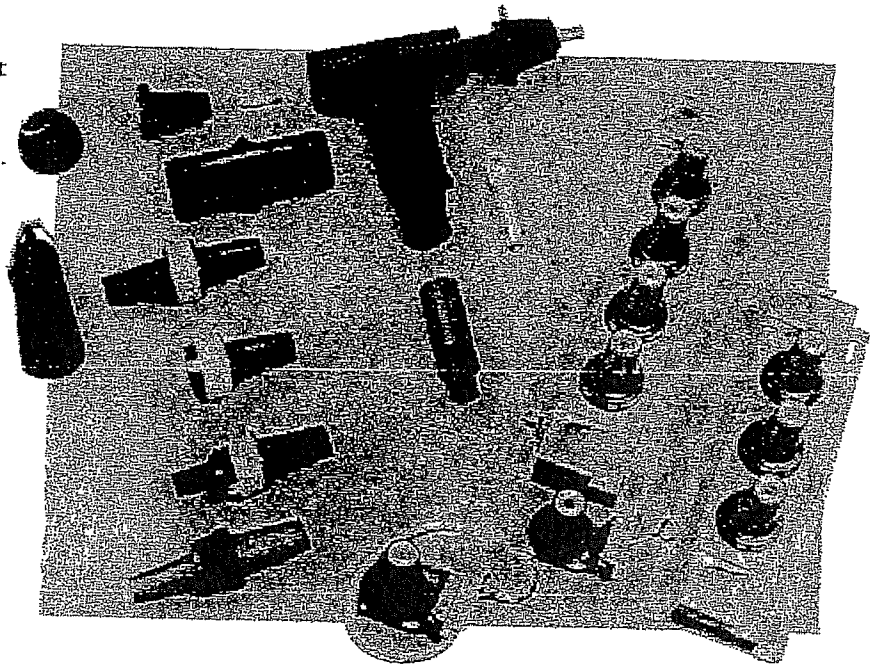
VOLTAGE RATINGS
15/25kV Class (5kV thru 28kV)
16.2kV Phase-to-Ground
28kV Phase-to Phase
140kV BIL
45kV AC Withstand
84kV DC Withstand
21.5kV Corona Extinction
35kV Class
21.1kV Phase-to-Ground
36.6kV Phase-to-Phase
150kV BIL
50kV AC Withstand
103kV DC Withstand
26kV Corona Extinction

Note: Elastimold has increased the IEEE Standard Production and Design Test levels for 25kV Class products to include 27kV and 28kV systems.

600 Series deadbreak elbows, straight receptacles, junctions, vault stretchers and accessories are used to connect equipment and cable on primary feeder and network circuits. Designs accommodate large conductors and feature bolted connections and deadfront modular construction for maximum reliability, performance and versatility.

DE-ENERGIZED connectors can be quickly and easily connected and disconnected using standard hand tools and equipment in accordance with accepted operating practices. Optional accessories allow visible external separation, by-pass, isolation, dead-ending, grounding, and testing as well as adding taps, surge arresters and circuit protection.

Hotstick operable and separable joint systems are shown on pages 14 thru 19.



RATINGS OVERVIEW

See page 2 for complete information.

CURRENT RATINGS

(Prefixes: 650, K650, K655, K656, 750, 755, 756 & 03700)
600 Amp Continuous
25kA sym., 10 cycles

(Prefixes 675, K675, K676, 775, 776 & 03702)
900 Amp Continuous
25kA sym., 10 cycles

NOTE: 900 Amp ratings require copper cable and copper current-carrying components.

VOLTAGE RATINGS

15/25kV Class (5kV thru 28kV)
16.2kV Phase-to-Ground
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140kV BIL
45kV AC Withstand
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21.1kV Phase-to-Ground
36.6kV Phase-to-Phase
150kV BIL
50kV AC Withstand
103kV DC Withstand
26kV Corona Extinction

Note: Elastimold has increased the IEEE Standard Production and Design Test levels for 25kV Class products to include 27kV and 28kV systems.

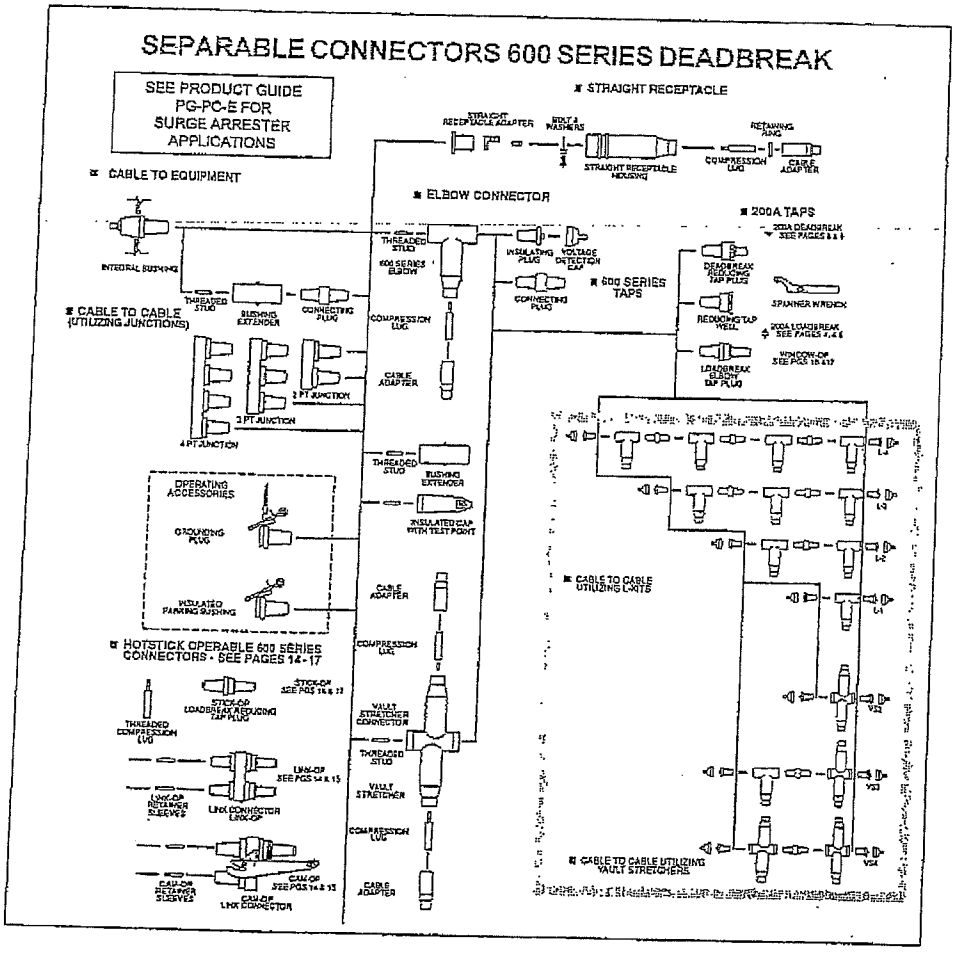


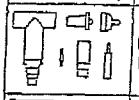
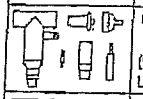
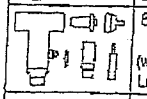
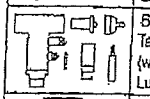
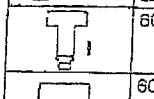
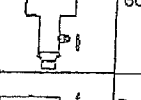
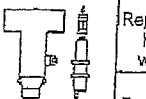
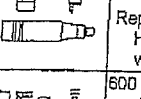
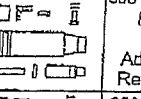
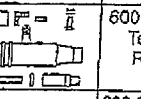
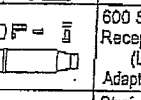
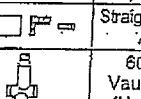
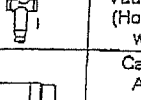
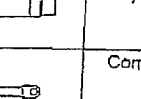
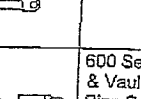
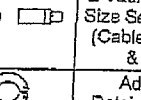
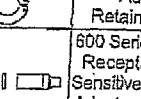
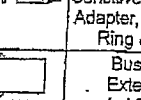
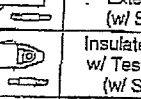
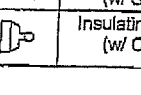
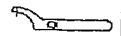
Illustration (not to scale)	Description	Voltage Class	ELASTIMOLD Part Number	Notes
	600 Series Elbow (w/ Insul. Plug, Cap, Stud, Lug and Cable Adapter)	15/25kV 35kV	K655LR-W0X Use Tables W7 and X6 755LR-W0X Use Tables W9 and X6	N1,2,12 N1,2,12
	600 Series Direct Test Elbow (w/ Insul. Plug, Cap, Stud Lug and Cable Adapter)	15/25kV 35kV	K655DLR-W0X 755DLR-W0X	N1,2,12,14 N1,2,12,14
	600 Series Elbow w/ Test Point (w/ Insul. Plug, Cap, Stud, Lug and Cable Adapter)	15/25kV 35kV	K656LR-W0X Use Tables W7 and X6 756LR-W0X Use Tables W9 and X6	N1,2,12 N1,2,12
	600 Series Direct Test Elbow w/Test Point (w/ Insul. Plug, Cap, Stud, Lug and Cable Adapter)	15/25kV 35kV	K656DLR-W0X Use Tables W7 and X6 756DLR-W0X Use Tables W9 and X6	N1,2,12,14 N1,2,12,14
	600 Series Elbow Housing only (w/ Stud)	15/25kV 35kV	K655BLR 755BLR	N1,3 N1,3
	600 Series Elbow w/ Test Point Housing only (w/ Stud)	15/25kV 35kV	K656BLR 756BLR	N1,3 N1,3
	600 Series Replacement Elbow Housing only w/o Test Point	15/25kV	K655BRLR	N,16
	600 Series Replacement Elbow Housing only w/ Test Point	15/25kV	K656BRLR	N,16
	600 Series Straight Receptacle (w/ Cable Adapter, Lug & Retaining Ring)	15/25kV	K655SR-W0X Use Tables W7 and X6	N1,2,11
	600 Series Direct Test Straight Receptacle Elbow	15/25kV	K655DSR-W0X Use Tables W7 and X6	N1,2,11,14
	600 Series Straight Receptacle Housing (Lug & Cable Adapter not included)	15/25kV	K655BSR	N1,11
	Straight Receptacle Adapter	15/25kV	K650SRA	N1,4
	600 Series Vault Stretcher (Housing only w/ Stud)	15/25kV 35kV	K655BVS 755BVS	N1,9 N1,9
	Cable Size Adapter	15/25kV 35kV	655CA-W Use Table W7 755CA-W Use Table W9	
	Compression Lug	ALL ALL	03700X Use Table X6 03702X Use Table X6	N5 N6
	600 Series Elbow & Vault Stretcher Size Sensitive Kit (Cable Adapter & Lug)	15/25kV 35kV	655CK-W0X Use Tables W7 and X6 755CK-W0X Use Tables W9 and X6	N2 N2
	Adapter Retaining Ring	ALL	650ARR-X Use Table X6	
	600 Series Straight Receptacle Size Sensitive Kit (Cable Adapter, Retaining Ring & Lug)	15/25kV	655CK-W0X-ARR Use Tables W7 and X6	N2
	Bushing Extender (w/ Stud)	15/25kV 35kV	K655BE 755BE	N1,3 N1,3
	Insulated Cap w/ Test Point (w/ Stud)	15/25kV	K656DR	N3,7
	Insulating Plug (w/ Cap)	15/25kV 35kV	K650BIP 750BIP	N1,7,8 N1,7,8

Illustration (not to scale)	Description	Voltage Class	ELASTIMOLD Part Number	Notes
	Grounding Plug (Ground Lead 2/0 AWG x 30")	15/25kV 35kV	650GP 750GP	N1,7,8 N1,7,8
	Insulated Parking Bushing	15/25kV 35kV	K650SOP 750SOP	N7,8 N7,8
	Connecting Plug	15/25kV 15/25kV 35kV	K650CP K651CP 750CP	N1,7,8,9,13 N1,7,8,10 N1,7,8,10
	Deadbreak Reducing Tap Plug	15/25kV	K650RTP	N1,7,8,9
	Reducing Tap Well	15/25kV	K650RTW	N1,7,8,9
	Loadbreak Elbow Tap Plug	15kV 25kV 35kV	650ETP K650ETP 750ETP	N1,7,8,10,12 N1,7,8,10,12 N1,7,8,10,12
	Vault Stretcher Threaded Stud	15/25kV 35kV	650VSA 750VSA	N1 N1
	600 Series Elbow Threaded Stud	15/25kV 35kV	650SA 750SA	N1 N1
	Assembly Tool (Window-Op)	ALL	600ATM	N12
	Spanner Wrench	ALL	600SW	N9
	Direct Voltage Test Meter Adapter for:			
	HD Electric Meters	ALL	200TC-1	N14
	Ross Meters		200TC-2	N14
	Chance Meters		200TC-4	N14

N1. For 900 Amp ratings, substitute 675 for 650 and 655; 676 for 656; K671 for K651; K675 for K650 and K655; K676 for K656; 775 for 750 and 755; 776 for 756 and 2X for 0X in the part number. The 900 Amp rating requires copper current-carrying connector components and copper conductor cable.

N2. Add suffix symbol from page 29 to include cable shield grounding kit and/or cable jacket sealing kit.

N3. Available without the stud by adding "N" to the part number.

N4. Straight Receptacle Adapter is used to connect Straight Receptacles K655YBSR and K655YSR-W0X (Pg.19) to equipment bushings.

N5. Aluminum lug for use on aluminum or copper conductors. DO NOT substitute threaded 03600X lug.

N6. Copper lug for use on COPPER CONDUCTOR ONLY. DO NOT substitute threaded 03602X lug.

N7. Available with the stud factory-assembled by adding "SP" to the part number. 675ETP, K675ETP and 775ETP are available as -SP only. The stud is not field removable.

N8. Available with a loose stud by adding suffix "S" to the part number.

N9. 600SW spanner wrench is recommended for installation of K650CP connecting plug, deadbreak reducing tap plugs and reducing tap wells.

N10. Use 600ATM Assembly Tool.

N11. 600 Series Elbows and Straight Receptacles with IEEE Std. 386 capacitive test points are available by substituting 656 for 655; K656 for K655; K676 for K675; 756 for 755; 676 for 675; K676 for K675 and 776 for 775 in the part number.

N12. See page 17 for Window-Op Connector Kit.

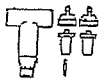
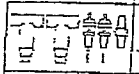
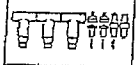
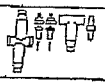
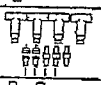
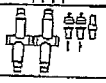
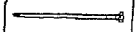
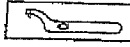
N13. Superseded by K651CP.

N14. Direct Test Connectors, along with a 200TC-X series meter adapter, a properly rated voltage meter and Hot-line Stick; provides a means for direct conductor voltage testing.

N15. With stainless steel bracket.

N16. Replacement Elbow includes an I-Adapter, and Straight Receptacle, resulting in a net gain of 20".

Refer to the W and X tables on pages 38 and 39 for sizing to cable insulation diameter and conductor size.
For cable shield adapters and jacket seals, see page 28.

Illustration (not to scale)	Description	Voltage Class	ELASTIMOLD Part Number	Notes
	2-Point Junction	15/25kV 35kV	K650J2 750J2	N1,9,10 N1,9,10
	3-Point Junction	15/25kV 35kV	K650J3 750J3	N1,9,10 N1,9,10
	4-Point Junction	15/25kV 35kV	K650J4 750J4	N1,9,10 N1,9,10
	1-way L-Kit	15/25kV 35kV	K655L1 755L1	N1,2,3,4 N1,2,3,4
	2-way L-Kit	15/25kV 35kV	K655L2 755L2	N1,2,3,4,5,6,7 N1,2,3,4,5,6,7
	2-way VS-Kit	15/25kV 35kV	K655VSL2 755VSL2	N1,2,3 N1,2,3
	3-way L-Kit	15/25kV 35kV	K655L3 755L3	N1,2,3,4,5 N1,2,3,4,5
	3-Way VS Kit	15/25kV 35kV	K655VSL3 755VSL3	N1,2,3,5,6,7 N1,2,3,5,6,7
	4-Way L-Kit	15/25kV 35kV	K655L4 755L4	N1,2,3,4,5 N1,2,3,4,5
	4-Way VS-Kit	15/25kV 35kV	K655VSL4 755VSL4	N1,2,3,5 N1,2,3,5
	Assembly Tool (Window-Op)	ALL	600ATM	N8
	Spanner Wrench	ALL	600SW	N2

N1. For 900 Amp ratings, substitute 675 for 650 and 655; 676 for 656; K675 for K650 and K655; K676 for K656; 775 for 750 and 755; 776 for 756 and 2X for 0X in the part number. The 900 Amp rating requires copper current-carrying connector components and copper conductor cable.

N2. 600SW spanner wrench is recommended for installation of K650CP connecting plug, deadbreak reducing tap plugs and reducing tap wells.

N3. L-Kits and VS-Kits do not include cable adapters or compression lugs. These items must be ordered separately.

N4. 600 Series Elbows and Straight Receptacles with IEEE Std. 386 capacitive test points are available by substituting 656 for 655; K656 for K655; K676 for K675; 756 for 755; 676 for 675; K676 for K675 and 776 for 775 in the part number.

N5. 600ATM is recommended for installing K651CP and 750CP.

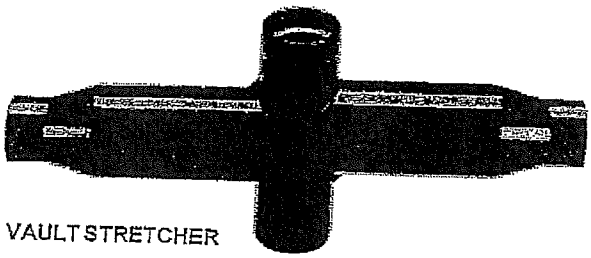
N6. Can be used as a repair joint. (Gains 3-1/2" of repair length)

N7. Can be used as a reducing joint for different size cables.

N8. See page 17 for Window-Op Connector Kit.

N9. Rubber junction with stainless steel mounting plate and back plate.
Add "-U" for rubber junction with stainless steel mounting plate, back plate and adjustable mounting bracket.
Add "-4" for rubber junction only.
Add "-5" for rubber junction, stainless steel U-straps and back plate.

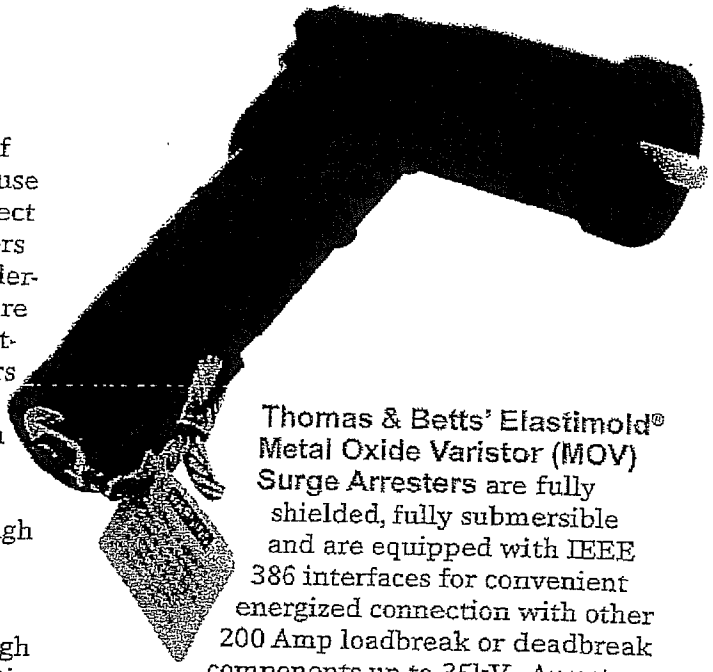
N10. Two - six-position multi-point junctions shown on pages 20 and 21.



VAULT STRETCHER

Provides an alternate method of splicing and joining various types and styles of cables using standard 600 Series components.

Refer to the W and X tables on pages 38 and 39 for sizing to cable insulation diameter and conductor size.
For cable shield adapters and jacket seals, see page 28.



Voltage surges that exceed the BIL rating of the distribution system components will cause damage to the installed equipment. To protect against these surges overhead surge arresters are widely used and their application is understood since overhead lines and equipment are directly affected by voltage surges (e.g. lightning). However, the use of overhead arresters alone will not guarantee proper protection of the insulation in the underground portion of an electrical distribution system. The let-through surge from the riser pole arresters into the underground systems could be enough to cause damage to the aging equipment insulation.

Elastimold® MOV Surge Arresters provide high voltage lightning and switching surge protection of transformers, cable, equipment and other components typically located on underground power distribution systems. Proper placement, voltage selection and coordination with riser pole arresters minimizes damaging surge voltages by improving protective margins.

Typical applications include installing an arrester at the end of a radial system, or at both ends of an open point on a loop system. Additional arresters can be added at strategic locations upstream from the endpoint for optimum protection.

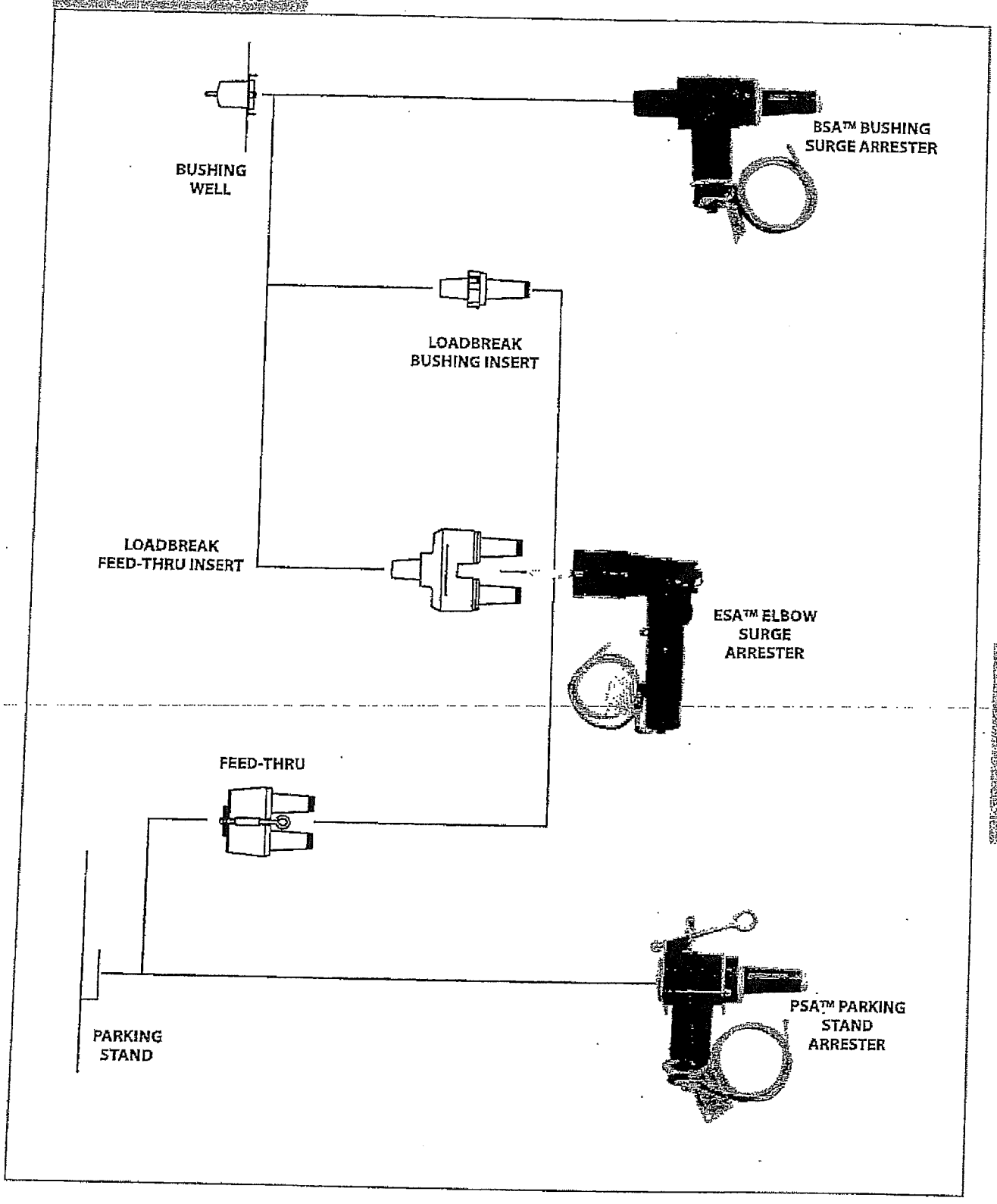
Thomas & Betts' Elastimold® Metal Oxide Varistor (MOV) Surge Arresters are fully shielded, fully submersible and are equipped with IEEE 386 interfaces for convenient energized connection with other 200 Amp loadbreak or deadbreak components up to 35kV. Arresters are available in three styles: Elbow (ESA), Parking Stand (PSA) and Bushing (BSA). The PSA and BSA arresters permit direct connection, eliminating the need for additional accessories.

ESA Elbow Arresters are also available with a 200 Amp Deadbreak interface for mating with other Deadbreak Accessories.

The following tables highlight the different installation options using Bushing and Parking Stand Arresters where Elbow Arresters are normally used. Using BSAs and PSAs will contribute to save space inside transformers and improve operability.

FEATURE	BENEFIT/DESCRIPTION
IEEE 386 Interfaces	Convenient energized connection with other 200 Amp loadbreak or deadbreak components
EPDM Molded Rubber Construction	Fully shielded, fully submersible
Compact	Allow installation in existing cabinetry
Elbow (ESA), Parking Stand (PSA), and Bushing (BSA) styles available	Ease of application and installation
Direct connection on PSA and BSA	Eliminates the need for additional accessories
No. 4AWG Ground Lead Tethered to the Jacket	Withstands 10,000 amp for 10 cycles without fusing Controls end plug when ejected, preventing uncontrolled trajectory Maintains the housing shield ground connection after failure

INSTALLATION OPTIONS



LOOP-FEED CIRCUIT (TYPE 2 TRANSFORMER)

TWO ELBOW ARRESTERS AND A FEED-THRU

This is one approach using elbow arresters only. (One of the elbow arresters could be mounted on the H_{1A} bushing if allowable by operating procedures.)

ELBOW ARRESTER AND PARKING STAND ARRESTER

This approach can reduce overcrowding (by eliminating the feed-thru device). This desirable in a mini-pad transformer.

BUSHING ARRESTER AND PARKING STAND ARRESTER*

This approach is best for increasing operability and reducing transformer overcrowding

- The bushing arrester allows the source cable to be positioned on H_{1A} which conforms with some operating practices.
- Potential interference between an elbow arrester on H_{1B} and a cable parked on P is eliminated.

A bushing arrester mounted on H_{1A} can be directed downward without interference.

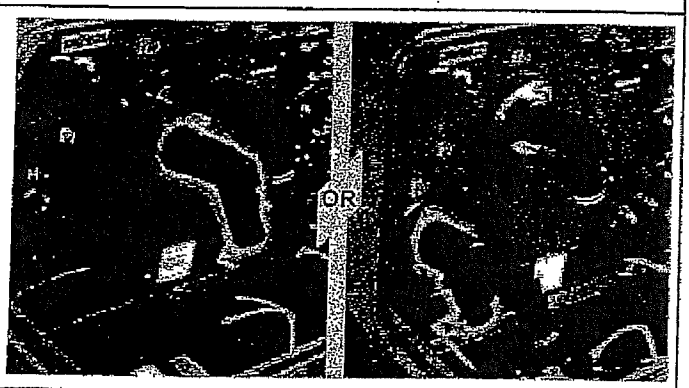
- The bushing arrester requires significantly less space than an elbow arrester used with a feed-thru insert.
- Operability is enhanced because the open point can be closed by moving the parked cable to H_{1B} without removing an arrester.

*Transformers must be specified with bushing wells.

ADDITIONAL MARGIN OF PROTECTION

An additional margin of protection may be gained by adding an arrester at the next transformer upstream on each side of the open point. This application is dependent on the system voltage and condition of the cable.

If an additional arrester is added in the circuit, it can be an elbow arrester in combination with a feed-thru insert or it can be a bushing arrester. Use of bushing arrester will reduce tranformer faceplate overcrowding.



OTHER CONFIGURATIONS

Other configurations are possible such as specifying a bushing arrester on every transformer. This will allow the open point to be quickly and easily moved to any point in the circuit while maintaining the surge protection (without moving all of the portable surge arresters).

The externally mounted bushing arrester provides the surge protection benefits without the negative factors of a under oil arrester.

RADIAL-FEED CIRCUIT (END POINT)

SINGLE-BUSHING TRANSFORMER*

To add surge protection to a single-bushing transformer, utilize a bushing arrester or an elbow arrester with a feed-thru insert.

TWO-BUSHING TRANSFORMER

To add surge protection to a two-bushing transformer at the end point of a radial-feed circuit, add an elbow arrester to the unoccupied bushing or utilize a bushing arrester.

CONVERSION OF A RADIAL-FEED TRANSFORMER TO A LOOP-FEED, OPEN POINT TRANSFORMER

To convert a single-bushing transformer to a loop-feed, open-point transformer, add a parking stand arrester and an elbow arrester in combination with a feed-thru insert.

RATINGS

High Current Short Duration	All MOV Arresters withstand two discharges of 40kA crest.
Low Current Long Duration	All MOV Arresters withstand 20 surges of 75 amperes/2000 microsecond duration
Duty Cycle Test	All MOV Arresters withstand 22 operations of 5kA crest at 8 x 20 microsecond duration while energized at rated voltage for the initial 20 operations and at maximum continuous operating voltage (MCOV) for the final two operations.
Following each of the preceding tests, MOV Arresters demonstrate thermal recovery at MCOV.	

PROTECTIVE CHARACTERISTICS

	MCOV (kVrms) Note 1	Duty Cycle Rating (kVrms)	Maximum Discharge Voltage (kV crest) 8x20 microsecond current wave				
			1.5kA	3kA	5kA	10kA	20kA
15kV CLASS	2.55	3	10.5	11.0	11.5	13.0	14.5
	5.1	6	20.5	21.5	23.0	25.5	30.0
	8.4	10	30.5	32.5	34.5	38.5	43.5
	10.2	12	40.0	42.5	45.0	50.0	56.5
	12.7	15	48.0	51.0	54.0	60.0	68.0
	15.3	18	56.5	60.0	64.0	71.0	80.5
25kV CLASS	8.4	10	30.5	32.5	34.5	38.5	43.5
	10.2	12	40.0	42.5	45.0	50.0	56.5
	12.7	15	48.0	51.0	54.0	60.0	68.0
	15.3	18	56.5	60.0	64.0	71.0	80.5
	17.0	21	65.5	69.5	74.0	82.5	93.0
35kV CLASS	19.5	24	78.5	83.5	89.0	99.0	112.0
	22.0	27	87.5	93.0	99.0	110.0	124.5
	24.4	30	95.5	101.5	108.0	120.0	136.0

NOTE:
MCOV = Maximum Continuous Operating Voltage

ORDERING INFORMATION

To specify and order an MOV Surge Arrester:

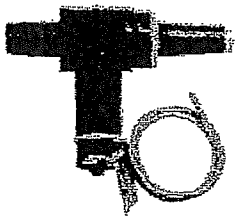
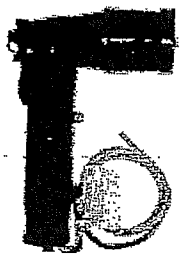
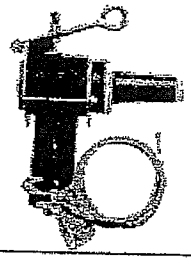
1. Determine the appropriate Maximum Continuous Operating Voltage (MCOV) for your system voltage by using the Elastimold® ARRESTER APPLICATION TABLE.
2. Specify the appropriate Elastimold® part number from the SELECTION CHART.

ARRESTER APPLICATION TABLE

	System Line-to-line Voltage kV rms		MCOV (Max. Continuous Voltage Operating Voltage)	
	Nominal	Max.	Solidly Grounded Neutral Circuits	3-Wire Ungrounded Circuits
15kV CLASS	2.40	2.54	2.55	2.55
	4.16	4.40	2.55	5.10
	4.80	5.08	5.10	5.10
	6.90	7.26	5.10	8.40
	8.32	8.80	5.10	8.40
	12.47	13.20	8.40	15.30
	13.20	13.97	8.40	15.30
	13.80	14.50	8.40*	15.30
	13.80	14.50	10.20	15.30
25kV CLASS	6.90	7.26	5.10	8.40
	8.32	8.80	5.10	8.40
	12.47	13.20	8.40	15.30
	13.20	13.97	8.40	15.30
	13.80	14.50	8.40*	15.30
	13.80	14.50	10.20	15.30
	20.78	22.00	12.70	-
	20.78	22.00	15.30*	-
	23.00	24.34	15.30	-
	24.94	26.40	15.30	-
	24.94	26.40	17.00*	-
	28.00	29.80	17.00	-

* Preferred arrester MCOV for this system voltage.

SELECTION CHART

Picture	Description	Voltage Class	Elastimold® Part Number	MCOV kVrms
	BSA Bushing Surge Arrester (includes assembly tool) See Notes N1, 2, 3, 4	15kV	167BSA-3	2.55
		15kV	167BSA-6	5.10
		15kV	167BSA-10	8.40
		15kV	167BSA-12	10.20
		15kV	167BSA-15	12.70
		25kV	273BSA-10	8.40
		25kV	273BSA-12	10.20
		25kV	273BSA-15	12.70
		25kV	273BSA-18	15.30
Picture	Description	Voltage Class	Elastimold® Part Number	MCOV kVrms
	ESA Elbow Surge Arrester See Notes N2, 3, 5	15kV	167ESA-3	2.55
		15kV	167ESA-6	5.10
		15kV	167ESA-10	8.40
		15kV	167ESA-12	10.20
		15kV	167ESA-15	12.70
		15kV	167ESA-18	15.30
		25kV	273ESA-10	8.40
		25kV	273ESA-12	10.20
		25kV	273ESA-15	12.70
		25kV	273ESA-18	15.30
Picture	Description	Voltage Class	Elastimold® Part Number	MCOV kVrms
	PSA Parking Stand Arrester See Notes N1, 2, 3	15kV	167PSA-3	2.55
		15kV	167PSA-6	5.10
		15kV	167PSA-10	8.40
		15kV	167PSA-12	10.20
		25kV	273PSA-10	8.4
		25kV	273PSA-12	10.20
		25kV	273PSA-15	12.70
		25kV	273PSA-18	15.30

SELECTION CHART NOTES

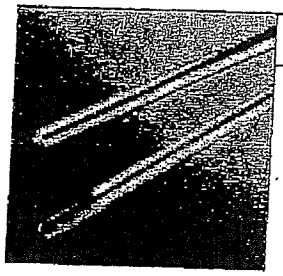
N1 Elastimold® PSA and BSA Arresters are equipped with a fully rated 200A switching and fault close loadbreak bushing.

N2 Elastimold® Arresters use high-strength silver epoxy bonded MOV blocks and shunted spring connections for the best circuit connection.

N3 A 36 inch free lead length #4 AWG ground lead provided with each unit.

N4 BSA installed by turning internal hex bolt (accessed through the 200 Amp Bushing Interface) with 5/16" hex wrench and bent wire torque wrench supplied with each unit.

N5 For 15kV and 25kV Class DEADBREAK system Elbow Arresters, use part number 156ESA with the appropriate Duty Cycle rating.



ERITECH® Copperbonded Ground Rods

ERITECH®

Where to buy Printer friendly

In a grounding system, the ground electrode provides the physical connection to the earth and is the instrument used to dissipate current into it. There are two main types of electrodes.

"Natural" electrodes are intrinsic to the facility and include metal underground water pipe, the metal frame of the building (if effectively grounded), and reinforcing bar in concrete foundations.

"Made" electrodes are installed specifically to improve the performance of the grounding system and include wire meshes, metallic plates, buried copper conductor and rods or pipe driven into the ground.

The ground rod is the most widely used grounding electrode. ERICO® is the world's largest manufacturer of ground rods and offers a complete line of rods and accessories to meet the needs of every user.

Related Products

CADWELD® PLUS ONE SHOT

ERITECH® Ground Rod Accessories - North & Latin America

Product Available In:
North America
Latin America
Asia/Australia
Europe/Middle East/Africa

Features

Copperbonded Ground Rods

- Resist corrosion better than galvanized rods allowing for a 30-year service life in most soils
- State of the art manufacturing process ensures uniform plating thickness
- Average tensile strength of 80,000 psi and straightness tolerance of .010" per linear foot
- Exceed the requirements of ANSI®/UL® 467-1984, CSA®, and ANSI/NEMA® GR-1

Pointed Copperbonded Ground Rods

- Manufactured of high strength 1035 cold drawn steel
- The ERICO preferred ground rod

Compression Couplers for Pointed Rods

- For use when coupling pointed rods

Sectional Copperbonded Ground Rods

- For use when it is necessary to deep-drive rods
- Cold-rolled threads - stronger than cut threads

Threaded Couplers for Sectional Rods

- For use when coupling sectional rods

Drive Studs for Sectional Rods

- Screws into threaded coupler while rod is being driven

Applications

ERICO has a complete line of ground rods and accessories to meet the needs of every user.

