

PCN 98778	DOCUMENT RELEASE AUTHORIZATION KENNEDY SPACE CENTER, NASA	PAGE 1	OF 3
ESR		REV/DATE	
DIR	DRA NO. E-AC000000 -1108	SIGNATURE	
EFF	TITLE REPLACE FDRS & DUCTS, VAB AREA N, PADS A, B REPLACE PROTECTIVE RELAYS AT C5, C5A & ORSINO SUBSTATION WITH SEL RELAYS MODIFY C-5 SUBSTATION FOR RING BUS \ CONFIGURATION , REPLACE PAD B SWITCHGEARS	VEN CODE	
EQ. LOC. UK-0020, K6-1141, M6-0996		CONTRACT	
SDL 79K11107			

DOCUMENTS									
I #	PREF	DOCUMENT NUMBER	ISSUE	SIZE	SHTS	B/L NO.	SS	MODEL NUMBER	WUC
1	DR	79K38608	NEW	F	21	353.00	K-	K60-0419	K-FAC90000
2	SP	79K38609	NEW	A	93	*	*	*	*
3	DR	79K38612	NEW	F	29	353.00 353.01	EU MS	K61-0415 K61-0546	EUFAC60000 MSFAC60000
4	SP	79K38613	NEW	A	109	*	*	*	*
5	DR	79K38551	NEW	F	37	353.00	EU	K61-0415	EUFAC60000
6	DR	79K38550	NEW	F	25	353.00 353.25 355.00	LB LB LB	K61-1685 K61-1663 K61-0619	LBFACR0000 LBFACRL000 LBSSAAS000
7	DR	79K36517	REV. A	F	18	353.00	LB	K61-1685	LBFACR0000
8	SP	79K38549	NEW	A	210	*	*	*	*
9	DM	KSC-TA-10354 cover, 1-110, 110a, 111-176, 183-232, 177-182, 287-335, 287-335, 287-335, 287-335	NEW	A	327	*	*	*	*
10	SW	79K38608	NEW	B	10	*	*	*	*
11	SW	79K38609	NEW	M(1)	1	**	**	**	**
12	SW	79K38612	NEW	M(1)	1	**	**	**	**
13	SW	79K38613	NEW	M(1)	1	**	**	**	**
14	SW	79K38551	NEW	M(1)	1	**	**	**	**

TECHNICAL REMARKS

*: Denotes Item 2 same as Item 1; Denotes Item 4 same as Items 3 and 5; Denotes Item 9 same as Items 6 and 7;
 1: CD-1 contains 79K38608, 79K38609, 79K38612, 79K38613, 79K38551 and KSC-TA-10354
 **: Denotes same as Items 1 through 5
 ***: Denotes same as Items 7, 8 and 9
 2: CD-2 contains 79K36517 Rev. A, 79K38549 and 79K38550

Note: Drawings released on this DRA are accessible by using WWW browsers (i.e. Mosaic, Netscape, etc) via a hyperlink on the DE home page or by typing the URL location: <http://www-de.ksc.nasa.gov/keds/keds.htm>

APPROVALS			
TECHNICAL CONTACT	MAIL CODE	DATE	R&QA
<i>Dung Trang</i> Dung Trang, 861-2266	TA-B3-B	9/30/09	N/A
<i>Ernesto T. Camacho</i> Ernesto Camacho, 867-4002	TA-B3-B	9/30/09	OTHER N/A
N/A		JOINT RELEASE N/A	
PROCUREMENT PKG		RELEASE <i>Dung Trang</i> Dung Trang, 861-2266	
		TA-B3-B	9/30/09

9/30/09

**DOCUMENT RELEASE AUTHORIZATION CONTINUATION
KENNEDY SPACE CENTER, NASA**

2.

1. DRA No.

E-AC000000 -1108

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3. I #	4. PREF	5. DOCUMENT NUMBER	6. ISSUE	7. SIZE	8. SHTS	9. B/L NO.	10. SS	11. MODEL NUMBER	12. WUC
15	SW	79K36517	Rev. A	M-2	1	***	***	***	***
16	SW	79K38549	NEW	M-2	1	***	***	***	***
17	SW	79K38550	NEW	M-2	1	***	***	***	***

QUANTITY	MAIL CODE	NAME	QUANTITY	MAIL CODE	NAME
DRA	TA-B3B	E. CAMACHO	DRA+1C+1S	NE-M8	J. RYMKOS
DRA	TA-B3D	R. BOYLES	DRA+1C+1S	NE-M8	S. LUCIANO
DRA+1C+1S	ISC-4013	M. SKIDMORE	DRA+1C+1S	ISC-4220	D. HAINSEY
DRA	ISC-4013	T. POBJECKY	DRA+1B+1S	TA-B3B	D. TRANG
DRA+1C+1S	ISC-2100	S. T. HO	DRA+1B+1S	USK-427	R. SALAS
DRA+1C+1S	ISC-2100	D. BAYLER	DRA+1B+1S	USK-069	R. BRAHM
DRA	ISC-5140	B. MARTIN	DRA+1C+1S	TA-B3D	J. NELSON
DRA	ISC-8600	L. SARDELLA	DRA+1C+1S	TA-B3B	J. MILLER
DRA	ISC-4027	M. DIXON	DRA+1C+1S	IHA-4100	M. RAMSEY
DRA	ISC-4026	R. WILSON	DRA+1C+1S	TA-B1C	J. SHAFFER
DRA	ISC-4250	B. BUCKAWIECKI	DRA+1C+1S	SA-E2	J. BOBERSKY
DRA+1C+1S	ISC-4300	E. BEYETTE	DRA+1C+1S	TA-B3E	R. DAVIS
DRA	TA-B3C	B. GRAF	DRA+1C+1S	TA-B3E	K. LUTHER
DRA+1C+1S	OP-CS	S. GASAWAY	DRA+1C+1S	NE-M8	D. GOVAN
DRA	NE-M8	M. CABRERA	DRA+1C+1S	SA-E3-MSRS	J. LeBLANC
			1P + 1S	FW&A	
				3970 Hendricks Ave	
				Jacksonville, Florida 32207	

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 P = F-Size Drawings (79K38608, 79K38612, 79K38551, 79K36517 Rev. A, and 79K38550)
 S = A-Size Specification (79K38609, 79K38612, and 79K38549)
 DRA = DRA only

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Ernesto T. Camacho, TA-B3-B	<i>Ernest T. Camacho</i>	9/29/09

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(Stamp Revision: (05-19-2009))

UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	ORIGINAL DATE OF DRAWING	Replace Protective Relays at C5, C5A & Orsino Substations with SEL Relays Modify C5 Substation for Ring Bus Configuration PCN 98778 September 25, 2009 FW&A No. 0601-25.4 & 0601-25.5	JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER, FLORIDA	
	DRAFTSMAN M.YUDIN			CHECKER W.WILSON
MATERIAL	TRACER			CHECKER
HEAT TREATMENT	ENGINEER D. TRANG			ENGINEER
FINAL PROTECTIVE FINISH	SUBMITTED <i>[Signature]</i> TA-B3B 9/29/09	SCALE UNIT WT	DWG SIZE A	
		79K38613 SHEET 1 OF 109		

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SECTION 01110

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SECTION 01110

SUMMARY OF WORK
01/08

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The work includes projects at the C5 and Orsino substations. The projects are to be performed in two (2) stages. Stage one involves the C5 substation and the disassembly of the 115kV high bay steel structure, busses, insulators and motor operated switches in bays H-6 through H-11 and the installation of two (2) 115kV SF6 power circuit breakers and group operated disconnect switches and modifying copper busses in bays H-14 and H-16. Install associated transformer and bus differential and breaker failure relays and communication processors in the existing control panels in both control buildings at the C5 substation . Relocate motor operated switch LBPT4 to bay H-5.

Stage 2 involves replacing the 15kV bus differential relays at C5 with Schweitzer Engineering Laboratories SEL-587Z high impedance differential relays, all of the 15kV protective relays at the C5, C5A and Orsino substations with Schweitzer Engineering Laboratories SEL-751A Feeder Protection Relays, replace the existing 5 amp current input cards and serial number/model number labels on the twenty one (21) GFE SEL-751A relays and incidental related work. Additionally, replace the existing radiators, fans and hardware on transformers T9 and T10 at the C5A substation.

1.1.2 Location

The work shall be located at the Kennedy Space Center, Florida_____, approximately as indicated. The exact location will be shown by the Contracting Officer.

1.2 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

- Drawing No. 79K38551
- Sheets 1 through 37 _____
- Drawing No. 79K38612
- Sheets 1 through 29

1.3 GOVERNMENT-FURNISHED MATERIAL AND EQUIPMENT

Pursuant to Contract Clause "FAR 52-245-4, Government-Furnished Property (Short Form)", the Government will furnish the following materials and equipment for installation by the Contractor:

DESCRIPTION	QUANTITY
SEL-751A Relay _____	21 _____
Retrofit Kit	21

DESCRIPTION	QUANTITY
SEL-2032 Communication Processor	2

Quantities stated for the above items are all that will be furnished by the Government. Contractor shall furnish any additional quantities required.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

SPECIFICATION COVER SHEET

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01330

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02/09

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PART 2 PRODUCTS

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-- End of Section Table of Contents --

SECTION 01330

SUBMITTAL PROCEDURES

02/09

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

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

SD-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-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.

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.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets 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.

1.1.2 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.

1.2 PREPARATION

1.2.1 Format for SD-02 Shop Drawings

- a. 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.
- b. Present A4 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.
- c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."
- d. 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.
- e. Reserve a blank space, t for the Government disposition stamp.
- f. 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.
- g. Include the nameplate data, size and capacity on drawings. Also include applicable federal, military, industry and technical society publication references.

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

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

- d. Provide product data in metric dimensions. Where product data are included in preprinted catalogs with English units only, submit metric dimensions on separate sheet.
- e. 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.
- f. 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.
- g. 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.
- h. Submit manufacturer's instructions prior to installation.

1.2.3 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.

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

- a. Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.
- b. Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

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

Comply with the requirements specified in Section 01780 PROJECT RECORD DOCUMENTS for O&M Data format.

1.2.6 Format of SD-11 Closeout Submittals

- a. 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.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS

05/09

PART 1 GENERAL

1.1 REFERENCES

1.2 ORDERING INFORMATION

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SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS

05/09

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 B 564 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.

ACI 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>

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@aaashto.org
Internet: <http://www.aashto.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1819 L Street, NW, 6th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: info@ansi.org
Internet: <http://www.ansi.org/>

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500

Fax: 610-832-9555
E-mail: service@astm.org
Internet: <http://www.astm.org>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
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Piscataway, NJ 08855-1331
Ph: 732-981-0060
Fax: 732-981-1712
E-mail: customer-services@ieee.org
Internet: <http://www.ieee.org>

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
P.O. Box 687
106 Stone Street
Morrison, CO 80465
Ph: 303-697-8441
Fax: 303-697-8431
E-mail: neta@netaworld.org
Internet: <http://www.netaworld.org>

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National Aeronautics and Space Administration
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 1752
Rosslyn, VA 22209
Ph: 703-841-3200
Fax: 703-841-5900
E-mail: webmaster@nema.org
Internet: <http://www.nema.org/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
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E-mail: webmaster@nfpa.org
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- - - - - Commercial Item Description Documents - - - - -

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01780

PROJECT RECORD DOCUMENTS

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 - 1.4.2 Guidelines
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SECTION 01780

PROJECT RECORD DOCUMENTS
10/05

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications as pertains to the preparation of project record documents to include, but not limited to, as-constructed drawings, utility as-constructed drawings, utility as-constructed survey, equipment warranty lists, and operation and maintenance manuals..

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with each section of the project's specification:

SD-07 Certificates

A Work Plan shall be submitted in accordance with paragraph entitled, "General," of this section.

Certificates shall be submitted showing qualifications of the following:

Professional Land Surveyor

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

SD-11 Closeout Submittals

Special requirements necessary during and at the closeout of a construction project.

Equipment/Product Warranty List
Posted Instructions
Spare Parts List
As-constructed drawings
Utility as-constructed drawings
Utility as-constructed survey

1.3 GENERAL

A Work Plan shall be submitted to the Contracting Officer for project closeout. Plan shall include all scheduled inspections, instruction classes, items, closeout dates for all functions, and shall list the required Government and Contractor personnel that will be taking part in these functions.

Posted Instructions shall be submitted by the Contractor with labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

Contractor shall submit 6 copies of the project operation and maintenance manuals 30 days prior to testing the system involved. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Spare Parts List shall indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

1.4 MAINTENANCE OF DOCUMENTS

1.4.1 Record Documents

Maintain at the job site, one copy of each of the following as Record Documents:

- a) Contract Drawings.
- b) Technical Specifications including Addenda/Bulletins.
- c) Approved shop drawings and samples.
- d) Contracting Officer Approved Engineering Orders, Answers to RFI's, Revisions, Directives and other written Amendments to the Contract.
- e) Field Test reports.