More Information

View product information by region: North & Latin America · Europe · Asia & Australia

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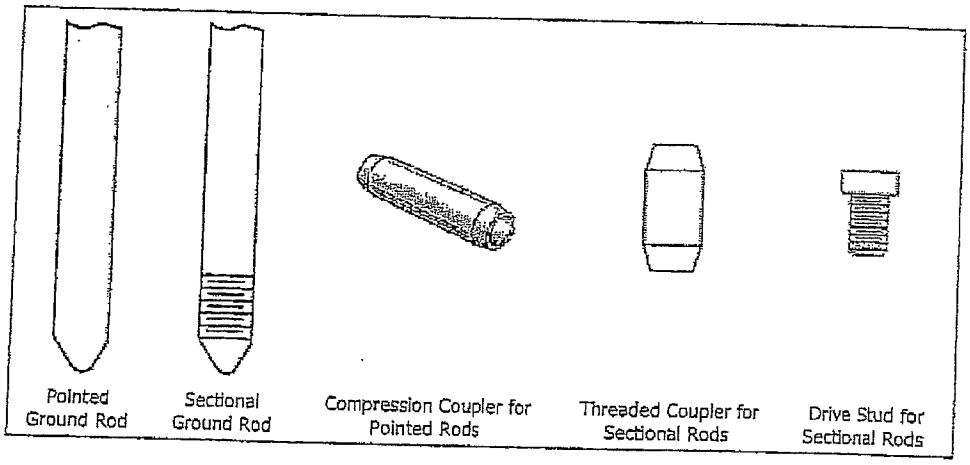
Product Information - North & Latin America Return to Top



Pointed Copperbonded Ground Rods

Part No.	Plating Thickness (mil)	Diameter (in)	Length (ft)	Standard Package	Weight per 100
613852	5	3/8	5	5	160
613862	5	3/8	6	5	198
613880	10	3/8	8	5	270
611255	5	1/2	5	5	296
611265	5	1/2	6	5	310
611285	5	1/2	8	5	482
611380*	10	1/2	8	5	553
611205	5	1/2	10	5	557
611300*	10	1/2	10	5	738
615850	10	5/8	5	5	420
615860	10	5/8	6	5	509
615880*	10	5/8	8	5	680
615883*	13-REA	5/8	8	5	680
615800*	10	5/8	10	5	844
615803*	13-REA	5/8	10	5	844
615812*	10	5/8	12	5	1000
615815*	10	5/8	15	5	1275
613460	10	3/4	6	5	750
613480*	10	3/4	8	5	1000
613483*	13	3/4	8	5	1000
613400*	10	3/4	10	5	1240
613412*	10	3/4	12	5	1480

613415*	10	3/4	15	5	1850
614400*	10	1	10	5	2204

** UL Listed*

Sectional Copperbonded Ground Rods

Part No.	Plating Thickness (mil)	Diameter (in)	Length (ft)	Standard Package	Weight per 100
631380*	10	FS 1/2	8	5	540
631300*	10	FS 1/2	10	5	688
635830	10	5/8	3	5	262
635840	10	5/8	4	5	344
635850	10	5/8	5	5	420
635860	10	5/8	6	5	504
635880*	10	5/8	8	5	680
635883*	13- REA	5/8	8	5	680
635800*	10	5/8	10	5	844
633480*	10	3/4	8	5	1000
633400*	10	3/4	10	5	1240
634400*	10	1	10	5	2204

** UL Listed*

Product Information - Europe Return to Top

Part Number	Description	Nominal Diameter		Length		Pack	Unit Weight (kg)
		mm	inches	m	feet		
155000	1.2M38*	9	3/8"	1.2	4	5	0.650
155010	1.5M38*	9	3/8"	1.5	5	5	0.800
155030	2.1M38*	9	3/8"	2.1	7	5	1.100
155050	3.0M38*	9	3/8"	3.0	10	5	1.600
155060	1.2M12	12.5	1/2"	1.2	4	5	0.800
155070	1.5M12	12.5	1/2"	1.5	5	5	1.150
155090	2.1M12	12.5	1/2"	2.1	7	5	1.600
155110	3.0M12	12.5	1/2"	3.0	10	5	2.300
155240	1.2M58	14.2	5/8"	1.2	4	5	1.500
155250	1.5M58	14.2	5/8"	1.5	5	5	1.900
155270	2.1M58	14.2	5/8"	2.1	7	5	2.450
155290	3.0M58	14.2	5/8"	3.0	10	5	3.750
155420	1.2M34	17.2	3/4"	1.2	4	5	2.150
155430	1.5M34	17.2	3/4"	1.5	5	5	2.750
155450	2.1M34	17.2	3/4"	2.1	7	5	3.800
155470	3.0M34	17.2	3/4"	3	10	5	5.450

* Non-Extending

Product Information - Asia & Australia Return to Top

Part No.	Nominal Diameter		Actual Diameter		Length		Pack	Master Bundle	Unit Weight (kg)
	in	mm	in	mm	feet	m			
611350	1/2"	13	0.500"	12.70	5	1.52	5	100	1.56
611360	1/2"	13	0.500"	12.70	6	1.83	5	100	2.01
611380*	1/2"	13	0.500"	12.70	8	2.44	5	100	2.50
611300*	1/2"	13	0.500"	12.70	10	3.05	5	100	3.13
615840	5/8"	15	0.561"	14.25	4	1.22	5	100	1.53
615850	5/8"	15	0.561"	14.25	5	1.52	5	100	1.91
615860	5/8"	15	0.561"	14.25	6	1.83	5	100	2.31
615880*	5/8"	15	0.561"	14.25	8	2.44	5	100	3.08
615800*	5/8"	15	0.561"	14.25	10	3.05	5	100	3.83
613460	3/4"	17	0.677"	17.20	6	1.83	5	50	3.37
613480*	3/4"	17	0.677"	17.20	8	2.44	5	50	4.55
613400*	3/4"	17	0.677"	17.20	10	3.05	5	50	5.62
614400*	1.0"	23	0.910"	23.11	10	3.05	3	25	5.74

**UL listing requires a minimum of 10 mil thickness of copper with minimum rod diameter 0.500" and a minimum of 8 feet length*

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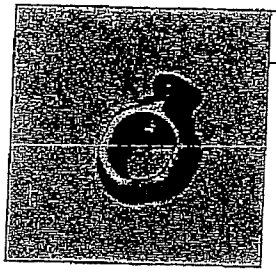


ERITECH® Ground Rod Accessories - North & Latin America

ERITECH

Where to buy Printer friendly

ERICO provides a range of accessories to complement the ERITECH ground rod product line.

Features

Ground Rod Clamps
Used for attaching ground wire to rod

Compression Couplers for Copperbonded Rods
For use with pointed copperbonded ground rods

Compression Couplers for Galvanized Rods
For use with pointed galvanized ground rods

Threaded Couplers for Copperbonded Rods
For use with sectional copperbonded ground rods

Threaded Couplers for Stainless Steel Rods
For use with sectional stainless steel ground rods

Drive Studs
Used in conjuction with threaded couplers while driving sectional ground rods

Related Products

ERITECH® Copperbonded Ground Rods

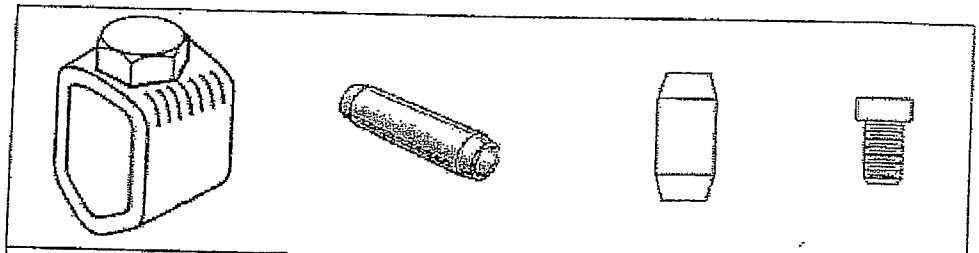
ERITECH® Stainless Steel Ground Rods - North & Latin America

Product Available In:
North America
Latin America

Applications

A range of accessories to complement ERITECH ground rods.

More Information



Ground Rod Clamps Compression Couplers Threaded Couplers Drive Studs

Ground Rod Clamps

Part No.	Description	Diameter (in)	Standard Package	Weight per 100
HDC12*	Heavy Duty, 10 Sol-2 Str	1/2	50	12

HDC58*	Heavy Duty, 8 Sol- 1/0 Str	5/8	50	13
HDC58R*	Heavy Duty, 8 Sol- 1/0 Str	5/8	50	18
HDC34*	Heavy Duty, 8 Sol- 1/0 Str	3/4	50	20
HDC34SP*	Heavy Duty, 8 Sol- 3/0 Str	3/4	50	32
HDC1*	Heavy Duty, 8 Sol- 4/0 Str	1	50	32
CP38*	Standard, 10 Sol- 4 Str	3/8	50	6
CP12*	Standard, 8 Sol- 2 Str	1/2	50	9
CP58*	Standard, 8 Sol- 2 Str	5/8	50	11
CP34*	Standard, 8 Sol- 2 Str	3/4	50	13
S58*	Galvanized, 14 Sol-1/0 Str	1/2- 5/8	50	16
S68*	Galvanized, 14 Sol-4/0 Str	5/8 - 3/4	50	20

**UL Listed*

Compression Couplers for Copperbonded Rods

Part No.	Description	Diameter (in)	Standard Package	Weight per 100
CC12F*	Compression	1/2	25	17
CC58*	Compression	5/8	25	25
CC34*	Compression	3/4	25	40

** UL Listed*

Compression Couplers for 5/8" Galvanized Rods

Part No.	Description	Diameter (in)	Standard Package	Weight per 100
GCC58	For Galv. Rods	5/8	25	31

Threaded Couplers for Copperbonded Rods

Part No.	Description	Diameter (in)	Standard Package	Weight per 100
CR12	Threaded	1/2	25	16
CR12S*	Threaded	1/2	25	17
CR58*	Threaded	5/8	25	25
CR34*	Threaded	3/4	25	40
CR100*	Threaded	1	25	85

** UL Listed*

Threaded Couplers for Stainless Steel Rods

Part No.	Description	Diameter (in)	Standard Package	Weight per 100
CR58SS	Threaded	5/8	25	25
CR34SS	Threaded	3/4	25	40

Drive Studs

Part No.	Description	Diameter (in)	Standard Package	Weight per 100
DS12	Nominal	1/2	25	15
DS12S	Full Size	FS 1/2	25	15

DS58	Nominal	5/8	25	21
DS34	Nominal	3/4	25	32
DS1	Nominal	1	25	64

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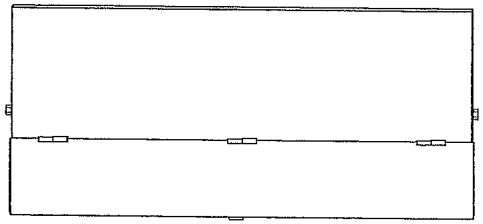
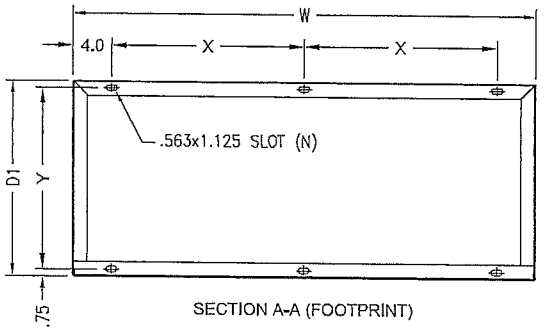
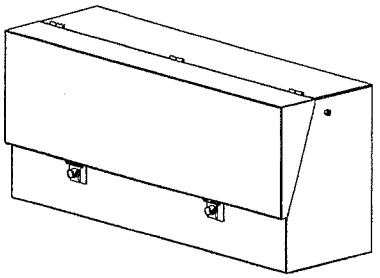
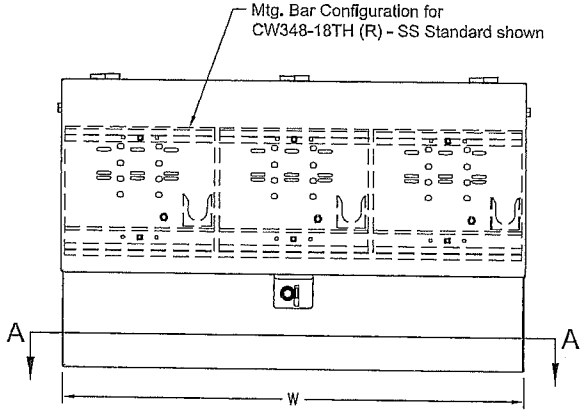


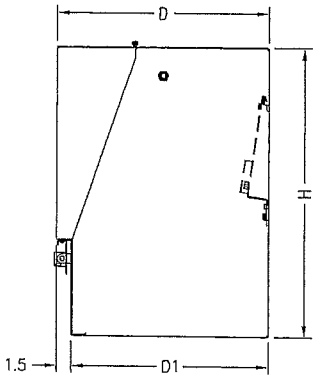


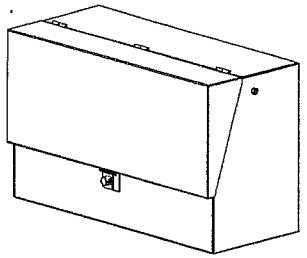
SECTION A-A (FOOTPRINT)

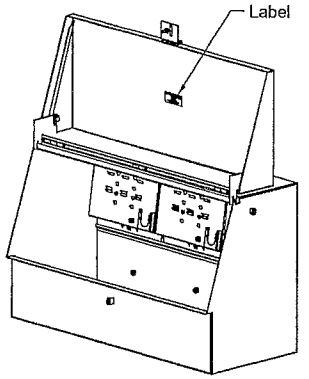


DUAL LOCK
CC366-22TH (R) - SS Standard Shown









SINGLE LOCK
CW348-18TH (R) - SS Standard Shown

Phase	Max # of Junction Points 200A 15 kV	Max # of Junction Points 200A 25 kV	Max # of Junction Points 600A 15/25 kV	# of Parking Stands/Phase	Enclosure Gauge	Dimensions Width (W)	Depth (D)	Base Depth (D1)	Height (H)	Distance (X)	Distance (Y)	# of Holes (N)	# of Locks	Catalog Number (Stainless Steel)	Trinetics Part Number
1	4	4	-	2	14	26	18	16.5	30	18	15	4	1	CW326-18TH (R) - SS Standard	63788094
						30				22	15			CW330-18TH (R) - SS Standard	63388067
3	4	3	2	1	14	48	18	16.5	30	20	15	6	1	CW348-18TH (R) - SS Standard	63488054
		4	-	2	12	60				26	15			CW360-18TH (R) - SS Standard	63488000
		4	4	1	12	66	22	20.5		29	19		2	CC366-22TH (R) - SS Standard	63488097
		4	4	1	12	78				35	19			CC378-22TH (R) - SS Standard	63588000
		4	4	1	12	84				38	19			CC384-22TH (R) - SS Standard	63488009

Notes:
1) Standard color: Munsell Green 7GY 3.29/1.5.
   Alternate materials and colors are available upon request.
2) All enclosures have a painted stainless steel junction mounting bar. Alternate available upon request.
3) Please consult the factory or your local sales representative for any requirements not listed here.

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Menomonee Falls, Wisconsin, USA
www.trinetics.com

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DATE 03/26/2012

THIRD ANGLE PROJECTION

Sectionalizing Enclosure Stainless Steel

CC & CW300-Series

Distribution Transformers

COOPER Power Systems

Electrical Apparatus

Three-Phase Pad-Mounted Compartmental Type Transformer

210-12

GENERAL

At Cooper Power Systems, we are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality, most reliable transformers. Cooper Power Systems Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. In order to drive this innovation, we have invested both time and money in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin. Headquarters for the Systems Engineering Group of Cooper Power Systems, such revolutionary products as distribution-class UltraSIL™ Polymer-Housed Evolution™ surge arresters and Envirotemp™ FR3™ fluid have been developed at our Franksville lab.

With transformer sizes ranging from 45 kVA to 12 MVA and high voltages ranging from 2400 V to 46 kV, Cooper Power Systems has you covered. From fabrication of the tanks and cabinets to winding of the cores and coils, to production of arresters, switches, tap changers, expulsion fuses, current limit fuses, bushings (live and dead) and molded rubber goods, Cooper Power Systems does it all. Cooper Power Systems transformers are available with electrical grade mineral oil or Envirotemp™ FR3™ fluid, a less-flammable and bio-degradable fluid. Electrical codes recognize the advantages of using Envirotemp™ FR3™ fluid both indoors and outdoors for fire sensitive applications. The bio-based fluid meets Occupational Safety and Health Administration (OSHA) and Section 450.23 NEC Requirements.

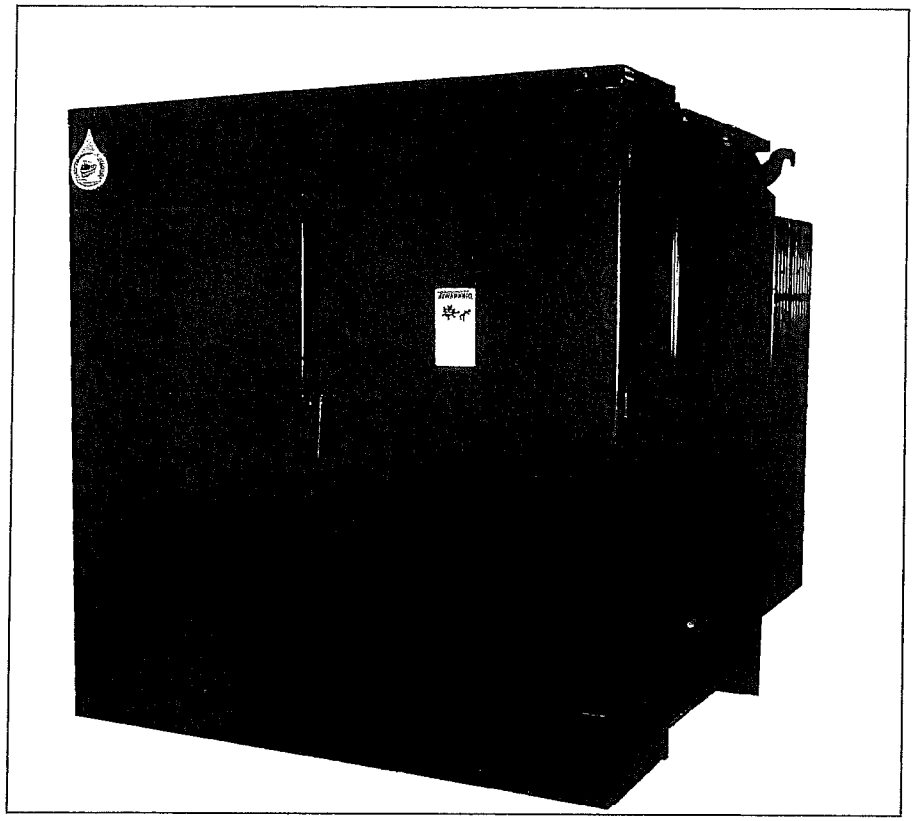


Figure 1.
Three-phase pad-mounted transformer.

PRODUCT SCOPE

Type	Three Phase, 50 or 60 Hz, 65 °C Rise (55 °C, 55 °C/65 °C)
Fluid Type	Mineral oil or Envirotemp™ FR3™ fluid
Size	45 – 12,000 kVA
Primary Voltage	2,400 – 46,000 V
Secondary Voltage	208Y/120 V to 14,400 V
Specialty Designs	Inverter/Rectifier Bridge
	K-Factor (up to K-19)
	Vacuum Fault Interrupter (VFI)
	UL Listed & Labeled and Classified
	Factory Mutual (FM) Approved
	Solar/Wind Designs
	Differential Protection
	Seismic Applications (including OSHPD)

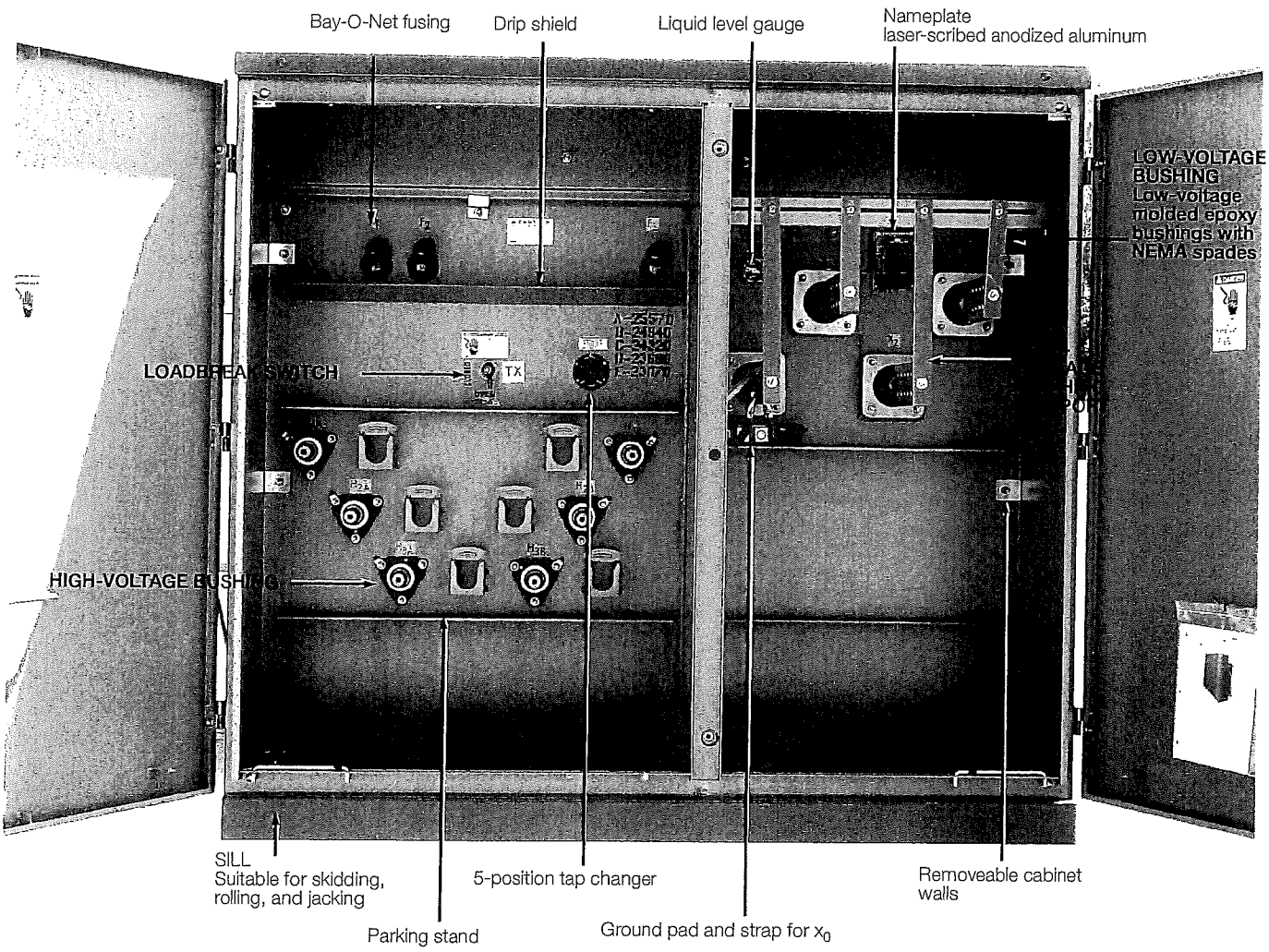


Figure 2.
Three-phase pad-mounted compartmental type transformer.

TABLE 1
Three-Phase Ratings

Three-Phase 50 or 60 Hz
kVA Available[1]: 45, 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 3750, 5000, 7500, 10000, 120000

[1]Transformers are available in the standard ratings and configurations shown or can be customized to meet specific needs.

TABLE 2
Audible Sound Levels

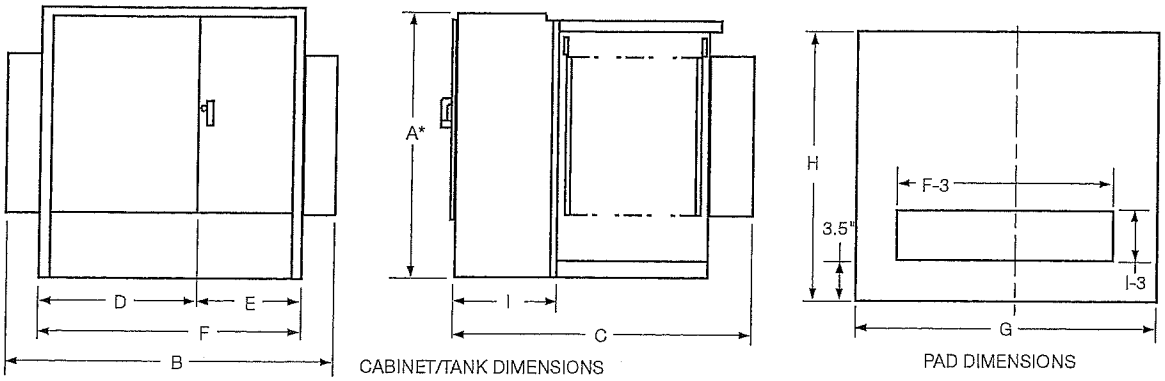
Self-Cooled, Two Winding kVA Rating	NEMA TR-1 Average Decibels (dB)
45-500	56
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001-4000	64
4001-5000	65
5001-6000	66
6001-7500	67
7501-12000	68

TABLE 3
Insulation Test Levels

KV Class	Induced Test 180 or 400 Hz 7200 Cycle	kV BIL Distribution	Applied Test 60 Hz (kV)
1.2	TWICE RATED VOLTAGE	30	10
2.5		45	15
5		60	19
8.7		75	26
15		95	34
25 (grd Y Only)		125	40
25		150	50
34.5 (grd Y Only)		125	40
34.5		150	70
46		200	95

TABLE 4
Temperature Rise Ratings 0-3300 Feet (0-1000 meters)

	Standard	Optional
Unit Rating (Temperature Rise Winding)	65 °C	55 °C, 55/65 °C
Ambient Temperature Max	40 °C	50 °C
Ambient Temperature 24 Hour Average	30 °C	40 °C
Temperature Rise Hotspot	80 °C	65 °C



CABINET/TANK DIMENSIONS

PAD DIMENSIONS

Figure 3.
Transformer and pad dimensions.

* Add 9" for Bay-O-Net fusing.

TABLE 5
Fluid-filled–aluminum windings 55/65 °C Rise1

65° Rise	DEAD-FRONT–LOOP OR RADIAL FEED–BAY-O-NET FUSING OIL FILLED–ALUMINUM WINDINGS										
	OUTLINE DIMENSIONS (in.)									Gallons of Fluid	Approx. Total Weight (lbs.)
kVA Rating	A*	B	C	D	E	F	G	H	I		
45	50	68	39	42	26	68	72	43	20	110	2,100
75	50	68	39	42	26	68	72	43	20	115	2,250
112.5	50	68	49	42	26	68	72	53	20	120	2,350
150	50	68	49	42	26	68	72	53	20	125	2,700
225	50	72	51	42	30	72	76	55	20	140	3,150
300	50	72	51	42	30	72	76	55	20	160	3,650
500	50	89	53	42	30	72	93	57	20	190	4,650
750	64	89	57	42	30	72	93	61	20	270	6,500
1000	64	89	59	42	30	72	93	63	20	350	8,200
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	490	12,500
2500	73	72	99	42	30	72	76	103	24	530	14,500
3000	73	84	99	46	37	84	88	103	24	620	16,700
3750	84	85	108	47	38	85	88	112	24	660	19,300
5000	84	96	108	48	48	96	100	112	24	930	25,000
7500	94	102	122	54	48	102	100	126	24	1,580	41,900

1 Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Cooper Power Systems for exact dimensions.
* Add 9" for Bay-O-Net fusing.

TABLE 6
Fluid-Filled–Copper Windings 55/65 °C Rise1

65° Rise	DEAD-FRONT–LOOP OR RADIAL FEED–BAY-O-NET FUSING OIL FILLED–COPPER WINDINGS										
	OUTLINE DIMENSIONS (in.)									Gallons of Fluid	Approx. Total Weight (lbs.)
kVA Rating	A*	B	C	D	E	F	G	H	I		
45	50	64	39	34	30	64	69	43	20	110	2,100
75	50	64	39	34	30	64	69	43	20	115	2,350
112.5	50	64	49	34	30	64	69	53	20	115	2,500
150	50	64	49	34	30	64	69	53	20	120	2,700
225	50	64	51	34	30	64	73	55	20	140	3,250
300	50	64	51	34	30	64	75	55	20	160	3,800
500	50	81	53	34	30	64	85	57	20	200	4,800
750	64	89	57	42	30	72	93	61	20	255	6,500
1000	64	89	59	42	30	72	93	63	20	300	7,800
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	420	11,600
2500	73	72	99	42	30	72	76	103	24	500	14,000
3000	73	84	99	46	37	84	88	103	24	720	18,700
3750	84	85	108	47	38	85	88	112	24	800	20,500
5000	84	96	108	48	48	96	100	112	24	850	25,000
7500	94	102	122	54	48	102	100	126	24	1,620	46,900

1 Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Cooper Power Systems for exact dimensions.
* Add 9" for Bay-O-Net fusing.

STANDARD FEATURES

Connections and Neutral Configurations

- Delta - Wye: Low voltage neutral shall be a fully insulated X0 bushing with removable ground strap.
- Grounded Wye-Wye: High voltage neutral shall be internally tied to the low voltage neutral and brought out as the H0X0 bushing in the secondary compartment with a removable ground strap.
- Delta-Delta: Transformer shall be provided without a neutral bushing.
- Wye-Wye: High voltage neutral shall be brought out as the H0 bushing in the primary compartment and the low voltage neutral shall be brought as the X0- bushing in the secondary compartment.
- Wye-Delta: High voltage neutral shall be brought out as the H0 bushing in the primary compartment. No ground strap shall be provided (line to line rated fusing is required).

High and Low Voltage Bushings

- 200 A bushing wells (15, 25, 35 kV)
- 200 A, 35 kV Large Interface
- 600 A (15, 25, 35 kV) Integral bushings (dead-front)
- Electrical-grade wet-process porcelain bushings (live-front)

Tank/Cabinet Features

- Bolted cover for tank access (45-1750 kVA)
- Welded cover with hand hole (2000-12,000 kVA)
- Three-point latching door for security
- Removable sill for easy installation
- Lifting lugs (4)
- Stainless steel cabinet hinges and mounting studs
- Steel divider between HV and LV compartment
- 20" Deep cabinet (45-1000 kVA)
- 24" Deep cabinet (1500-7500 kVA)
- 30" Deep cabinet (34.5/19.92 kV)
- Pentahead Captive Bolt
- Stainless steel 1-hole ground pads (45-500 kVA)
- Stainless steel 2-hole ground pads (750-10,000 kVA)
- Parking Stands

Valves/Plugs

- One-inch upper filling plug
- One-inch drain plug (45-500 kVA)
- One-inch combination drain valve with sampling device in low voltage compartment (750-12,000 kVA)
- Automatic pressure relief valve

Nameplate

- Laser-scribed anodized aluminum Nameplate

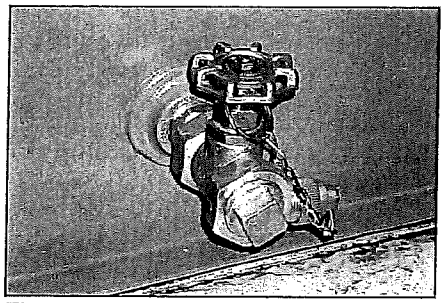


Figure 4.
Drain valve with sampler.

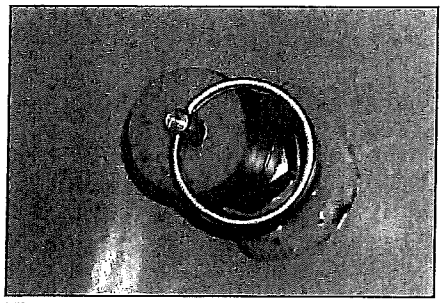


Figure 5.
Automatic Pressure relief valve.

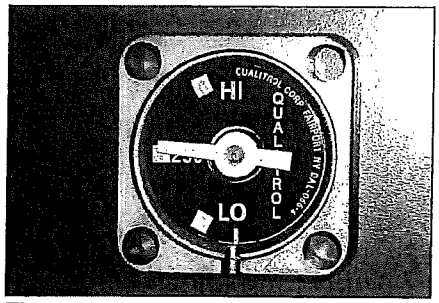


Figure 6.
Liquid level gauge.

OPTIONAL FEATURES

High and Low Voltage Bushings

- 200 A (15, 25 kV) bushing inserts
- 200 A (15, 25 kV) feed thru inserts
- 200 A (15, 25 kV) (HTN) bushing wells with removable studs
- High-voltage 600 A (15, 25, 35 kV) deadbreak one-piece bushings
- Low voltage 6-, 8-holes spade
- Low voltage 12-, 16-, 20-holes spade (750-2500 kVA)
- Low voltage bushing supports

Tank/Cabinet Features

- Stainless steel tank base and cabinet
- Stainless steel tank base, cabinet sides and sill
- 100% Stainless Steel Unit
- Service entrance (2 inch) in sill or cabinet side
- Touch-up paint (domestic)
- Copper Ground Bus Bar
- Kirk-Key Provisions
- Nitrogen Blanket
- Bus duct cutout

Special Designs

- Factory Mutual (FM)
- UL Classified
- Triplex
- High altitude
- K-Factors
- Step-up
- Critical Application
- Modulation Transformers
- Seismic Applications (including OSHPD)

Switches

- One, two, or three On/Off loadbreak switches
- 4-position loadbreak V-blade switch or T-blade switch
- Delta-wye switch
- 3-Position V-Blade selector switch
- 100 A, 150 A, 300 A Tap Changers
- Dual voltage switch

Gauges and Devices

- Liquid level gauge (Optional Contacts)
- Pressure vacuum gauge (Optional Contacts and Bleeder)
- Dial-type thermometer (Optional Alarm Contacts)
- Cover mounted pressure relief device
- Ground connectors
- Hexhead captive bolt
- Breaker mounting provisions

Overcurrent Protection

- Bay-O-Net fusing (Current sensing, dual sensing, dual element, high amperage overload)
- Bay-O-Net expulsion fuse in series with a partial range under-oil ELSP current limiting fuse (below 23 kV)
- Cartridge fusing in series with a partial range under-oil ELSP current limiting fuse (above 23 kV)
- MagneX™ Interrupter with ELSP current limiting fuse
- Vacuum Fault Interrupter (VFI)
- Visible Break Window
- Fuse/switch interlock

Valves/Plugs

- Drain/sampling valve in high-voltage compartment
- Globe type upper fill valve

Overvoltage Protection

- Distribution-, Intermediate-, or Station-class surge arresters
- Elbow arresters (for dead-front connections)

Metering/Fan/Control

- Full metering package
- Current Transformers (CTs)
- Metering Socket
- NEMA 4 Control Box (Optional Stainless Steel)
- NEMA 7 Control Box (Explosion Proof)
- Fan Packages

Testing

- Customer Test Witness
- Customer Final Inspection
- Zero Sequence Impedance Test
- Heat Run Test
- ANSI Impulse Test
- Audible Sound Level Test
- RIV (Corona) Test
- Dissolved Gas Analysis (DGA) Test
- 8- or 24-Hour Leak Test

Coatings (Paint)

- ANSI Bell Green
- ANSI #61 Light Gray
- ANSI #70 Sky Gray
- Special paint available per request

Nameplate

- Stainless Steel Nameplate

Decals and Labels

- High voltage warning signs
- Mr. Ouch
- Bi-lingual Warning
- DOE Compliant
- Customer stock code
- Customer stenciling
- Shock and Arc Flash Warning Decal
- Non-PCB Decal

CONSTRUCTION

Core

The three-legged, step-lap mitered core construction is manufactured using a high-quality cutting machine. For maximum efficiency, cores are precisely stacked, virtually eliminating gaps in the corner joints.

Five-legged wound core or shell-type triplex designs are used for wye-wye connected transformers, and other special transformer designs.

Cores are manufactured with precision cut, burr-free, grain-oriented silicon steel. Many grades of core steel are available for optimizing core loss efficiency.

Coils

Pad-mounted transformers feature a rectangular coil configuration with wire-wound, high-voltage primaries and sheet-wound secondaries. The design minimizes axial stress developed by short circuits and provides for magnetic balancing of tap connections.

Coils are wound using the highest quality winding machines providing exacting tension control and conductor placement for superior short-circuit strength and maximum efficiency.

Extra mechanical strength is provided by diamond pattern, epoxy-coated paper insulation, used throughout the coil, with additional epoxy at heavy stress points. The diamond pattern distribution of the epoxy and carefully arranged ducts, provide a network of passages through which cooling fluid can freely circulate.

Coil assemblies are heat-cured under calculated hydraulic pressure to ensure performance against short-circuit forces.

Core and Coil Assemblies

Pad-mounted transformer core and coil assemblies are braced with heavy steel ends to prevent the rectangular coil from distorting under short-circuit conditions. Plates are clamped in place using presses, and welded or bolted to form a solid core and coil assembly. Core and coil assemblies exceed ANSI/IEEE requirements for short-circuit performance. Due to the rigidity of the design, impedance shift after short-circuit is comparable to that of circular wound assemblies.

Tanks

Transformer tanks are designed for high strength and ease of handling, installation, and maintenance. Tanks are welded using precision-cut, hot rolled, pickled and oiled steel. They are sealed to protect the insulating fluid and other internal components.

Transformer tanks are pressure-tested to withstand 7 psig without permanent distortion and 15 psig without rupture.

Tank Finish

An advanced multi-stage finishing process exceeds IEEE Std C57.12.28™ standards. The eight-stage pre-treatment process assures coating adhesion and retards corrosion. It converts tank surfaces to a nonmetallic, water insoluble iron phosphate coating.

The paint method consists of two distinct layers of paint. The first is an epoxy primer (E-coat) layer which provides a barrier against moisture, salt and corrosives. The two-component urethane final coat seals and adds ultraviolet protection.

Vacuum Processing

Transformers are dried and filled with filtered insulating fluid under vacuum, while secondary windings are energized. Coils are heated to drive out moisture, ensuring maximum penetration of fluid into the coil insulation system.

Insulating Fluid

Transformers from Cooper Power Systems are available with electrical-grade mineral insulating oil or Envirotemp™ FR3™ fluid. The highly refined fluids are tested and degassed to assure a chemically inert product with minimal acid ions. Special additives minimize oxygen absorption and inhibit oxidation. To ensure high dielectric strength, the fluid is re-tested for dryness and dielectric strength, refiltered, heated, dried, and stored under vacuum before being added to the completed transformer.

Cooper Power Systems transformers filled with Envirotemp™ FR3™ fluid enjoy unique fire safety, environmental, electrical, and chemical advantages, including insulation life extending properties.

A bio-based, sustainable, natural ester dielectric coolant, Envirotemp™ FR3™ fluid quickly and thoroughly biodegrades in the environment and is non-toxic per acute aquatic and oral toxicity tests.

Building for Environmental and Economic Sustainability (BEES) total life cycle assessment software, utilized by the US Dept. of Commerce, reports its overall environmental performance impact score at 1/4th that reported for mineral oil. Envirotemp™ FR3™ fluid has also earned the EPA Environmental Technology Verification of transformer materials.

With a fire point of 360 °C, Envirotemp™ FR3™ fluid is FM Approved and Underwriters Laboratories Classified "Less-Flammable" per NEC Article 450-23, fitting the definition of a Listed Product per NEC.

Pad-Mounted VFI Transformer

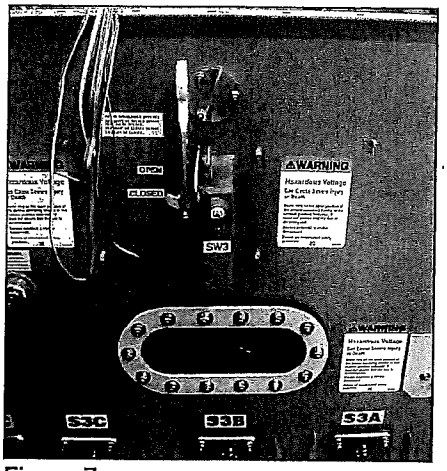


Figure 7.
VFI transformer with visible break.

The VFI transformer combines a conventional distribution transformer from Cooper Power Systems with the proven Vacuum Fault Interrupter (VFI). This combination provides both voltage transformation and transformer over current protection in one space saving and money saving package. The pad-mounted VFI transformer protects the transformer and provides proper coordination with upstream protective devices. When a transformer fault or overload condition occurs, the VFI breaker trips and isolates the transformer.

The three-phase VFI breaker has independent single-phase initiation, but is three-phase mechanically gang-tripped. A trip signal on any phase will open all three phases. This feature eliminates single-phasing of three phase loads. It also enables the VFI breaker to be used as a three-phase load break switch.

Due to the resettable characteristics of the VFI breaker, restoring three-phase service is faster and easier.

The sealed visible break window and switch is an option that can be installed to provide visible break contact. This feature provides enhanced safety and allows an operator to see if the loadbreak switch contacts are in an open or closed position before performing maintenance.

Envirotran™ FM Approved Special Protection Transformer

The Envirotran™ transformer from Cooper Power Systems is FM Approved and suitable for indoor locations. Factory Mutual Research Corporation's (FMRC) approval of the Envirotran transformer line makes it easy to comply with and verify compliance with Section 450.23, 2008 NEC, Less-Flammable Liquid-Filled Transformer Requirements for both indoor and outdoor locations.

Envirotran FM Approved transformers offer the user the benefit of a transformer that can be easily specified to comply with NEC, and makes FM Safety Data Sheet compliance simpler, while also providing maximum safety and flexibility for both indoor and outdoor installations.

Because the "FM Approved" logo is readily visible on the transformer and its nameplate, NEC compliance is now easily verifiable by the inspector.

Envirotran FM Approved transformers are manufactured under strict compliance with FMRC Standard 3990 and are filled with FM Approved Envirotemp™ FR3™ fluid, a fire-resistant dielectric coolant.