1.4.2 Guidelines

Adhere to the following guidelines for maintenance of Record Documents:

- a) Store record documents in temporary field office, apart from documents used for construction purposes.
- b) Provide files and racks for the storage of Record Documents.
- c) Maintain Record Documents in clean, dry and legible condition.
- d) Do not use Record Documents for construction purposes.
- e) Make Record Documents available at all times for inspection by the Contracting Officer's representative. The red-lined record drawings shall be available at each construction status meeting for review.

1.5 RECORDING

Provide fine ball-point red and green pens for marking. Markings shall comply with good drafting standards as follows:

- a) Green shall indicate deletions and red shall indicate additions.
- b) Lettering for the changes shall be printed block lettering.
- c) Lines drawn to indicate changes shall be done using a straight edge

and curves to provide clear and clean lines.

d) Use the same symbols and follow as much as possible the same drafting standards used on the Contract Drawings.

1.5.1 As-Constructed Drawings

a) Label each record document PROJECT RECORD in 2-inch printed letters.

b) Keep Record Documents current at the end of work each day marking any changes and inserting all engineering changes into the documents.

c) Do not permanently conceal any work until required information has been recorded. This includes markups and any as-constructed survey as required by these Specifications.

d) Fully as-constructed the following:

1) Field changes of dimension and detail.

2) Changes made by Contracting Officer Approved Engineering Orders, Answers to RFI's, Revisions, and other written modifications. A copy of all documents relating to a change shall be kept in a 3-ring binder with the red-lined record drawings.

3) Details not shown on the original Contract Drawings.

4) Update all drawings affected by each change.

5) Cloud each change on the drawings and identify change with change document number, if applicable. Clouding the changed area and marking with change document number without showing the actual change, is not acceptable.

1.5.1.1 As-Constructed Drawings - Interior

1) Fully as-constructed the following: Interior

a) Installation of power and control wiring with point-to-point wiring identification as required.

b) Update all cable and panel schedules to show actual installation.

1.5.1.2 Utility As-Constructed Drawings - Exterior

1) Installation of cables in manholes and conduits. Identify the duct or conduits used to install new cable in manhole layouts and duct cuts on plan sheets and details. Clearly show all changes, such as where cables were to be removed but were in fact abandoned.

2) Update cable schedules to show actual installation.

1.5.2 Utility As-Constructed Survey

a) The Contractor shall engage the services of a professional land surveyor registered in the State of Florida prior to any construction activities.

- b) Submit certification of Professional Land Surveyor.
- c) The surveyor must comply with all requirements of Chapter 21HH-6.05 of the Florida statutes.
- e) The surveyor shall provide on-site survey while construction is in progress and at such times as required to fulfill his professional obligations and as listed below:
- 1) All survey points and coordinates shall be provided in a tabular form.
 - 2) All offsets, both vertical and horizontal, shall be identified by survey data.
 - 3) Coordinates shall be identified along the center line of direct buried cable, buried conduit or duct bank by the number of points shown on the drawings. The surveyor shall lay out the duct run to be followed. If the duct run deviates from the shown coordinates by 3-feet or more, the surveyor shall provide the actual coordinates.
 - 4) Coordinates shall be identified for the ends of all conduits installed or used for construction, ends of all duct bank stub-outs and all direct buried cable splice locations on the drawings. The surveyor shall lay out these items. If the location of these items deviates by 3-feet or more, the survey shall provide the actual coordinates.
 - 5) All manhole rings, slab on grade, switch pads, transformer pads, substation pads, buried conduits and other project construction features identified on drawings for construction shall be laid out and checked by the surveyor according to coordinates shown. Items that deviate by 3-feet or more from the shown coordinates shall be surveyed and corrected coordinates shown as as-constructed.
 - 6) All existing structures, utilities and features revealed during the course of construction, excluding irrigation, shall be accurately located and dimensioned. Movement of such utilities required by project installation shall be recorded as as-constructed. This requirement shall apply even if the existing structure, utility or feature was not shown on the original Contract Drawings.
 - 7) For directionally drilled crossings and other trenchless technology installations, provide plots of utility plan and profile derived from actual telemetry data used during the installation.
 - 8) The Contractor shall stake each directional drill a minimum of every 50 feet. Each stake shall signify the depth of the drill at that location and shall be consecutively numbered and shown as as-constructed.
- f) The Contractor shall submit the set of drawings used for the utility as-constructed survey to the Contracting Officer.

1.5.3 Other Records

Legibly mark-up Specification and Addenda Sections for record including:

- a) Changes made by Revision Order, Directive and other modifications.
- b) Other materials or equipment not originally specified.
- c) Maintain legibly annotated shop drawings and samples for record changes made after approval as record documents.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EQUIPMENT/PRODUCT WARRANTIES

3.1.1 Equipment/Product Warranty List

Furnish to the Contracting Officer a bound and indexed notebook containing written warranties for equipment/products furnished under the contract, and prepare a complete listing of such equipment/products. The equipment/products list shall state the specification section applicable to the equipment/product, duration of the warranty therefor, start date of the warranty, ending date of the warranty, and the point of contact for fulfillment of the warranty. The warranty period shall begin on the same date as project acceptance and shall continue for the full product warranty period. Execute the full list and deliver to the Contracting Officer prior to final acceptance of the project.

3.1.2 Equipment Warranty and Guarantor's Local Representative

Furnish with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment is installed. The guarantor's representative, upon request of the Government representative, shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty.

3.2 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Information shall be bound in manual format and grouped by technical sections. Test data shall be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals shall have 10 millimeter holes and be bound in 3-ring, loose-leaf binders. Data shall be organized by separate index and tabbed sheets, in a loose-leaf binder. Binder shall lie flat with printed sheets that are easy to read. Caution and warning indications shall be clearly labeled.

Contractor shall submit as part of the closeout work plan, the schedule for the classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services shall be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. After approval of

the work plan, the Contracting Officer shall be given 7 days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, shall be made available to the Contracting Officer.

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SECTION 02311

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06/04

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SECTION 02311

EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES
06/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 145	(1991; R 2003) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 103	(1991; R 2000) Soundness of Aggregates by Freezing and Thawing
AASHTO T 180	(2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 2	(2000) Sampling of Aggregates
AASHTO T 87	(1986; R 2000) the Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2003) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2005) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 88	(1999a) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1556	(2000) Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 2216	(2005) Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2922	(2004) Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3282	(2004) Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D 3740	(2004) Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction
ASTM D 422	(2002) Standard Test Method for Particle-Size Analysis of Soils
ASTM D 4318	(2000) Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Construction Equipment List shall be submitted.