SPECIAL APPLICATION TRANSFORMERS

Data Center Transformer

With focus rapidly shifting from simply maximizing uptime and supporting demand to improving energy utilization, the data center industry is continually looking for methods to increase its energy efficiency and reliability. Utilizing cutting edge technology, Cooper Power Systems Hardened Data Center (HDC) transformers are the solution. Designed with special attention given to surge protection, HDC liquid-filled transformers provide superior performance under the harshest electrical environments. Contrary to traditional dry-type units, HDC transformers provide unsurpassed reliability, overloadability, operational life, efficiency, thermal loading and installed footprint. These Cooper Power Systems units have reliably served more than 750 MW of critical data center capacity for a total of more than 4,000,000 hours without an hour of downtime.

The top priority in data center operations is uninterrupted service. Envirotran HDC transformers from Cooper Power Systems, having substantially higher levels of insulation, are less susceptible to voltage surges. Cooper Power Systems has experienced zero failures due to switching transients. The ANSI/IEEE standard impulse withstand ratings are higher for liquid-filled transformers, making them less susceptible to insulation failure. The Envirotran HDC transformer provides ultimate protection by increasing the BIL rating one level higher than standard liquid-filled transformer ratings. The cooling system of liquid-filled transformers provides better protection from severe overloads—overloads that can lead to significant loss of life or failure.

Data center design typically includes multiple layers of redundancy, ensuring maximum uptime for the critical IT load. When best in class transformer manufacturing lead times are typically weeks, not days, an unexpected transformer failure will adversely affect the facility's reliability and profitability. Therefore, the ability to determine the electrical and mechanical health of a transformer can reduce the probability of costly, unplanned downtime. Routine diagnostic tests, including key fluid properties and dissolved gas analysis (DGA), can help determine the health of a liquid-filled transformer. Although sampling is not required for safe operation, it will provide the user with valuable information, leading to scheduled repair or replacement, and minimizing the duration and expense of an outage. With a dry-type transformer, there is no reliable way to measure the health or likelihood of an impending failure.

Solar Transformer

As a result of the increasing number of states that are adopting aggressive Renewable & Alternative Energy Portfolio Standards, the solar energy market is growing—nearly doubling year over year. Cooper Power Systems, a key innovator and supplier in this expanding market, is proud to offer Envirotran transformers specifically designed for Solar Photovoltaic medium-voltage applications. Cooper Power Systems is working with top solar photovoltaic developers, integrators and inverter manufacturers to evolve the industry and change the way we distribute power.

In accordance with this progressive stance, every Cooper Power Systems Envirotran Solar transformer is filled with non-toxic, biodegradable Envirotemp™ FR3™ dielectric fluid, made from renewable seed oils. On-top of its biodegradability, Envirotemp™ FR3™ fluid substantially extends the life of the transformer insulation, saving valuable resources. What better way to distribute green power than to use a green transformer. In fact, delaying conversion to Envirotran transformers places the burden of today's environmental issues onto tomorrow's generations. Cooper Power Systems can help you create a customized transformer, based on site specific characteristics including: temperature profile, site altitude, solar profile and required system life. Some of the benefits gained from this custom rating include:

- Reduction in core losses
- Improved payback on investment
- Reduction in footprint
- Improved fire safety
- Reduced environmental impact

For the solar photovoltaic industry, Cooper Power Systems is offering standard step up transformers and dual secondary designs.

Wind Transformer

Cooper Power Systems is offering custom designs for renewable energy power generation. Cooper Power Systems manufactures Generator Step-Up (GSU) transformers for installation at the base of every wind turbine. Additionally, grounding transformers are available for wind power generation.

DOE Efficiency

The United States Department of Energy (DOE) has mandated efficiency values for most liquid type, medium voltage transformers. As a result, all applicable Cooper Power Systems transformers are designed to meet or exceed the standard efficiency values per DOE 2010; Final Ruling, 10 CFR Part 431.

Underwriters Laboratories® (UL®) Listed and Labeled/ Classified

The Envirotran transformer from Cooper Power Systems can be specified as UL Listed & Labeled, and/ or UL Classified. Underwriters Laboratories (UL) listing is a verification of the design and construction of the transformer to the ANSI/IEEE standards. UL listing generally is the most efficient, cost-effective solution for complying with relevant state and local electrical codes. UL Combination Classification/Listing is another way in which to comply with Section 450.23, 2008 NEC requirements. This combines the UL listed transformer with a UL Classified Less-Flammable Liquid and complies with the use restrictions found within the liquid Classification.

K-Factor Transformer

With a drastic increase in the use of ferromagnetic devices, arcing devices, and electric power converters, higher frequency loads have increased significantly. This harmonic loading has the potential to generate higher heat levels within a transformer's windings and leads by as much as 300%. Harmonic loading has the potential to induce premature failure in standard-design distribution transformers.

In addition to standard UL "K-Factor" ratings, transformers can be designed to customer-provided specifications detailing precise loading scenarios. Onsite measurements of magnitude and frequency, alongside harmonic analysis of the connected load can be performed by Cooper Power Systems engineers or a third party consultant. These field measurements are used to determine exact customer needs and outline the transformer specifications.

Cooper Power Systems will design harmonic-resistant transformers that will be subjected to the unique harmonic loads. These units are designed to maintain normal temperature rise under harmonic, full-load conditions. Standard UL "K-Factor" designs can result in unnecessary costs when the "next-highest" K-Factor must be selected for a calculated design factor. To save the customer these unnecessary costs, Cooper Power Systems can design the transformer to the specific harmonic spectrum used in the application. K-factor transformers from Cooper Power Systems are filled with mineral oil or Envirotemp™ FR3™ fluid and enjoy the added benefits of dielectric cooling such as higher efficiencies than dry-type transformers.

Modulation Transformer

Bundled with an Outboard Modulation Unit (OMU) and a Control and Receiving Unit (CRU), a Modulation Transformer Unit (MTU) is designed to remotely achieve two way communication.

The use of an MTU reduces travel time and expense versus traditional meter reading performed by high voltage electricians. Additionally, with MTU it is possible to manage and evaluate energy consumption data, providing reduced metering costs and fewer tenant complaints.

An MTU utilizes existing utility infrastructure, therefore eliminating the need to engineer and construct a dedicated communication network.

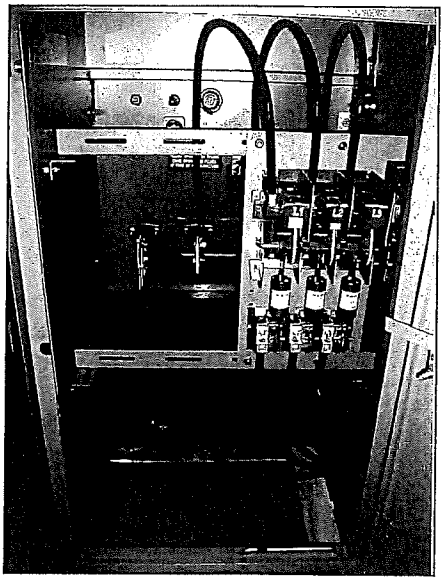


Figure 8.
Modular transformer.

Inverter/Rectifier Bridge

Cooper Power Systems complements its range of applications for transformers by offering dual winding designs. These designs are intended for connection to 12-pulse rectifier bridges.

PRODUCT ATTRIBUTES

To set us apart from other transformer manufactures, Cooper Power Systems includes the following guarantees with every three-phase pad-mounted transformer.

Engineered to Order (ETO)

Providing the customer with a well developed, cost-effective solution is the number one priority at Cooper Power Systems. Using customer specifications, Cooper Power Systems will work with the customer from the beginning to the end to develop a solution to fit their needs. Whether it is application specific, site specific, or a uniquely specified unit, Cooper Power Systems will provide transformers with the best in class value and performance, saving the customer time and money.

Made in the U.S.A.

Cooper Power Systems three-phase pad-mounted transformers are produced right here in the United States of America. Our manufacturing facilities are positioned strategically for rapid shipment of products. Furthermore, should the need arise, Cooper Power Systems has a broad network of authorized service repair shops throughout the United States.

Superior Paint Performance

Protecting transformers from nature's elements worldwide, Cooper Power Systems E-coat system provides unrivaled transformer paint life, and exceeds ANSI standards C57.12.28 and C57.12.29. In addition to the outside of the unit, each transformer receives a gray E-coat covering in the interior of the tank and cabinet, providing superior rust resistance and greater visibility during service.

If the wide range of standard paint selections does not suit the customer's needs, Cooper Power Systems will customize the paint color to meet their requirements.

Rectangular Coil Design

Cooper Power Systems utilizes a rectangular coil design. This winding technique results in a smaller overall unit footprint as well as reducing the transformer weight. The smaller unit size does not hinder the transformer performance in the least. Units have proven short circuit withstand capabilities up to 12 MVA.

TESTING

Cooper Power Systems performs routing testing on each transformer manufactured including the following tests:

- Insulation Power Factor: This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- Ratio, Polarity, and Phase Relation: Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- Resistance: This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- Applied Potential: Applied to both high-voltage and low-voltage windings, this test stresses the entire insulation system to verify all live-to-ground clearances.
- Induced Potential: 3.46 times normal plus 1000 volts for reduced neutral designs.
- Loss Test: These design verification tests are conducted to assure that guaranteed loss values are met and that test values are within design tolerances. Tests include no-load loss and excitation current along with impedance voltage and load loss.
- Leak Test: Pressurizing the tank to 7 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or fluid oxidation.

Design Performance Tests

The design performance tests include the following:

- Temperature Rise: Our automated heat run facility ensures that any design changes meet ANSI/IEEE temperature rise criteria.
- Audible Sound Level: Ensures compliance with NEMA requirements.
- Lightning Impulse: To assure superior dielectric performance, this test consists of one reduced wave, two chopped waves and one full wave in sequence, precisely simulating the harshest conditions.

THOMAS A EDISON RESEARCH AND TEST FACILITY

We are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality transformer for the lowest cost. Cooper Power Systems Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. We have invested millions of dollars in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin affirming our dedication to introducing new innovations and technologies to the transformer industry. Headquarters for the Systems Engineering group of Cooper Power Systems, this research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.

c UL us LISTED

FM APPROVED

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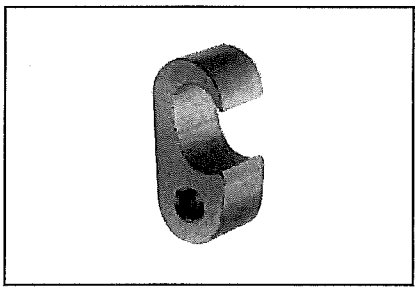
COOPER Power Systems

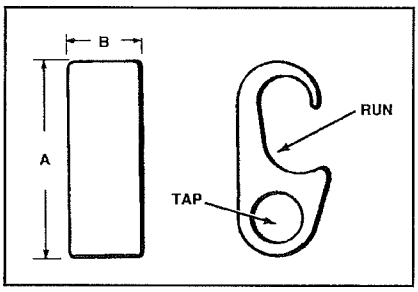
2300 Badger Drive
Waukesha, WI 53188

TYPE YGHP-C

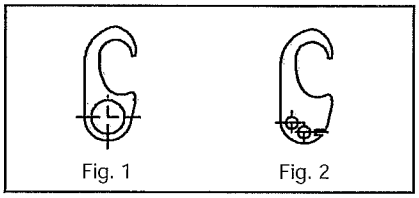
HYTAP™ CONNECTOR

Irreversible compression ground tap figure 6 can be used as a tap connector or as a tap splice connector. Four die sets and eight connectors can accommodate a conductor range from #8 solid through 500 kcmil plus 1/2", 5/8", and 3/4" copper bonded ground rods. UL467 Listed. Acceptable for direct burial in earth and concrete. Prefilled with PENETROX™ compound and strip sealed.





UL96 Listed for Lightning Protection.



IEEE-837 UL 467 96 CSA DIRECT BURIAL

CATALOG NUMBER	FIG. NO.	ACCOMMODATES RUN	ACCOMMODATES TAP	⑤ CABLE TO REBAR RUN	⑤ CABLE TO REBAR TAP	B	DIE INDEX NO.	INSTALLATION DATA Y750/Y35 Y39 HYPRESS™	INSTALLATION DATA PAT750-18V	INSTALLATION DATA ③ Y45 HYPRESS™	INSTALLATION DATA ④ Y46 HYPRESS™	NO. OF CRIMPS
YGHP2C2	1	#6 SOL. (0.162) {59500} – #2 STR. (0.292) {59500}	① #6 SOL. (0.162) {#2 STR.} – #2 STR. (0.292) {#2 STR.}	—	—	.75 [19]	0	U0	U0	U0	U0	1
YGHP2C6W6W⑧	2	#6 SOL. (0.162) – #2 STR. (0.292)	#8 SOL. (0.128) – 6 STR. (0.184) QTY. 2	—	—							
YGHP29C6W6W⑧	2	1/0 STR. (0.372) {98500} – 250 kcmil (0.575) {131500} 1/2" – 5/8" ROD	#8 SOL. (0.128) – 6 STR. (0.184) QTY. 2	#3 REBAR 3/8 THRU 1/2 #4 REBAR	#8 SOL. – 6 STR.		997	U997	⑦ U997P	U997	U997	1
YGHP29C2	1		#4 SOL. (0.204) {#4 SOL.} – #2 STR. (0.292) {#2 STR.}		#2 STR.							
YGHP29C26	1		1/0 STR. (0.372) {98500} – 2/0 STR. (0.419) {98500}		1/0 STR. – 2/0 STR.							
YGHP29C29 ②	1		3/0 STR. (0.470) {131500} – 250 kcmil (0.575) {211500}		3/0 STR. – 250 kcmil							
YGHP34C2 ⑥	1	250 kcmil (0.575) {250 kcmil} – 500 kcmil (0.813) {500 kcmil} 5/8" – 3/4" ROD	#4 SOL. (0.204) – #2 STR. (0.292)	#5 REBAR 5/8 THRU 3/4 #6 REBAR	—		998	PU998	PU998	PU998 or S998	PU998 or P998	1
YGHP34C26 ⑥	1		1/0 STR. (0.372) {98500} – 2/0 STR. (0.419) {98500}		1/0 STR. – 2/0 STR.							
YGHP34C29 ⑥	1		3/0 STR. (0.470) {131500} – 250 kcmil (0.575) {211500}		3/0 STR. – 250 kcmil							
YGHP34C34 ⑥	1	250 kcmil (0.575) – 500 kcmil (0.813) 5/8" – 3/4" ROD	350 kcmil (0.681) – 500 kcmil (0.843)		350 kcmil – 500 kcmil	1.10 [28]	1011	⑥U1011	U1011	S1011	P1011	3

Dimensions in brackets { } represent lightning protection conductors.

NOTES:

① When using #6 SOL. in tap, fold conductor double to improve fill in YGHP2C2.
② For YGHP29C29 when using 3/0 in tap, minimum run conductor is 2/0 STR.
③ Where a 'U' or 'PU' die is recommended with the Y45 HYPRESS™, a PT6515 adapter must be used.
④ Where a 'U' or 'PU' die is recommended with the Y45 HYPRESS™, a P-UADP-1 adapter must be used.
⑤ Clean rust and protective coatings from rebar before connector installation to provide a proper ground connection. Precrimping is not required.
⑥ These connectors can only be installed using the Y750, Y45 or Y46 HYPRESS™ with the recommended dies. These connectors can not be installed with the Y35 and Y39 HYPRESS™.
⑦ Polarized die for the PAT750-18V.
⑧ Not UL96/CSA.

GROUND ROD DIA.	PRECRIMP DIES	
1/2"	UPRECRIMP 12	U2CABT
5/8"	UPRECRIMP 58	
3/4"	UPRECRIMP 34	

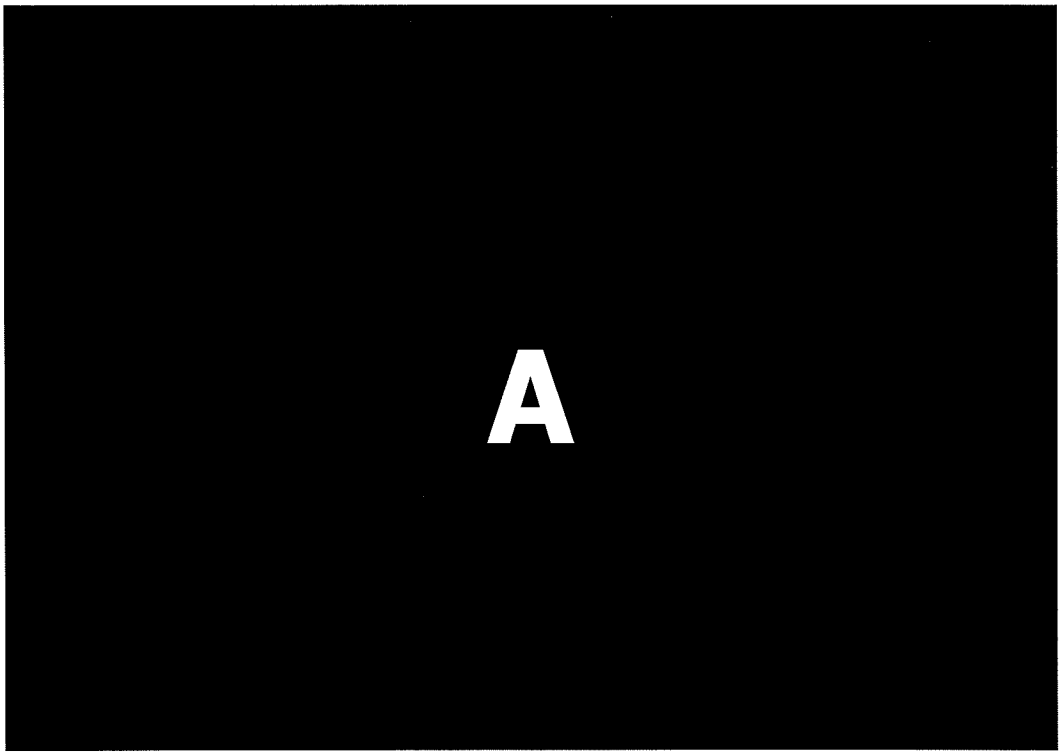
For increased rotational resistance on ground rods, pre-crimp ground rod with U2CABT die Index 348 or uprecrimp dies may be used for even greater rotation and vibration resistance on ground rods.

CABLE TO GROUND ROD
CABLE TO REBAR
CABLE TO CABLE
FOR CONCRETE ENCASED ELECTRODE GROUNDING APPLICATIONS

Throughout the catalog you will notice blue highlighted items. These are the most frequently ordered BURNDY® Products.

ATTACHMENTS

DESIGN REVIEW RESPONSES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DESIGN COORDINATION AND REVIEW COMMENTS			JOB ORDER NO.
COMMENTS BY Philip Smith	CODE 228	PHONE (757) 824.1363	DATE 8/28/12
PROJECT TITLE AND LOCATION **Design for North Island Feeder and Communications Upgrades**			**TYPE OF REVIEW** X 30% 60% FINAL OTHER (Draft)

DWG. NO. OR PAR NO.	COMMENTS (MAKE GENERAL COMMENTS AFTER SPECIFIC COMMENTS)	ACTION TAKEN (& REASONS WHERE SIGNIFICANT)
POL	Project also involves designing (and installing) the second source tie into the existing switches.	Proposed one line diagrams have been added, POL-1 thru POL-4, to indicate second source tie to each switch.
POL	One end of the loop needs to be landed on the NASA West bus.	All proposed one line diagrams have been revised to show split between east and west feed.
POL	For clarity, consider leaving the unaffected branch circuits (i.e. Pad0A and South Loop, and NAVY) off the drawing or graying out. This would provide space to draw the north loop with loads in the center of the loop.	Separate one line diagrams have been added to allow for all loads located in the center of the loop
EOL	Need to add the new trident switch into the circuit on feed out of G/S WI16 to S/S WI 17.	Trident switch has been added to the existing one line diagram
PCP and PE drawings	Consider calling out new work by bolding or contrasting with background layers for clarity.	Background has been shaded light grey to allow for all new work to be shown black.
PCP-1	Connection to existing in X-141 must be clarified. Is the contractor to pull feeders into spare conduits upstream of the first switch and primary junction enclosures?	New underground electric callouts have been added into X-141. Construction notes this sheet indicate using spare conduits currently available.
PCP and PE sheets, POL	Apply naming to each new primary junction enclosure as well as switchgear. Ensure naming or numbering is displayed and coordinated between site plans and single line drawings.	Nomenclature has been added to each switch, primary junction, and transformer. Primary junctions were numbered as NE-J1 and NW-J1 to indicate northeast and northwest feeder and subquentially numbered thereafter.
PCP-1	Why move X-075 from the South Loop to the North Loop?	Transformer for X-075 was moved to the south loop to make the causeway the division line between the north and south feed. During the 30% design review meeting it was decided to leave as shown on the prints.
PCP-1	Likely cross the road to the east to pick up the X-079 switch that is not shown on the drawing. The switch feeding X-079 is located on the east side of the road across from the SE corner of the building.	Primary electric has been moved to the east side of the road.

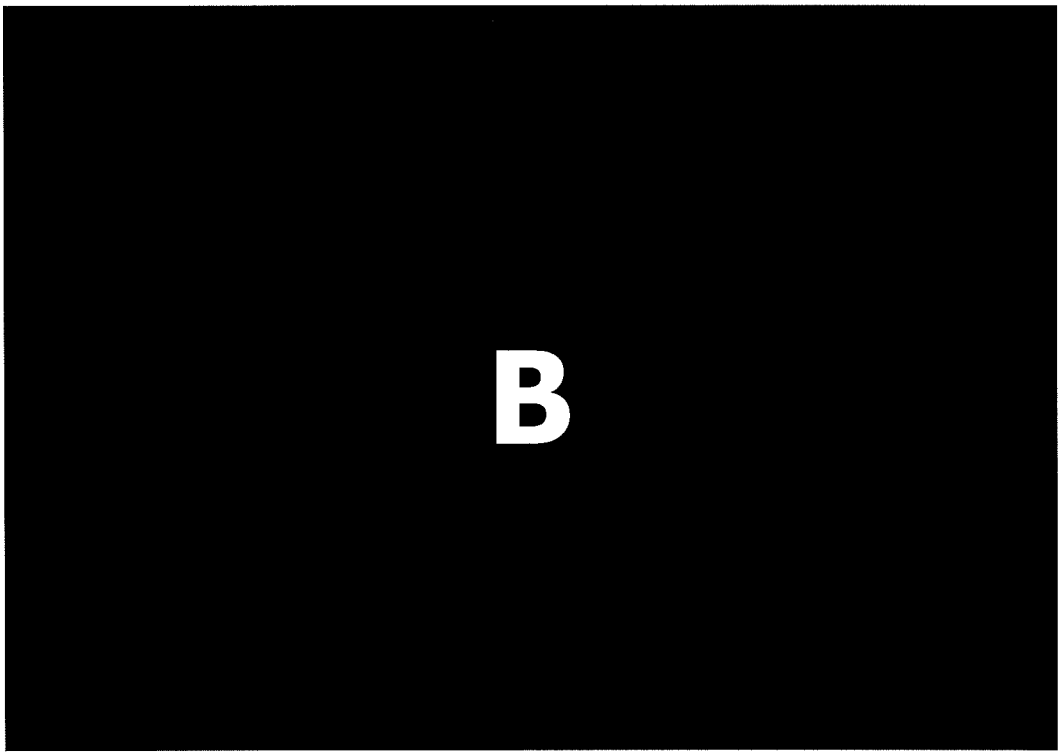
PCP-2	Likley route on east side of road to eliminate road crossing to pick up the switch feeding the met tower (G/S Met). Same for G/S WI 13 feeding W-065.	Primary electric has been moved to the east side of the road.
PCP general	Distance between pull points varies from 350'-700'+. Please provide the pulling tension calculations that will support the distance between enclosures.	Distances between pull points have been revised to be roughly 500' between junctions. See documentation for cable pulling calculations.
Legend and symbols	-Is there linework for new communications? -Readers cannot differentiate between lines in black and white. -Eliminate sybmbols and linework that are not utilized in the drawings -Eliminate all reference to overhead electric -Symbol for underground pad mounted transformer is used on PCP sheets. We shouldn't have any of these. -Some symbols are identical for different items (i.e. 'H', 'J', and 'T'.	Communication cable and size have not been called out in this set. Wallops communication department still to provide cable type to be used. Overhead electric has been removed. Underground pad mounted transformers are to be installed as part of this project. See comment below.
PCP-3,4	Why route on west of road when existing switches are on the east? Wouldn't this eliminate road crossings?	Primary electric has been moved to the east side of the road.
PCP-3, 4	Buildings W-022, W-050, W-057 Tower, W-015, and W-010 are currently fed from the secondary of the W-020 service. This collection of buildings needs to come off of the W-020 service. Please evaluate placement of switchgear and add necessary pad mounted transformers to accommodate.	New transformers have been added for buildings W-10, W-40, W-50. It was discussed at the 30% design review to leave building W-022 currently as is.
PCP-5,6	Adjust layout to bring proposed switchgear into view on one sheet or the other.	Proposed switchgear has been adjusted to be shown on PCP-5
PCP-5	Incorporate new trident single way switch.	New trident switch has been called out on conduit plans.
PCP-1 thru PCP-6	If power can be moved to the east side of the road, we should be able to avoid to separate bores for power and communications.	Primary electric has been moved to the east side of the road.
PCP-1 thru PCP-6	How many conduits and what size for communications? This is shown for layouts beyond PCP-5 but not prior.	Communication conduits have been called out as 2-4" conduits as discussed at the 30% design review meeting.
PCP general	Conduit runs off main trunk (i.e. for road crossings and drops to transformers) are not detailed with pipe quantity and size.	All conduit sizes and cable types have been shown on the drawings.
PCP-13	Please include replacement of primary drop to V-050. This is a critical facility that will be used for hypergolic fueling operations and consider another switch near V-050 with spare positions. Growth is possible at the V Complex and at present, all three buildings (V-045, V-050, and V-055) are fed from the same 300KVA transformer behind V-050. There may be a need in the future to give each building its own primary feed and step down transformer.	Primary drop to V-050 has been shown as a replacement in this drawing set. Currently an additional piece of switchgear for V-050 has not been shown. If new switchgear at V-050 is to be installed G/S WI 21 may not be needed. This option is open for discussion at the 60% design meeting.

PCP-15	Need to show new north island communications shelter. This will be the primary hub for the North Island.	Base drawings provided did not include size and location of north island communication shelter. This is to be provided by Wallops Island from the 30% design submittal meeting.
PE Sheets	-Suggest to provide simple exploded schematic for gas switches. -We typically run 3 insulated phase cables plus a bare grounding conductor per feeder. Why are four conductors per feeder proposed?	Details have been added for the proposed switchgear on UD-4. Cable call outs show 3-4/0 primary one 4/0 bare copper ground.
All sheets	Drawing block where "G-001" is located on each sheet is where PE, PCP, etc. should go. The NASA sheet number will be assigned later on and should be located in the bottom right block.	All drawing reference nomenclature has been moved to the correct location. NASA sheet number has been left blank at this time.
Title Page	Title should be Electrical and Communication Upgrades, North Wallops Island Take out Goddard Space Flight Center and replace with Wallops Flight Facility.	Title sheet has been updated as suggested.
General	Insert schedule detailing quantities and types of junction bars, government furnished switches, and contractor supplied switches	Schedules have been added at the end of the UD sheets for this submittal. These may change during subsequent submittals as needed.
General	The New Integrated Payload Processing Facility site is located near the north end of Wallops Island at the compound currently occupied by Building V-67. Extend conduit and wiring to V-067 vicinity.	Electric facilities have been added to intercept transformer at V-67 along with new switchgear.
UD-1	We should try and combine the bores for power and communications if at all possible.	Bores have been combined for both electric and communication installation. 2-4" electric and 2-4" communication as discussed during the 30% design submittal meeting.
PCP Sheets	No details are identified on site plans. Details identifiers on UD sheets should be utilized on PCP sheets.	Detail callouts have been added to the conduit plans.
UD-2, transformer details	Identify MSL; change from 5" conduit; change ROICC to COTR; mimic details 1 and 2 for three phase transformers as well as single phase	All conduit callouts indicate 4" conduit. ROICC has been changed to COTR
Transformer and switch details	When is new concrete encasement to be utilized for physical protection of conduits? Where will this approach be shown on the drawings?	Concrete encasement may be needed to satisfy NESC rules for entries into equipment pads due to the boring depths specified.
UD Sheets	Need a general pad-mounted switch detail	Details for switchgear proposed have been added.
UD Handhole detail	Will an in-the-ground handhole float during flood conditions?	
General Comms	Identify communication cabling to be installed in the conduit system.	Communication cable to be installed has not at this time been determined.
Estimate	Include construction estimate in 60% submittal.	Construction cost estimate has been included with this submittal
Specification	Include thinned-down, scrubbed specification in 60% submittal.	

Electrical Plan PCP-1 to PCP-15 and Primary and Secondary Cable Plan PE-1 to PE-15	O. Hooks – Virginia Law exempts utility construction from Sediment and Erosion Control Requirements. As a Best Management Practice, the WFF Environmetnal Office suggests the use of silt fence along the trenches to prevent silt runoff from disturbed areas.	Silt fences will be used in all excavation areas at locations where switchgear, junction enclosures, and transformers will be placed.
Electrical Plan PCP-1 to PCP-15 and Primary and Secondary Cable Plan PE-1 to PE-15	Suggested language that should be placed in plans and specifications: *The contractor shall divert at least 50% of Construction and Demolition materials and debris through recycling. The contractor shall keep track of the weight (in pounds or tons) diverted and provide the data in a brief report upon completion of the project.*	Note has been added to the general notes sheet, GN-1.
Electrical Conduit Plan PCP-5 and PCP-6	The land immediately adjacent to the east side and west side of the Island Road and immediately south of the parking lot for Building V-10 and directly across the road from V-10 contains areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met.	All precautions for disturbing wetland areas have been taken during the design. All conduit will be directionally bored at a depth of 6' to eliminate disturbance of conduit and cable installations. Equipment installation has been placed as close to existing facilities as possible and the land disturbance is expected to be minimal.
Electrical Conduit Plan PCP-9 and PCP-11	J. Mitchell – The land immediately adjacent to the east side and west side of the Island Road and immediately north of the parking lot for Building V-24, and also adjacent to both sides of the Island Road to the Beach Access contain areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met.	All precautions for disturbing wetland areas have been taken during the design. All conduit will be directionally bored at a depth of 6' to eliminate disturbance of conduit and cable installations. Equipment installation has been placed as close to existing facilities as possible and the land disturbance is expected to be minimal.
Electrical Conduit Plan PCP-12-13	The land immediately adjacent to the west side of the Island Road and immediately surrounding Buildings V-45, V-50 and V-55 contains areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met.	All precautions for disturbing wetland areas have been taken during the design. All conduit will be directionally bored at a depth of 6' to eliminate disturbance of conduit and cable installations. Equipment installation has been placed as close to existing facilities as possible and the land disturbance is expected to be minimal.

Electrical Conduit Plan PCP-14	The land immediately adjacent to the east side of the Island Road and immediately north and south of the Helipad Road contain areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met.	All precautions for disturbing wetland areas have been taken during the design. All conduit will be directionally bored at a depth of 6' to eliminate disturbance of conduit and cable installations. Equipment installation has been placed as close to existing facilities as possible and the land disturbance is expected to be minimal.
General comment	J. Mitchell – No protected areas or protected species issues.	Noted
Primary and Secondary Cable Plan PE-13	S. Silbert – The land in the immediate vicinity of Building V-55 contains an area classified as moderate for Prehistoric Archaeological Site Sensitivity. Consult immediately with the Historic Preservation Officer, Randy Stanley.	All precautions for disturbing archaeological sites have been taken during the design. All conduit will be directionally bored at a depth of 6' to eliminate disturbance of conduit and cable installations. Equipment installation has been placed as close to existing facilities as possible and the land disturbance is expected to be minimal.
Primary and Secondary Cable Plan PE-11 to PE-15	S. Silbert – The land immediately adjacent to the west side of the Island Road contains an area classified as high for Historic Archaeological Site Sensitivity.	All precautions for disturbing archaeological sites have been taken during the design. All conduit will be directionally bored at a depth of 6' to eliminate disturbance of conduit and cable installations. Equipment installation has been placed as close to existing facilities as possible and the land disturbance is expected to be minimal.
Primary and Secondary Cable Plan PE-11 to PE-15	S. Silbert – The land immediately adjacent to the east side of the Island Road and in the immediate vicinity of Building V-55 contains an area classified as high for Historic Archaeological Site Sensitivity.	All precautions for disturbing archaeological sites have been taken during the design. All conduit will be directionally bored at a depth of 6' to eliminate disturbance of conduit and cable installations. Equipment installation has been placed as close to existing facilities as possible and the land disturbance is expected to be minimal.

Primary and Secondary Cable Plan PE-8	T.J. Meyer – The NAVY used Building V-55 to launch ordnance in the 1950's. There is a low likelihood of encountering munitions and explosive constituents (MEC) in this location. Contractors should arrange to take MEC Awareness Training provided by the Wallops Environmental Office.	Note has been added to the general notes sheets, GN-1 that contractor shall arrange to take MEC Awareness Training provided by the Wallops Environmental Office.
Primary and Secondary Cable Plan PE-13	T.J. Meyer – The NAVY used this area in the 1950's as a cantonment or maintenance area composed of numerous buildings. Contractors may encounter buried debris such as: building foundations, septic tanks, tanks, electrical transformers and rubble. If debris is encountered during excavation, the contractor should immediately halt work and contact the WFF Environmental Office.	Note has been added to the general notes sheets, GN-1 that contractor shall contact the WFF Environmental Office if buried debris from existing infrastructure is encountered.
General	J. Mitchell – No protected areas or protected species issues.	Noted
Safety, G-001	Note 10 in General Notes states that the US Army Corps of Engineers Safety Manual EM 385-1 will be followed. Is this a Corp of Engineers job?? If not then this needs to be removed.	Note 10 has been removed.
Specifications	Add local safety information to the specification.	
General Notes	Add - 9.d. Workers shall have confined space safety training and be trained and knowledgeable in the proper use of confined space atmosheric monitoring equipment.	Note has been included.
Spec 26.08 (Inspections and Testing)	Contractor shall be responsible for performing ArcFlash study and labeling for all newly installed equpment.	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DESIGN COORDINATION AND REVIEW COMMENTS 5ND LANTDIV 3-11012/30 (NEW2/76)			JOB ORDER NO.
COMMENTS BY Michael Hooks-URS	CODE 250	PHONE (757) 824.2418	DATE 11/08/12
PROJECT TITLE AND LOCATION **North Island Electrical Upgrades**			**TYPE OF REVIEW** 30% X 60% FINAL OTHER (Draft)

DWG. NO. OR PAR NO.	**COMMENTS** (MAKE GENERAL COMMENTS AFTER SPECIFIC COMMENTS)	**ACTION TAKEN** (& REASONS WHERE SIGNIFICANT)
Electrical Plan PCP-1 to PCP-15 and Primary and Secondary Cable Plan PE-1 to PE-15	O. Hooks – Virginia Law exempts utility construction from Sediment and Erosion Control Requirements. As a Best Management Practice, the WFF Environmetnal Office suggests the use of silt fence along the trenches to prevent silt runoff from disturbed areas.	GN-1 General Notes, Item #20 The notes are adequate for requirements associated with developing a SWP3. The notes are adequate for requirements associated with monitoring water areas affected by construction activities and SWP3.
GN-1 General Notes, Item # 27	M. Simko - There is an Executive Order that requires federal agencies to recycle at least 50% of construction and demolition waste. Upon project completion, please provide the Wallops Environmetnal Office with a report of the total pounds C&D solid waste and the pounds C&D solid waste recycled by type. Suggested language that should be placed in plans and specifications: *The contractor shall divert at least 50% of Construction and Demolition materials and debris through recycling. The contractor shall keep track of the weight (in pounds or tons) diverted and provide the data in a brief report upon completion of the project.*	The language included in the general notes is adequate for requirements associated with diverting C & D Solid Waste.
Electrical Conduit Plan PCP-5 and PCP-6	J. Mitchell – The land immediately adjacent to the east side and west side of the Island Road and immediately south of the parking lot for Building V-10 and directly across the road from V-10 contains areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met. Contact the Natural Resources Lead, Joe Mitchell.	GN-1 General Notes, Item # 18 The language included in the general notes is adequate for requirements associated with areas classified as wetlands.

Electrical Conduit Plan PCP-9 and PCP-11	J. Mitchell – The land immediately adjacent to the east side and west side of the Island Road and immediately north of the parking lot for Building V-24, and also adjacent to both sides of the Island Road to the Beach Access contain areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met. Contact the Natural Resources Lead, Joe Mitchell.	GN-1 General Notes, Item # 18 The language included in the general notes is adequate for requirements associated with areas classified as wetlands.
Electrical Conduit Plan PCP-12-13	J. Mitchell – The land immediately adjacent to the west side of the Island Road and immediately surrounding Buildings V-45, V-50 and V-55 contains areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met. Contact the Natural Resources Lead, Joe Mitchell.	GN-1 General Notes, Item # 18 The language included in the general notes is adequate for requirements associated with areas classified as wetlands.
Electrical Conduit Plan PCP-14	J. Mitchell – The land immediately adjacent to the east side of the Island Road and immediately north and south of the Helipad Road contain areas classified as wetlands. Nationwide Permit 12 addresses activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in wetlands, provided the activity does not result in the loss of greater than 1/2-acre of wetlands for each single and complete project providing that all conditions and notifications of the Permit are met. Contact the Natural Resources Lead, Joe Mitchell.	GN-1 General Notes, Item # 18 The language included in the general notes is adequate for requirements associated with areas classified as wetlands.
General comment	J. Mitchell – No protected areas or protected species issues.	GN-1 General Notes, Item # 18 The language included in the general notes is adequate for requirements associated with areas classified as wetlands.
Primary and Secondary Cable Plan PE-13	S. Silbert – The land in the immediate vicinity of Building V-55 contains an area classified as moderate for Prehistoric Archaeological Site Sensitivity. Consult immediately with the Historic Preservation Officer, Randy Stanley.	Discussed at 8-29-2012 30% Design Review. NASA WFF's Historic Preservation Officer wil contact the State of Virginia Historic Preservation Office (SHPO) to discuss options such as directional boring. A Phase I Archaelological Assessment may be required (3 months or longer).

Primary and Secondary Cable Plan PE-11 to PE-15	S. Silbert – The land immediately adjacent to the west side of the Island Road contains an area classified as high for Historic Archaeological Site Sensitivity. Consult immediately with the Historic Preservation Officer, Randy Stanley.	Discussed at 8-29-2012 30% Design Review. NASA WFF's Historic Preservation Officer wil contact the SHPO to discuss options such as directional boring. A Phase I Archaelological Assessment may be required (3 months or longer).
Primary and Secondary Cable Plan PE-11 to PE-15	S. Silbert – The land immediately adjacent to the east side of the Island Road and in the immediate vicinity of Building V-55 contains an area classified as high for Historic Archaeological Site Sensitivity. Consult immediately with the Historic Preservation Officer, Randy Stanley.	Discussed at 8-29-2012 30% Design Review. NASA WFF's Historic Preservation Officer wil contact the State of Virginia Historic Preservation Office (SHPO) to discuss options such as directional boring. A Phase I Archaelological Assessment may be required (3 months or longer).
Primary and Secondary Cable Plan PE-8	T.J. Meyer – The NAVY used Building V-55 to launch ordnance in the 1950's. There is a low likelihood of encountering munitions and explosive constituents (MEC) in this location. Contractors should arrange to take MEC Awareness Training provided by the Wallops Environmental Office.	GN-1 General Notes, Item # 28 The language included in the general notes is adequate for requirements associated with Munitions, and Explosive Constituents MEC Awareness Training.
Primary and Secondary Cable Plan PE-13	T.J. Meyer – The NAVY used this area in the 1950's as a cantonment or maintenance area composed of numerous buildings. Contractors may encounter buried debris such as: building foundations, septic tanks, tanks, electrical transformers and rubble. If debris is encountered during excavation, the contractor should immediately halt work and contact the WFF Environmental Office.	GN-1 General Notes, Item # 28 The language included in the general notes is adequate for requirements associated with MEC Awareness Training.
N/A	B. Crawford, L. Chance – No tank issues.	No other comments.

DESIGN COORDINATION AND REVIEW COMMENTS		
CODE 803.2	DATE 11/09/12	
PROJECT TITLE AND LOCATION		**TYPE OF REVIEW**
North Island Electrical and Comm Design		60%
DWG. NO OR PAR NO.	**COMMENTS**	**COMMENTS BY**
Drawing PCP-8	Electrical runs near V-25 need to be looked at in relation to the new fire department project. Ensure new layout of fire department does not effect any new placements of manholes etc. Randy Stanley should be consulted.	Kenny Volante
Dwg 1.11 (page 4)	The following comment is provided by Jeff Shelton: Switchgear installed for this project requires arc-flash analysis and labeling in accordance with NFPA 70E. Suggest specifying that this is responsibility of contractor at time of installation.	Todd Thornes
General	Confined space work needs to conform to OSHA 29 CFR 1910.146 and GPR 1700.6B include information in Safe and Health Plan Confined spaces need to be labeled in accordance with 1910.146. New manholes need to be numbered and GIS confined space inventory database updated.	Marvin Bunting
General Notes Page	Note 10 in general notes: A comment was made in the 30% that EM 385-1 US Army Corps of Engineers Safety Manual needed to be taken out of the notes. This was agreed upon to be taken out during the review. Note 10 still states EM 385-1.	Kenny Volante
Specification	Section 9.7 states "Existing conduit systems where conductors will be removed and not replaced are to be capped/plugged at each end and abandoned in place in lieu of being removed." This is acceptable for in-ground cabling but not for abandoned cable in facilities: per NASA-STD-8719.11 section 9.1.2.4 "Cable and wiring shall not be abandoned in place and must be removed to reduce the fuel loading in NASA buildings (Requirement)." Ensure that no cable/wiring is abandoned in place in NASA buildings.	Luis Muniz
Specification General Comment	The specifications now contain GSFC safety documents at the end of the document but still does not include a general governmental specification for safety that spells out things like safety plans and what they should contain etc. There is a general governmental specification that can be submitted that will spell out this information. This needs to be submitted in the specification.	Kenny Volante

DESIGN COORDINATION AND REVIEW COMMENTS

THE FOLLOWING ARE RESPONSES TO THE 60% DESIGN REVIEW COMMENTS RECEIVED AS PART OF THE 60% DESIGN PACKAGE.

60% DESIGN REVIEW COMMENTS

DRAWING PCP-8 – THE NEW FIRE DEPARTMENT LAYOUT HAS BEEN ADDED TO THE BASE MAPS FOR BOTH CONDUIT AND CABLING PLANS. ASSOCIATED CHANGES HAVE BEEN MADE TO THE DESIGN DRAWINGS TO ACCOMMODATE THE LOCATION OF THE FIRE HOUSE ON SHEETS PCP-8 AND PE-8,

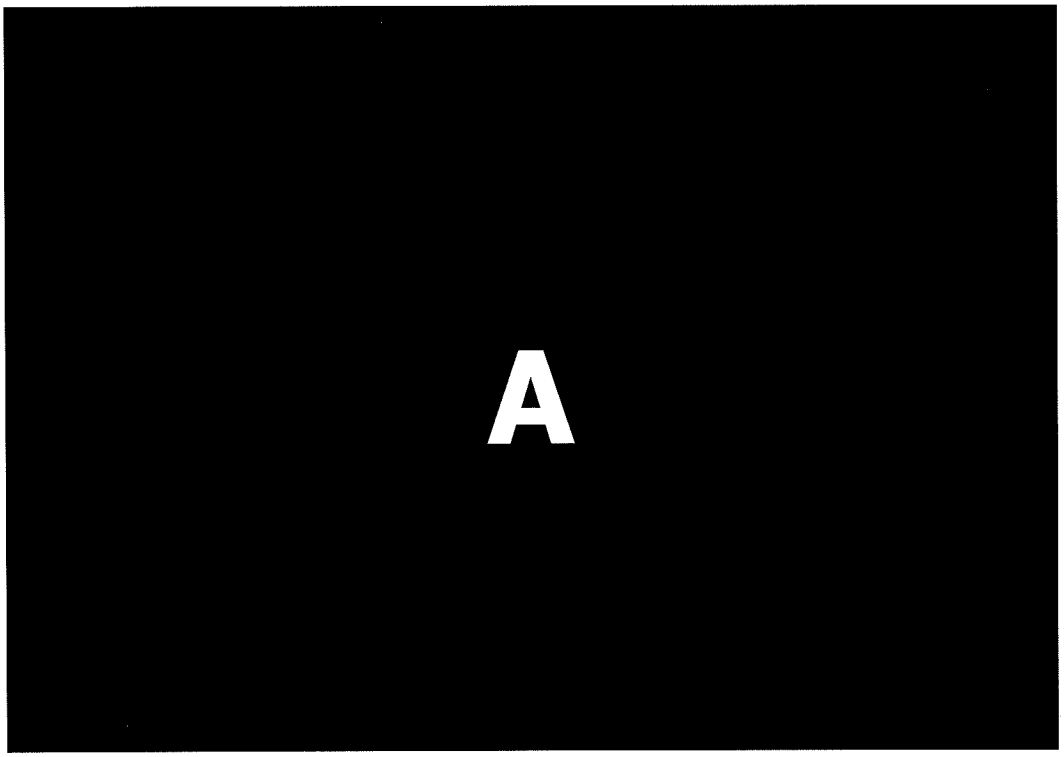
DWG. 1.11 (PAGE 4) – A NOTE HAS BEEN ADDED TO THE GENERAL NOTES SHEET, GN-1, THAT INSTRUCTS THE CONTRACTOR OF THEIR RESPONSIBILITY TO PROVIDE ARC-FLASH ANALYSIS AND LABELING OF ALL SWITCHGEAR INSTALLED AS PART OF THE PROJECT.

GENERAL NOTES PAGE – THE REFERENCE TO EM 385-1 US ARMY CORPS OF ENGINEERS SAFETY MANUAL HAS BEEN REMOVED FROM THE GENERAL NOTES SHEET.

SPECIFICATION – THERE ARE NOT ACTIVITIES IN WHICH ELECTRIC CABLES IN FACILITIES WILL BE AFFECTED. ALL WORK IS MEDIUM VOLTAGE DISTRIBUITON CABLE REPLACEMENT AS SHOWN ON THE DRAWING SETS.

SPECIFICATION GENERAL COMMENT – THE GENERAL GOVERNMENTAL SPECIFICATION HAS BEEN INCLUDED IN THE SPECIFICATION SECTION OF THE DESIGN DATA.

COST ESTIMATES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NASA Goddard Space Flight Center
Wallops Flight Facility

North Island Electrical Distribution Upgrades
60% Design Review Cost Estimate

UNDERGROUND DISTRIBUTION					
		Unit Price			
	Qty	Labor	Materials	Labor and Materials	Raw Extended Cost
Underground Construction					
Conductors					
4/0 AWG. CU. U.G. Primary, 15Kv cable	122,514	$2.50	$6.20	$8.70	$ 1,065,872
1/0 AWG. CU. U.G. Primary 15Kv cable	9,631	$2.00	$4.30	$6.30	$ 60,675
4/0 str. Bare Cu	42,385	$1.30	$3.00	$4.30	$ 182,256
#4 str. Al. U.G. 600v Secondary Cable (St. Lights) *	-	$2.00	$0.80	$2.80	$ -
4/0 str. Cu U.G .600 v Secondary Cable	1,040	$2.50	$3.00	$5.50	$ 5,720
500 kcmil Cu U.G. 600v Secondary Cable	-	$3.10	$4.20	$7.30	$ -
#2 str. Bare Cu	-	$1.30	$0.60	$1.90	$ -
	-				
	-				
Underground Padmounted Switchgear	-				
G&W RPFI 9F	9	$5,000.00	$45,000.00	$50,000.00	$ 450,000
G&W SPRAM - 4 Way	2	$5,000.00	$45,000.00	$50,000.00	$ 100,000
G&W T44	-	$5,000.00	$45,000.00	$50,000.00	$ -
S&C Vista 532	-	$7,500.00	$35,200.00	$42,700.00	$ -
	-				
Underground Primary Junctions (PJE)	-				
3 phase 600 A PJE - 4 way	82	$4,000.00	$4,400.00	$8,400.00	$ 688,800
3 phase 200 A PJE - 4 way	3	$3,000.00	$4,400.00	$7,400.00	$ 22,200
	-				
	-				
Grading of Switchgear, Junctions, Enclosures, and Transformer Installations per Site	87	$350.00	$200.00	$550.00	$ 47,850
	-				
Manhole with racking system 10' x 8' x 7' ht. Inside	6	$25,000.00	$15,000.00	$40,000.00	$ 240,000
Comm Handholes	45	$600.00	$400.00	$1,000.00	$ 45,000
	-				
Directional Boring	-				
2 - 4"	1,512	$30.00	$6.00	$36.00	$54,432.00
4 - 4"	17,791	$60.00	$12.00	$72.00	$1,280,952.00
1-4"	680	$18.00	$2.00		
4-6" (4bores)	-	$100.00	$60.00		
Bore Pit for Directional Bore	50	$500.00	$0.00	$500.00	$25,000.00
	-				

NASA Goddard Space Flight Center
Wallops Flight Facility

North Island Electrical Distribution Upgrades
60% Design Review Cost Estimate

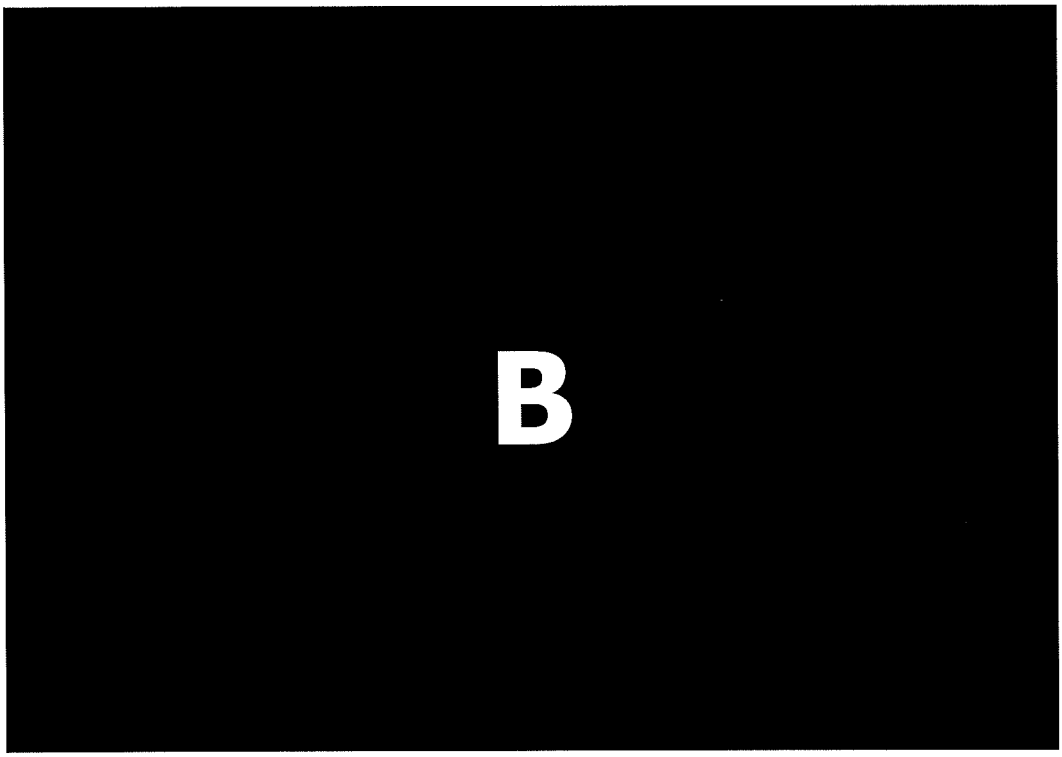
UNDERGROUND DISTRIBUTION					
		Unit Price			
	Qty	Labor	Materials	Labor and Materials	Raw Extended Cost
	-				
3 Phase Padmounted Transformer	-				
75 kVA	-	$1,000.00	$8,300.00	$9,300.00	$0.00
112.5 kVA	2	$1,100.00	$9,000.00	$10,100.00	$20,200.00
150 kVA	-	$1,200.00	$9,730.00	$10,930.00	$0.00
300 kVA	-	$1,400.00	$13,130.00	$14,530.00	$0.00
500 kVA	-	$1,600.00	$16,750.00	$18,350.00	$0.00
1000 kVA	-	$1,600.00	$24,510.00	$26,110.00	
Concrete Pad for 3 Phase Transformer	2	$500.00	$500.00	$1,000.00	$2,000.00
	-				
Underground Construction - Miscellaneous Units	-				
600 A Deadbreak Elbows for 4/0 cu	780	$200.00	$200.00	$400.00	$312,000.00
600 A Reducing Tap Plug for 1/0 AL	3	$200.00	$285.00	$485.00	$1,455.00
200 A Deadbreak Elbows for 1/0 AL	48	$200.00	$50.00	$250.00	$12,000.00
Lightning Arrestor Elbows 600 A & 200 A	258	$100.00	$105.00	$205.00	$52,890.00
Fault Indicators (per Phase)	-	$50.00	$170.00	$220.00	$0.00
Primary Conductor Splices 1/0 Al	-	$250.00	$50.00	$300.00	$0.00
Parking Bushings for 600A Switchgear	6	$100.00	$150.00	$250.00	$1,500.00
Parking Bushings for Transformers and 200A Junction Enclosures	-	$75.00	$150.00	$225.00	$0.00
600A Bushing Well Inserts	1,102	$75.00	$50.00	$125.00	$137,750.00
200A Bushing Well Inserts	84	$50.00	$50.00	$100.00	$8,400.00
Service Metering Enclosure	-	$500.00	$500.00	$1,000.00	$0.00
Bushing Well Plugs or Insulated Caps	120	$50.00	$75.00	$125.00	$15,000.00
Transformer Secondary Connector Blocks	-	$25.00	$75.00	$100.00	$0.00
	-				
Underground Removal	-				
Conductor (various sizes)	-	$2.50	$0.00	$2.50	$0.00
	-				
Existing Manhole Removal	-	$7,500.00	$750.00	$8,250.00	$0.00
	-				
	-				
Existing Padmounted Transformer or Switch Removal	5	$900.00		$900.00	$4,500.00
					$ -

NASA Goddard Space Flight Center
Wallops Flight Facility

North Island Electrical Distribution Upgrades
60% Design Review Cost Estimate

UNDERGROUND DISTRIBUTION					
		Unit Price			
	Qty	Labor	Materials	Labor and Materials	Raw Extended Cost
CONVERSION TOTAL FOR ITEM					$ 4,836,452

* Single conductor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NASA Goddard Space Flight Center
Wallops Flight Facility

North Island Electrical Distribution Upgrades
90% Design Review Cost Estimate

UNDERGROUND DISTRIBUTION					
		Unit Price			
	Qty	Labor	Materials	Labor and Materials	Raw Extended Cost
Underground Construction					
Conductors					
4/0 AWG. CU. U.G. Primary, 15Kv cable	122,514	$2.50	$6.20	$8.70	$ 1,065,872
1/0 AWG. CU. U.G. Primary 15Kv cable	9,631	$2.00	$4.30	$6.30	$ 60,675
4/0 str. Bare Cu	42,385	$1.30	$4.80	$6.10	$ 258,549
288 Count Fiber	122,750	$1.50	$1.00	$2.50	$ 306,875
4/0 str. Cu U.G .600 v Secondary Cable	-	$2.50	$3.00	$5.50	$ -
500 kcmil Cu U.G. 600v Secondary Cable	-	$3.10	$4.20	$7.30	$ -
#2 str. Bare Cu	-	$1.30	$0.60	$1.90	$ -
Ground Rod, 5/8" x 10'	-	$6.00	$15.00		$ -
	-				
Underground Padmounted Switchgear	-				
G&W RPFI 9F	9	$5,000.00	$45,000.00	$50,000.00	$ 450,000
G&W SPRAM - 4 Way	2	$5,000.00	$45,000.00	$50,000.00	$ 100,000
G&W T44	-	$5,000.00	$45,000.00	$50,000.00	$ -
S&C Vista 532	-	$7,500.00	$35,200.00	$42,700.00	$ -
	-				
Underground Primary Junctions (PJE)	-				
3 phase 600 A PJE - 4 way	82	$4,000.00	$6,500.00	$10,500.00	$ 861,000
3 phase 200 A PJE - 4 way	3	$3,000.00	$5,000.00	$8,000.00	$ 24,000
	-				
	-				
Grading of Switchgear, Junctions, Enclosures, and Transformer Installations per Site	87	$350.00	$200.00	$550.00	$ 47,850
	-				
Manhole with racking system 10' x 8' x 7' ht. inside	6	$8,000.00	$7,000.00	$15,000.00	$ 90,000
Comm Handholes	45	$600.00	$400.00	$1,000.00	$ 45,000
	-				
Directional Boring	-				
2 - 4"	1,512	$30.00	$6.00	$36.00	$54,432.00
4 - 4"	17,791	$60.00	$12.00	$72.00	$1,280,952.00
1-4"	680	$18.00	$2.00		
4-6" (4bores)	-	$100.00	$60.00		
Bore Pit for Directional Bore	50	$500.00	$0.00	$500.00	$25,000.00
	-				

NASA Goddard Space Flight Center
Wallops Flight Facility

North Island Electrical Distribution Upgrades
90% Design Review Cost Estimate

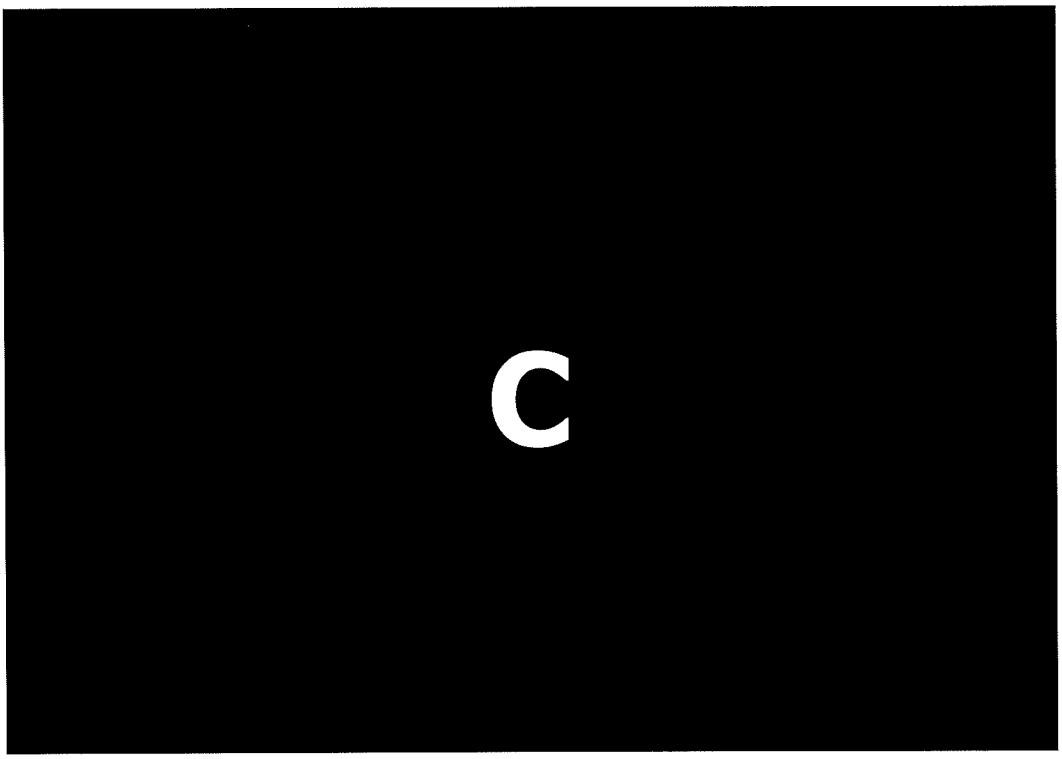
UNDERGROUND DISTRIBUTION					
		Unit Price			
	Qty	Labor	Materials	Labor and Materials	Raw Extended Cost
	-				
3 Phase Padmounted Transformer	-				
75 kVA	-	$1,000.00	$6,000.00	$7,000.00	$0.00
112.5 kVA	2	$1,100.00	$6,500.00	$7,600.00	$15,200.00
150 kVA	-	$1,200.00	$9,730.00	$10,930.00	$0.00
300 kVA	-	$1,400.00	$13,130.00	$14,530.00	$0.00
500 kVA	-	$1,600.00	$16,750.00	$18,350.00	$0.00
1000 kVA	-	$1,600.00	$24,510.00	$26,110.00	
Concrete Pad for 3 Phase Transformer	2	$500.00	$500.00	$1,000.00	$2,000.00
	-				
Underground Construction - Miscellaneous Units	-				
600 A Deadbreak Elbows for 4/0 cu	780	$200.00	$200.00	$400.00	$312,000.00
600 A Reducing Tap Plug for 1/0 AL	3	$200.00	$285.00	$485.00	$1,455.00
200 A Deadbreak Elbows for 1/0 AL	48	$200.00	$50.00	$250.00	$12,000.00
Lightning Arrestor Elbows 600 A & 200 A	258	$100.00	$105.00	$205.00	$52,890.00
Fault Indicators (per Phase)	-	$50.00	$170.00	$220.00	$0.00
Primary Conductor Splices 1/0 Al	-	$250.00	$50.00	$300.00	$0.00
Parking Bushings for 600A Switchgear	6	$100.00	$150.00	$250.00	$1,500.00
Parking Bushings for Transformers and 200A Junction Enclosures	-	$75.00	$150.00	$225.00	$0.00
600A Bushing Well Inserts	1,102	$75.00	$50.00	$125.00	$137,750.00
200A Bushing Well Inserts	84	$50.00	$50.00	$100.00	$8,400.00
Service Metering Enclosure	-	$500.00	$500.00	$1,000.00	$0.00
Bushing Well Plugs or Insulated Caps	120	$50.00	$75.00	$125.00	$15,000.00
Transformer Secondary Connector Blocks	-	$25.00	$75.00	$100.00	$0.00
	-				
Underground Removal	-				
Conductor (various sizes)	-	$2.50	$0.00	$2.50	$0.00
	-				
Existing Manhole Removal	-	$7,500.00	$750.00	$8,250.00	$0.00
	-				
	-				
Existing Padmounted Transformer or Switch Removal	5	$1,500.00		$1,500.00	$7,500.00
					$ -

NASA Goddard Space Flight Center
Wallops Flight Facility

North Island Electrical Distribution Upgrades
90% Design Review Cost Estimate

UNDERGROUND DISTRIBUTION					
		Unit Price			
	Qty	Labor	Materials	Labor and Materials	Raw Extended Cost
CONVERSION TOTAL FOR ITEM					$ 5,235,900

* Single conductor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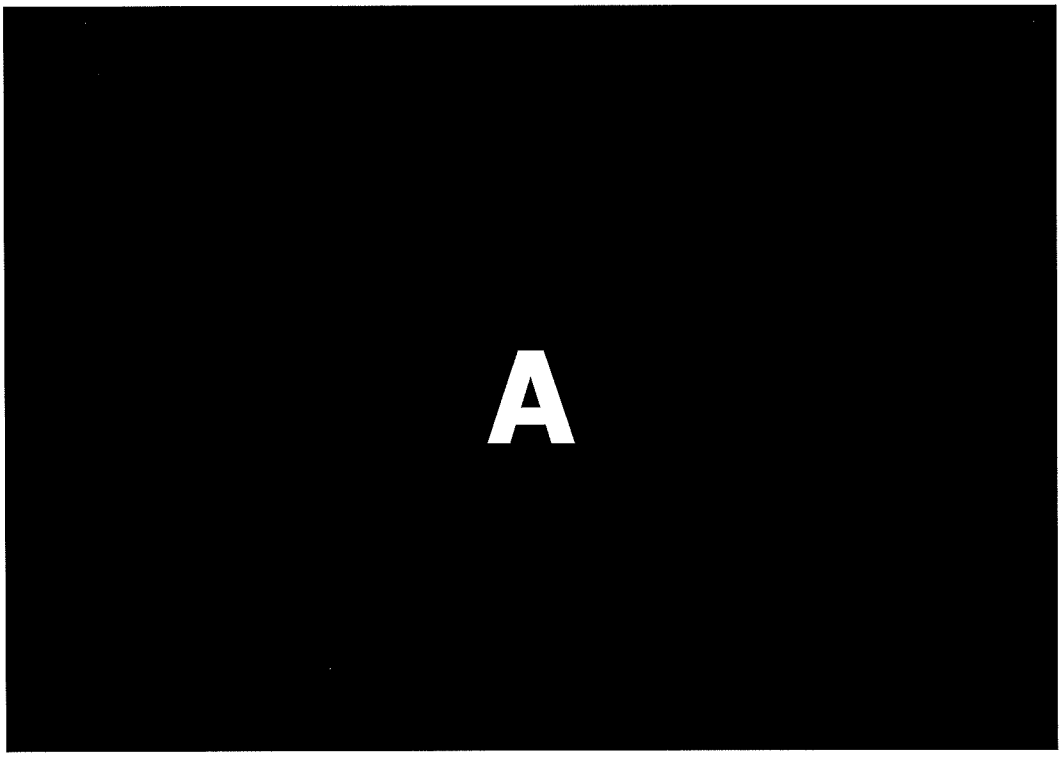
Goddard Space Flight Center
Wallops Island, Virginia
North Island Electrical and Communication Upgrades
Contract No. NAS5-01080
Construction Schedule

Item Number	Task	ıber	October		November		December	
1	Execute labor contracts							
2	Contractor Mobilization							
3	Procure Material							
4	Utility Locates							
5	Directional Bore Conduits							
6	Install Medium Voltage Cable							
7	Install Fiber Optic Cable							
8	Install Manholes							
9	Install Junction Enclosures							
10	Install Comm Handholes							
11	Install Switchgear							
12	Install Transformers							
13	Terminations							
14	Cutovers							
15	Cleanup & As-Built							
16	Demobilization							

Notes:

SAFETY REQUIREMENTS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Goddard Procedural Requirements (GPR)

DIRECTIVE NO.	GPR 1700.1A	**APPROVED BY Signature:**	*Original signed by M. Ryschkewitsch*
EFFECTIVE DATE:	November 10, 2010	**NAME:**	E. J. Weiler
EXPIRATION DATE:	February 21, 2013	**TITLE:**	Director

COMPLIANCE IS MANDATORY

Responsible Office: 350 / Occupational Safety and Health (OS&H) Division

Title: Occupational Safety Program at Goddard Space Flight Center

TABLE OF CONTENTS

P.1 Purpose
P.2 Applicability
P.3 Authority
P.4 References
P.5 Cancellation
P.6 Safety
P.7 Training
P.8 Records
P.9 Metrics
P.10 Definitions
P.11 Acronyms and Abbreviations
1.0 Overview
1.1 Management of Risk
1.2 Program and Policies
1.3 Four Essential Components for the GSFC Safety Program
2.0 Objectives and Principles
3.0 Roles and Responsibilities
3.1 Center Director and Assistant Director for Safety and Security (ADDS)
3.2 Supervisors
3.3 Employees
3.4 Resolution of Complaints
3.5 Professional Health and Safety Services
3.6 Public Safety
4.0 Risk Assessment
5.0 Safety Program Reviews
5.1 Review Categories
5.2 Notice and Abatement of Unsafe or Unhealthful Conditions
5.3 Access for Regulatory Representatives
5.4 Advisory, Panels, Committees, and Boards
5.5 Emergency Planning
5.6 Safety Motivation and Awards Program
5.7 Safety Management Information

5.8 Injury Recordkeeping and Reporting Requirements
5.9 Safety Lessons Learned
5.10 NASA Safety Reporting System (NSRS)
5.11 Safety Documentation
5.12 Safety Variance Process
6.0 Recordkeeping and Reporting Requirements
7.0 Contractor Safety and Risk Management Requirements for NASA Contracts
7.1 Program and Project Managers
7.2 Contract Officers
7.3 Safety Office and Mission Assurance Personnel
7.4 Access to NASA Facilities by Compliance Officers to Investigate Contractor Mishaps
7.5 Contractor Citations
7.6 Grants
8.0 Safety Training and Personnel Certification
8.1 Safety Training Responsibilities
8.2 Planning and Implementation
8.3 Personnel Safety Certification Program for Hazardous Operations and Materials
9.0 Operational Safety
9.1 Motor Vehicle Safety
9.2 Personal Protective Equipment
9.3 Control of Hazardous Energy (Lockout/Tagout Program)
9.4 Pressure and Vacuum Systems Safety
9.5 Electrical Safety
9.6 Hazardous Materials
9.7 Material Safety Data Sheets (MSDS)
9.8 Task Safety Analysis (TSA)
9.9 Laboratory Hazards
9.10 Lifting Safety
9.11 Explosives, Propellant, and Pyrotechnic Safety
9.12 Underwater Operations Safety
9.13 Non-Ionizing Electromagnetic Radiation
9.14 Ionizing Radiation
9.15 Confined Spaces
9.16 Facility Systems Safety
9.17 Fire Safety

PREFACE

P.1 PURPOSE

This directive is an overarching document containing procedures and requirements that defines the Goddard Space Flight Center (GSFC) Occupational Safety Program. More specific and detailed safety program requirements that employees, supervisors, and managers are to follow will be developed by the respective division/organization to address operational activities. This document must be used in

conjunction with the references listed in P.4 below. This is primarily a safety document and is not meant to provide direction to occupational health personnel or to provide guidance for occupational health activities. To address special and/or discipline unique requirements, the Headquarters Safety and Risk Management Division publishes standards that provide specific instructions that are beyond the scope and detail of this document.

P.2 APPLICABILITY

This directive applies to all GSFC civil service personnel, facilities, and activities, including all permanent and temporary sites. This directive shall also apply to all GSFC tenant organizations, contractors, grantees, clubs and other persons operating under the auspices of GSFC or on GSFC property as required by law and as directed by contractual, grant, and agreement documents. The term Safety Office is applicable equally to both the Greenbelt (Code 350), and Wallops Flight Facility (Code 803) safety organizations.

P.3 AUTHORITY

a. Executive Order 12196 of February 26, 1980, Occupational Safety and Health Programs for Federal Employees;

b. 5 USC Section 7902, 29 USC Sections 651 et seq., and 49 Appendix Section 1421, the Occupational Safety and Health Act of 1970 (Public Law 91-596);

c. 51 USC § 20113 (a) of the National Aeronautics and Space Act;

d. 29 CFR 1910, Occupational Safety and Health Standards;

e. 29 CFR 1960, Basic Program Elements for Federal Employees, Occupational Safety and Health. Programs and Related Matters; and

f. NPR 8715.3 NASA Safety Manual

P.4 REFERENCES

a. See references listed in P.4 of NPR 8715.3, NASA Safety Manual

b. GPD-8715.1A Goddard Space Flight Center Safety Policy

c. GPR 1700.2A Chemical Hygiene Program

d. GPR 1700.3 GSFC Chemical Hazard Communication Program (Non-Wet Chemistry)

e. GPR 1700.4 Laboratory Safety

f. GPR 1700.5 Control of Hazardous Energy (Lockout/Tagout)

g. GPR 1700.6 Confined Space Program at GSFC

h. GPR 1800.2 Occupational Health Program

i. GPR 1840.1 Asbestos Management Program at GSFC

j. GPR 7320.1A Facilities System Safety

k. GPR 1860.1A Ionizing Radiation Protection

l. GPR 1860.2A Laser Radiation Protection

m. GPR 1860.3 Radio Frequency Radiation Safety

n. GPR 1860.4 Ultraviolet and High Intensity Light Radiation

o. GPR 8621.1A Reporting of Mishaps and Close Calls

p. GPR 8621.2A Processing Mishap and Close Call Reports

q. GPR 8621.3B Mishap and Close Call Investigation

r. GPR 8710.1A Goddard Space Flight Center Safety Management Council

s. GPR 8710.2A Emergency Preparedness Program Plan for Greenbelt

t. GPR 8710.3A Certification and Recertification of Ground-Based Pressure Vessels and Pressurized Systems

u. GPR 8715.5 Fire Protection

v. GPR 8719.1 Certification and Recertification of Lifting Devices and Equipment

w. GPR 8834.1 Lifting Operations Requirements

P.5 CANCELLATION

GPR 1700.1, Occupational Safety Program at Goddard Space Flight Center

P.6 SAFETY

None

P.7 TRAINING

Supervisors shall ensure that all personnel are trained and certified (if applicable) for the type of activity/operation required to perform their work safely and effectively.

See section 8.0 for specific occupational safety training requirements.

P.8 RECORDS

Record Title	Record Custodian	Retention
Records of Safety & Health Training	Supervisors, Human Resources, Code 350	NRRS 3/33G1* – Destroy 5 years after employee discontinues or completes training.
Physician Report That Evaluates the Employee's Exposure to a Hazardous Chemical	Health Unit	NRRS 1/127A* – Retain until employee is transferred or separated. Upon transfer, ship medical record to medical office of new assignment. Within 30 days after separation, transfer to National Personnel Records Center.
Records of Safety Equipment Inspections and Testing	Inspecting Office	NRRS 1/117A* – Retire to Federal Records Center when related property is disposed of by NASA. Retire 5 years after disposal.
Task Safety Analysis (GSFC Forms 23-60)	Owning Organization	NRRS 1/116* – Destroy after organization determines analysis is not longer relevant.
Annual Workplace Safety and Health Audit Reports	Safety Office and Branch Chiefs	29 CFR 1960.73 - Records and reports shall be retained for 3 years following the end of the fiscal year to which they relate.
Quarterly Supervisor Safety Walkthroughs	Supervisors	29 CFR 1960.73 - Records and reports shall be retained for 5 years following the end of the fiscal year to which they relate.
NASA Forms 1390 & 1584	Supervisors, Facilities Management Division, Safety Office	29 CFR 1960.73 - Records and reports shall be retained for 5 years following the end of the fiscal year to which they relate.

Records of Occupational Injuries	Worker's Compensation Office	NRRS 1/127A* – Retain until employee is transferred or separated. Upon transfer, ship medical record to medical office of new assignment. Within 30 days after separation, transfer to National Personnel Records Center.
Record Title	**Record Custodian**	**Retention**
Waiver/Deviation of Standards Documentation	Safety Office, Division Chiefs, Headquarters Safety and Risk Management Division	NRRS 3/33G1* – Destroy Waiver/Deviation 5 years after it is no longer relevant.

NPR 1441 – NASA Records Retention Schedule

P.9 METRICS

The respective Safety Office will gather and monitor, as a minimum, trends and lessons learned which will be provided to Center organizations and briefed to senior GSFC management as necessary.

a. Analysis of annual/periodic review of requirements and organizational program compliance.

b. Analysis of lost-time and occupational illness incidents and property damage.

c. Training course completion rates.

P.10 DEFINITIONS

See **Appendix B** of NPR 8715.3

P.11 ACRONYMS and ABBREVIATIONS

See **Appendix A** of NPR 8715.3

PROCEDURES

In this document, a requirement is identified by "shall," a good practice by "should," permission by "may" or "can," expectation by "will" and descriptive material by "is."

1.0 OVERVIEW

This document provides the procedures and requirements that define the GSFC Safety Program. Safety program responsibility starts at the top with senior management's role of developing policies and providing strategies and resources and is enforced by the immediate task supervisor and line organization. All employees are responsible for their own safety, as well as that of others whom their actions may affect. All employees, including contractors, are empowered to call for the cease and desist of any process or operation they believe is unsafe, or presents an immediate danger to life and health, and request an analysis by a qualified safety professional. If the activity is unsafe, the safety professional will determine the corrective actions needed before resumption of operations. Employees are also to report any systems, designs, operations, processes, or software they feel are unsafe or do not meet safety requirements.

1.1 Management of Risk

GSFC undertakes certain activities involving a high potential of risk. Management of this risk (which involves identifying and eliminating, minimizing, controlling, or accepting the risk) is one of GSFC's most challenging activities and is an integral part of GSFC's safety efforts. The focus of risk management and loss prevention priorities and attention are the GSFC workforce, visitors, the public in general, and our high-value equipment and property.

1.2 Program and Policies

The Safety policy for the GSFC Safety Program is provided in GPD 8715.1. For specific health program requirements, see NPD 1800.1, and GPR 1800.2, Occupational Health Program.

1.3 Four Essential Components for the GSFC Safety Program

NASA has long recognized that compliance with the Occupational Safety and Health Administration (OSHA) standards and NASA Directives cannot by itself accomplish all the goals desirable in a comprehensive health and safety program. No matter how carefully conceived and properly developed, NASA Directives and regulatory standards will never address all unsafe activities and conditions. At the same time, contractors and their employees at all levels possess valuable firsthand knowledge of the processes, materials, and hazards involved in their own operations. This knowledge, combined with the ability to quickly evaluate and address unique hazards, can improve facility health and safety in ways which are simply not available through NASA or other oversight agencies.

The four essential components for the GSFC Safety Program are designed to utilize innovative, streamlined, and efficient management approaches. The four key elements are:

1.3.1 Management Commitment and Employee Involvement

Each organization must demonstrate top-level management commitment to occupational health and safety in general and to the specific baseline requirements of safety. Management systems for comprehensive planning must address health and safety.

a. Commitment to Health and Safety Protection

As with any other management system, authority and responsibility for employee health and safety must be integrated with the management system of the organization and must involve employees. This commitment includes the following:

1. Policy - there should be a clearly-stated organizational policy on safe and healthful working conditions that is communicated to employees at all levels, so they understand the priority of safety and health protection in relation to other organizational values;

2. Goal and Objectives - there should be established and communicated organizational goals and related objectives for the safety and health program so that the desired results and the planned measures for achieving those results are clearly understood; and

3. Planning - planning for safety and health must be part of the organizations' overall long-term management planning.

b. Written Safety and Health Program

All critical elements of the organizational safety and health program, including management leadership, employee involvement, worksite analysis, hazard prevention and control, and safety and health training, must be a part of the written program.

1. Adequacy - all aspects of the safety and health program must be appropriate to the size of the work site, the complexity of the hazards, and the nature of the industry;

2. Responsibility - responsibility for all aspects of the safety and health program must be assigned and communicated so that all managers, supervisors, and line employees know what is expected of them;

3. Authority and Resources - responsible personnel must have adequate authority and resources to perform the desired tasks. Commitment of necessary resources for workplace health and safety must be documented and must address staffing, space, equipment, training, and promotions. Budget and capital expenditures for health and safety improvements must also be included;

4. Line Accountability - managers, supervisors, and employees must be held accountable for meeting their assigned responsibilities, as demonstrated through evaluation of employees at all levels. A functional and operational system for rewarding good performance and correcting deficient performance must be in place;

5. Visible Management Involvement - top management involvement in health and safety related activities must be apparent to all employees. This involvement shall include:

   i. Establishing clear lines of communication with employees;

ii. Setting an example of safe and healthful behavior;
iii. Ensuring that all employees (including subcontract employees and vendors) and visitors have a safe and healthful workplace; and
iv. Being accessible to employees for health and safety concerns.