Contractor shall record Existing Conditions prior to starting work in accordance with the paragraph entitled, "Existing Conditions," of this section.

SD-06 Test Reports

Test Reports shall be submitted for Soil Test results within 7 calendar days. Test reports shall be submitted according to paragraph entitled, "Quality Control Testing During Construction," of this section.

SD-07 Certificates

Certificates of Compliance for Proposed Soil Materials shall be submitted according to paragraph entitled, "Tests for Proposed Soil Materials," of this section.

1.3 LIMITS OF CONSTRUCTION

Work in this section relates to excavation, fill, and backfill to a point 5 feet beyond the building or structure line.

1.4 SAMPLING AND TESTING

1.4.1 Soil Test and Inspection Service

Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil-testing service approved by the Contracting Officer shall be provided by the Contractor. Testing shall include soil survey for satisfactory soil materials; sampling and testing soil materials proposed for use in the work, and field-testing facilities for quality control during construction period.

Testing agencies shall conform to the requirements of ASTM D 3740.

1.4.2 Tests For Proposed Soil Materials

Materials shall be approved by the Contracting Officer prior to start of work.

Soil materials proposed for use in the work shall be tested as follows.

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Satisfactory soil materials	Sampling	AASHTO T 2	One from each source of materials to determine conformance to definition of satisfactory soil materials; additional tests whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis is of fine and coarse aggregates	ASTM C 136	
	Amount of material passing No. 200 sieve	ASTM C 117	
	Liquid limit	ASTM D 4318	
	Plastic limit and plasticity index	ASTM D 4318	
	Mechanical analysis	ASTM D 422	
	Moisture-density relations	ASTM D 1557 Method D	
			As required to determine moisture-density requirement of materials from

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u> each source
	Los Angeles abrasion of coarse aggregates	ASTM C 131	One for each soil material from each source if called for in reference specification
	Freezing and thawing soundness of aggregates	AASHTO T 103	
	Magnesium Sulfate Soundness Test	ASTM C 88	

1.4.3 Quality Control Testing During Construction

Soil materials shall be tested during construction as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Soil materials specified	Sieve analysis of fine and coarse aggregates	ASTM C 136	One daily for each soil material from each source; additional test whenever there is any apparent change
	Amount of material passing No. 200 sieve	ASTM C 117	
	Moisture content of subbase material	ASTM D 2216	
Soil materials prior to compaction	Moisture-density relations of soil	ASTM D 1557	One of each type of subgrade soil material except under backfill for structures; one for each backfill and fill material from each source
Soil material-	Density of soil-in-place	ASTM D 1556, Sand Cone	At least three daily for each

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
in-place after compaction		Method or ASTM D 2922, Nuclear Method (when approved by Contracting Officer)	subgrade soil material except under backfill for structures, and for each layer and backfill and fill material; additional test whenever there is any change in moisture conditions

1.4.4 Test Reports

No soil material shall be used until test reports have been reviewed and approved.

1.4.5 Evaluation of Test Results

Results of density of soil-in-place tests shall be considered satisfactory if the average of any group of four consecutive density tests which may be selected is in each instance equal to or greater than the specified density, and if not more than one density test in five has a value more than 2 percentage points below the specified density.

1.5 CONSTRUCTION EQUIPMENT LIST

Construction Equipment List of all major equipment to be used shall be submitted.

1.6 EXISTING CONDITIONS

Existing Conditions shall be recorded, in the presence of the Contracting Officer, and shall include all structures and other facilities adjacent to areas of alteration or removal. Such records shall contain the location of existing utilities, the elevation of the top of foundation walls, the location and extent of cracks and other damage, and a description of surface conditions that exist prior to the start of work. Copies of the record shall be submitted and the conditions prior to starting work shall be verified.

PART 2 PRODUCTS

2.1 BACKFILL AND FILL MATERIALS

Materials for backfill and fill shall be free of clay clods, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, and other deleterious matter and shall be satisfactory soil materials as follows:

<u>AREA CLASSIFICATION</u>	<u>BACKFILL OR FILL MATERIALS</u>
In excavations, unless otherwise specified	Excavated or borrow material that has been sampled, tested, and approved as

AREA CLASSIFICATION

BACKFILL OR FILL MATERIALS

Against face of structures where footing drains from top of porous fill for footing drains to indicated elevation, and from face of structure a distance equal to three footing drain diameters

Filtering material

Against surfaces having applied waterproofing for a distance of at least 6 inches from surface

Sand

In foundation subdrain trenches over porous fill drain pipe

Filtering material

Under grassed areas

Excavated or borrow material that has been sampled, tested, and approved as "Satisfactory Soil Material"

Under walks, steps, and paved areas

Subbase material or excavated or borrow material that has been sampled, tested, and approved as "Satisfactory Soil Material"

Under building slabs

Drainage fill

2.1.1 Satisfactory Materials

Satisfactory materials shall mean AASHTO M 145, (ASTM D 3282) Soil Classification Groups A-1, A-2-4, A-2-5, and A-3.

2.1.2 Unsatisfactory Materials

Unsatisfactory soil materials shall mean AASHTO M 145, Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, peat and other highly organic soil, and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

2.2 TOPSOIL

Topsoil shall be any soil removed from the project site which consists of clay or sandy loam.

The topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones,

stumps, roots, and other objectionable materials larger than 2 inches in any dimension.

2.3 Coarse Aggregate for Yard Cover

Aggregate for yard cover shall be washed crushed rock conforming to coarse aggregate size number 5 - (1 to 1/2 inch) per FDOT Standard Specifications Section 901.

Aggregate for exfiltration trenches and under drains shall be washed, crushed rock conforming to coarse aggregate size number 4 (1-1/2 to 3/4 in.) per FDOT Standard Specification Section 901.

2.4 COHESIONLESS MATERIALS

Cohesionless soil materials include gravels, gravel-sand mixtures, sands, and gravelly-sands. Moisture-density relations of compacted cohesionless soils, when plotted on graphs, will show straight lines or reverse-shaped moisture density curves.

2.5 COHESIVE MATERIALS

Cohesive soil materials include clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands. Moisture-density relations of compacted cohesive soils, when plotted on graphs, will show normal moisture-density curves.

2.6 SUBBASE MATERIAL

Subbase material shall be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, or sand.

2.7 DRAINAGE FILL

Drainage fill shall be a washed, uniformly graded mixture of crushed stone or crushed or uncrushed gravel, with 100 percent passing 1-1/2-inch sieve and not more than 5 percent passing No. 4 sieve.