6. Site Orientation and General Accountability - there must be documented programs for orienting and holding accountable all on-site employees operating in GSFC controlled spaces, including contractors and subcontractor employees, vendors, consultants, students, and visiting scientists;

7. Contractor Employee Coverage - organizations must be able to demonstrate that they have considered the health and safety programs and performance of all Prime and subcontractors during the evaluation and selection process, especially for operations such as construction. Records of the hours worked and the injuries and illnesses incurred by Prime and subcontractor employees while working in the contractor's controlled spaces must be kept. Rates calculated for such work are expected to be at or below the most appropriate industry average, as reported by the most recent Bureau of Labor Statistics (BLS) publication; and

8. Safety and Health Program Evaluation - organizations must have a system for evaluating the success of their safety and health program in meeting the goal and objectives, so that those responsible can determine and implement any needed changes.

i. The system must provide for an annual, written, narrative report, including recommendations for improvements and documented timely follow-up;
ii. The evaluation must assess the effectiveness of each element and sub-element; and
iii. The evaluation must be conducted collaboratively by competent Safety Office personnel and subject matter experts from the organization or by a third party from the private sector.

c. Employees at all levels must be involved in the structure and operation of the health and safety program and in decisions that affect employee health and safety. Employee participation is in addition to each employee's individual right to notify appropriate managers of hazardous conditions and practices. The employee participation requirement may be met in a variety of ways, as long as employees are able to participate actively and meaningfully in the identification and resolution of health and safety problems. The following are some examples of acceptable means of providing for employee impact on decision-making:

1. Safety committees;
2. Safety observers;
3. Ad hoc health and safety accident investigation and problem-solving groups;
4. Health and safety training of other employees;
5. Worksite safety inspections and analysis of job hazards; and
6. Committees that plan and conduct health and safety awareness programs.

1.3.2 System and Worksite Hazard Analysis

Management of health and safety programs must begin with a thorough understanding of all potentially hazardous situations and the ability to recognize and correct hazards as they arise, utilizing the activities and systems described below:

a. All planned or newly-acquired facilities, equipment, materials, and processes should be analyzed before they are used to determine potential hazards and to plan for prevention or control. Pre-job planning and preparation should be conducted for different phases of activities, such as experiments. Such planning may take the form of a Facility Hazard Analysis (FHA) for complex facilities undertaking hazardous operations;

b. Comprehensive health and safety surveys should be conducted by trained and qualified safety and health professionals at intervals appropriate for the nature of workplace operations, to identify existing hazards and potentially significant risks and to ensure employer awareness and control of those risks. This requirement starts with a baseline survey of health and safety hazards accomplished through initial comprehensive industrial hygiene and safety surveying. Nationally recognized procedures for all sampling, testing, and analysis must be used, and written records of results maintained;

c. There should be a system for conducting routine, general hazard assessments that follow written procedures or guidance and result in written reports of findings and tracking of hazard correction. For continuous activities, these hazard assessments must be conducted at least monthly and cover the whole work site at least quarterly. During construction, management hazard assessments shall cover the entire work site at least weekly. Also in construction, hazard assessments by members of the health and safety committee that cover the entire work site as appropriate, but no less frequently than once per month, are required;

d. Routine examination and analysis of hazards associated with individual jobs, processes, operations, or phases of construction must be conducted, and the results must be included in training and hazard control programs. This includes job/task safety analysis and process hazard review. For construction projects, the emphasis should be on the special health and safety hazards of each craft and possible overlapping activity hazards for each phase of construction;

e. A reliable system must be in place to allow employees, without fear of reprisal, to notify appropriate management personnel in writing about conditions that appear hazardous and to receive timely and appropriate responses. The system may additionally include oral notification by employees, but in all instances must include written tracking of responses and hazard corrections;

f. There must be an accident/incident investigation system that includes written procedures or guidance, requires written reports of findings, hazard correction tracking, identification of causes, and provides for preventive or corrective actions. The system shall also include provisions for a narrative report suitable for dissemination to all employees which contains root causes, analysis, and lessons learned.; and

g. Trend analyses must be conducted for all data accumulated under the health and safety program (including injury and illness experience, inspection, and employee reports of hazards) to help identify systemic problems that may not be noticed when only isolated incidents are considered.

1.3.3 Hazard Prevention and Control

Hazards and potential hazards identified in the work site analysis must be prevented or minimized by the implementation of effective controls and measures. Effective controls and measures shall include the following:

Certified Industrial Hygienists, Certified Safety Professionals, Safety Engineers, Fire Protection Engineers, Certified Occupational Physicians, and Certified Occupational Health Nurses shall be available as needed, based on the potential risks at the site.

a. Means for eliminating or controlling hazards are to be implemented in the following order:

1. Process and/or material substitution;
2. Engineering controls;
3. Administrative controls; and
4. Personal protective equipment.

b. Where administrative controls (including work rules and operating procedures) are adopted, they must be appropriate to the hazards of the site, fully implemented (i.e., used by employees), and reviewed at least annually and revised as necessary;

c. There must be procedures for positive reinforcement, reorientation, and, when necessary, consistent, fair disciplinary action for all managers, supervisors, and employees who break or disregard safety rules, safe work practices, materials handling procedures, or emergency plans. These procedures must be written, communicated to employees, and used;

d. There must be on-going monitoring and preventive/predictive maintenance to prevent workplace equipment from becoming hazardous;

e. A system must be in place for initiating and tracking hazard correction in a timely manner;

f. Emergency response procedures must be written and communicated to all employees. These procedures must list requirements for personal protective equipment, first aid, medical care, and emergency egress. They should also include emergency telephone numbers, exit routes, and provisions for training drills, including at least annual evacuation drills; and

g. There must be a medical program that includes timely access to occupational physicians and provides the services required by any applicable Federal and/or State regulations. Occupational professionals, such as occupational physicians and nurses, shall assist in hazard analysis activities (such as job hazard analyses and comprehensive surveys), in early recognition and treatment of

illness and injury, and in limiting the severity of harm. Personnel trained in Cardiopulmonary Resuscitation (CPR) and first aid must be available to all persons working in applicant-controlled spaces during all shifts.

1.3.4 Safety and Health Training:

Managers, supervisors, and employees must know and understand the policies, rules, and procedures established to prevent exposure to hazards. Training for health and safety must ensure that responsibilities are understood, as outlined below:

a. Managers must understand their safety and health responsibilities, as described under "Management Commitment," and know how to carry out those responsibilities effectively; and

b. Likewise, supervisors must understand their responsibilities and know how to carry them out effectively. These responsibilities include:

1. Understanding the hazards associated with a job and the potential effects on employees;
2. Understanding how to ensure, through teaching and enforcement, that employees follow the rules, procedures, and work practices for avoiding or controlling exposure to the hazards; and
3. Knowing how to ensure that everyone understands what to do in emergencies.

c. Employees, through training and enforcement, must become aware of hazards and the safe work procedures to follow to protect themselves. Employee responsibilities include using personal protective equipment where required and knowing why it is required, what its limitations are, how to maintain it, and what to do in emergency situations.

2.0 OBJECTIVES AND PRINCIPLES

The objectives of GSFC's Safety Program are to affect positively the overall success rate of missions and operations and to prevent injury to personnel, loss of or damage to property, loss of technical stature, or environmental harm. Requisite program principles include the following:

a. An aggressive and independent safety function for GSFC to ensure that its programs/projects are accomplished with proper safety planning;

b. Planning, direction, development of requirements, policies, methodology, procedures, implementation, and evaluation of the safety program to ensure its goals are achieved effectively and efficiently;

c. Compliance with the safety standards issued by the Occupational Safety and Health Administration (OSHA) pursuant to Section 6 of Public Law (PL) 91-596 (the Occupational Safety and Health Act of 1970 as amended), 29 USC Section 655. If no OSHA standards apply, GSFC will develop its own supplementary or alternate standards for safety and mission assurance to support its unique

operations, materials, facilities, equipment, procedures, and practices. See NPD 8070.6, Technical Standards, and NPR 8715.1 for further information on the policy for all NASA Technical Standards;

d. Technical reviews by the developing organization of the safety aspects of all development efforts and operations to ensure that they are being conducted in accordance with sound safety-engineering principles;

e. Safety assessments of all systems prior to changes so as to preclude an increase in risk to personnel or equipment. Assessments of both qualitative and quantitative safety risks to people or property along with recommendations to either reduce the risks or accept them. Final risk acceptance is a management responsibility. However, employees have the right to be informed of the risk acceptance process if it affects their personal safety or health;

f. Investigation of all hazardous conditions, close calls, environmental incidents, and mishaps, without retribution to the employees, and the prompt publication of lessons-learned as part of accident prevention and a continuous improvement effort. Procedures for mishap and close call reporting are found in GPRs 8621.1, 2, & 3 and Investigation and NPR 8621.1; and

g. Safety oversight/insight and periodic inspection to ensure compliance with safety policies and assess the effectiveness of GSFC safety activities as required by NASA policy and national consensus standards.

3.0 ROLES AND RESPONSIBILITIES

The NASA Chief Medical Officer is the Designated Agency Safety and Health Official (DASHO), pursuant to Executive Order 12196, Section 1-102. The DASHO coordinates the NASA Occupational Safety and Health Programs (reference NPD 8710.2). The authority and responsibility for safety policy and oversight of its implementation are vested in the Safety and Risk Management Division within the Office of Safety and Mission Assurance (OSMA). Overall responsibility for safety at GSFC rests with the Center Director.

3.1 Center Director and Assistant Director for Safety and Security (ADSS) shall:

a. Ensure that the safety organization is placed at a high enough level (is interpreted to mean that the Functional Director can interface directly with the Center Director and ADSS when problems arise), and the program implementation authority is vested in a person sufficiently senior to manage the effort so the safety review function can be conducted independently. The Center Director and ADSS shall also ensure that adequate resources are made available to support the safety efforts and that the safety responsibilities of each organizational element are properly emphasized and accomplished. Proper safety organizational alignment will support the importance of safety at all organizational levels;

b. Ensure that senior GSFC managers incorporate safety considerations into the planning and execution of programs, projects, and operations in their management function. The officials to whom they report will evaluate and document this in their performance evaluations;

c. Hold managers accountable for the direct safety of their workers. This responsibility extends to any place where their employee(s) are engaged in work related to his/her job, including international and extraterrestrial locations. Ensure supervisors incorporate measurable performance criteria in performance plans and evaluate and document results in their performance evaluations; and

d. Ensure no employee is subjected to restraint, interference, coercion, discrimination, or reprisal for filing a report of an unsafe or unhealthful working condition, participation in the activities of the Agency's occupational safety and health programs, or the exercise of any right or privilege afforded by Section 19 of the Act, Executive Order 12196, or 29 CFR Part 1960.

3.2 **Supervisors** shall:

Comply with the requirements listed in NPD 8715.1 Section 2.3, GPD 8715.1A, Section 5 and:

a. Furnish a safe and healthful place of employment and ensure that identified hazards are eliminated or controlled through a rigorous proactive inspection and abatement process. Assure that a safe and healthful workplace is maintained through active coordination with and support to the designated Facility Operations Manager (FOM) and Building Manager;

b. Provide site/job specific orientation safety training to ensure employees work safely and follow prescribed workplace rules to protect their own and fellow workers, safety and health (this includes any matrixed and co-located employees assigned to their workplace). Inform employees of hazards associated with the workplace and ensure use of appropriate personal protective equipment (PPE);

c. Ensure that NASA employees are provided safety and health training and PPE as applicable to the work environment. Contractor support employees are required by NASA and Federal Procurement Law to have the appropriate safety training/certifications provide by their company "before" they can begin work;

d. Cooperate with and assist safety and health personnel while they are performing their duties as specified in the NASA Occupational Safety and Health (OSH) program;

e. Ensure timely reporting of mishaps and close calls and timely follow up of any corrective actions;

f. Directors of will ensure there is a written Safety Management Plan/Manual for their organizations and provided to employees;

g. Ensure appropriate safety and mission assurance Risk-Based Acquisition Management (R-BAM) requirements are included in procurement, design, development, fabrication, test, or operations of systems, equipment, and facilities and will serve as a basis for awarding any fee on contracts;

h. Consult Safety Office personnel in the procurement process for the acquisition of hardware, services, materials, and equipment with safety implications;

i. Ensure employees have access to information about and participation in the Safety and Health Program;

j. Ensure, as a minimum, Quarterly Safety Walkthrough Audits of their work areas/operations are accomplished and that any noncompliance findings are recorded on a tracking log. Ensure hazards are controlled and/or corrected to eliminate injury to personnel or property;

k. Attend Safety and Health classes/courses when scheduled by the Safety and Human Resource Offices; and

l. Ensure that any matrixed and/or co-located employees assigned from their organization to another host organization are provided with a safe and healthful environment. This means having direct communication with the gaining supervisor and, if required, physically assessing their employees new worksite for potential hazards.

3.3 Employees shall:

Comply with the requirements and be provided information and participation opportunities delineated in NPD 8715.1, Sections 2.4 - 2.6, and GPD 8715.1A, Section 5, and:

a. OSHA 300 log and summary of occupational injuries and illnesses, including OSHA Form 100F or its equivalent, subject to the Privacy Act of 1974, as amended, 5 USC 552a;
b. Access to inspection reports, Task Hazard Analyses of work operations, associated job safety and health documentation, and accident investigations;

c. Be empowered to cease any process or operation they believe is unsafe and request analysis by a qualified individual. Qualified individual will determine the corrective actions needed (if any) and when the process or operation may be resumed;

d. Attend all initial and refresher safety and health training as mandated by Federal, NASA, and GSFC occupational work standards/requirements. Failure to do so, within a reasonable schedule, will result in the suspension of the employees work activities until the training is completed.

3.4 Resolution of Complaints:

3.4.1 Where an employee has made a report of a suspected unsafe or unhealthful condition to his/her supervisor and is dissatisfied with the abatement action taken, the following appeal options shall be available:

a. Center Safety/Health Official(s), as appropriate;

b. Center Director or Director of;

c. Center Ombudsman (Assistant Director for Safety and Security);

d. Designated Agency Safety and Health Officer for NASA;

e. NASA Safety Reporting System (NSRS); and

f. Office of Federal Agency Safety and Health Programs – OSHA/DOL.

3.4.2 Complaints or grievances may also be registered through the NASA grievance procedures, through those procedures contained in agreements negotiated with recognized labor organizations or through the NASA Office of Inspector General.

3.5 Professional Health and Safety Services

a. The Safety Office shall exercise oversight authority to ensure the implementation of overall OSHA, NASA and GSFC safety policies, regulations, standards, and procedures;

b. The Safety Office shall provide specialized assistance to employees and all levels of management. The staff shall provide support and assistance in:

1. Occupational Safety
2. Fire Protection
3. Occupational Medicine
4. Industrial Hygiene/Chemical Safety
5. Mishap Investigation and Process
6. Workers Compensation
7. Education and Awareness
8. Safety Management System
9. Contractor Safety Program Oversight
10. Facilities System Safety
11. Radiation Safety
12. Cryogenics Safety
13. Public Safety

c. The Safety Office shall establish a formal schedule of audits for all operations/facilities. All active areas and operations of each establishment shall be inspected at least annually. More frequent

inspections shall be conducted in all establishments where there is an increased risk of accident, injury, or illness due to the nature of the workplace.

1. Only qualified inspectors shall conduct official facility inspections. Safety and Health Specialists must meet the qualifications as defined in 29 CFR 1960.2 and NPR 8715.3. Safety Office shall be responsible for the determination and certification of qualified personnel;

2. Inspectors shall have sufficient documented training and experience in safety and health necessary for the recognition, evaluation, and general abatement procedures of health and safety hazards;

3. Any facility, structure, operation, vehicle, or equipment that is in an inactive status shall undergo a thorough inspection to identify potential hazards;

4. Sufficient unannounced inspections and unannounced follow-up inspections shall be conducted to ensure the identification and abatement of hazardous conditions;

5. Special inspections shall be conducted at the request of safety and health committees, employees or their representatives, or upon notice of an unsafe or unhealthful condition; and

6. Inspections shall be conducted in accordance with 29 CFR 1960.26. GSFC shall maintain documentation of all inspections and the results thereof for a minimum of 3 years.

3.6 Public Safety

A priority of GSFC is to protect the public from any adverse effects of GSFC operations. The Center Director, program/project managers, and line supervisors shall strive to eliminate the risk or the adverse effect of GSFC operations on the public. Where GSFC cannot do this, GSFC will provide protection by exclusion or other protective measures. If there is likelihood that the public and surrounding communities could be affected by GSFC operations, GSFC safety and emergency planning officials shall establish cooperative programs with the local communities and shall perform the following:

a. Ensure community awareness regarding the nature and extent of actual and potential hazards arising from the GSFC operations and the measures to be taken to protect the community;
b. Jointly develop emergency response plans, including protective action guides, to address the effects posed by hazards from radiological contamination, explosive/propellant mishaps, and toxic chemical spills;

c. Participate in community safety activities and cooperate with local authorities to develop response plans to contend with natural disasters such as tornadoes, hurricanes, and floods; and

d. Coordinate emergency planning, response, and notification activities required by Section 313 of the Emergency Planning and Community Right-To-Know Act (42 USC Section 11023) involving local

jurisdictions with the environmental management organization, following the procedures established in NPR 8820.3, Pollution Prevention.

Occasionally, research personnel who are neither contractors nor visitors are allowed access to GSFC facilities to conduct individual research under grants or cooperative agreements. These research operations must not be allowed to interfere with or damage GSFC facilities or operations. If their work involves exposure to hazardous operations, the Safety Office shall require them to follow all GSFC and NASA safety requirements. Also, if these personnel will be operating or using potentially hazardous GSFC equipment, they shall receive training and be certified as a qualified operator in accordance with Section 3 of this document.

4.0 RISK ASSESSMENT

a. The primary purpose of risk assessment is to identify and evaluate risks to support decision-making regarding actions to ensure safety and mission success as well as to support decision-making in other areas, such as selection of contract type, development of fee incentives and surveillance plans, and information security. The decision (based on all relevant factors) to accept a hazard with its associated risk is a line management responsibility but shall require coordination with the appropriate safety official. In all cases, when a decision is made to accept a hazard with its associated risk, that decision shall be communicated to the next higher management level for review. The probability of a mishap coupled with the severity of the possible consequences shall be a major consideration in that decision. This is discussed in detail in GPR 7320.1.

b. Personnel conducting risk assessment analysis shall use the simplest methods that adequately characterize the probability and severity of undesired events. Qualitative methods that characterize hazards and failure modes shall be used first. Quantitative methods shall be used when qualitative methods do not provide an adequate understanding of failure causes, probability of undesired events, or the consequences of hazards or potential failures. GSFC organizations shall use the procedures and the Risk Assessment Code Matrix outlined in NPR 8715.3, Chapter 3, and NASA Form 1584 for hazard identification and risk reduction analysis.

5.0 SAFETY PROGRAM REVIEWS

In addition to normal management surveillance, competent and qualified safety personnel through safety staff assistance visits, audits, and process verification evaluations shall formally assess the Centers' Safety Programs annually. Safety representatives, or an independent outside source, may perform the formal assessments. These assessments shall:

a. Annually evaluate the effectiveness of the Safety Management System;

b. Evaluate the implementation of Public Law 91-596, The Occupational Safety and Health Act of 1970, as amended; EO 12196, Occupational Safety and Health Programs for Federal Employees, as amended; OSHA Regulations at 29 CFR 1910, Occupational Safety and Health Standards, and other pertinent Federally mandated requirements;

c. Identify hazards and deficiencies in the safety program;

d. Evaluate the effectiveness of the abatement process;

e. Determine the adequacy of safety standards and procedures;

f. Observe compliance with safety practices; and

g. Verify corrective actions from previous assessments.

5.1 Review Categories

Three types of qualitative assessments are described below:

a. Safety staff assistance visits are informal onsite evaluations by specialists and safety personnel who, after making spot checks and/or sampling and holding discussions with appropriate levels of management, provide assessments to the affected organization.

b. Safety Audits are in-depth technical reviews conducted at the working or facility level to assess the compliance with safety policies and standards that apply to the particular workplace. The safety inspection team shall provide formal reports to the appropriate management level responsible for correcting the deficiencies.

c. Compliance Verification Audits are documented Headquarters-level reviews performed in accordance with pre-approved subject area outlines to verify, by examination and evaluation of objective evidence, whether required safety and mission assurance program elements are in place and functioning. Although the process verification team provides a written report, specific written responses are not required. Corrective actions are documented through normal reporting processes and follow-up assessments.

5.2 Notice and Abatement of Unsafe or Unhealthful Conditions

a. The receipt of information concerning unsafe conditions at GSFC, whether received through a report from an employee and verified, or as a result of a workplace inspection, will require the issuance of a Notice of Unsafe or Unhealthful Condition (NF 1390) if the condition is a Risk Assessment Code of 2 or higher (see GPR 7320.1) and may require a NASA Safety and Health Hazard Abatement Form (NF 1584) or equivalent forms. Imminent danger issues will be addressed in accordance with 29 CFR 1960.26, Conduct of Inspections (see NPR 8715.1 for more information).

b. Inspection requirements vary according to the type of unsafe or unhealthful conditions that are reported.

c. An allegation of an imminent danger condition shall require an immediate inspection by the worksite management and the Safety Office.

d. An allegation of a potentially serious condition requires an inspection within 3 working days.

e. Any allegation of other than imminent or serious safety or health conditions shall be inspected within 5 working days.

f. Further inspections may not be necessary if the hazardous condition(s) can be abated immediately through normal management action and prompt notification to employees and safety and health committees if the abatement is permanent.

g. Written reports/notices of safety or health violations shall be issued not later than 30 working days after completion of the inspection and confirmation by the inspection official.

1. A copy of the notice shall be sent to the supervisor in charge of the workplace, the representative of the employees, and the safety and health committee of the workplace, if any.
2. Upon receipt of any notice of an unsafe or unhealthful working condition, the supervisor in charge of the workplace shall post such notice (when required by the safety or health office) at or near each place where the condition exists or existed.
3. Each notice shall remain posted (when required) until the unsafe or unhealthful working condition has been abated or for three (3) working days, whichever is later.
4. For those deficiencies that can be rectified within 30 days, written notification by the supervisor in charge of the establishment indicating the corrective action and associated cost, along with verification of proper abatement by the safety and health office(s), is required, using NASA Form 1390, Notice of Unsafe or Unhealthful Conditions.
5. The supervisor in charge of the establishment shall ensure that a copy of the notice is filed and retained for a period of 5 years after abatement and made available to OSHA or National Institute of Occupational Safety and Health (NIOSH) officials upon request. electronic versions are acceptable for recordkeeping purposes.

h. An Abatement Plan (NF 1584 or equivalent) is required for hazards that cannot be abated within 30 days. A copy shall be provided to the safety and health committee and employee representatives as applicable. A copy shall be provided to the Safety and Risk Management Division if Headquarters advocacy is required to secure funding. In all cases, operations shall not proceed until alternative procedures are in place to provide temporary mitigation or reduction of the risk to acceptable levels.

i. The supervisor in charge of the work operation, or a person empowered to act for that official, shall undertake immediate abatement, or cease operations and withdraw exposed personnel who are not necessary for abating an imminent danger condition. In the event the supervisor in charge of the operation needs assistance to undertake full abatement, that official shall promptly contact the responsible support organizations who shall assist in the abatement effort.

j. Upon request of the employee, his or her name shall not be disclosed except to the Safety Office in connection with the report of a suspected unsafe or unhealthful condition.

k. All written reports and imminent danger oral reports of unsafe or unhealthful conditions will be recorded as received by the Safety Office and a file maintained as to the disposition. (Electronic versions are acceptable for recordkeeping purposes.)

l. The notice shall be sent to the supervisor in charge of the establishment for correction (and posting if directed by the Safety Office.) The Safety Office shall establish closed-loop procedures to ensure necessary follow-up and correction.

5.3 Access for Federal Regulatory Representatives

a. Official representatives of OSHA and NIOSH are authorized to enter NASA establishments for purposes of inspection and/or evaluation of conditions therein. The NASA DASHO or designee must be notified immediately of any OSHA inspection or visit.

b. Access to security controlled areas will be coordinated with the Center Security Division. Such representatives shall be required to present appropriate identification, receive necessary security clearance, and be escorted during their visits.

c. OSHA and NIOSH representatives shall be provided, upon request, available safety and health information on GSFC or Component Facility to be visited.

d. Arrangements shall be made for such officials to interview and be accompanied by employees or representatives of employees during their visit. Within 10 working days following written notification of findings of an inspection by OSHA or an evaluation by NIOSH, GSFC shall provide a summary of any findings and corrective action necessary to the DASHO.

5.4 Advisory Panels, Committees, and Boards

It is GSFC's intent that maximum use be made of the Nation's most competent safety resources. In keeping with this philosophy, GSFC may enlist consultants, interagency and interdisciplinary panels, and ad hoc committees, consisting of representatives from industry (management and union), universities, and Government (management and union), to review and advise on the needs of the GSFC Safety Program. For a complete list of safety resources, see NPR 8715.3, Section 1.11.

5.4.1 Goddard Safety Committee

The GSFC Center Director, or a designee, will be the chairperson. The purpose of this committee is to provide a forum for meaningful discussion of, and a channel for input to, management's decisions relative to occupational safety and health matters. For these reasons, membership shall be broad based and shall include representatives of both management and employees. Safety and health, as well as other technical personnel, shall be either full members or advisors to the committee and shall attend meetings. See GPR 8710.1A for information on the GSFC Safety Management Council.

5.4.2 Subordinate Safety and Health Committees

Special safety and health committees may be formed on an ad hoc or continuing basis in accordance with 29 CFR 1960.38 to assist GSFC safety and health officials in dealing with particular programs, projects, geographical areas, or special operations. Committee members chosen for this assignment shall receive safety or health training as required. Directorates and divisions are also encouraged to form supervisor- and employee-level safety committees to assist in the implementation of the safety and health programs. Written minutes of each committee meeting shall be maintained and distributed per 29 CFR 1960.37.

5.5 Emergency Planning

The GSFC Emergency Preparedness Plan is part of the Government program to maintain critical GSFC functions during national emergencies ranging in severity from fires and civil riots to a full-scale military attack on the United States.

a. Directors of and supervisors are responsible for preparing their organizations to handle emergencies and disasters effectively, and for ensuring the development of organizational-specific Emergency Action Plans.

b. Emergency Action Plans shall be in place, discussed with the appropriate personnel, and exercised periodically for all GSFC activities so that reaction to emergency situations is rapid and effective.

c. Such plans shall cover the response to national and local emergencies, disasters, and mishaps, and the attendant communication of information. For specific responsibilities, functions, and program requirements, see GPR 8710.2A for Greenbelt.

5.6 Safety Motivation and Awards Program

GSFC is committed to continued improvement of safety in all operations. GSFC's policy is to stimulate the participation of employees in this effort. The presentation of awards is considered appropriate for recognizing outstanding safety-related performance/contributions and is an effective means of encouraging safety excellence. GSFC safety awards programs also may provide for the recognition of non-Government personnel supporting GSFC objectives. For more information see GPD 3451.1.

GSFC recognizes responsible individuals and organizations for the following:

1. Taking significant safety initiatives.
2. Making truly innovative safety suggestions.
3. Meeting major safety goals.
4. Making significant achievements leading to the safer and more effective use of resources or execution of GSFC operations.
5. Encouraging and rewarding safety excellence among employees, supervisors, and contractors.

5.7 Safety Management Information

Efficient communication of safety information is necessary to meet the needs of safety officials and the managers they support. This includes communications between and among operational and safety organizations.

a. The Safety Office will pursue every practical means for communicating verbal and written safety management information, lessons learned, and statistics.

b. Examples of information systems are the Incident Reporting Information System (IRIS) and the Lessons Learned Information System (LLIS).

c. Records and reports of accidents, occupational injuries, incidents, failure analyses, identified hazards, mishaps, appraisals, and like items contain information necessary for developing corrective measures and lessons learned.

5.8 Injury Recordkeeping and Reporting Requirements

GSFC shall maintain detailed records of occupational injuries that are reported to OSHA in accordance with 29 CFR 1960, Subpart I, and NPR 8621.3. Employees are allowed access to this data and their medical exposure records in accordance with 29 CFR 1960. To obtain the information, contact the Safety Office who will advise the employee on proper procedures.

5.9 Safety Lessons Learned

The distribution of safety lessons learned is vital to improving understanding of hazards, preventing the occurrence of accidents, and suggesting better ways of implementing system safety programs.

a. Safety lessons learned during the performance of management and technical functional activities or mishap or close call investigations shall be developed and disseminated by the code experiencing the event to managers and throughout NASA Centers and Headquarters by responsible personnel.

b. Affected managers will contribute appropriate information to the LLIS. The LLIS shall provide a library of lessons learned data for use by program managers, design engineers, operations personnel, and safety personnel. Procedures for disseminating lessons learned are found at http://llis.nasa.gov/.

c. Affected managers shall also include this information in program, procurement, and Center newsletters to communicate more effectively with other management entities.

d. Lessons learned that indicate the need to revise source documents (e.g., policies, procedures, specifications, and standards) shall be submitted directly to the person(s) preparing the document.

5.10 NASA Safety Reporting System (NSRS)

The NSRS is a confidential, voluntary, and responsive safety reporting system that provides a direct channel for NASA employees and contractors to notify the Safety and Risk Management Division of safety concerns.

a. The NSRS enables safety personnel to identify safety problems and implement corrective actions independently. The nature of corrective actions may be engineering, manufacturing, administrative, procedural, or operational.

b. All involved safety professionals having timely information about actual hazards are of the highest priority; the NSRS has been established to collect, evaluate, and communicate such information in a timely and accurate manner.

c. NSRS is intended to supplement, not replace, existing local hazard reporting systems when those systems do not resolve an individual's safety concerns. Information about the NSRS and a copy of the NSRS form are found at http://www.hq.nasa.gov/office/codeq/nsrs/index1.htm.

5.11 Safety Documentation

a. The HQ documentation tree represents the Safety and Mission Assurance top-level NASA Policy Directives, NASA Procedures and Requirements, applicable NASA Technical Standards, and other top-level documents in the NASA Safety Program. The Safety and Mission Assurance documentation tree is posted on the Internet at http://www.hq.nasa.gov/office/codeq/doctree/index.htm

b. GSFC Safety, Environmental, and Health documents are found on the Goddard Document Management System (GDMS) Menu.

5.12 Safety Variance Process

The primary objective of the GSFC safety variance policy is to define the roles of Headquarters, program managers, and safety personnel in such a way that Headquarters will maintain control over the requirements it sets while providing the Centers and program managers with the responsibility and freedom to accept risks necessary to accomplish their tasks. This is consistent with an ISO 9001 requirement of maintaining process control of services that an organization provides. It is NASA's preference to comply with requirements through an abatement process. Where this is impossible for whatever reason, a variance may than be considered.

a. The following definitions apply to the GSFC safety variance approval policy:

1. Variance – Documented and approved permission to perform some act or operation contrary to established requirements.

2. Deviation – A documented variance that authorizes departure from a particular safety requirement that does not strictly apply or where the intent of the requirement is being met through alternate means that provide an equivalent level of safety with no additional risk. The OSHA term for deviation is alternate or supplemental standard only when it applies to OSHA requirements.

3. Waiver – A variance that authorizes departure from a specific safety requirement where a special level of risk has been documented and accepted.

4. Shall – "Shall" indicates that the rule is mandatory. Noncompliance with a "shall" statement requires approval of a variance.

5. Should – "Should" indicates that the rule is a recommendation, the advisability of which depends on the facts in each situation. Implementation of a "should" statement is at the discretion of the local officials.

b. The GSFC variance process does not apply to Federal and applicable State/local regulations (e.g., OSHA, EPA, MOSH). Any variance of a Federal or State/local regulation must be approved by the appropriate Federal/state/local agency (e.g., NASA Alternate Safety Standard for Suspended Load Operations approved by OSHA). The HQ Safety and Risk Management Division shall review all proposed safety variances of Federal regulations before submittal for approval.

c. The GSFC Safety Variance Policy (adopted from the NASA policy) is provided in table 1.1. It applies to all GSFC safety requirements unless otherwise specified in the appropriate requirements document. Variance policies developed for specific safety programs shall follow this general policy as closely as possible.

d. When a variance is approved by Headquarters and is considered appropriate for use throughout the Agency, it shall be distributed as an interim change to the applicable requirement documents.

e. All requests for variance will be accompanied by documentation as to why the requirement can not be met, the risks involved, alternative means to reduce the hazard or risk, the duration of the variance, and comments from any affected employees or their representatives (if the variance affects personal safety). Variances will normally be approved by the HQ Safety and Risk Management Division for up to 5 years. Variances approved at the Center or program level can remain in place as long as Headquarters status reporting is current.

Table 1.1 GSFC Safety Risk Acceptance and Approval Process Matrix

Type of Document	Wording	Routing (see Note A)	Approval Level and Duration (see Note B)	After Action Reporting and Statusing Requirements
Federal or National Consensus Guidelines	Standard or Policy	Through Code 302 Office Chief, or Code 350 Division Chief, and the Code 300 Director Of, and NASA HQ/QS in-turn	Issuing Federal Agency or Consensus Committee	Assessed and statused annually with input for OSHA report
State	Standard or Policy	Through Code 302 Office Chief, or Code 350 Division Chief, and the Code 300 Director Of, and NASA HQ/QS in-turn	Issuing State Agency	Assessed and statused annually with input for OSHA report
NPD	Policy	Through Code 302 Office Chief, or Code 350 Division Chief, and the Code 300 Director Of	NASA HQ IPO or Enterprise	Assessed and statused annually with input for OSHA report
NPR	Shall	Through Code 302 Office Chief, or Code 350 Division Chief, and the Code 300 Director Of	Center Director * Directorate level Facility Manager or Program Manager	To NASA HQ/QS within 14 days and then assessed and statused annually with input for OSHA report To NASA HQ/QS Quarterly and then assessed and statused annually with input for OSHA report
NASA Technical Standard or GPR	Shall	Through Code 302 Office Chief, or Code 350 Division Chief, and the Code 300 Director Of	Center Director *	To NASA HQ/QS within 14 days and then statused annually with input for OSHA report

Note A: The lowest organizational or program level of management having responsibility to implement safety requirements (e.g. facility manager, program systems manager, first line supervisory personnel) will assess, prepare, and submit a variance request through the appropriate levels of authority to the official with final approval authority. Safety officials (both program and Center as applicable) will concur or non-concur with the request but will not serve as the responsible approving official.
Note B: Using the guidelines of this matrix, the final approval is the responsibility of the listed manager or director who, by their position, has the authority to accept the risk. Variances approved against mandatory ("shall") requirements are valid for up to 5 years.

Example: A variance request to a requirement stated in an NPR (fourth row of matrix) that uses the word shall would be routed through the Center Safety Director for concurrence and approved or denied by the Center Director. A copy would then be sent to NASA HQ/QS within 14 days along with the detailed rationale for its approval and other documentation. Annual status reports will be provided to HQ/QS concurrently with the input to the annual OSHA report.

*Approval is allowed at this level if the specific requirement is not implementing Federal regulatory policy. In those cases, forward to NASA HQ/QS for variance request to applicable Federal agency.

6.0 RECORDKEEPING AND REPORTING REQUIREMENTS

See the records retention schedules in P.8.

Annual Summary – Occupational Injuries/Illnesses (OSHA Form 102F and 102FF) summarizing the calendar year information will be forwarded to the DASHO or designee within 30 days following the end of the calendar year. A summary of all open abatement plans and a listing of those closed during the reporting period will also be provided to the DASHO or designee as part of the input to the annual report.

7.0 CONTRACTOR SAFETY AND RISK MANAGEMENT REQUIREMENTS FOR NASA CONTRACTORS

This section describes the requirements for assuring that all GSFC contractors have effective safety and risk management programs.

a. When GSFC activities include contractor involvement, contracts shall be written to hold contractors accountable for the safety and health of their employees, services, and products (as applicable).

b. The Contracting Officer (CO) and the Safety Office shall assure that the requirements of this directive are included in GSFC contracts. Those requirements must be coordinated with the program or project office, and other offices as needed.

c. Contracts shall contain safety and mission success and risk management requirements as appropriate for design, development, fabrication, test, or operations of systems, equipment, and facilities.

d. Where appropriate, solicitations shall require the submission and evaluation of safety and risk management documentation (e.g., corporate safety policies, implementation procedures, their safety performance experience, and their mishap rates by SIC codes) and draft program planning documents, such as safety and health plans, risk management plans, etc. (See Chapter 3, Appendix H and Appendix I of NPR 8715.3, for more information.)

e. On a case-by-case basis and before contract performance begins, the Safety Office shall brief onsite contractors on local safety requirements and document these briefings. The responsible organizational safety representatives will also inform the onsite contractor of any adjacent GSFC and other contractor operations that could pose a hazard to their operation and employees.

f. To the extent specified in the contract, contractors shall develop motivation, awareness, training, and certification programs for their employees in safety matters. This will include regularly scheduled safety meetings for supervisors, foremen, and employees. Contractors shall document safety-related training in accordance with OSHA requirements and as specified in the contract.

g. To the extent specified in the contract, contractors shall report safety data on mishaps, close calls, and lessons learned as required in this document, NPR 8621.1, and in accordance with OSHA requirements. Investigation of contractor mishaps shall be performed in accordance with investigation procedures as specified in the contractor's safety plan. The CO or the Contracting

Officer's Technical Representative (COTR) shall evaluate and verify implementation of corrective actions.

h. To the extent specified in the contract, contractors shall monitor and self-evaluate activities for compliance with the safety provisions or requirements of the contract. Contractor activities also shall be properly monitored and evaluated by NASA officials (or delegated agencies). These safety program reviews shall be conducted to identify and correct any safety problems at an early stage.

i. Safety Office personnel shall assist the program or project manager or other responsible official in implementing contractor safety surveillance and evaluation programs. The depth of insight and oversight employed will fit the extent of hazards and the importance of the program.

j. To the extent specified in the contract, contractors shall provide the CO or safety officials with access to their activities to determine the adequacy of safety measures. Contractors shall also provide access for NASA Headquarters and Center safety program review teams for them to conduct selected announced and unannounced reviews of contractor operations.

k. To the extent specified in the contract, contractors located on GSFC facilities shall comply with Center safety and emergency planning requirements. Contractors shall document their emergency points of contact and safety responsibilities for all operations with safety implications.

l. To the extent specified in the prime contract, contractors shall include safety responsibilities in subcontracts.

m. To the extent specified in the contract, contractors shall assess all Government-Furnished Property (GFP) or Facilities (GFF) associated with the contract and advise the CO of areas not in compliance with OSHA standards.

7.1 Program and Project Managers shall:

a. Coordinate with the Safety Office to develop and approve safety requirements and objectives for efforts to be contracted and advise COs of these specific safety concerns or issues related to the contract performance.

b. Develop safety requirements and objectives that are clearly delineated in the specifications. Provide specific tasks to the contracting officer for incorporation into the contract as required.

c. Tailor surveillance of contractor safety matters appropriate to the nature of the procurement. (Even a performance-based contract must have a surveillance plan.)

d. Where appropriate, include safety as an element under Mission Suitability and/or Past Performance in the Source Selection Plan.

7.2 Contract Officers shall:

a. Coordinate any matters regarding proposed deviations to safety requirements of NASA FAR Supplement (NFS) Subpart 1823.70, Safety and Health, with the Director, Safety and Risk Management Division, or his/her designated representative.

b. Establish safety performance, where appropriate, as an element to be evaluated in contracts with fee plans.

c. Require copies of Material Safety Data Sheets (MSDS) be entered into the Center's MSDS Inventory System for all hazardous materials brought onsite or where requested by the Safety Office.

d. Contractors' hazard analyses/safety risk assessment shall be developed and provided to GSFC for approval before the start of any hazardous deliverable work or support operations as directed by the CO or the COTR.

7.3 Safety Office and Mission Assurance Personnel shall:

a. Participate in the development of the safety tasks and requirements in conjunction with program officials.

b. Participate in onsite visits and pre-bid conferences to ensure potential bidders understand safety provisions.

c. Assist the CO in evaluating the safety record of the prospective contractors.

d. Assist the CO as appropriate in evaluating the contractor's performance regarding safety.

e. Assist the CO as appropriate in applying any special safety provisions to grants or cooperative agreements.

7.4 Access to NASA Facilities by Compliance Officers to Investigate Contractor Mishaps

a. Compliance safety and health officers are persons authorized by the OSHA, U.S. Department of Labor (DOL), to conduct inspections. Federal (OSHA) or state compliance safety and health officers shall be allowed on GSFC property to review and survey contractor operations and investigate mishaps. If the State does not have a DOL-approved safety plan or the Center is under exclusive Federal jurisdiction, only Federal compliance officers shall have the right of access to NASA or contractor operations.

b. Unless exclusive Federal jurisdiction is claimed by Federal OSHA, both Federal and state OSHA investigators shall be allowed to investigate a contractor mishap occurring on a NASA Center. The HQ Safety and Risk Management Division or the Office of Heath Affairs as applicable and the DASHO shall be notified of OSHA's (Federal or state) impending investigation and shall be provided the results of their investigation.

7.5 Contractor Citations

Under the Occupational Safety and Health Act of 1970 (P.L. 91-596), as amended, an employer is responsible for providing employees with safe working conditions regardless of where the employees are working. Therefore, it is the contractor's responsibility to submit a timely reply to any OSHA citation it receives. The contractor is responsible for settling citations issued against the operation unless specifically addressed in the contract.

7.6 Grants

A "special safety condition"(NASA FAR 1852.223-70) addressing safety shall be included in grants and cooperative agreements when performance involves GSFC facilities, GFE, or hazardous or energetic materials or chemicals that may pose a significant safety or health risk when used. Program offices that select research projects that could contain possible safety issues shall identify the need for a safety special condition to be included in the grant or cooperative agreement award document. The special safety condition shall include the provision that all applicable OSHA requirements, host institution, and general industry-accepted practices shall be followed during the research to eliminate or control the risks associated with the grant or cooperative agreement.

8.0 SAFETY TRAINING AND PERSONNEL CERTIFICATION

NASA is committed to the development and implementation of a comprehensive program of occupational safety and health training and instruction. The purpose is to assure the highest practical skill levels for safety and health professionals, safe work habits for employees involved in controlled hazardous operations, and sufficient information to enable management officials and supervisors to recognize their responsibilities under the Occupational Safety and Health Act and the NASA safety and health programs.

a. Training shall be provided to assist managers/supervisors and employees in their specific roles and responsibilities in the safety programs. Executive Order 12196, Occupational Safety and Health Programs for Federal Employees, February 26, 1980, and 29 CFR 1960 (Subpart H) require that GSFC establish comprehensive safety training programs. See NPR 8715.1.

b. This section describes the requirements for establishing safety training programs and minimum training certification levels necessary for personnel involved in potentially hazardous GSFC operations. Some of this training is available on the Internet through the Site for On-line Learning and Resources (SOLAR) at https://solar.msfc.nasa.gov. Instructor-based courses are available through the Human Resources Training Division, the Safety Office, and NASA Safety Training Center (NSTC). The list of safety and health training courses provided by the Center is also located on the Safety1st web site, which links to safety training tools and resources.

8.1 Safety Training Responsibilities

a. The Human Resource Training and Personnel Development Office's and the Safety Office shall jointly be responsible for determining safety and certification training needs and overseeing those training efforts. Typical responsibilities are as follows:

   1. Identification of training needs.
   2. Identification of budget requirements for training.
   3. Development of training courses and materials.
   4. Assurance that training records reflect employee safety training.

b. Each line organization shall manage the certification program for its employees and contractors in accordance with procedures and guidelines in this section.

c. Medical Clinic. The GSFC Medical Director oversees or conducts the required personnel medical examinations in support of the safety certification effort and ensures compliance with OSHA and other Federal, State, and local agency medical monitoring and recordkeeping requirements. The Medical Director shall determine the depth, scope, and frequency of medical examinations. The Medical Director is also responsible for medical certification in health hazard and related activities.

8.2 Planning and Implementation

a. The Center shall formulate a comprehensive safety training program. Center subject matter experts shall review training materials at least annually and update GSFC promulgated materials as needed when regulatory agencies or changes in GSFC and NASA policy documents generate technical changes.

b. Each Directorate shall review annually operations being performed at the Center to ensure that the implemented safety training program is working effectively, and to identify those jobs that are potentially hazardous, in addition to the mandatory listing in Table 8.1. Employee safety committees, employee representatives, and other interested groups should be provided an opportunity to assist in the identification process.

8.3 Personnel Safety Certification Program for Hazardous Operations and Materials

Many GSFC operations involve hazardous materials or chemicals, technology, or systems with potential hazards to life, the environment, or property. People who perform or control hazardous operations or use or transport hazardous material must possess the necessary knowledge, skill, judgment, and physical ability (if specified in the job classification) to do the job safely, and be certified to do so.

a. Exclusions. This section does not apply to personnel engaged in operations that already require skill certification by quality assurance organizations, such as soldering, brazing, crimping, potting, etc., or to personnel performing inspections using dye penetrant, magnetic particle, ultrasonic, radiograph, and magnaflux, etc.
b. This section shall not be used as a justification for allowing hazardous duty payments, environmental differential pay, or premium pay, nor will the fact that a job qualifies for hazardous duty pay imply that it is covered by this section. It has always been GSFC and NASA safety policy to make all

operations as safe as possible. Hazard duty pay differentials are covered in 5 CFR Part 532, Prevailing Rate System, and 5 CFR Part 550, Pay Administration.

c. Hazardous operation safety training is required for those tasks that potentially have an immediate danger (death/injury) to the individual if not done correctly, or could create a danger (death/injury) to other individuals in the immediate area, or are a danger to the environment. Detailed training and certification requirements are found in specific OSHA and NASA Standards. Safety Office Personnel, or their designees, can require additional hazardous operation safety training/certifications but must include, as a minimum, the following occupations/tasks:

d.

Table 8.1

Asbestos Abatement Workers	Heavy Equipment Operators	Rescue Personnel
Altitude Chamber Operators	High-Pressure System Operators (150 psi or greater)	Riggers for Hoisting Operations
Confined Space Entry Personnel	Scaffolding Riggers	Self-Contained Breathing Apparatus (SCBA) users
Centrifuge Operators	Electricians	Self-Contained Underwater Breathing Apparatus (SCUBA) users
Crane Operators	Hyperbaric Chamber Operators	Tank farm workers
Explosive Handlers	Laser Users and Maintenance Personnel	Welders
Laboratory Workers	Lockout/Tagout Personnel	Facility Operations & Maintenance Personnel
Forklift Drivers	Propellant or Explosives Handlers and Users	Hazardous Materials Handlers
Critical Lift Operators	Radiation Ionizing and Non-Ionizing Source Users	
Machine and Wood Working Shop Equipment users	Construction Workers	

e. All personnel engaged in hazardous operations or hazardous material handling, as determined by line management or Safety and Health personnel, shall be trained/certified as capable to operate the equipment or perform their jobs in a safe manner. All contractor personnel engaged in potentially hazardous operations or hazardous material handling shall be certified via a similar process by their respective employer.

f. Unless otherwise specified, the need for physical examinations to support operator training/certification requirements shall be determined by the appropriate health official and will be in compliance with the applicable codes, regulations, and standards covering the occupation or environment. The need for fitness-for-duty examinations should be based on the hazardous consequences of employee's inability to perform the job correctly due to physical or mental deficiencies.

g. Personnel who are hazardous operations safety trained/certified or, hazardous material handler certified, shall be identified through the issuance of a certificate, card, license, or badge (to be immediately available) or a listing on a personnel roster or database. The roster indicates name, date, materials or operations for which training/certification is valid, name of certifying official, and date of expiration (if applicable).

9.0 OPERATIONAL SAFETY

The purpose of this section is to protect the public, flight, ground, laboratory, the environment, spacecraft payloads, and property from operations-related safety hazards. This section is not inclusive of all regulations and requirements governing operations. References are indicated liberally throughout the text for detailed or working standards, specifications, and other references.

9.1 Motor Vehicle Safety

a. GSFC shall adopt all procedures that comply with applicable Federal, state, and local motor vehicle safety regulations.

b. Operators of motor vehicles shall not drive a motor vehicle for a continuous period of more than 10 hours, including non-GSFC driving; nor shall the combined duty period exceed 12 hours in any 24-hour period, without at least 8 consecutive hours of rest. Variation in the above policy requires documented Safety Office approval.

c. If operation of the vehicle involves skills beyond those associated with normal, everyday operation of private motor vehicles, formal initial training, consisting of both classroom and operational testing, shall be conducted to ensure operator proficiency. Refresher training and testing shall be accomplished periodically as determined by the Safety Office.

d. All GSFC motor vehicles used off Center shall be inspected to the standards of the State or other jurisdiction's vehicle safety inspection requirements.

e. Federal employees will use seat belts while on official business as required in Section 1 of Executive Order (EO) 13043 of April 16, 1997, Increasing Seat Belt Use in the United States. The EO states seat belt use is required by Federal employees operating or in any vehicle with seat belts while on Federal business. All GSFC employees shall comply with this mandatory requirement while traveling on official business.

f. Passengers are forbidden to be carried in the cargo area of pickup trucks, flatbeds, or special purpose equipment such as fire trucks or escape trucks unless designated occupant positions are provided (see 49 CFR Part 571) and required seat belts are provided.

g. All occupants of motor vehicles (so equipped) operated on GSFC property, including delivery vans and trucks of all sizes, shall have their seat belt properly fastened around themselves at all times the vehicle is in motion.

h. Traffic Control Devices and Markings. American National Standard Institute (ANSI) D6.1, Manual on Uniform Traffic Control Devices for Streets and Highways, shall be used for guidance when setting traffic control devices or marking roads for motor vehicle operations on NASA property.
i. Use of hand-held wireless phones is prohibited by NASA employees when driving motor vehicles owned, leased, or rented by the Federal Government per NPL 6700-1, Use of Hand-held Wireless Phones.

9.2 Personal Protective Equipment

Personal Protective Equipment (PPE) shall be issued to GSFC employees at Government expense in those situations where engineering controls, management controls, or other corrective actions have not reduced the hazard to an acceptable level or where use of engineering controls, management controls, or other techniques is not feasible.

9.2.1 Procurement

a. Division Chiefs and line managers are authorized to purchase PPE after the purchase request has been reviewed by safety and health professionals to determine proper specifications and adequacy of protection. It is recommended that Directorate Safety and Health Committees be involved in the decision.

b. The authority for the purchase of PPE with appropriated funds is 5 U.S.C. 7903, Protective Clothing and Equipment.

c. Only clothing and equipment meeting Federal regulations, industrial standards, or NASA special testing requirements shall be used.

9.2.2 Issuance

a. PPE shall be issued to all GSFC Civil Service employees exposed to known hazards. Accountability shall be in accordance with NPR 4200.1E. Transients or visitors may be furnished PPE on a temporary basis if they are on site for GSFC-related business purposes or at NASA's invitation. The host, guide, or area supervisor shall be responsible for obtaining, issuing, and recovering the PPE. Other non-GSFC, contractor, and other personnel must procure their own PPE to provide an equivalent level of safety as required by NASA, GSFC, and Federal safety standards.

b. PPE shall be provided, used, stored, and maintained, and employees trained in its use, in accordance with 29 CFR 1910.132 through 1910.137. GSFC PPE shall be stocked and issued as specifically directed in NPG 4100.1.

c. Health-related PPE. If respirators are needed, GSFC has a formal Respiratory Protection Program. The Industrial Hygiene Office provides guidance and assistance for purchasing, training, selection, and qualification for use of respiratory protective devices and other health-related PPE.

9.3 Control of Hazardous Energy (Lockout/Tagout Program)

GSFC shall meet or exceed OSHA minimum performance requirements for the control of hazardous energy as outlined in 29 CFR 1910.147. GSFC has established a program for controlling hazardous energy during service and maintenance operations where the unexpected energizing or startup of equipment could cause injury to employees or equipment damage. The GSFC program complies with all aspects of 29 CFR 1910.147 for electrical, pressure, hydraulic, pneumatic, and mechanical systems as a minimum. For lockout/tagout procedures, refer to the specific organizational written Control of Hazardous Energy Program document and GPR 1700.5.

9.4 Pressure and Vacuum Systems Safety

GSFC's program for ensuring the structural integrity of pressure vessels and pressurized systems (PV/S) and minimizing the associated mishap potential is outlined in GPR 8710.3. This directive assigns responsibilities for the various aspects of the program; references the codes, standards, guides, and Federal regulations that must be followed; and establishes unique NASA requirements in areas such as certification/recertification, documentation, configuration management, and operator training/certification.

9.5 Electrical Safety

GSFC electrical systems shall be designed in accordance with the National Electric Code, MIL-STD 454, Standard General Requirements for Electronic Equipment, or Center requirements if more specific. Electrical systems shall be operated and maintained to adequately control hazards that are likely to cause death or serious physical harm or severe system damage.

GSFC organizations engaged in electrical operations shall develop an electrical safety procedures and guidelines program document that delineates safe work methods, and assigns responsibilities for complying with OSHA, National Electrical Code, and other associated national consensus standards.

9.6 Hazardous Material

a. GSFC policy for transporting hazardous material or hazardous or radiological waste shall be incompliance with NASA's agency policies contained in NPD 6000.1, Transportation Management.

b. Storage, use, and disposal shall comply with Federal, GSFC and state regulations and address the requirements for release prevention, control, countermeasures, contingency planning, and a listing of restricted/prohibited materials for purchasing and use at GSFC. Inventories shall be conducted at least annually and conditions of materials in storage assessed at least monthly, and those determined to be unsuitable for use removed from active inventory.

9.7 Material Safety Data Sheets (MSDS)

GSFC procurement activities require the referencing of 29 CFR 1910.1200 and Federal Standard 313, Federal Standard for Preparation and Submission of Material Safety Data Sheets, as revised, in commodity specifications, purchase descriptions, purchase orders, contracts, and other purchase documents. The receiving office shall provide copies of the MSDS for receipt of such commodities to the central office responsible for maintaining the MSDS records. Online Inventories or paper copies of all MSDS shall be maintained in the work area where the material is being used or stored. See also GPR 1700.2, GSFC Chemical Hygiene Plan. The MSDS Inventory is accessible at http://msds.gsfc.nasa.gov.

9.8 Task Safety Analysis (TSA)

Generally, all hazardous operations shall require TSAs (these are also known as Job Safety/Hazard Analysis, Hazardous Operation Procedures, etc.). TSAs consist of a detailed plan listing step-by-step functions or tasks to be performed on a system or equipment to ensure safe and efficient operations. Because of its in-depth and detailed nature, the TSA can identify less obvious potential hazards that may go undetected during routine management observations or audits.

9.8.1 Each Directorate shall identify hazardous operations/tasks and assess, analyze, and develop adequate safety controls.

a. Hazardous analysis shall be marked conspicuously on the title page, e.g., THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS, to alert operators that strict adherence to the procedural steps and safety and health precautions contained therein is required to ensure the safety and health of personnel and equipment.

b. All TSAs developed for GSFC operations shall have a concurrence from the responsible development official and an approval signature to certify that a review has been performed by the appropriate organizational or contractor safety representative as applicable to include any and all deviations or changes to the TSAs.

9.8.2 As missions change and grow, so will the need for TSAs. Perform a TSA if any aspect of a job changes with respect to new materials, equipment, or methods. If a serious accident occurs conducting a task, a new TSA will help to identify the cause of the accident and determine ways to prevent future incidents. To help with the development of the analysis, use GSFC Form 23-60 and the Instructions found at http://safety1st.gsfc.nasa.gov.

9.8.3 Certain operations (e.g., rigging, high voltage, etc.) depend on adherence to overall standards and general guidelines and specific training as opposed to TSA's for each specific operation. In these cases, specific personnel certification requirements shall be established as listed in Table 8.1. Personnel other than the certified operators shall be excluded from exposure to the operation. Where the risk of injury is high, personnel shall use the buddy system whereby an adjacent or nearby person not directly exposed to the hazard serves as an observer to render assistance.

9.9 Laboratory Hazards

Laboratories meeting the definition as described in 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories, shall be operated in accordance with the GSFC Chemical Hygiene Plan, GPR 1700.2, NHS/IH-1845.3, Hazard Communications, NHS/IH-1845.5, Occupational Exposure to Hazardous Chemicals in Laboratories, and OSHA 29 CFR 1910.1450.

9.10 Lifting Safety

GSFC shall use the standards and guidelines in NASA-STD-8719.9, and GPR 8834.1 for protecting persons and property during lifting operations. This document establishes minimum safety requirements for the design, testing, inspection, personnel certification, maintenance, and use of overhead and gantry cranes, mobile cranes, derricks, hoists, special hoist-supported personnel lifting devices, hydrasets, hooks, and slings for GSFC owned and contractor-supplied equipment used in support of GSFC operations.

9.11 Explosive, Propellant, and Pyrotechnic Safety

GSFC shall use GPR 8719.12 and NASA-STD-8719.12 for protecting persons and property from hazards of explosives and explosive materials, including all types of explosives, propellants (liquid and solid), oxidizers, and pyrotechnics. NASA-STD-8719.15 and NASA-STD-8719.16 address the requirements for working with those substances. Explosive, propellant, and pyrotechnic operations shall be conducted in a manner that exposes the minimum number of people to the smallest quantity of explosives for the shortest period consistent with the operation being conducted. An Authority Having Jurisdiction (AHJ) for Explosives, Propellant, and Pyrotechnic operations will be designated in writing by the Center Director. Responsibilities of the AHJ are contained in NASA-STD-8719.12.

9.12 Underwater Operations Safety

NASA-STD-8719.10 shall be used by GSFC as the minimum standard to establish the safety requirements for all GSFC neutral buoyancy facilities, equipment, personnel, and operations involving underwater activities that provide simulation of a weightless environment. This standard also applies to GSFC personnel participating in underwater operations at non-NASA facilities.

9.13 Non-Ionizing Electromagnetic Radiation

Microwave and radar protection standards are covered in various state regulations, national consensus standards, and Federal standards including 29 CFR 1910.97. This paragraph provides directives for protecting persons and property during laser use in NASA operations. The primary laser hazard to humans is eye and/or skin damage from direct exposure to the beam or specular reflection, and in some cases, viewing the diffuse reflection. Laser operations during any open-air laser scenario conducted on Department of Defense (DOD) controlled ranges or test facilities or by DOD personnel shall use Document 316-91, Laser Range Safety, for guidance. For specific GSFC requirements and policies see GPR 1860.2.

9.14 Ionizing Radiation

Policies and guidance for handling, use, and storage of radioactive material are contained in directives under the purview of the occupational health organizations. See NPD 1800.2 and GPR 1860.1 for GSFC policy requirements.

9.15 Confined Spaces

A confined space is any space that is large enough and so configured that an employee can enter and perform work; has limited or restricted means for entry or exit; and is not designed for continuous occupancy. Entry into confined spaces requires written procedures and authorizations. No entry into confined spaces shall be made until an assessment of that space has been made and a permit or operating procedures posted. Supervisors have overall responsibility for entry and work in confined spaces and for ensuring adherence to NASA Health Standard (NHS)/IH-1845.2, Entry Into and Work in Confined Spaces, OSHA 29 CFR 1910.146, Permit Required Confined Spaces, American National Standards Institute (ANSI) Z117.1, Safety Requirements for Confined Space, and NIOSH Publication No. 87-113, A Guide to Safety in Confined Spaces. For specific policy requirements and responsibilities see GPR 1700.6, and for operational procedures see the requisite Directorate PG and/or contractor written program.

9.16 Facility Systems Safety

Facility Systems Safety utilizes safety procedures and guidelines to enhance the safety and mission success aspect of NASA's facility acquisition, construction, and activation process.

a. Existing facilities undergoing major renovations must meet national consensus code in effect at the time of the renovations. Specific safety tasks to be accomplished to ensure safety during construction, operation, maintenance, and final disposition of the facility will be documented in accordance with the Facility System Safety GPR 7320.1A.

b. The Facility System Safety efforts for each acquisition shall be tailored to include those tasks appropriate to the size and complexity of the project and associated safety risks. NASA-STD-8719.7 provides a review of the facility life cycle and the safety tasks that shall be accomplished (as applicable) during acquisition, modification, test activities, facilities operations, maintenance, and disposal.

9.17 Fire Safety

GSFC shall implement a comprehensive fire safety program. This program is further defined by specific requirements and procedures found in NASA-STD-8719, Safety Standard for Fire Protection, and GPR 8715.5. The program generally provides for the following:

a. Providing appropriate automatic fire detection and suppression systems for all facilities containing significant hazards, mission essential equipment, or permanently housed personnel in accordance with 29 CFR 1910 Subpart L.
b. Complying with National Fire Protection Association (NFPA) and other nationally recognized building and fire safety codes and any applicable local codes in accordance with 40 U.S.C. Section 619, (Section 6(a) of Public Law 100-678, Public Buildings Amendments of 1988, November 17, 1988), as amended.

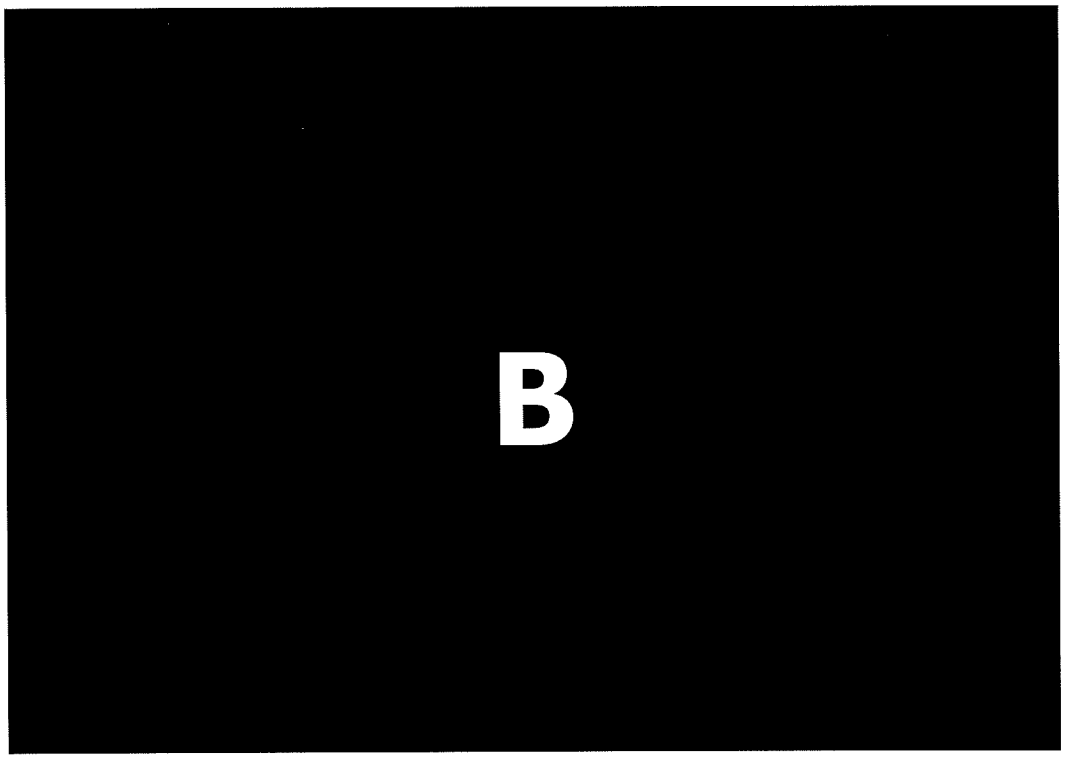
c. Ensuring employees, other than trained professional firefighters, trained volunteers, or emergency response personnel, do not fight fires except in cases where the fire is incipient in nature.

d. Adhering to the more stringent of fire safety requirements imposed by local, state, or Federal agencies.

e. An AHJ for Fire Protection for Greenbelt and Wallops Flight Facility (WFF) will be designated in writing by the Center Director. Responsibilities of the AHJ are delineated in NASA-STD-8719.11.

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	2/21/06	This document replaces the cancelled GMI 1700.2C, Goddard Space Flight Center Health and Safety Program.
A	11/10/10	Administratively extended and revised to reflect organization name and code change.
A	01/27/12	Administratively extended for 1 year from original expiration date.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Goddard Procedural Requirements (GPR)

DIRECTIVE NO.	GPR 1700.7A	**APPROVED BY Signature:**	*Original signed by*
EFFECTIVE DATE:	November 10, 2010	**NAME:**	Robert Strain
EXPIRATION DATE:	January 12, 2014	**TITLE:**	Director

COMPLIANCE IS MANDATORY

Responsible Office: 350/Occupational Safety and Health (OS&H) Division

Title: Electrical Safety

PREFACE

P.1 PURPOSE

This directive sets forth the minimum electrical safety requirements within the framework of Goddard Space Flight Center's (GSFC) safety policies and constraints. It is primarily for use by qualified persons who routinely engage in facility-related electrical work; however, it also applies to electrical equipment in office and laboratory environments. It does not apply to spacecraft-related power systems. It is not an instruction manual for untrained personnel, nor is it a substitute for detailed procedures judged necessary for the safe conduct of a specific electrical task by individuals and their supervisors.

P.2 APPLICABILITY

This directive applies to all GSFC civil servants, contractors, tenants, and other persons involved in the design, construction, operation, maintenance, research and development of nonspacecraft electrical/electronic systems on GSFC property, including all permanent and temporary sites. This includes nonfacility-related electrical operations, such as extension cords and temporary wiring setups. Electrical/electronic systems and hardware that are 50 volts AC (rms)/DC or less are exempt from the requirements of this GPR.

The term "Safety Office" applies equally to the safety offices at both Greenbelt (Code 350) and Wallops Flight Facility (Code 803).

P.3 AUTHORITY

a. Occupational Safety and Health Administration (OSHA) 1910, General Industry Standards
b. OSHA 1926, Construction Industry Regulations
c. National Fire Protection Association (NFPA) 70E, Standard for Electrical Safety in the Workplace

P.4 REFERENCES

a. NFPA 70, National Electrical Code.
b. NFPA 70B, Recommended Practice for Electrical Equipment Maintenance.
c. NFPA 70E Standard for Electrical Safety in the Workplace
d. NPR 8715.3, NASA General Safety Program Requirements.

e. GPR 1700.1, Occupational Safety Program at Goddard Space Flight Center.
f. GPR 1700.5, Control of Hazardous Energy (Lockout/Tagout).
g. GPR 1700.6, Confined Space Program at GSFC.
h. GPR 8719.1, Certification and Recertification of Lifting Devices and Equipment.
i. GSFC Form 23-83, Energized Electrical Work Permit.

P.5 CANCELLATION

GPR 1700.7, Electrical Safety

P.6 SAFETY

As described throughout this directive.

P.7 TRAINING

Civil Servant and Contractor Supervisors shall ensure that all personnel under their authority are qualified for the type of activity/operation required to perform their electrical work safely and effectively. The qualified person(s) (see Section 2.1) shall be trained in and knowledgeable of the installation, construction and/or operation and maintenance of electrical equipment and be able to recognize and avoid the electrical hazards that are present with respect to equipment or work procedures. Training shall meet, at minimum, requirements set forth in NASA, NFPA, OSHA, and national consensus electrical standards.

Civil service and contractor supervisors shall maintain copies of current training records, and shall identify training requirements for each of their employees tasked to perform electrical activities.

See Section 3 for specific Electrical Safety Training Requirements.

P.8 RECORDS

Record Title	Record Custodian	Retention
Records of Electrical Safety Training	Office of Human Capital Management	NRRS 3/33G1, 2* – Destroy 5 years after employee discontinues or completes training.
Physician Report That Evaluates the Employee's Ability to Conduct High Voltage Work.	Health Unit	NRRS 1/127A* – Retain until employee is transferred or separated. Upon transfer, ship medical record to medical office of new assignment. Within 30 days after separation, transfer to National Personnel Records Center.
Energized Electrical Work Permit Form 23-83	Organizations Conducting Electrical Operations and	NRRS 1/123* – Destroy after organization determines analysis is

	Safety Office	not longer relevant.

Waiver/Deviation of Standards Documentation	Safety Office	* NRRS 1/120E - Retire to FRC when the risk/safety assessment/analysis is complete/inactive. Destroy when 15 years old.
Inspection Records	Organizations Conducting Electrical Operations	29 CFR 1960.73 - Records and reports shall be retained for 3 years following the end of the fiscal year to which they relate.
Building Drawings	FMD	* NRRS 8/48B2 - *Permanent* May retire to FRC 2 Years after disposal Of installation Transfer to NARA 25 years after disposal of installation
Annual Electrical Safety Program Survey Reports	Safety Office	29 CFR 1960.73 - Records and reports shall be retained for 3 years following the end of the fiscal year to which they relate.

**NRRS – NASA Records Retention Schedules (NPR 1441.1)*

P.9 METRICS

The Safety Office will gather metrics from the following activities and analyze them for trends and lessons learned:

a. Audits/inspections of electrical safety operations to ensure organizational program compliance; and

b. Review close calls, lost-time incidents, and property damage due to electrical mishaps in order to prevent future occurrences.

In addition, the Electrical Safety Committee (see Section 1.9) shall report to the Assistant Director for Safety and Security on the effectiveness of the Electrical Safety Program as determined by periodic electrical safety assessments and evaluations.

P.10 DEFINITIONS

Following are some key definitions related to electrical safety. Many additional related definitions are contained within referenced documents such as the NFPA 70, National Electrical Code (NEC), NFPA 70E, Standard for Electrical Safety in the Workplace, and the National Electrical Safety Code (NESC).

Unless expressly stated elsewhere herein, the following terms shall have the meanings indicated below:

a. Barrier – A physical obstruction that is intended to prevent contact with exposed energized electrical conductors or circuit parts. Barriers can be temporary or permanent.
b. De-energized – Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.
c. Electrical Hazard – A dangerous condition such that inadvertent or unintentional contact or equipment failure can result in shock, arc flash-burn, thermal burn, or blast.
d. Electrical Quality Assurance Representative – An individual who is authorized by line management to perform electrical inspections for code compliance and quality.
e. Electrical Safety Officer – A collateral-duty position that refers to an identified person who by ensures the organization complies with electrical safety standards.
f. Electrically Safe Work Condition – A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked and tagged in accordance with GPR 1700.5.
g. Electrical Work – (1) Working on or near energized electrical parts; (2) Assembly or fabrication of potentially energized electrical equipment, (3) Installation , maintenance, and repair of electrical conductors, equipment, and systems over 50 volts.
h. Energized – Electrically connected to or having a voltage source. NOTE: "De-energized" parts that have not been placed into an electrically safe work condition are considered energized.
i. Energized Electrical Work Permit (EEWP) – A Director Of approved written permit (GSFC Form 23-83) required by the National Fire Protection Association (NFPA) 70E for non-routine work on energized equipment 50v and above that cannot be placed in an electrically safe work condition.
j. Exposed (as applied to energized parts) – Capable of being inadvertently touched or approached nearer than a safe distance by a person, especially parts that are not suitably guarded, isolated, or insulated.
k. Facility – Relating to Center infrastructure and/or utilities. The term facility does not include specific test equipment such as thermal/vac chambers or test cells.
l. Field Verified – (as applied to electrical configuration controlled drawings): Verification that the drawing accurately depicts the configuration of installed systems or equipment by visual comparison and by point-to-point wire checks prior to placing the system into service. Point-to-point wire checks require ringing out or talking down the wiring between points of termination and are usually done during installation.
m. Flash Hazard – A dangerous condition associated with the release of energy caused by an electric arc.
n. Functionally Verified (as applied to electrical configuration controlled drawings) – Verification that the drawing accurately depicts the configuration of a functional system or equipment by visual comparison.
o. Grounded – Connected to earth or to some conducting body that serves in place of the earth.
p. Guarded – Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger.

q. Hazard Analysis – The identification and evaluation of existing and potential electrical hazards and the recommend mitigation for the hazard sources found
r. Live Part – An energized conductive component.
s. Lockout/Tagout (LOTO) – The full procedure of determining what is required to make a system safe; the action of making the system safe; and the placing of locks, locking devices, and "Do Not Operate" tags to preclude changing from the safe condition. See GPR 1700.5 for LOTO requirements.
t. Qualified Person – One who has been trained in and demonstrates adequate knowledge of the installation, construction, and/or operation and maintenance of electrical equipment and has received safety training on the hazards involved.
u. Service Point – The point of connection between the facilities of the serving utility and the premises wiring. Service points for buildings at GSFC are defined as the line side of the first service disconnecting means for the facility.
v. Shock Hazard – A dangerous condition associated with the possible release of energy caused by contact or approach to live parts.
w. Two Person Rule – The practice of employing a second electrically qualified person to directly observe the electrical work of a Qualified Person working on, or near (unguarded) energized electrical equipment.
x. Unqualified Person – Individuals, who do not meet the requirements of Section 2.1, but work with or use electrical equipment. They are protected from risk of exposure to electrical hazards by the presence of protective barriers. Unqualified persons shall be trained in, and familiar with, any electrical safety-related practices necessary for their safety.
y. Voltage (of a circuit) – The greatest root-mean-square (rms) (effective) difference of electrical potential between any two conductors of the circuit concerned.
z. Voltage, High – Electric power system and equipment operating at greater than 600 volts Nominal and above.
aa. Voltage, Low – Electric power system and equipment operating at less than or equal to 600 volts Nominal
bb. Working on (live parts) – Coming in contact with exposed energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment a person is wearing.

P.11 ACRONYMS

EEWP	Energized Electrical Work Permit
ESC	Electrical Safety Committee
ESO	Electrical Safety Officer
FMB	Facilities Management Branch
FMD	Facilities Management Division
FRC	Federal Records Center
GPR	Goddard Procedural Requirements
NARA	National Archive and Records Administration
NEC	National Electric Code (NFPA 70E)
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
OJT	On-the-Job Training

OSHA	Occupational Health and Safety Administration
PPE	Personal Protective Equipment
WFF	Wallops Flight Facility

PROCEDURES

In this document, a requirement is identified by "shall," a good practice by "should," permission by "may" or "can," expectation by "will" and descriptive material by "is."

1. RESPONSIBILITIES

Assistant Director for Safety and Security (ADSS) shall ensure their responsibilities as defined in GPR 1700.1 are met and:

a) Appoint the chair of the Electrical Safety Committee (ESC).

1.2 Directors Of shall:

a. Ensure that written Hazard Analysis and Operational Procedures involving the use, exposure to, generation of, or control of electrical safety hazards are reviewed annually and updated as needed;
b. Ensure that personnel are provided appropriate training and workplace orientation to identify electrical hazards and the protective measures required for their safety;
c. Ensure that personnel are notified of any changes or modifications to policies or systems used to control electrical safety hazards;
d. Directors Of whose workers engage in electrical work shall appoint Electrical Safety Officer(s) (ESO) to serve as their Directorate's representative to the Electrical Safety Committee (ESC) and shall ensure that appropriate time is allotted and resources are provided for ESOs to perform their assigned duties; and
e. Be final approver for Energized Electrical Work Permits (EEWPs) or designate an authorized representative as such.

1.3 Division Chiefs

Division Chiefs whose workers engage in electrical work shall be responsible for ensuring that safe electrical work is accomplished within their area of responsibility, and:

a. Ensure full implementation of electrical safety requirements throughout their organizations;
b. Ensure full implementation of the applicable requirements of this GPR; and
c. Address and resolve deficiencies noted during electrical inspections.

1.4 Supervisors

Supervisors are responsible for ensuring that the requirements herein are adhered to in the design, construction, modification, operation, and maintenance of electrical systems. Supervisors who authorize electrical work (e.g., area work supervisors, team leaders, foremen, facility managers, project leaders, etc.) shall:

a. Ensure that safe work is accomplished within their area(s) of responsibility;
b. Review and approve Task Safety Analysis and hazardous operating procedures for working with energized equipment;
c. Ensure that subordinate workers are qualified and have received training as required by this GPR and that this training is documented;
d. Ensure prime and subcontractors are provided with descriptions of site-specific hazards for proposed work;
e. Ensure that workers have the required tools, PPE, and other resources to perform their work safely;
f. Authorize the performance of energized electrical work using approved Energized Electrical Work Permits (EEWPs) as applicable (see Section 4.2); and
g. Report all mishaps or close calls as described in GPR 8621.1.

1.5 All Implementing Organizations

Organizations that engage in electrical work at a GSFC-managed site, or site controlled by the GSFC including Contractors, inclusive of lower tier subcontractors, and consultants, shall implement the requirements contained in this GPR. This shall primarily be done by defining, establishing, and understanding individual accountabilities, authorities, interfaces, and responsibilities as defined in this document. Furthermore, each organization shall:

a. Incorporate and implement the requirements of this GPR into the organization's Safety and Health Plan as required by Agency Contract Clause (for contractors);
b. Conform with lockout/tagout requirements and procedures as described in GPR 1700.5;
c. Implement Quality Control/Quality Assurance functions if work can potentially impact flight hardware or critical test equipment (or if appropriate to operational needs) to monitor and ensure that electrical work performed by the organization is performed in accordance with OSHA, NFPA, and GSFC standards. Quality control/Quality assurance functions shall include:
   - Inspection of electrical installations as covered by the National Electrical Code (NEC);
   - Maintenance of records of all electrical inspections, including the date of such inspections, a summary of any violations found to exist, and a record of the final disposition of all violations;
   - Verification that safe electrical work practices are followed; and
   - Verification that electrical systems are de-energized and placed in an electrically safe work condition as required in GPR 1700.5.
d. Respond to ESC-initiated assessments and action items;
e. Submit to the Facilities Management Division (FMD) updates to Facility-related electrical systems drawings to reflect changes or modifications as a result of the work performed by the organization;
f. At the Wallops Flight Facility, all electrical utility / power distribution electrical changes will be performed by the Wallops Integrated Institutional Contract (WICC) or by a Facilities Management Branch (FMB) approved contract; and
g. Develop Pre-Emergency Outage Plans (as appropriate) to address realistic scenarios in order to prevent the need for exposing workers to energized circuits during emergency situations.

1.6 Safety Office

The Safety Office shall:

a. Serve as secretary of the ESC (Code 350);
b. Provide assistance to organizations for assessing GSFC compliance to the requirements of this GPR and electrical codes;
c. In conjunction with the Office of Human Capital Management, identify adequate electrical safety training resources;
d. Review contractor health and safety plans to ensure that the applicable provisions of this GPR are properly incorporated;
e. Ensure contractor health and safety plans meet the requirements of NPR 8715.3, section 9.4.2 and recommend approval to the Contracting Officer;
f. Conduct annual organizational electrical safety program reviews to ensure operating activities are complying with requirements; and
g. Conduct periodic inspections of job sites to ensure work activities comply with the requirements of this GPR.

1.7 Organizations Procuring Electrical Work shall:

a. Include the requirements of this GPR in all contracts for the design, construction, operation and maintenance of facilities, and electrical systems operating under the auspices of GSFC, or on GSFC property;
b. Ensure contractor solicitations meet the requirements of NPR 8715.3, section 9.4.1; and
c. Take necessary remedial action when the contractor is in violation of the requirements of this GPR or a deficiency in performance of work impacting a contractual provision is identified.

1.8 Facilities Management Division (FMD)

The Facilities Management Division shall:

a. Meet the requirements set forth in section 1.5 of this GPR;
b. Manage the Outage Approval Process;
c. Develop and maintain systems drawings for the Center in accordance with Section 5.2;
d. Authorize connection of premises, buildings, or additions to the source of electrical supply, and authorize connection of equipment to the source of electrical supply; and
e. Develop and implement design standards for electrical work and electrical systems operating under the auspices of GSFC, or on GSFC property, including all permanent and temporary sites.

1.9 Electrical Safety Committee (ESC)

The ESC shall be composed of a representative from each Directorate and WFF performing work governed by this GPR. The committee shall:

a. Develop a Committee Charter that describes the purpose, chairmanship, membership, goals/objectives, responsibilities, etc.;
b. Assist in the implementation of the GSFC Electrical Safety Program, and in the maintenance of this GPR and its companion documents;
c. Evaluate and recommend the adoption of new or revised standards, codes, and requirements for electrical work;
d. Provide a forum for electrical workers to address and resolve workplace electrical safety issues;
e. Evaluate the impact of electrical safety requirements or interpretations;
f. Review mishaps and close calls that involve electrical issues and participate in the root-cause analyses; and
g. Report to the Assistant Director for Safety and Security on the effectiveness of the Electrical Safety Program as determined by periodic electrical safety assessments and evaluations.