2.8 FILTERING MATERIAL

Filtering material shall conform to ASTM C 33 and shall be a uniformly graded mixture of natural or crushed gravel, crushed stone, and natural sand, with 100 percent passing 3/8-inch sieve and 2 to 10 percent passing a No. 100 sieve.

2.9 SAND

Sand shall be natural sand.

PART 3 EXECUTION

3.1 PREPARATION

Before earthwork is started, the location of underground utilities shall be carefully verified by hand methods. Utilities to be left in place shall be protected from damage.

3.2 UNAUTHORIZED EXCAVATION

Unauthorized excavation shall consist of removal of materials beyond indicated subgrade elevations or side dimensions specified without specific direction and shall be replaced as specified at no additional cost to the Government.

Unauthorized excavation under foundations or retaining walls shall be filled by lowering the bottom elevation of the footing or base to the excavation bottom without altering the approved top elevation.

Elsewhere unauthorized excavations shall be backfilled and compacted as specified for authorized excavations of the same classification.

3.3 SHORING AND BRACING

Shoring and bracing in excavations shall be maintained regardless of the length of time excavations will be open. Shoring and bracing shall be carried down with the excavation.

Wherever subsequent removal of sheet piling could permit the lateral movement of soil under adjacent structures, steel sheet piling or pressure-cresoted timber sheet piling shall be used and left permanently in place, cut off as required.

3.4 WATER REMOVAL

Water removal shall conform to Dewatering Permit Chapter 40C-22, F.A.C., permit #84324, dated May 18, 2005.

Water shall not be permitted to accumulate in excavations, or flood the site and surrounding area. Dewatering systems shall be provided by the Contractor to convey water away from excavations so that softening of foundation bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be approved by the Contracting Officer.

Dewatering shall be continued until construction subject to water pressure has obtained full specified strength and backfill is completed.

Water removal from excavations shall be conveyed to approved collecting or runoff areas, e.g. storm water retention area on the west side. Temporary drainage ditches and other diversions as necessary shall be provided and maintained outside of excavation limits.

Trench excavations for utilities shall not be used for temporary drainage ditches.

3.5 MATERIAL STORAGE

Excavated materials classified as satisfactory soil material shall be stockpiled, where directed, until required for backfill or fill. Stockpiles shall be placed, graded, and shaped for proper drainage.

Materials required in the work shall be located and retained a sufficient distance from the edge of excavations to prevent such material falling or sliding back into the excavations and to prevent cave-ins.

3.6 EXCAVATION FOR STRUCTURES

Excavation for structures shall conform to the dimensions and elevations indicated within a tolerance of plus or minus 0.10 foot and shall extend a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services and other construction indicated, and for inspection.

In excavating for footings and foundations, care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall be done just before concrete is placed. Bottoms shall be trimmed to the required lines and grades to leave a solid bed to receive concrete.

Stock piling of existing aggregate that will be removed for providing access to the conduit and grounding systems and structures shall be done inside the fence perimeter as close as possible to the work site. If it becomes necessary to stockpile outside the fence, the aggregate should be placed as close to the perimeter as possible. In addition, barrier material such as plastic sheeting should be placed as ground cover to prevent contact with the soil. The entire pile should then be covered (with plastic sheeting) to prevent rain water intrusion. No other measures such as the installation of silt fencing or hay bales to prevent run-off will be required as long as the ground barrier is installed and the pile is covered.

3.7 REMOVAL OF UNSATISFACTORY SOIL MATERIALS

Unsatisfactory soil materials encountered that extend below the required elevations shall be excavated to the depth directed.

3.8 REMOVAL OF EXISTING UNDERGROUND UTILITIES

Existing underground utilities indicated to be removed shall be demolished and completely removed from the excavation.

3.9 CLOSING ENDS OF ABANDONED UNDERGROUND UTILITIES

Open ends of abandoned underground utilities to remain shall be closed to prevent water that may accumulate in such utilities from flowing into excavated areas. Closures shall withstand any hydrostatic or earth pressure that may result after ends of the abandoned utilities have been closed.

Open ends of metallic conduit and pipe shall be closed with threaded galvanized metal caps or plastic plugs or other approved method suitable for the type of material and size of pipe. Wood plugs will not be permitted.

3.10 FILLING AND BACKFILLING

3.10.1 Preparations Prior to Backfill Placement

Excavations shall be backfilled as promptly as the work permits but not until completion of the following:

Approval of construction below finish grade

Inspection, testing, approval, and recording location of underground utilities

Removal of concrete formwork

Removal of shoring and bracing; backfilling of voids with satisfactory soil material; temporary sheet piling driven below bottom of structures; and cutting off and removing of utilities in a manner that prevents settlement of the structure or utilities

Removal of trash and debris

Completion of concrete waterproofing

3.10.2 Preparation of Ground Surface to Receive Fill

Vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials shall be removed from ground surface prior to the placement of fills. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stripped, or broken up in such manner that fill material will bond with the existing material.

When the ground surface has a density less than that specified for the particular area classification, the ground surface shall be broken up, pulverized, moisture-conditioned to near optimum moisture content of the soil material, and compacted to the required depth and percentage of maximum density.

3.10.3 Placement and Compaction

Backfill and fill materials shall be placed in layers not more than 6 inches in loose depth. Before compaction, each layer of backfill or fill material shall be moistened or aerated as necessary to provide the optimum moisture content of the soil material and shall then be compacted to the percentage of maximum density for each area classification as specified. Backfill or fill material shall not be placed on surfaces that are muddy, frozen, icy, or contain frost.

Backfill and fill materials adjacent to structures shall be brought up evenly around structures and shall be carried up to the indicated elevations.

Compaction adjacent to structures, within a horizontal distance from the face of the structure equal to the depth of backfill or fill material (measured from the bottom of footing or bottom of foundation or retaining wall) to final grade, shall be done with power-driven hand tampers.

3.11 COMPACTION

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure in AASHTO T 180, Methods B or D.

3.11.1 Percentage of Maximum Density Requirements

Actual density of each layer of soil material-in-place shall be not less than the following percentages of the maximum density of the same soil material determined by the moisture-density test specified.

<u>AREA CLASSIFICATION</u>	<u>PERCENT MAXIMUM DENSITY COHESIONLESS SOIL MATERIAL</u>
Structures	
Each layer of backfill material	95
Building slabs and steps	
Top 12 inches of subgrade and each layer of backfill material	95

3.11.2 Moisture Control

Moisture content in soil material at time of compaction shall be within limits specified.