1.10 Electrical Safety Officer (ESO)

Collateral-duty ESO(s) will be appointed by each Directorate engaged in electrical work covered by this GPR. Each ESO shall:

a. Assist in the development of and provide concurrence with EEWPs initiated by their organization;
b. Facilitate corrective actions regarding work performed under the direction of their organization, including stopping work or activities that do not meet GSFC electrical safety requirements;
c. Provide clarification of codes, standards, and regulations within their organization(s), and request formal interpretations through the ESC as necessary.

1.11 Electrical Quality Assurance (QA) Representative

Electrical QA Representatives (for organizations that utilize them) shall:

a. Inspect electrical installations as covered by the NEC;
b. Whenever any installation subject to inspection is covered or concealed, be authorized to require that such work be exposed for inspection;
c. Keep records of all electrical inspections, including dates of such inspections, findings, and a summary of violations, and a record of final disposition of violations. Periodically turn over all such records to Code 220;
d. Verify that electrical systems are either disconnected or placed in an electrically safe work condition as required by GPR 1700.5; and
e. Require that safe work practices be followed at all times.

1.12 Qualified Persons (as defined by NFPA 70E) shall be responsible for performing electrical work safely by assessing and controlling hazards and by adhering to safety-related work practices in accordance with NFPA 70E. Responsibilities include:

a. Maintaining qualification by participating in electrical safety and Arc Flash training as described in this document;
b. Reviewing the scope of work, developing the hazard analysis, and determining hazard mitigation techniques for each assigned work task;

c. Develop EEWPs if their equipment must remain energized;
d. Using required PPE appropriately;
e. Stopping work immediately or excusing themselves from a job when an operation is perceived to be imminently hazardous or if they do not believe they possess the competency to perform the work safely;
f. Informing an immediate supervisor of any electrical task or deficiency that exceeds the worker's resources, competency, or level of authority;
g. Maintaining an approved copy of the EEWP at the work site when energized work is being performed; and
h. Immediately report all close calls and mishaps to their supervisor.

2 QUALIFICATIONS

2.1 Qualified Persons

Qualifications shall meet those specified in OSHA 29 CFR 1910.332, NFPA 70E and Section 3 of this document.

2.2 Electrical Safety Officer

An ESO shall be a person designated by their organization to oversee the electrical safety program within their work area. This person should have knowledge of the applicable electrical/electronic safety requirements, or have access to subject matter experts who possess that knowledge.

2.3 Electrical Quality Assurance Representative

An Electrical QA Representative shall be a Qualified Person knowledgeable of applicable electrical safety requirements, as well as experience with the NEC, and GSFC electrical design standards.

3. TRAINING REQUIREMENTS

Qualified Persons shall be trained and experienced in the work methods required by their electrical work assignments and shall have safety training, including Arc Flash training if applicable, on the operation of the equipment and the use of safe work practices per OSHA 29 CFR 1910.332.

3.1 Technical training commensurate with the assignments of the Qualified Person shall be documented and shall meet the requirements of their job description. Refresher technical training shall be taken as required by the qualified person's job assignments and certification requirements.

3.2 An individual who is undergoing on-the-job technical training shall be under the direct supervision of a Qualified Person. This individual shall complete safety training on the hazards involved prior to performing the work.

3.3 The degree of training necessary shall be determined by their supervisor based on the work to be performed and the risk to the employee. Training for Qualified Persons shall include, but not be limited to, the following:

a. The safety-related electrical work practices pertinent to the equipment or job at hand;
b. The required procedures on how to perform jobs safely and properly;
c. The use, care, and limitations of the PPE necessary to perform jobs safely and properly;
d. The skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment;
e. The skills and techniques necessary to determine the nominal voltages, currents, power levels, and energy levels of exposed energized parts; and
f. The minimum approach distances, flash protection boundaries, and the corresponding voltages to which the qualified person could be exposed when working on energized electrical systems.

	Required Training	**Type and Frequency**	
		Initial	***Every 3 Years**
Qualified Persons	• NFPA 70E • Arc Flash • Low Voltage Safety • High Voltage Safety • Lockout/Tagout • Confined Space Entry (if applicable) • Job Specific Tasks* • First Aid/CPR	Comprehensive	Refresher

**** Task specific refreshers shall also be conducted if there is change to a process, system or equipment.***

Table 1

4. SAFE ELECTRICAL SYSTEM REQUIREMENTS

4.1 Mitigating Electrical Hazards

Employees performing electrical work where any person might be exposed to live parts shall put these parts in an electrically safe work condition as determined by the appropriate ESO before beginning work unless it can be demonstrated that de-energizing the systems introduces additional or increased hazards.

Where equipment or systems cannot be placed into an electrically safe condition and the work must be done with a circuit energized, an EEWP shall be submitted and approved prior to the start of the work. See Section 4.2.

Exemption: EEWPs are not normally required for routine tasks performed on or near live parts such as testing, troubleshooting, and voltage measuring of electrical systems to include flight hardware and associated flight ground support equipment. If there is a question as to whether the scope of work is

"routine" the organization will contact the Safety Office for guidance. These activities are exempt from an EEWP provided that such work is performed by a Qualified Person and that the appropriate safe work practices and PPE are utilized in accordance with NFPA 70E.

Where equipment or systems are placed into an electrically safe condition, the lockout/tagout requirements of GPR 1700.5 shall be met.

An electrically safe workplace shall be ensured by:

a. Implementing electrical safety requirements during construction, modification, maintenance, and utilization, including research and development (R&D) activities, of GSFC facilities and equipment;
b. Establishing training programs for electrical workers to meet the qualification requirements and to implement safety-related work practices;
c. Promoting electrical safety awareness at the workplace;
d. Complying with the most recent OSHA and other applicable electrical regulations and standards;
e. Continuously reducing the quantity and severity of electrical safety incidents, injuries and close calls; and
f. Meeting the requirements of NFPA 70E for an Electrical Safety Program.

4.2 Energized Electrical Work Permit (EEWP)

Per NFPA 70E, Section 130.1, EEWPs (GSFC Form 23-83) shall be required for work on or near exposed energized electrical equipment and systems that do not fit the profile of tasks described in the exemption in Section 4.1. If there is no reasonable method of obtaining an outage, or de-energizing the equipment, then the following requirements shall apply:

a. The EEWP shall be initiated by the organization that requires the electrical work be performed while energized.
b. The EEWP shall include an electrical hazard assessment, by a Qualified Person who would perform the work, of the specific electrical hazards associated with each task or activity. The electrical hazard assessment shall include all the elements listed in NFPA 70E, Section 130.1 (A)(2).
c. The EEWP shall be approved by the qualified person, their supervisor, and the appropriate ESO, with final approval resting with the Codes' Director Of (or a designee).
d. Unexpected (non-routine) and off-hour and emergency energized electrical work may be approved by the on-site cognizant supervisor in order to facilitate abating the immediate hazard. After the work has been a performed, an EEWP shall be completed at the earliest opportunity to justify the decisions made for working energized.
e. Completed EEWPs shall be maintained by the ESO and a copy provided to the Safety Office for retention.
f. Two Person Rule for all energized work that requires an EEWP shall be enforced.

4.3 Temporary Wiring

a. Temporary electrical wiring shall be permitted during emergencies, tests, experiments, developmental work, maintenance and repair not to exceed 120 days without Safety Office approval.

b. Temporary electrical wiring shall not be run directly on ungrounded conductive surfaces but shall be supported by suitable wood or other insulating materials.
c. Temporary electrical wiring and portable electrical cords shall be kept out of water at all times unless the cable is approved by the NEC for that purpose.
d. Temporary electrical wiring shall be removed immediately upon completion of construction, or the purpose for which the wiring was installed.

4.4 Extension Cords

NEC Article 400.8. "Flexible Cords and Cables," and Article 590, "Temporary Installations" do not permit flexible cords and cables to used as a substitute for permanent building wiring. Use of extension cords and relocatable multiple outlet power strips are to be used in a manner compatible with a Nationally Recognized Testing Laboratory (NRTL), for example, Underwriters Laboratory and Factory Mutual rating and listing. They shall not be used in a manner that substitutes for the installation of permanent building branch circuits.

a. Extension cords usage shall abide by the restrictions for temporary wiring as delineated in Section 4.3. Note: A surge protector power strip is a special type of extension cord intended to protect computers and related office equipment from damaging power fluctuations. They may be used indefinitely;
b. Where extension cords are utilized, they shall not be:
    1. Used as a substitute for the fixed wiring of a structure;
    2. Routed through holes in walls, doorways, under rugs/carpet, windows, ceilings, floors, or attached to building surfaces;
c. High-current equipment (5 amps or greater), e.g., microwave ovens, refrigerators, space heaters, coffee pots, etc., shall not be plugged directly into a power strip/surge protector;
d. Extension cords used in outdoor or wet locations shall utilize integral or separate Ground Fault Circuit Interrupters (GFCIs) for shock protection.

4.5 Shock and Flash Hazards

Hazards associated with shock and flash shall be mitigated in compliance with NFPA 70E sections 130.2 (shock) and 130.3 (flash). Results of any shock or flash analysis shall be included as part of the EEWP.

4.6 Labeling of Electrical Equipment

Labeling of electrical equipment shall be in accordance with NFPA70E.

5. ELECTRICAL SAFETY PROGRAM DOCUMENTATION

5.1 Documented Procedures. External organizations and contractors performing electrical work at GSFC shall have, and work in accordance with, a written Electrical Safety Program that utilizes the guidance in Appendix E of NFPA 70E and establishes policies, processes, and procedures applicable to their particular activities, projects or contracts. The document shall be controlled such that it is kept up to date, and revision or version control shall be exercised to ensure the latest version is in use. The

following lists of topics are general and are not all inclusive. They should be addressed as appropriate depending on the types and categories of electrical work performed.

1) Electrical Safety and Approval Process
2) Electrical Hazards (medium-high)
3) Controls for Electrical Work and Electrical Equipment
4) Work on Electrical Components and Systems
5) Work Clearances and Illumination
6) Temporary Wiring
7) Extension Cords
8) Ground Fault Circuit Interrupters
9) Portable Electric Tools Equipment and Instruments
10) Equipment Grounding
11) Unknown Electrical Hazards (e.g., penetrations)
12) De-Energized Electrical Work
13) Personal Protective Equipment
14) Welding, Cutting, or Burning
15) Lockout/Tagout Procedure
16) Confined Space Entry
17) Work > 600 Volts and Protective Grounding
18) Underground Utilities and Operations
19) Energized Cables in Manholes
20) Cutting and Splicing Power Cables
21) Racking Medium and HV Circuit Breakers
22) HV Switching
23) Working Space Around Equipment
24) Cranes, Lifting Equipment, and Ladders (fixed/portable) Adjacent to Exposed Energized Parts
25) Initial Energization of Electrical Systems Above 600 Volts
26) Infrared (IR) Thermography
27) Work in Energized Substations

5.2 Facility Electrical System Drawings

5.2.1 Drawing Control. Facility Drawings shall be controlled and updated by FMD in accordance with the following requirements. Note this does not apply to flight project related equipment or sub-systems.

a. It shall be the responsibility of the organization preparing facility associated design drawings to initiate action to document changes to the drawings described in the following paragraphs. In the event that changes are made to the systems and drawings are not produced prior to the changes, the organization performing the work shall be responsible for preparing drawings of such detail that the information can be entered onto the record drawings. Such updates shall be provided to FMD for incorporation into the building drawings.

b. It is the intent that all building drawings and diagrams be updated to the "as-built" configuration. As projects and system modifications occur, drawings shall be updated to reflect the "as-built"

configuration. Information should be field verified for accuracy prior to implementing any design changes.

c. No changes shall be made to drawings without the approval of FMD.

5.2.2 TYPES OF DRAWINGS

The following types of drawings shall be maintained by FMD:

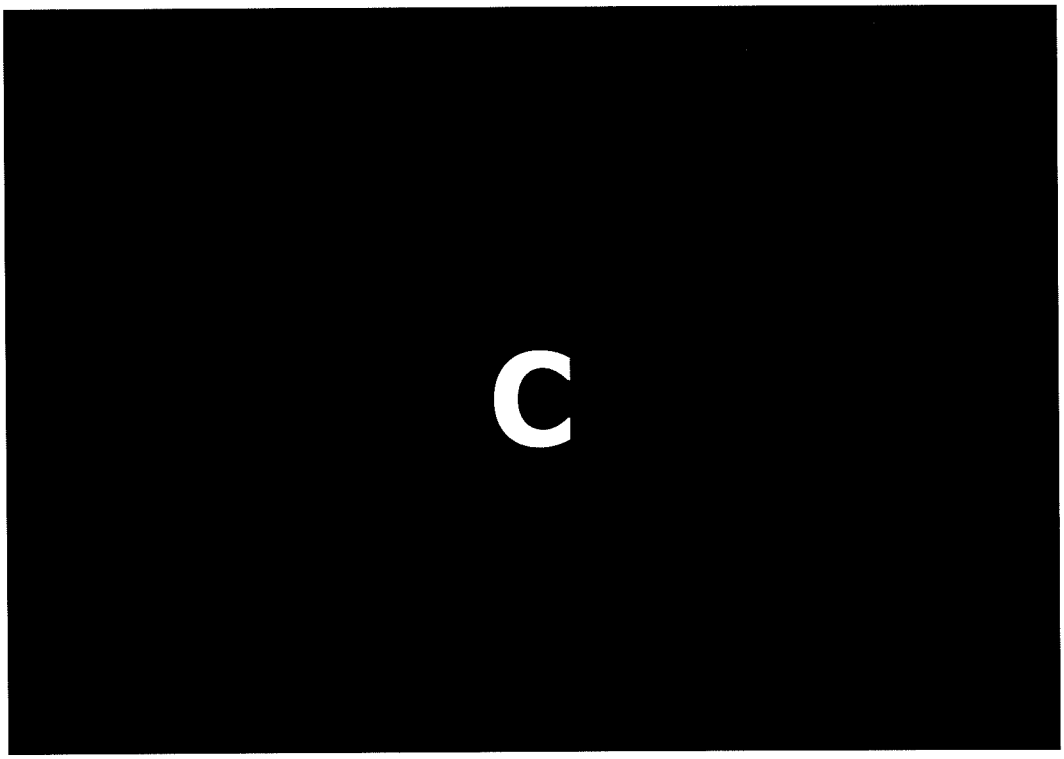
a. Low voltage and high voltage diagrams for each building and substation;
b. Protective relaying diagrams for GSFC substations;
c. Underground utility drawings, including the locations of underground electrical utilities; and
d. Record Drawings for GSFC facilities including floor plans, equipment location plans, system schematics, and/or elementary wiring diagrams. Note: Does not include special purpose/test facilities.

5.3 Drawing Accessibility

Hardcopies of the Electrical Systems Drawings are available from FMD and are provided to organizations performing work on electrical systems at GSFC on an as-needed basis.

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	01/12/2009	Initial Release
A	11/10/2010	Administratively Revised to update the Responsible Office Code, Organization Title and organization name within the document.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Goddard Procedural Requirements (GPR)

DIRECTIVE NO.	GPR 1700.5B	**APPROVED BY Signature:**	*Original Signed By*
EFFECTIVE DATE:	January 13, 2012	**NAME:**	Judith N. Bruner
EXPIRATION DATE:	January 13, 2017	**TITLE:**	Director, Safety and Mission Assurance

COMPLIANCE IS MANDATORY

Responsible Office: Code 350 / Occupational Safety and Health (OS&H) Division

Title: Control of Hazardous Energy (Lockout/Tagout)

PREFACE

P.1 PURPOSE

This directive identifies practice and procedure requirements designed to protect employees through Lockout/Tagout (LOTO) procedures. Specific definitions, practices, and procedures are outlined in Occupational Safety and Health Administration (OSHA) Standards under 29 CFR. 1910.147, "The Control of Hazardous Energy."

P.2 APPLICABILITY

This directive applies to all Government and, to the extent provided in their contracts, contractor hazardous-energy control operations at the Goddard Space Flight Center (GSFC), including Greenbelt, Wallops Flight Facility, and remote locations under GSFC control. This directive applies to civil servant and contractor operations at these facilities. This directive applies to all hazardous-energy control operations (both industrial and construction) such as, but not limited to, electrical, mechanical, hydraulic, pneumatic, chemical, and thermal sources. For GSFC contractors, this directive is applicable through contract clauses in conformance with NASA FAR (Federal Acquisition Regulations) Procurement Supplements.

P.3 AUTHORITIES

a. 29 CFR Part 1910.147, The Control of Hazardous Energy (Lockout/Tagout), OSHA
b. 29 CFR Part 1926.417, Locking and Tagging of Circuits

P.4 APPLICABLE DOCUMENTS

a. NPR 8715.3, NASA General Safety Program Requirements
b. GPR 1700.7, Electrical Safety

P.5 CANCELLATION

GPR 1700.5A, Control of Hazardous Energy (Lockout/Tagout)

P.6 SAFETY

Safety requirements are addressed in P.7 Training.

P.7 TRAINING

Designated personnel shall be required to attend a Lockout/Tagout Authorized Training Course developed by and specific to their organization and all associated on-the-job training (OJT). Initial and refresher training shall:

a. Include the course content requirements as defined by 29 CFR 1910.147(c)(7);
b. Include other training classes as required by NPR 8715.3 7.3 and 7.4;
c. Include a written examination to determine adequacy and retention of training;
d. Be conducted periodically not to exceed 4 years or whenever there is a change in their job assignments, a change in machines, equipment or processes that present a new hazard, or when there is a change in the energy control procedures; and
e. Be conducted whenever a periodic inspection reveals, or whenever the manager or supervisor has reason to believe, that there are deviations from or inadequacies in the authorized or affected employee's knowledge or use of these LOTO procedures. The retraining activity shall re-establish authorized or affected employee proficiency and introduce new or revised control methods and procedures as necessary.

Managers and/or supervisors shall maintain written or electronic documentation identifying current training records and requirements for each employee tasked to LOTO activities. First Aid and Cardiopulmonary Resuscitation (CPR) certification is required as defined in GPR 1700.7, Electrical Safety.

Affected employees shall be trained in the purpose and use of the energy control procedure. All other employees whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure, and about the prohibition relating to attempts to restart or reenergize machines or equipment which are locked out or tagged out.

P.8 RECORDS

Record Title	Record Custodian	Retention
LOTO Authorized Training and Associated OJT.	Office of Human Resources and Supervisors	NRRS 3/33G1. Destroy 5 years after employee discontinues or completes training
Emergency Removal of LOTO Device	LOTO Manager/Supervisor	NRRS 1/117.5. Handle as permanent pending retention approval.
Annual Review of the Control of Hazardous Energy Program.	LOTO Manager/Supervisor and Safety Office	NRRS 1/125A. Destroy when 10 years old or when superseded or obsolete, whichever comes first.

LOTO Outage Log.	LOTO Manager/Supervisor	NRRS 1/117.5.

**NRRS – NASA Records Retention Schedules (NPR 1441.1)*

P.9 MEASUREMENT/VERIFICATION

a. Annual/periodic review of Hazardous Energy Control Programmatic scores.
b. Number of employees identified for LOTO training and completion rates.

PROCEDURES

In this document, a requirement is identified by "shall," a good practice by "should," permission by "may" or "can," expectation by "will," and descriptive material by "is."

1. ROLES AND RESPONSIBILITIES (CIVIL SERVICE AND CONTRACTOR)

1.1 Division Chiefs shall:

Ensure that Civil Service employees, onsite contractors, and construction contractors in their Divisions are informed of and adhere to the GSFC LOTO policy.

1.2 Occupational Safety and Health Division (OS&H) shall:

a. Administer, maintain, and revise the LOTO requirements in this directive as needed;
b. Evaluate/approve specific written procedures for (1) equipment that cannot be locked out; or (2) situations when a secondary means of isolation is not possible or deemed appropriate;
c. Provide information and consultation as necessary to management and employees involved in LOTO operations;
d. Review LOTO procedures for specific projects at the request of managers or supervisors;
e. Review periodically this directive and the effectiveness of the LOTO program as outlined herein;
f. Coordinate with the Career Development and Employee Worklife Office Career Development and Training Group (Code 114) to make training in LOTO standards available to civil service staff;
g. Provide contract and specification review as requested by GSFC management;
h. Function as the regulatory liaison with outside agencies as needed for LOTO issues;
i. Verify compliance with standards set forth in the program by periodic inspection of LOTO operations; and
j. Suspend work where unsafe conditions are present.

1.3 LOTO-Authorized Managers and Supervisors shall:

a. Complete the Organizational LOTO Training Course;
b. Ensure that identified LOTO-authorized employees complete the Organizational LOTO Training Course and initial OJT for all applicable LOTO procedures;
c. Maintain records, including those identifying OJT of LOTO authorized employees;

d. Upon the completion of training and authorization requirements, issue an certification that stipulates the specific equipment or types of equipment on which the authorized employee may perform LOTO operations;
e. Provide additional OJT as needed to ensure that employees are thoroughly familiar with new or changed equipment and/or procedures;
f. Maintain control of emergency keys for LOTO locks/devices;
g. Remove LOTO locks/devices in the event of an emergency;
h. Prepare and make available written equipment-specific procedures;
i. Maintain records of LOTO outages;
j. Ensure an Energy Control Program and associated LOTO procedures are written and adhered to in accordance with the requirements defined in 29 CFR 1910.147; and
k. Evaluate LOTO procedures at least annually in accordance with 29 CFR1910.147(c)(6).

1.4 **LOTO-Authorized Employees** shall:

a. Complete the Organizational LOTO Training Course and initial OJT for all applicable LOTO procedures;
b. Recognize the conditions of work requiring the utilization of LOTO procedures;
c. Be able to determine and verify that isolation and de-energization methods are adequate and whether residual or stored energy is present.
d. Use the materials and procedures specified in their organizations' Energy Control Program and this directive to implement the LOTO program compliance requirements;
e. When tagging out the energy source, use a standard GSFC tag which can be acquired via store stock. The organization performing the LOTO will be responsible for procuring and using the correct tag and lock; and
f. Develop written equipment specific procedures as defined by section 2.6 of this procedure.

1.5 **All Affected Employees** shall:

Be familiar with their organizations' LOTO Program and:

a. The purpose and use of LOTO procedures;
b. How to recognize LOTO procedures when in use;
c. The importance of not tampering with or removing a lock and/or tag in use as a part of a LOTO procedure; and
d. Complete and document LOTO awareness training.

1.6 **Contracting Officers** shall:

Enforce the contractual safety clauses and specifications for noncompliance if records of equivalent training cannot be produced or if LOTO procedures are found to be deficient with respect to this document.

1.7 **Contracting Officer's Technical Representatives (COTRs)** shall:

a. Review Contractor Safety Plans to ensure that LOTO programs are compliant with the provisions of this directive;
b. If an instance of noncompliance is found, take appropriate corrective action to ensure NASA and Federal requirements are met; and
c. Contact OS&H division office or Directorate Safety Representative for support in reviewing written LOTO programs.

1.8 Onsite and Construction Contractors shall, unless otherwise required:

a. Submit as part of the contract-required Safety Plan a LOTO program that meets the provisions of this directive; and
b. Make available upon request training and certification records that meet the requirements of the training section in this document.

2. LOTO PROCEDURAL REQUIREMENTS

LOTO-identified activities shall have written LOTO procedures for each LOTO activity unless exclusions apply (see sections 2.1 and 2.6). Typical activities requiring LOTO procedures include, but are not limited to:

a. Repairing electrical circuits or equipment;
b. Working on or near equipment with movable parts;
c. Clearing blocked or jammed mechanisms; and
d. Working on lines carrying hazardous materials/substances, materials/substances under pressure, or materials/substances involving dangerous temperatures.

Appendix A of 29 CFR 1910.147 provides a sample of a typical "minimum" LOTO procedure.

LOTO procedures shall include:

a. Scope – A list of the applicable equipment and any limits to the scope of the program;
b. Purpose – A statement that equipment shall be isolated from hazardous energy or materials/substances, and that the equipment shall be locked or tagged out before equipment servicing or maintenance is performed;
c. Authorization – The names of authorized and affected employees, if any, on the tag;
d. Preparation for lockout or tagout – A list of the isolating devices to be locked or tagged out; and
e. The procedural steps for locking or tagging out the hazardous energy source; the sequence of the lockout or tagout event.

2.1 Exclusions

LOTO procedures do not apply, to minor tool changes, adjustments or other minor servicing activities that take place during normal production operations if they are routine, repetitive, and

integral (as defined by OSHA) to the use of the equipment for production, provided that the work is performed using alternative measures that provide effective protection.

Refer to the decision-making flowchart on page 14. Use the flowchart as a tool to guide actions taken during the assessment of a variety of potential LOTO situations.

2.2 Administrative Locking Procedures

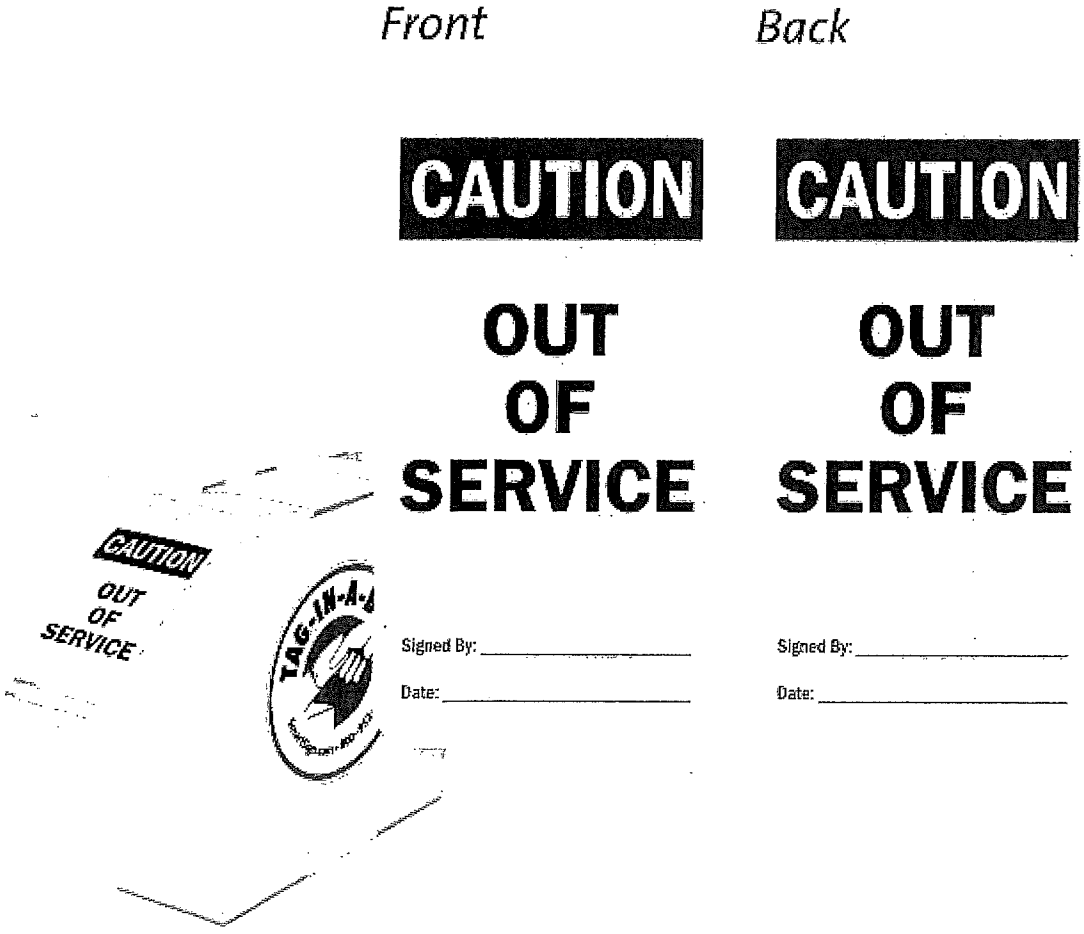
Administrative locking shall only be used when equipment or processes need to be rendered in a safe condition for instances other than maintenance or servicing. Examples of administrative locking include:

a. Locked fences around high-voltage transformers;
b. Locks on overhead-crane disconnect switches to prevent unauthorized use;
c. A locked door to a laboratory that contains hazardous equipment;
d. A water valve locked in the open position to prevent tampering; and
e. Administrative locking is not a substitute for performing LOTO during servicing or maintenance work.

2.2.1 Administrative locking devices shall be:

a. A yellow tag that states "Out of Service", see Figure 1.
b. A blue lock. Blue shrink wrap material can be used to meet this requirement.

Figure 1



2.3 Emergency Removal

The LOTO Manager or Supervisor may remove the energy-controlling device when the authorized employee who applied a LOTO device is not available to remove it. This emergency procedure shall be performed only under extreme circumstances and in accordance with 29 CFR1910.147(E)(3). Documentation shall be maintained by the LOTO Manager/Supervisor summarizing the circumstances and rationale in such an event.

2.4 Tagout Only Procedures

a. The use of a "tagout only" procedure shall be permitted only if an energy-controlling source is incapable of being locked out. Any energy-isolating device capable of being locked out shall be locked out using the LOTO program, without exception;
b. Where possible, a secondary means of isolating the hazardous energy shall be used to provide an equivalent level of safety as if a lockout device would been placed. Examples include removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnect device, or removal of a valve handle. Secondary means of isolation shall be identified on the tag, and tags shall be affixed to both the primary energy-isolating device at the same location that the lockout device would be attached, and to the mechanism at the secondary point of isolation;
c. An equipment-specific LOTO written procedure shall be used if it is determined that an energy-supplying source is incapable of being locked out and a second means of isolation is not possible. Approval of this procedure must be obtained from OS&H prior to implementation; and
d. The design and procurement of hazardous energy-producing equipment shall allow for the acceptance of a primary lockout device when new machinery or equipment is installed, repaired, renovated, or modified.

2.5 Equipment De-Energization (Outage)

All affected employees shall be notified prior to the de-energizing of equipment to be locked and/or tagged out. The person responsible for the outage will contact the Facility Operations Manager (FOM), who is acting on behalf of the employer, and/or the affected employees' Supervisor, who shall then notify the affected persons as to when and where the LOTO procedure will take place, and on what equipment.

2.6 Equipment-Specific Written Procedures

Procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this document. The authorized employee shall ensure a procedure is written to address all LOTO operations that do not meet the exception as stated below.

Note: Exception: The employer need not document the required procedure for a particular machine or equipment, when all of the following elements exist: (1) The machine or equipment has no potential for stored or residual energy or reaccumulation of stored energy after shut down which could endanger employees; (2) the machine or equipment has a single energy source which can be readily identified and isolated; (3) the isolation and locking out of that energy source will completely deenergize and deactivate the machine or equipment; (4) the machine or equipment is isolated from that energy source and locked out during servicing or maintenance; (5) a single lockout device will achieve a locker-out condition; (6) the lockout device is under the exclusive control of the authorized employee performing

the servicing or maintenance; (7) the servicing or maintenance does not create hazards for other employees; and (8) the employer, in utilizing this exception, has had no accidents involving the unexpected activation or reenergization of the machine or equipment during servicing or maintenance. Equipment specific procedures shall include a section to release equipment or processes from a locked and tagged out situation in accordance with 29 CFR1910.147(e).

2.7 Requirements for Shift and Personnel Changes

LOTO operations shall ensure the continuity of LOTO protection during shift or personnel changes if work is to be continued by an oncoming shift. An orderly transfer of LOTO devices and procedures between authorized employees or supervisors shall be maintained.

Requires that	Shall
Both shifts and/or authorized employees	• Be present.
The outgoing shift	• Remove its lock and tag after oncoming shift has applied its lock and tag, and give an update of any work changes.
The oncoming shift	• Place its lock and tag on the group LOTO device, immediately.
An outgoing authorized employee	• Remove his or her LOTO device. • Inform the authorized oncoming employee of any potential hazards.
An oncoming authorized employee	• Place his or her LOTO device immediately after the outgoing authorized employee remove his or her LOTO device.

3. LOTO DEVICE

a. Lockout locks shall be red in color and contain the authorized employees name and contact information. Red locks will not be used for any other purpose. Red shrink wrap material can be used to meet this requirement. These LOTO devices shall be durable to the environment to which they are exposed. See Figure 2 for examples of red locks and acceptable red shrink wrap material.
b. Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided by the responsible party for the purpose of isolating, securing or blocking of machines or equipment from hazardous energy sources.

3.1 Keys

a. Each LOTO padlock shall have two keys, primary and emergency;
b. The primary key shall remain in the possession of the authorized employee who applied the lock;

c. The emergency key shall be kept in a secured area (e.g., a lock box) with access limited to the authorized employee's immediate supervisor and one level of management above the authorized employee's supervisor; and
d. Emergency keys shall only be used in accordance with Section 2.3 of this procedure.

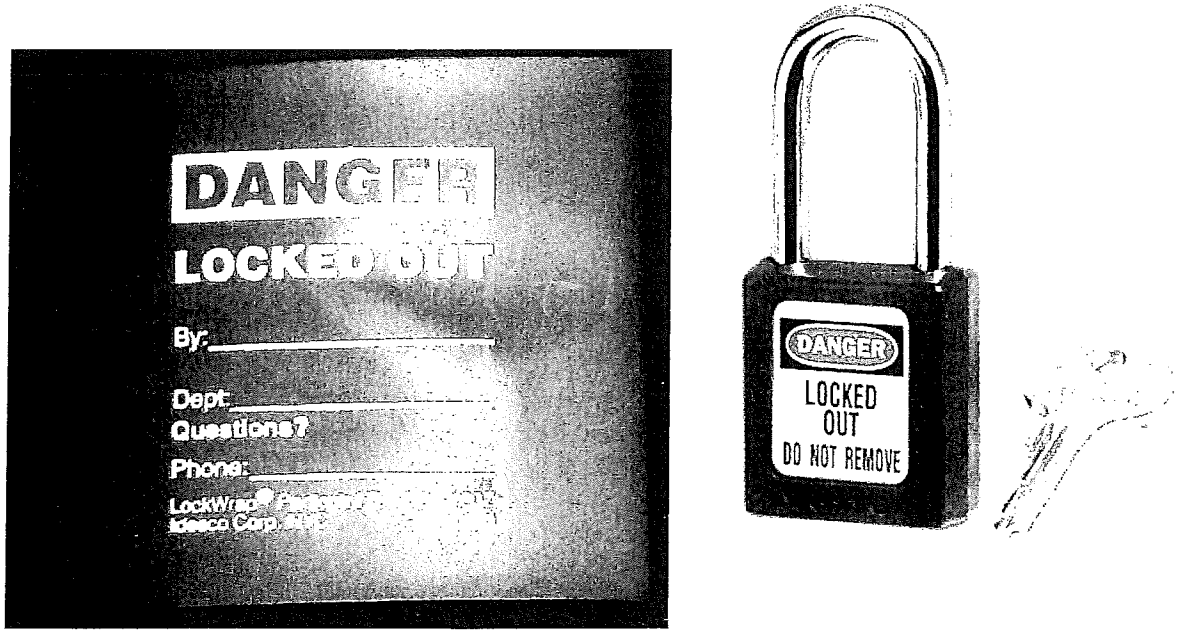


Figure 2

3.2 Tags

a. Tags shall not be used in lieu of a lock unless the energy-isolating device is not physically capable of being locked. In the event a lock cannot be used tagout procedures will comply with 29CFR1910.147(c)(3);
b. Tagout tags shall read "Do Not Operate" and be identical to tags in Figure 3;
c. Tagout tags shall conform to the durability and securing requirements specified in 29CFR1910.147(c)(5); and
d. The authorized employee who performs LOTO shall complete all applicable sections of the tag.

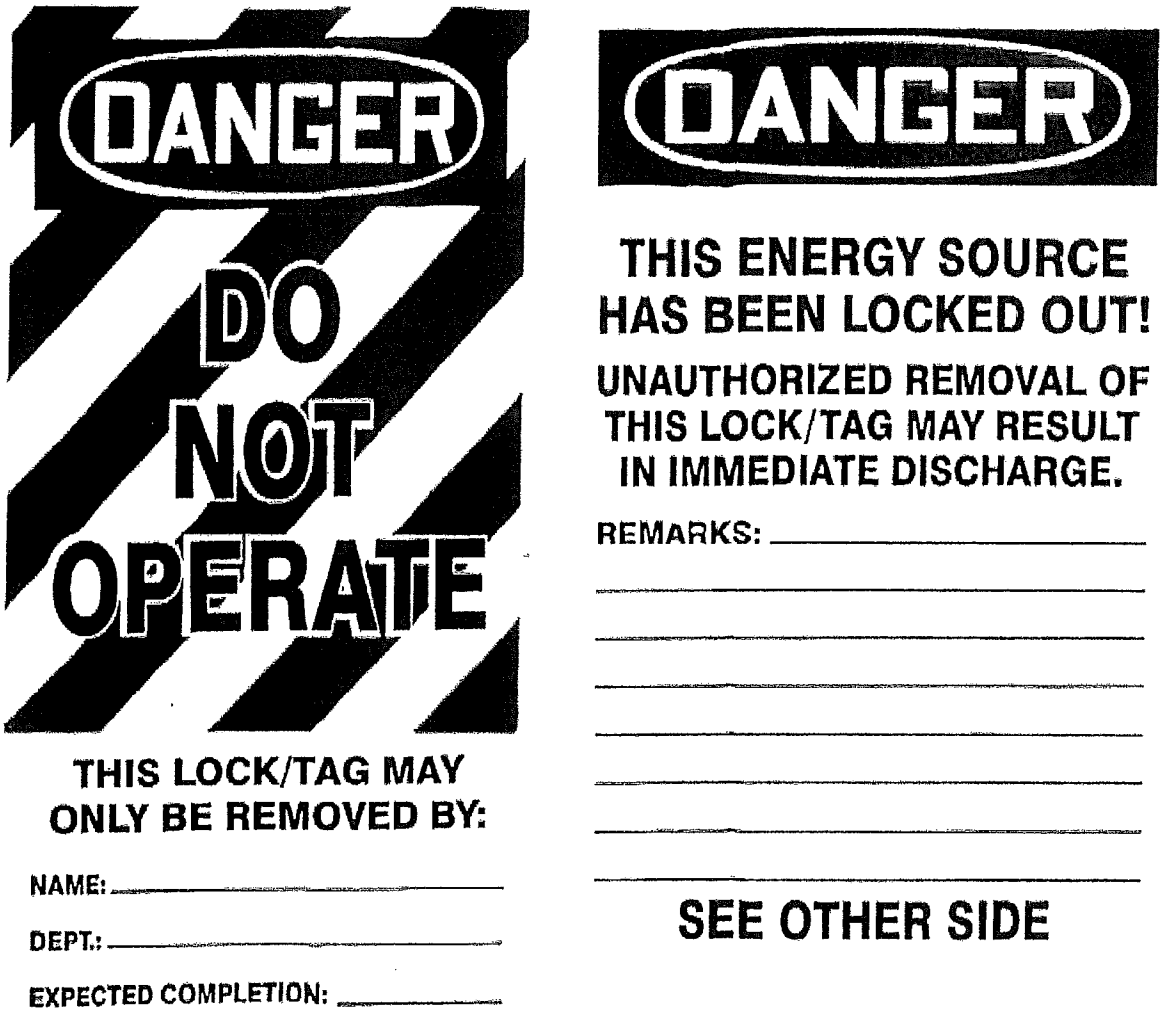


Figure 3

3.3 Other Hardware

LOTO procedures shall allow for supervisors to provide other hardware as required, such as multiple lock hasps and circuit breaker or valve lockout devices.

3.4 Record of LOTO Events

Documentation for each LOTO event is required to be recorded in an organizational/department or project log, or the equivalent. The following information shall be recorded:

a. Name of authorized employee who performed the LOTO process;
b. Date and time LOTO was applied;
c. Equipment and/or circuit identification;
d. Reason for LOTO application;
e. Schematic drawing or print numbers, when available;
f. Date and time of proposed LOTO removal; and
g. Name of authorized employee who will remove LOTO if different from authorized employee who initiated the LOTO process.

4. Release from Lockout and/or Tagout

Before the device(s) is/are removed and energy restored, the authorized employee shall:

a. Inspect the machine/equipment for foreign objects and remove them to bring an operational safety state; and
b. Ensure other employee(s) are in a safe area away from the machine / equipment, notify affected employee(s) about the LOTO devices been lifted.

Appendix A – Definitions

A.1 **Affected employee** – An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

A.3 **Authorized employee** – A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.

A.4 **Capable of being locked out** – An energy-isolating device is capable of being locked out if it has a hasp or other means of attachment to which or through which a lock can be affixed, or it has a locking mechanism built into it. Other energy-isolating devices are capable of being locked out if lockout can be achieved without the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability.

A.6 **Energy isolating device** – A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches, and other control circuit-type devices are not energy-isolating devices.

A.7 **Energy source** – Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

A.9 **Lockout** – The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

A.10 **Lockout device** – A device that utilizes a positive means such as a lock, either key or combination-type, to hold an energy isolating device in a safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

A.11 **LOTO-Authorized Manager/Supervisor** – An individual trained and qualified to identify existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

A.12 **Normal production operations** – The utilization of a machine or equipment to perform its intended production function.

A.13 **Servicing and/or maintenance** – Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning, or unjamming of machines or equipment, and making adjustments or tool changes, where the employee may be exposed to the unexpected energizing or startup of the equipment or release of hazardous energy.

A.14 **Setting up** – Any work performed to prepare a machine or equipment to perform its normal production operation.

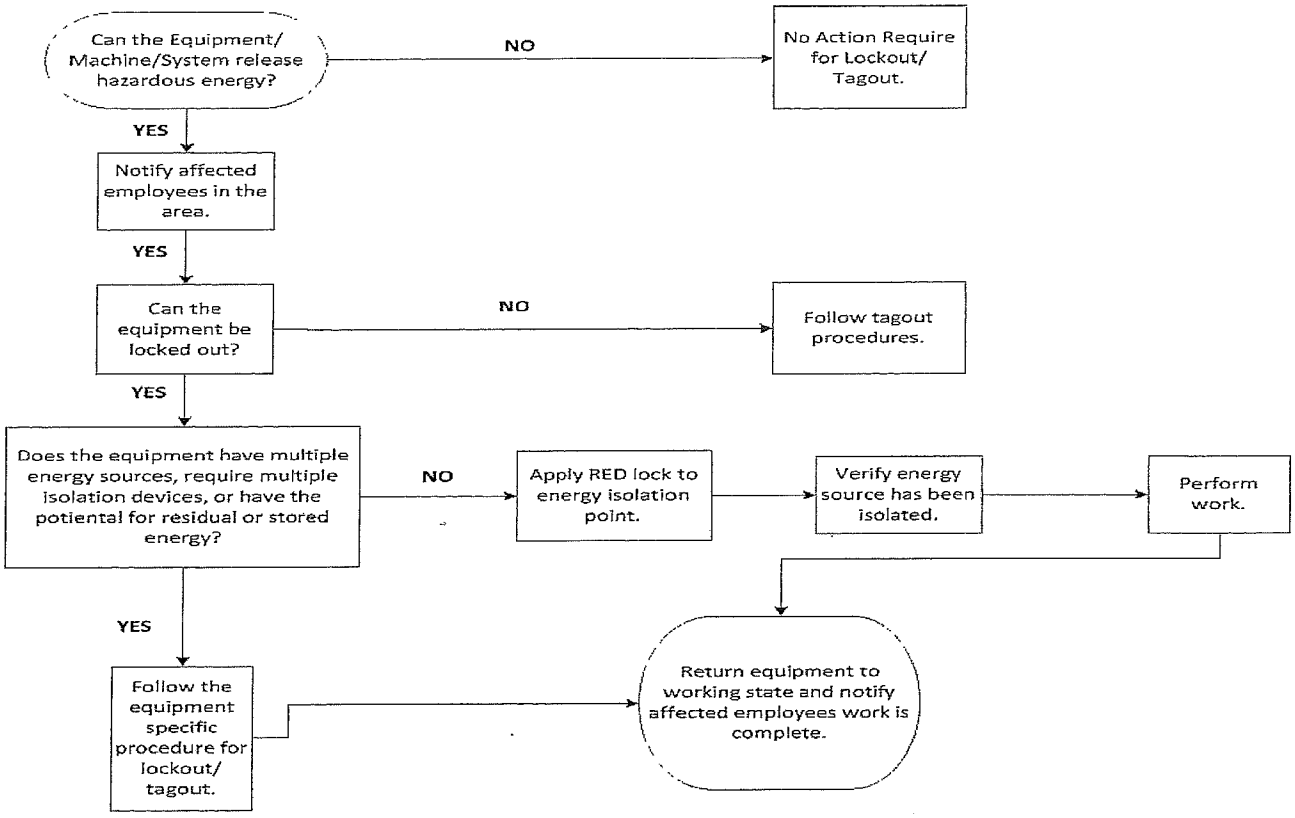
A.15 **Tagout** – The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

A.16 **Tagout device** – A prominent warning device, such as a tag and a means of attachment, which can be fastened securely to an energy-isolating device in accordance with an established procedure, to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Appendix B – Acronyms

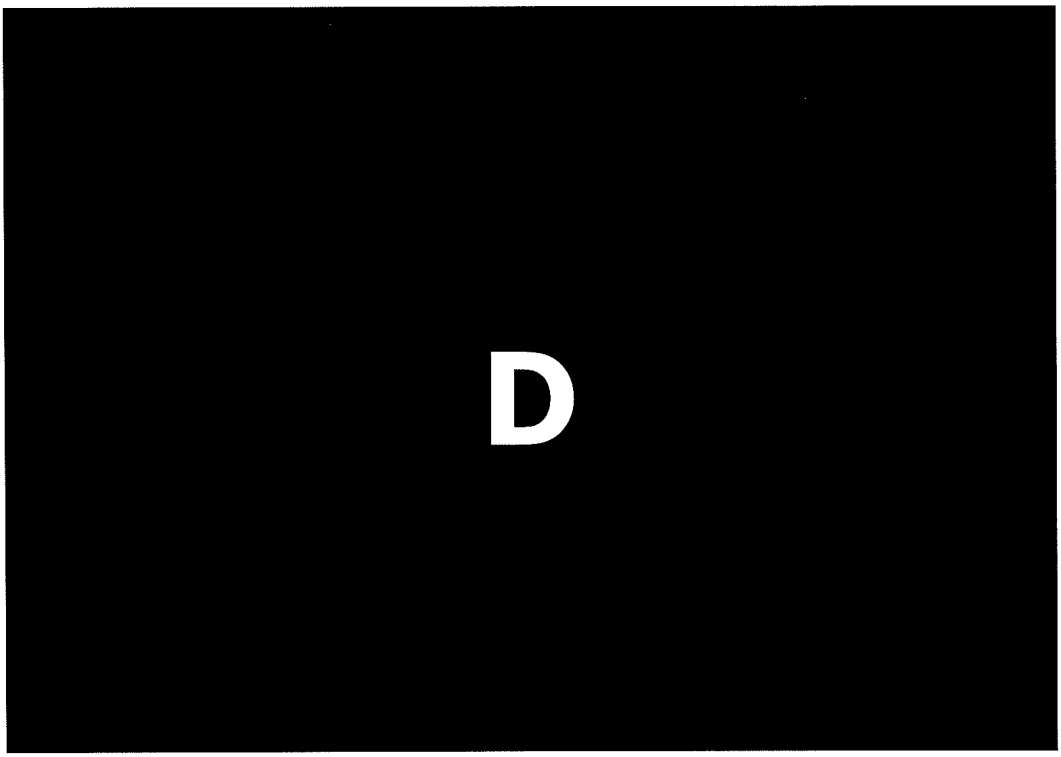
CFR	Code of Federal Regulations
COTR	Contracting Officer's Technical Representatives
CPR	Cardiopulmonary Resuscitation
FAR	Federal Acquisition Regulation
FOM	Facility Operations Manager
GPR	Goddard Procedural Requirement
GSFC	Goddard Space Flight Center
LOTO	Lockout/Tagout
NASA	National Aeronautics and Space Administration
NPR	NASA Procedural Requirement
NRRS	NASA Records Retention Schedules
OJT	On-the-Job Training
OS&H	Occupational Safety & Health
OSHA	Occupational Safety and Health Administration

Appendix C - LOTO Process



CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	06/02/05	Initial Release
A	04/02/10	Administratively Revised to update the Responsible Office Code, Organization Title and organization name within the document. Administratively extended for 1 year from original expiration date.
B	01/13/12	Document has been updated to comply with standardization requirements for LOTO devices across the center.


D

ENERGIZED ELECTRICAL WORK PERMIT (EEWP)

GODDARD SPACE FLIGHT CENTER

INSTRUCTIONS FOR COMPLETING THIS FORM ARE ON PAGE 2

PART I: TO BE COMPLETED BY THE REQUESTER

1. Date:	2. Building(s):	3. Room(s) (If applicable):	4. Equipment ID/Circuit/Panel (if known):

5. Description of work location (building/floor/room):

6. Description of work to be done:

7. Justification why circuit/equipment cannot be turned off:

Critical Equipment (unable to be de-energized)

*Impacts Mission: Yes ☐ No ☐ Specify Mission Impact:

8. Requester Name/Title:	Signature:	Date:
9. Branch (or Division) Head Name/Title:	Signature:	Date:

PART II: TO BE COMPLETED BY THE ELECTRICAL SAFETY OFFICER (ESO)

1. Electrical Safety Officer concurrence for working energized: Yes ☐ No ☐ (If yes, proceed to Part III; If no, return to requester)
Justification for concurrence:

2. Electrical Safety Officer Name/Title:	Signature:	Date:

PART III: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSON(S) DOING THE WORK

1. Voltage rating of equipment: ☐120V/208V ☐277V/480V ☐5kV ☐15kV ☐35kV ☐50+

	Check When Complete
2. Detailed job description procedures to be used in performing the above work:	☐
3. Description of the Safe Work Practices to be employed:	☐
4. Results of the Shock Hazard Analysis:	☐
5. Determination of Shock Protection Boundaries:	☐
6. Results of the Flash Hazard Analysis:	☐
7. Determination of the Flash Protection Boundary:	☐
8. Identify personal protective equipment (PPE) to safely perform the assigned task (attach complete checklist):	☐
9. Means employed to restrict the access of unqualified persons from the work area:	☐

10. Evidence of completion of a Job Briefing including discussion of any job-related hazards:

11. Do you (qualified person) agree the above-described work can be done safely? Yes ☐ No ☐
If no, provide explanantion and return to the ESO

PART IV: FINAL APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED

1. Electrical Qualified Person's Name/Title:	Date:
2. Supervisor Name/Title:	Date:

3. Directorate of Name/Title: (See Instructions)	Signature (Authorized Representative):	Building:	Room:

Provide a copy to the Requester *and* to the Qualified Person

Instructions for completing GSFC Form 23-83
Energized Electrical Work Permit (EEWP)

Services Requiring EEWP

At Goddard Space Flight Center-Greenbelt and its Sites, Any energized work 50V+ requires an EEWP. Exceptions are routine tasks performed on or near live parts such as testing, troubleshooting, and voltage measuring of electrical systems. If there is a question, as to whether the scope of work is "routine," contact the Safety Office at (301) 286-6296. Note: at WFF, ***all*** EEWP forms must be submitted to Code 803.

Be sure to fill in all blocks pertaining to the permit. If the block does not apply to you, write, "N/A."

PART I: Requester Information.

Block 1: Date

Block 2: Enter the location/Building(s) where work will be performed. Details are to be placed in Part I, Item 1.

Block 3: Indicate the room(s) in which the equipment panel is located.

Block 4: Enter the Equipment ID number, Panel number, or Circuit number if known.

Block 5: Detailed information on the location of all equipment, panel, or circuit(s) involved.

Block 6: Detailed description of work.

Block 7: Explain why the work needs to be done while energized. Note whether it is Mission Impacted or Critical equipment. Specify the impact de-energizing will have on the Mission.

Block 8: Requester's name and title, signature and date.

Block 9: Branch/Division Chief's name and title, signature and date.

PART II: Electrical Safety Office approval.

Block 1: ESO's concurrence, justification for concurrence.

Block 2: ESO's – Name, title, signature and date.

PART III: Information to be completed by the Electrically Qualified Person doing the work. Attach a copy of the Personal Protective Equipment being utilized.

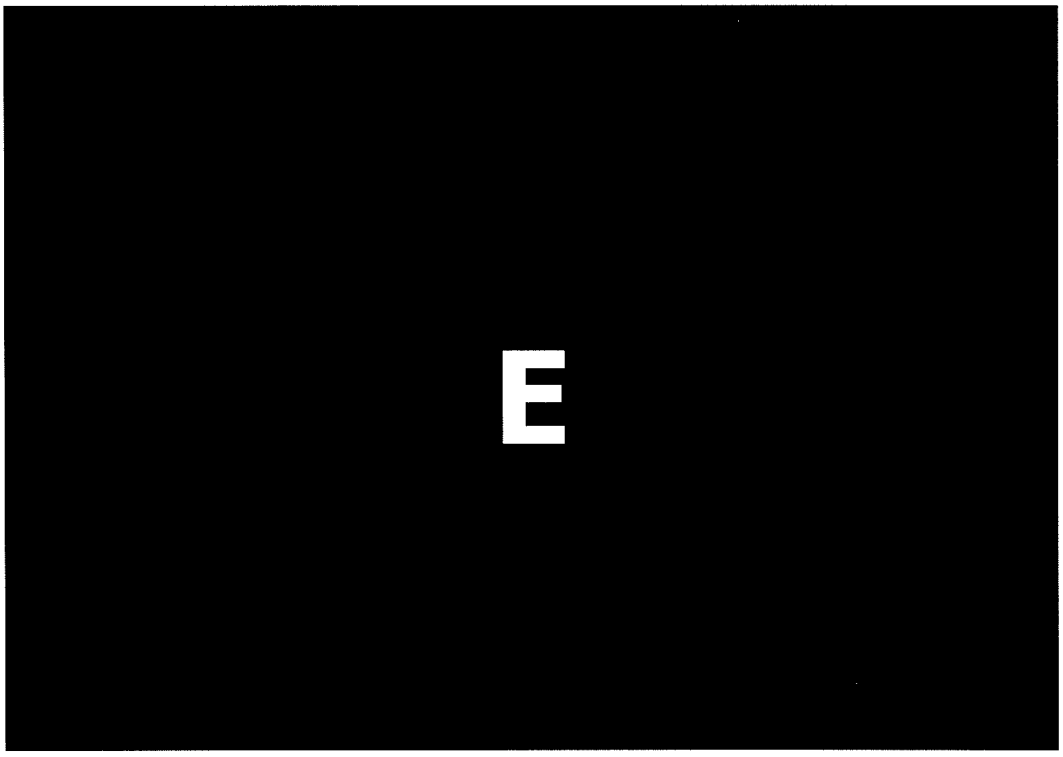
PART IV: Final approvals: The qualified person, and their Supervisor, shall approve the EEWP, with final approval resting with the Codes' Director Of:

Block 1: Name/Title of Electrically Qualified Person doing the work.

Block 2: Name/Title of Supervisor of Qualified Person doing the work

Block 3: Name/Title of Directorate or Authorized Authority of the Code requiring the work.

Please be sure to retain a copy for reference.


E

Goddard Procedural Requirements

DIRECTIVE NO.	GPR 1700.6A	**APPROVED BY Signature:**	*Original Signed By*
EFFECTIVE DATE:	January 27, 2012	**NAME:**	Edward. J. Weiler
EXPIRATION DATE:	February 4, 2013	**TITLE:**	Director

COMPLIANCE IS MANDATORY

Responsible Office: Code 350/Occupational Safety & Health (OS&H) Division

Title: Confined Space Program at the Goddard Space Flight Center (GSFC)

PREFACE

P.1 PURPOSE

This directive establishes requirements for practices and procedures to protect employees who enter confined space work locations at GSFC as defined by the Occupational Safety and Health Administration (OSHA) Standards.

P.2 APPLICABILITY

This directive applies to all government and contractor confined space entries associated with industrial operations at GSFC, including Greenbelt, Wallops Flight Facility (WFF), and remote locations under GSFC control. Confined space entries associated with construction activities are covered under 29 CFR 1926.21(b)(6)(i). This directive shall apply to all operations involving confined spaces, or potentially hazardous atmospheres. For GSFC contractors, this directive is applicable as specified in the contract clauses for the particular contract by NASA FAR Supplement 1823.7001 NASA Safety and Health Solicitation Provisions and Contract Clauses. The term "Safety Office" is applicable equally to both the Greenbelt (Code 350), and WFF (Code 803) safety organizations.

P.3 AUTHORITY

a. NPD 8700.1, NASA Policy for Safety and Mission Success
b. NPD 8710.2, NASA Safety and Health Program Policy
c. NPR 8715.3, NASA Safety Manual

P.4 REFERENCES

a. 29 Code of Federal Regulations (CFR) 1910.146, Permit-Required Confined Spaces
b. 29 CFR 1910 Subpart Z, Toxic and Hazardous Substances
c. American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) for Chemical Substances and Physical Agents & Biological Exposure Indices
d. Form 23-52 – GSFC Confined Space Entry Permit
e. NASA FAR Supplement 1823.7001, NASA Safety and Health Solicitation Provisions and Contract Clauses
f. WSM 2002 Entering Confined Spaces (WFF ONLY)

g. 29 CFR 1926.21(b)(6)(i), Safety Training and Education

P.5 CANCELLATION

GPR 1700.6, Confined Space Program at the Goddard Space Flight Center (GSFC)

P.6 SAFETY

Use one or more of the hazard analysis tools appropriate to this activity, such as the Task Safety Analysis or the Chemical Lab Safety Analysis tools or equivalent found at: http://safety1st.gsfc.nasa.gov/.

P.7 TRAINING

a. Personnel who enter confined spaces, or are responsible for facilities/equipment that have confined spaces, shall take a confined space training course that meets OSHA requirements. As set forth in their contracts, contractors are responsible for obtaining training for their personnel, and ensuring all subcontractors have met OSHA and NASA training requirements. Initial and refresher training shall include the course content requirements as defined by 29 CFR 1910.146(g). Personnel shall be retrained as required by OSHA.

b. All personnel that complete the training shall be required to pass a written examination that adequately measures the knowledge and understanding of the requirements, policies, and procedures applicable to entering confined spaces.

c. Personnel designated to conduct atmospheric testing of confined spaces shall also be trained in the requirements above, and in the operation, calibration, and care of specific testing equipment to be used. Individuals conducting atmospheric tests must be qualified to interpret the test results.

d. Managers and/or supervisors shall maintain current training records, as well as training requirements for each employee tasked to perform confined space entry activities and documentation shall be in writing. The Safety Office will oversee the respective programs to ensure only trained personnel enter confined spaces.

P.8 RECORDS

Entry into a permit space must be authorized by the Entry Supervisor using GSFC Form 23-52, GSFC Confined Space Entry Permit.

Record Title	Record Custodian	Retention
Form 23-52 Entry/Evaluation Permit or equivalent form	Organization/Supervisor of Employees Entering Confined Spaces	*NRRS 8/38B. Destroy when 5 years old
Certificate of Confined Space Training	Human Resources, Supervisor of Employee and Codes 350/803	*NRRS 3/33G1. Destroy 5 years after employee discontinues or completes training
Annual Review of the Confined Space Entry Program	Organizations Conducting Confined Space Operations and Codes 350/803	NRRS 1/125A. *Destroy when 10 years old or when superseded or obsolete, whichever comes first
List of Permit Required Confined Spaces	Organizations Who Manage the Confined Space and Codes 350/803	29 CFR 1960.73. Records and reports shall be retained for 5 years following the end of the fiscal year to which they relate

**NPR 1441.1 – NASA Records Retention Schedules*

P.9 METRICS

Organizations that conduct confined space entry activities, as a minimum, shall collect the following data to monitor trends and lessons learned which will be provided to line organizations and briefed to senior GSFC management as necessary:

a. Listing of permit-required confined spaces in their work areas, and the number of spaces added to the base list over the last year.
b. Number of submitted permits annually.
c. Prioritized listing of most frequent hazards encountered and abatement/control measure actions.
d. Number of employees identified for confined space training and annual completion rates.

P.10 DEFINITIONS

a. Acceptable Entry Conditions – The conditions that shall exist in a confined space location to allow entry and to ensure that employees involved with confined space operations can safely enter into, and work within the space.

b. Attendant – An individual stationed outside one or more permit-required spaces, who monitors the authorized entrants and who performs all attendant's duties assigned in the organization's Confined Space Program.

c. Authorized Entrant – An employee who is authorized by the employer to enter a confined space.

d. Confined Space – A space that is:

(1) Large enough, and so configured that an employee can bodily enter and perform assigned work,
(2) Has limited or restricted means for entry or exit, and
(3) Is not designed for continuous occupancy.

Confined spaces generally include, but are not limited to tanks, vaults, vessels, storm water/sewer systems, telecommunications tunnels, shipping containers/transporters, underground piping, raised floor areas, clean tents, bins, boilers, ventilation or exhaust ducts, manholes, digesters, ovens, kilns, pulpers, tunnels, furnaces, degreasers, test chambers, vats, certain locations within aircraft and spacecraft when not in flight, pipelines, and similar restrictive locations. Open top spaces more than four feet in depth, such as pits, tubs, vaults, vessels, trenches, and excavations may also be designated as confined spaces under certain circumstances.

e. Downgraded (reclassified) Confined Space – A downgraded confined space is a confined space previously classified as a permit-required confined space. Permit-required confined spaces can be reclassified as non-permit confined spaces only once it is proven that all actual or potential hazards within and around the space have been eliminated, and will remain eliminated for the full duration personnel are within the space (29 CFR 1910.146, (c)(7)).

f. Engulfment – The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be expected to cause death or serious physical harm by filling or plugging the respiratory system, or that can exert enough force on the body to cause critical injury/death by strangulation, constriction, or crushing.

g. Entry – Entry into a confined space occurs as soon as any part of the entrant's body breaks the plane of an opening into the space.

h. Entry Permit – The written permit defining the conditions under which a permit-required confined space may be entered (see below).

i. Entry Supervisor – The person (such as employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at either a permit-required space or non-permit-required space where entry is planned, for authorizing entry and overseeing entry operations, based on the pre-entry evaluation, and for terminating entry as required by this section.

j. Hazardous Atmosphere – An atmosphere that exposes employees to a risk of death, incapacitation, injury, or acute illness from one or more of the following causes:

(1) A flammable gas, vapor, or mist in excess of 10 percent of its Lower Flammable Limit;
(2) An atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
(3) A combustible dust environment;
(4) An atmospheric concentration of any substance for which exposure would exceed the Permissible Exposure Limit (PEL) or TLV, whichever is more stringent; and
(5) Any atmospheric condition recognized as immediately dangerous to life or health.

k. Immediately Dangerous to Life or Health (IDLH) Condition – Any condition that poses an immediate threat of loss of life or physical injury or that may result in irreversible or immediate, severe health effects or other conditions that could impair escape from the confined space. If entry into an IDLH condition is required, rescue personnel and equipment shall be standing by the site.

l. Non-Permit-Required Confined Space – A confined space that does not contain, or with respect to atmospheric hazards have the potential to contain, any hazard capable of causing death or serious physical harm. Examples include vented vaults, motor control cabinets, and dropped ceilings. Although they are technically defined by OSHA as confined spaces, these spaces have either natural or permanent mechanical ventilation to prevent the accumulation of a hazardous atmosphere, and they are not likely to present suffocation, engulfment or other serious hazards.

m. Occupational Exposure Limit – Goddard consensus on the amount of a chemical or physical stressor that a person may be exposed to over a working lifetime without suffering ill effects from the exposure. These limits are taken from either the OSHA PELs; published in 29 CFR 1910.1000, tables Z-1, Z-2, or Z-3, or the most current ACGIH TLV guide. Goddard will use whichever is the most stringent standard of the two.

n. Permit-Required Confined Space – A confined space that has the potential to contain an IDLH hazardous atmosphere, or contains one or more of the following:
(1) A material/substance that has the potential for suffocating an entrant;
(2) A material/substance that has the potential for engulfing an entrant;
(3) A material/substance that poses a probable shock hazard;
(4) An internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor sloping downward and tapering to a smaller space; and
(5) Any other recognized serious safety or health hazards likely to cause death or serious physical harm to the occupant(s), to include any hazard introduced into the space that is required as part of the work being performed within the space, such as coating, cleaning materials, hot work, i.e., welding, cutting or brazing, for which specific permits are required.

o. Testing – The process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing enables employers to devise and implement adequate control

measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to entry, during entry, and re-entry following extended periods of time. Testing includes specifying the tests that are to be performed in the permit space and the maintenance of a written record of test results at the location of the test site.

p. Two-Person Rule - A system of organizing employees into work groups for hazardous work activities in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the Two-Person Rule is to provide rapid assistance to employees in the event of an emergency.

PROCEDURES

In this document, a requirement is identified by "shall," a good practice by "should," permission by "may" or "can," expectation by "will" and descriptive material by "is."

1. CONFINED SPACE OPERATIONS

These procedures define requirements to reduce significantly accidental injury and death associated with entering, working in, and exiting from, confined spaces. They are designed not only to make the confined space safe for the worker, but also to make the worker cognizant of the hazards associated with this work area and the safe work practices necessary to deal with these hazards. Conditions deemed unacceptable for safe operations will necessitate appropriate safeguards, including adequate control measures for all specific and/or potential hazards identified and documented during the preparation of an entry permit that is signed and issued by an authorized entry supervisor.

2. CONFINED SPACE POLICY

Safe practices, applicable to all civil service personnel, contractors, and non-contractors performing operations at GSFC facilities, are in place to prevent exposure to unsafe conditions prior to entering, and while working within, non-permit-required and permit-required confined spaces. Unsafe conditions include exposure to hazardous atmospheres, including potential contact hazards such as steam burns and electrical shock, and engulfment and drowning. Dangerous air contamination within a confined space is any atmosphere presenting risk of suffocation, health impairment, contact injury, disablement, or death. Examples include:

a. Combustible or flammable gases and vapors at concentrations in excess of 10 percent of the lower explosive limit,
b. An oxygen concentration less than 19.5 percent or greater than 23.5 percent by volume, and
c. Toxic substances present at concentrations in excess of their occupational exposure limits.

3. ROLES AND RESPONSIBILITIES (CIVIL SERVICE AND CONTRACTORS)

3.1 Division Chiefs shall:

Ensure that civil service employees, onsite mission support, and construction contractors in their Divisions are informed of, and adhere to, GSFC Confined Space Policy.

3.2 Center Safety Organizations shall:

a. Provide information and consultation as necessary to project management and employees involved in
confined space operations;
b. Review confined spaces procedures for specific projects, at the request of managers or supervisors;
c. Review at least annually this directive and the effectiveness of the confined space program as outlined herein;
d. Coordinate with the Career Development and Employee Worklife Office Career Development and Training Group (Code 114) to make training in confined spaces procedures available to civil service staff;
e. Using confined spaces regulations, assist GSFC management in making appropriate decisions about confined spaces in their areas of operation;
f. Provide contract and specification review as requested by GSFC management;
g. Function as the regulatory liaison with regulatory agencies as needed for confined space entries;
h. Ensure compliance with standards set forth in the program by periodic inspection of entry sites and canceling permits where unsafe conditions are present; and
i. Elect to provide more stringent controls and oversight of their respective confined space programs provided all minimum requirements established within this document are complied with.

3.3 Confined Space Authorized Entry Supervisors and Managers shall:

Have overall responsibility for the approval for entry into and work conducted within confined spaces. As such, they are responsible for ensuring that the requirements of this directive are implemented. If uncertainty exists, entry supervisors shall request assistance from Safety Office personnel who will resolve questions about whether a location meets the criteria of an OSHA-defined confined space, or a permit-required confined space, prior to any confined space entry.

Proper application of the decision flow chart (diagram 7.0) will facilitate initial compliance with this requirement. In the event that the confined space contains hazards that pose potential danger to entrants or occupants, the responsible organization shall:

a. Develop and implement a written Permit-Required Confined Space Program that is consistent with provisions outlined with 29 CFR 1910.146, "Permit-Required Confined Spaces." The written program shall be available for inspection by employees and their authorized representatives;
b. Evaluate and approve entry by permit and/or operating procedures and prepare a written Entry Permit if necessary;
c. Review equipment to be used;
d. Ensure that atmospheric measuring equipment is installed, calibrated, maintained, and used properly;
e. Identify and post as such those areas considered permit required confined spaces;
f. Ensure that personnel designated as confined space entrants have received appropriate confined

space training;

g. Conduct and certify initial atmosphere tests and retests as deemed necessary to ensure that all appropriate safety measures are being taken for maximum safety protection and;

(1) Perform confined space pre-entry evaluations with emphasis on hazard recognition, evaluation, and control;
(2) Classify a confined space as a permit-required or non-permit required space based on actual and potential hazards associated with the confined space and the work to be performed; and
(3) Identify necessary controls and procedures for worker safety.

h. Notify the Emergency Console (Fire Department Dispatcher at WFF) of the date, time, and location of a Permit-Required Space Entry to obtain permission from the Console. Entry will not occur unless the Console can coordinate rescue support from the local Fire Department.
i. Control access to their respective managed confined spaces. Specifically, they shall:

(1) Ensure all confined spaces are controlled through the use of locks or other measures that prevent unauthorized personnel from entering,
(2) Ensure that all permit required confined spaces within their control are properly placarded with appropriate signage,
(3) Ensure that all personnel working within their respective facilities or areas are aware of all permit required confined spaces and the specific hazards they pose, and
(4) Coordinate with the Safety Office for assistance in evaluating and documenting the actual and/or potential hazards within all identified confined spaces.

j. Ensure that all control measures for safety of personnel are taken, including availability of communication equipment, notification of rescue personnel prior to the start of confined space entry, and proper Personal Protective Equipment (PPE), tools, and materials are on hand and utilized as required on the Confined Space Permit.
k. May serve as an attendant, or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of the Entry Supervisor may be passed from one individual to another during the course of the entry operation.

3.4 Confined Space Authorized Entrants shall:

a. Recognize the conditions and hazards of work requiring the utilization of confined space procedures including mode, signs, symptoms, and consequences of exposure, and
b. Use the materials, equipment, and procedures specified in their written procedures to implement the Confined Space Program.

3.5 Attendant shall:

a. Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;
b. Be aware of possible behavioral effects of hazard exposure in authorized entrants;
c. Continuously maintain an accurate count of authorized entrants in the permit space and ensures that

the means used to identify authorized entrants accurately identifies who is in the permit space;
d. Remain outside the permit space during entry operations until relieved by another attendant;
e. Communicate with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under paragraph (i)(6) of this section;
f. Monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions;
   (1) If the attendant detects a prohibited condition;
   (2) If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;
   (3) If the attendant detects a situation outside the space that could endanger the authorized entrants;
   (4) If the attendant cannot effectively and safely perform all the duties required.
g. Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;
h. Take the following actions when unauthorized persons approach or enter a permit space while entry is underway:
   (1) Warn the unauthorized persons that they must stay away from the permit space;
   (2) Advise the unauthorized persons that they must exit immediately if they have entered the permit space;
   (3) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space and;
   (4) Perform no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

3.6 Contracting Officers shall:

Enforce contract specifications if records of required training cannot be produced, or if confined space procedures are found to be deficient with respect to this document.

3.7 Onsite and Construction Contractors shall:

a. Submit, as part of their contracts, any required Safety Plan, a Confined Space Program (if required) that meets the provisions of this directive; and
b. Make available upon request training and authorization records that meet the requirements of the training section in this document.

4. CONFINED SPACE PERMIT PROCEDURE

The proper use of confined space entry permits comprises the following actions:

a. The Entry Supervisor shall document, before entry into a permitted space is authorized, that the space has been evaluated and is safe to enter. Information shall be annotated on the Confined Space Entry Permit; and
b. The Entry Supervisor, attendant, and entrant(s) shall verify that all necessary precautions have been taken to ensure safety, and then sign the Entry Permit.

The Entry Supervisor shall terminate entry and cancel the Entry Permit when:

a. A condition that is not allowed under the permit arises in, or near, the permit space, e.g., emergency, change in atmosphere, etc.; or
b. When the job is completed, all entrants have exited the space, and the space is ready to be returned to service.

Permit-required confined space procedures will be enhanced by the use of area and/or job-specific procedures. Confined space work often involves trade-skilled individuals routinely working in areas that are permit required spaces. In some cases, the work is preventative maintenance that already has specific work procedures; thus, the confined space requirements for working in such an area can be added to the written work procedures as long as they meet the requirements of this directive.

4.1 Confined Space Entry Permit Posting

At the time of entry, the Entry Supervisor shall make available to all authorized entrants and the attendant the completed Entry Permit. The Entry Permit may be posted at the entry portal or made available by other equally effective means; so that both entrant and attendant can confirm that pre-entry preparations have been completed. Danger signage shall also be posted to inform personnel working in the immediate area.

4.2 Confined Space Entry Permit Duration

The duration of the Entry Permit shall not exceed the time required to complete the assigned task or job identified on the Entry Permit. In addition, the duration of an Entry Permit must not extend beyond one shift with the same crew. If a new crew arrives, a new Entry Permit must be completed. Consideration to deviate from this requirement may be made if the organization can provide written control methods that will ensure the level of safety is not reduced.

4.3 Reclassifying (Downgrading) Permit-Required Confined Spaces

Organizations that have personnel that enter confined spaces, or have confined spaces within their respective facilities, or areas for which they are responsible, may reclassify permit-required confined spaces provided they have met the following requirements:

a. A detailed written and approved procedure/analysis that details the decision-making process in downgrading procedures;
b. Compliance with all requirements and stipulations established with OSHA 29 CFR 1910.146 for reclassifying permit required confined spaces;
d. Specific training provided to all designated personnel that covers the organizations' procedures in reclassifying permit required spaces.

Only the Safety Office can approve the reclassification of a permit-required space to a non-permit required space.

4.4 Alternative Procedures for Entering Confined Spaces

An organization may use alternate procedures for entering a permit-required space under the conditions set forth below:

a. The organization can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;
b. The organization can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry; or
c. The organization develops monitoring and inspection data that supports the demonstrations required by paragraph (c)(5)(i) of 29 CFR 1910.146.

Continuous forced air ventilation shall be used, as follows:

a. An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere,
b. The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is, or will be present within the space and shall continue until all employees have left the space,
c. The air supply for the forced air ventilation shall be from a clean source, and may not increase the hazards in the space, and
d. The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this paragraph.

If a hazardous atmosphere is detected during entry:

a. Each employee shall leave the space immediately,
b. The space shall be evaluated to determine how the hazardous atmosphere developed, and
c. Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

5. CONFINED SPACE RESCUE

Prior to starting any operation involving entry into permit required confined spaces, the Entry Supervisor shall coordinate the operation with Code 240 Emergency Services (Fire Department Dispatcher at WFF). Emergency Services are required to know the place, time, duration, and activity of the entry operation. No entry shall take place until the Emergency Console has coordinated rescue services with the local Fire Department. The "Two-Person Rule" is in effect for all entries into permit-required confined spaces.

5.1 Confined Space Emergency Retrieval Systems

To facilitate non-entry rescue, appropriate retrieval systems or methods shall be used whenever an authorized entrant enters a permit-required confined space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet requirements outlined in 29 CFR 1910.146.

5.2 Confined Space Entry Rescue

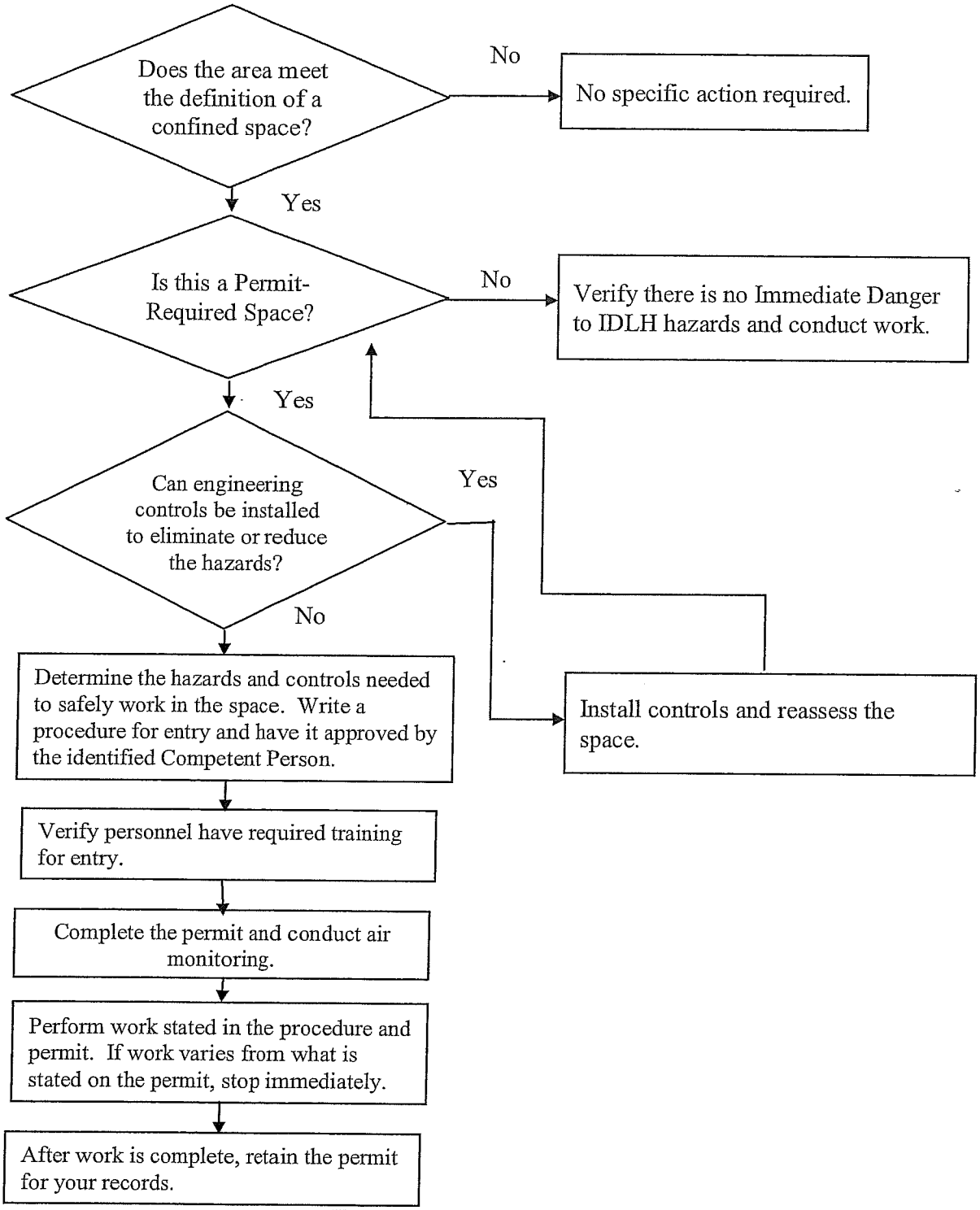
If, in the course of a non-permit or permit-required confined space entry, an attendant becomes aware that an entrant requires assistance in escaping from the confined space, the attendant will summon rescue and other emergency services by notifying the Emergency Console via radio, dialing 911 on any on-Center telephone, or dialing (301) 286-8661 for Greenbelt, (757) 824-1333 for WFF from any off-Center or cell phone. The attendant will initiate non-entry rescue procedures determined in the Pre-Entry Checklist (Confined Space Entry Permit).

Note: Attendants shall not enter a permit-required space to attempt rescue nor shall they leave their post unless relieved by another appropriately trained attendant.

6. CONFINED SPACE DECISION-MAKING FLOWCHART

The decision-making flowchart is included on the following page. The flowchart is to be used as a tool to guide the user on what actions are to be taken during the assessment of a confined space in a variety of situations.

Diagram 7.0
Confined Space Decision Flow Chart



CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	02/04/2006	Initial Release
A	11/10/2010	Administratively extended and revised to reflect organization name and code change.
A	01/27/2012	Administratively extended for 1 year from original expiration date.