Where the moisture content of a layer of soil material is below optimum before compaction, the required amount of water shall be uniformly applied to the surface of the layer of soil material and the layer of soil disked or otherwise mixed until a uniform moisture content is reached.

Moisture of a layer of soil material that is above optimum shall be removed by drying.

3.12 GRADING

Areas within the limits of grading under this section, including adjacent transition areas, shall be uniformly graded. Finished surface shall be smooth within the specified tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

3.12.1 Grading Outside Building Lines

Areas outside the building lines for each structure shall be hand-graded to drain away from the structure and to prevent ponding of water after rains. Finished surface shall be within the tolerance specified below for each area classification, compacted as specified, and free from irregular surface changes.

Grassed or planted areas:

Finished surface of areas to receive topsoil blend shall be not more than 0.10 foot above or below the indicated finish elevations.

Walks:

Surface of areas under walks shall be shaped to line, grade, and cross section; finished surface shall be not more than 0.0 foot above or 0.10 foot below the indicated finish elevation.

Pavements:

Surface of areas under pavements shall be shaped to line, grade, and cross section; the finished surface shall be not more than 1-inch above or below the indicated finish elevation when tested with a 10-foot straightedge applied both parallel with and at right angles to the centerline of the area. Finished surface shall vary no more than 1 inch.

3.12.2 Grading Surface of Fill Under Structures

Surface of fill under building slabs shall be smooth and even, free of voids, compacted as specified and to indicated grade within the specified tolerances. When tested with a 10-foot straightedge, parallel with and at right angles to the building lines, the finished surface shall show no deviation in excess of 1 inch.

3.13 MAINTENANCE

3.13.1 Protection of Graded Areas

Newly graded areas shall be protected from traffic and erosion and shall be maintained free of trash and debris.

3.13.2 Reconditioning Compacted Areas

Where approved compacted areas are disturbed by subsequent construction operations or adverse weather, the surface shall be scarified, reshaped, and compacted as specified to the required density prior to further construction.

3.14 DISPOSAL OF EXCESS AND WASTE MATERIALS

Excess excavated satisfactory materials shall be removed from Government property.

Waste materials, including excavated material classified as unsatisfactory soil material, trash, and debris, shall be removed from Government property and legally disposed at no additional cost to the Government. Permits and fees for disposal shall be paid by the Contractor.

Prior to removing waste material, the Contractor shall file a support request to JBOSC Waste Management for the purpose of management and evaluation of the waste material. The support request shall be in accordance with established procedures outlined in NASA documents EVM-I-0446-16 (Spaceport Waste Services Guidance Manual) and KNPR 8500.1 (Kennedy NASA Procedural Requirements - KSC Environmental Requirements).

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SECTION 03305

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SECTION 03305

CAST-IN-PLACE CONCRETE (SHORT SECTION)
06/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ACI INTERNATIONAL (ACI)

- | | |
|--------------|--|
| ACI 304R | (2000) Guide for Measuring, Mixing, Transporting, and Placing Concrete |
| ACI 308R | (2001) Standard Practice for Curing Concrete |
| ACI 315 | (2000) Details and Detailing of Concrete Reinforcement |
| ACI 318/318R | (2005) Building Code Requirements for Structural Concrete and Commentary |
| ACI 347R | (2003) Guide to Formwork for Concrete |

ASTM INTERNATIONAL (ASTM)

- | | |
|-------------------|--|
| ASTM A 615/A 615M | (2005) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| ASTM C 143/C 143M | (2005) Standard Test Method for Slump of Hydraulic-Cement Concrete |
| ASTM C 260 | (2001) Standard Specification for Air-Entraining Admixtures for Concrete |
| ASTM C 309 | (2003) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C 39/C 39M | (2004) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C 494/C 494M | (2005) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C 618 | (2003) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete |
| ASTM C 94/C 94M | (2004) Standard Specification for Ready-Mixed Concrete |

ASTM D 2628

(2005) Standard Specification for
Preformed Polychloroprene Elastomeric
Joint Seals for Concrete Pavements

1.2 GENERAL

All work shall be in accordance with ACI 318/318R.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings shall be provided for the following:

Concrete Placement
Forms
Steel Reinforcement

SD-05 Design Data

Mix design data shall be submitted in accordance with the paragraph entitled, "Ready-Mix Concrete," of this section.

SD-06 Test Reports

Test reports shall be in accordance with tests as described in the paragraph entitled, "Field Testing," of this section for the following items:

Slump
Compressive Strength
Air Entrainment

SD-07 Certificates

Bill of Lading for Ready-Mix Concrete deliveries.

Certificates of compliance shall be provided showing conformance with referenced standards contained in this section for the following:

Proposed Ready-Mix Concrete
Fly Ash
Air-Entraining Admixtures

1.4 INSTALLATION DRAWINGS

Specific locations of Concrete Placement and Forms.

PART 2 PRODUCTS

2.1 READY-MIX CONCRETE

Concrete shall be ready-mix concrete and mix design data shall conform to

ACI 304R, minimum Compressive Strength 3000 psi at 28 days.

Slump: 3 inch to 4 inch according to ASTM C 143/C 143M.

Air-Entraining Admixtures shall conform to ASTM C 260.

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C 494/C 494M.

Fly Ash used as an admixture shall conform to ASTM C 618, Class C with 4 percent maximum loss on ignition and 20 percent maximum cement replacement by weight.

2.2 STEEL REINFORCEMENT

2.2.1 Deformed Steel Bars

Steel bars shall conform to ASTM A 615/A 615M, Grade 60 ksi and ACI 318/318R.

2.3 FORMS

Forms shall be of wood, steel, or other approved material and shall conform to ACI 318/318R.

Form release shall conform to ACI 347R.

2.4 ACCESSORIES

2.4.1 Waterstops

Waterstops shall be the flat dumbbell type not less than 3/16-inch thick for widths up to 5 inches and not less than 3/8-inch thick for widths 5 inches and over.

Waterstops shall be made of polyvinylchloride (PVC) and shall conform to ASTM D 2628.

2.4.2 Curing Compound

Curing compound shall conform to ASTM C 309.

PART 3 EXECUTION

3.1 FORM WORK

Form work shall be in addition to ACI 318/318R, ACI 308R, and ACI 347R.

3.1.1 Preparation of Form Surfaces

Forms shall be true to line and grade, mortar-tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags, or holes. Exposed joints and exposed edges shall be chamfered. Internal ties shall be so arranged that when the forms are removed, the form ties will be not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structure.

3.1.2 Form Coating

Forms for exposed surfaces shall be coated with a nonstaining form release coating which shall be applied before the steel case is added to avoid contaminating the reinforcing steel. Forms for unexposed surfaces may be wetted in lieu of coating immediately before the placing of concrete, except that in freezing weather form release coating shall be used.

3.1.3 Removal of Forms

Forms shall be removed carefully to prevent damage to the concrete. Forms shall not be removed before the expiration of the minimum time indicated below:

Grade Slabs & Pavement Repair Patching	24 hours
--	----------

3.2 STEEL REINFORCING

3.2.1 General

Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

3.2.2 Fabrication

Steel reinforcement shall be shop fabricated in accordance with ACI 315. Shop details and bending shall be in accordance with ACI 318/318R.

3.2.3 Splicing

Splices shall be in accordance with ACI 318/318R.

3.2.4 Supports

Reinforcement shall be secured in place by the use of metal or concrete supports, spacers, or ties.

3.3 EMBEDDED ITEMS

Before placing concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place. Embedded items shall be free of oil and other foreign matter such as loose coatings of rust, paint and scale.

3.4 BILL OF LADING

Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C 94/C 94M.

3.5 CONCRETE CONVEYING

Concrete shall be conveyed from mixers to forms as rapidly as practical by methods that will prevent segregation or loss of ingredients.

3.6 CONCRETE PLACING

3.6.1 General Placing Requirements

Concrete shall be placed in accordance with ACI 318/318R.

Concrete shall be worked into the corners and angles of the forms and around reinforcement and embedded items without permitting the materials to segregate. Concrete shall be placed within 90 minutes after it has been mixed. It shall be placed on clean, damp surfaces free from water, ice, frost, mud, debris, or objectionable coatings. Concrete shall be consolidated with the aid of mechanical vibrating equipment supplemented by handspading and tamping. Vibrating equipment shall be of the internal type.

3.6.2 Lifts in Concrete

Concrete shall be deposited in horizontal layers not to exceed 24 inches in thickness. Placement shall be carried on at a rate that will prevent the formation of cold joints. Slabs shall be placed in one lift.

3.7 FINISHING

Defective concrete, voids left by the removal of tie rods, and ridges and local bulging on concrete surfaces permanently exposed to view or exposed to water on the finished structure shall be repaired immediately after the removal of forms. Voids left by the removal of the tie rods shall be reamed and completely filled with dry-patching mortar. Defective concrete shall be repaired by cutting out the unsatisfactory material and placing new concrete secured with keys, dovetails, or anchors. Excessive rubbing of formed surfaces will not be permitted. Unformed surfaces of concrete exposed in the completed work shall have a wood float finish without additional mortar and shall be true to indicated elevations. Other surfaces shall be brought to specified elevations and left true and regular.

3.8 TROWEL FINISH

A trowel finish shall be applied to slab surfaces that are to be exposed to view.

3.9 CURING AND PROTECTION

Concrete shall be cured in accordance with ACI 308R.

Curing shall be accomplished by moist curing, by moisture-retaining cover curing, by membrane curing, or by combinations thereof.

Moist curing shall be accomplished by keeping surface of concrete wet or by covering with absorptive cover saturated with water and kept wet.

Moisture-retaining cover curing shall be accomplished by covering concrete surfaces with moisture-retaining cover for curing concrete.

Membrane curing shall be accomplished by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared.

3.10 FIELD TESTING

Testing shall conform to ASTM C 39/C 39M. Quality control testing shall be

provided by the Contractor.

Specimens shall be tested for compressive strength at 7 and 28 days for each design mix.

Slump shall be tested at the site for Air Entrainment and concrete temperature in accordance with ASTM C 143/C 143M.

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SECTION 16003

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SECTION 16003

GENERAL ELECTRICAL PROVISIONS

06/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.1 (2002) Safety Color Code

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS-03 (2003) Accepted Testing Specifications for Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-T-704 (Rev K) Treatment and Painting of Material

UNDERWRITERS LABORATORIES (UL)

UL Elec Const Dir (2003) Electrical Construction Equipment Directory

1.2 SUBMITTALS

Not Used

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

It is the intent of these specifications and the contract drawings to provide a complete and workable facility.

Design drawings are diagrammatic and do not show all offsets, bends, elbows, or other specific elements that may be required for proper installation of the work. Such work shall be verified at the site. Additional bends and offsets, and conduit as required by vertical and horizontal equipment locations or other job conditions, shall be provided to complete the work at no additional cost to the Government.

Except where shown in dimensional detail, the locations of switches, receptacles, lights, motors, outlets, and other equipment shown on plans are approximate. Such items shall be placed to eliminate interference with ducts, piping, and equipment. Exact locations shall be determined in the field. Door swings shall be verified to ensure that light switches are properly located.

Equipment sizes indicated are minimum. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and shall install wire, conduit, disconnect switches, motor starters, heaters, circuit breakers, and other items of the correct size for the equipment actually installed. Wire and conduit sizes shown on the drawings shall be taken as a minimum and shall not be reduced without written approval.

1.4 CODES AND STANDARDS

Equipment design, fabrication, testing, performance, and installation shall, unless shown or specified otherwise, comply with the applicable requirements of NFPA 70 and IEEE C2 to the extent indicated by the references.

1.5 COORDINATION

Installation of the electrical work shall be coordinated with the work of other trades.

1.6 APPROVAL REQUIREMENTS

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories (UL), Inc., the label of, or listing with re-examination, in UL Elec Const Dir will be acceptable as sufficient evidence that the items conform to the requirements.

Where materials or equipment are specified to be constructed or tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized standards, a manufacturer's certificate of compliance indicating complete compliance of each item with the applicable NEMA, ANSI, ASTM, or other commercial standards specified will be acceptable as proof of compliance.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Identification plates shall be 3-layer white-black-white, engraved to show black letters on a white background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16-inch thick with engraved lettering 1/8-inch high. Identification plates larger than 1-1/2 inches high shall be 1/8-inch thick with engraved lettering not less than 3/16-inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled.

2.2 WARNING SIGNS

Each item of electrical equipment operating at 480 volts and above shall be provided with conspicuously located warning signs conforming to the requirements of Occupational Safety and Health Agency (OSHA) standards.

Any equipment with externally powered wiring shall be marked with a laminated plastic nameplate having 3/16-inch high white letters on a red

background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Safety color coding for identification of warning signs shall conform to ANSI Z535.1.

2.3 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or slabs.

2.4 PAINTING

Enclosures of the following listed items shall be cleaned, primed, and factory-painted inside and outside in accordance with MS MIL-T-704 and the equipment sections of this specification.

ITEM	FINISH COLOR
Circuit Breakers	ANSI No. 61 gray
Transformers	ANSI No. 61 gray

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be accomplished by workers skilled in this type of work.

3.2 IDENTIFICATION PLATE INSTALLATION

For equipment installed indoors, identification plates shall be fastened by means of corrosion-resistant steel or nonferrous metal screws. Hand lettering, marking, or embossed self-adhesive tapes are not acceptable.

For equipment installed outdoors, identification shall be made using stenciled characters, 1 inch high and Rust-Oleum #7776-830 (or approved equal) flat black paint.

3.3 EQUIPMENT PADS

Equipment pads shall be constructed with a minimum 4-inch margin around the equipment and supports.

3.4 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching on the building structure.

Holes in or through existing masonry walls and floors in exposed locations shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

3.5 DAMAGE TO WORK

Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Contracting Officer, and at no

additional cost to the Government.

3.6 CLEANING

Exposed surfaces of wireways, conduit systems, and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish or painting or are enclosed within the building structure.

Before final acceptance, electrical equipment, including lighting fixtures and glass, shall be clean and free from dirt, grease, and fingermarks.

3.7 MANDATORY INSPECTION POINTS (MIPs)

The Contractor shall provide the MIPs in the construction schedule so that arrangements can be made in advance for inspection of equipment prior to energizing. All submittals that require government approval be dispositioned as such prior to inspection. Any impacts resulting from the Contractor's inability to meet these requirements will be borne at no additional cost to the Government.

Coordinate with the Contracting Officer to provide MIPs within the contract with appropriate monitoring and scheduling for MIPs. MIPs shall be scheduled anytime a major piece of equipment has been installed and ready for service, or major substation modification work is scheduled to be completed.

Government is to be notified at least two weeks in advance of planned equipment/system energization. Contractor shall submit test and/or checkout procedures in accordance with specification section 16960, paragraph titled "Preparation of Procedures and Schedules".

3.8 FIELD TESTING AND TEST EQUIPMENT

Provide evidence of calibration to Contracting Officer prior to initial tests.

Date of last calibration and certification shall conform to NETA ATS-03 and consist of:

1. The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.
2. The firm providing calibration service shall maintain up to date instrument calibration instructions and procedures for each test instrument calibrated.
3. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).
4. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a) Field instruments: Analog, 6 months maximum. Digital, 12 months maximum.
 - b) Laboratory instruments: 12 months maximum.
 - c) Leased specialty equipment: 12 months maximum.

5. Dated calibration labels shall be visible on all test equipment.
6. Records, which show date and results of instruments calibrated or tested, must be kept up to date.
7. Calibrating standard shall be of better accuracy than that of the instrument tested.

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SECTION 16050

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11/08

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SECTION 16050

COMMON WORK RESULTS FOR ELECTRICAL
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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1 (1994) Rigid Steel Conduit - Zinc Coated

ASTM INTERNATIONAL (ASTM)

ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.29 (2005) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1 (2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2 (2003) Standard for Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

NEMA TC 3 (2004) Standard for Polyvinyl Chloride PVC Fittings for Use With Rigid PVC Conduit and Tubing

NEMA VE 1 (2002) Standard for Metallic Cable Tray Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

- TIA/EIA-568-B.1 (2001 Addendums 2001, 2003, 2003, 2003, 2004, 2007) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
- TIA/EIA-568-B.2 (2001) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components

UNDERWRITERS LABORATORIES (UL)

- UL 1 (2005; Rev thru Jul 2007) Standard for Flexible Metal Conduit
- UL 489 (2002; Rev thru Mar 2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
- UL 6 (2007) Standard for Electrical Rigid Metal Conduit-Steel

1.2 SUBMITTALS

Government approval is required for all submittals. Submit the following in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceways and Fittings
Wire and Cable
Circuit Breakers

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway sand Fittings
Wire and Cable
Circuit Breakers
Spare Parts

SD-06 Test Reports

Continuity Test
Phase-Rotation Tests
Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.
Submit Certification required to install equipment components and system packages

1.3 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. 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.

1.4 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 Std 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.

1.5 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.

1.6 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.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For

operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.7 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.

1.8 FIELD FABRICATED NAMEPLATES

ASTM D 709. 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 and have beveled edges. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by three inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including power circuit breakers 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, 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. PPS0710D72 or approved equal.

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 and fittings

Rigid steel conduit and fittings shall comply with UL 6 and ANSI C80.1 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 for fittings 1-1/2 inches or less. 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.

2.1.2 Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.3 Rigid Nonmetallic Conduit and fittings

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 80.

Rigid PVC conduit shall be the slip-joint solvent weld type and fittings shall be unthreaded PVC.

2.1.4 Cable Trays

Provide ladder type cable trays conforming to NEMA VE 1.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN/THWN. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be solid. All multiconductor control cables shall have stranded conductors and an overall foil shield.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 CIRCUIT BREAKERS

New circuit-breakers shall have interrupting ratings that match the existing circuit breakers. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

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.

Conduits shall be effectively sealed to prevent condensation and water intrusion from entering the system. Seal and grout penetrations into buildings and vaults. Patch and paint walls to match existing surfaces.

Expansion fittings with flexible ground strap shall be provided in conduit runs across building expansion joints.

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.

3.1.2 Flexible Metallic Conduit

Use flexible metallic conduit to connect power circuit breakers and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Liquidtight flexible metallic conduit shall be used in wet and oily locations.

3.1.3 Rigid Nonmetallic Conduit

Rigid PVC conduit for underground work shall be direct buried and provided with suitable protection..

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.

3.1.4 Cable Trays

Support cable trays from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Provide support when the free end extends beyond 3 feet. Maximum support spacing shall be 6 feet. Trays 10-inches wide or less shall be supported by two hangers. Trays greater than 10-inches wide shall be supported by two hangers. Bond cable trays at splices.

3.2 WIRING

120/208 voltfeeder and branch circuit conductors shall be color coded as follows:

<u>CONDUCTOR</u>	<u>COLOR AC</u>
Phase A	Black___
Phase B	Red___

<u>CONDUCTOR</u>	<u>COLOR AC</u>
Phase C	Blue_____
Neutral	White
Equipment Grounds	Green

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Multiconductor cables shall conform to ICEA, Method 1.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.2.1 Category 5 Cable and Connections

Cable shall be tested in accordance with TIA/EIA-568-B.1 and conform to TIA/EIA-568-B.2. Cable shall be constructed with four balanced unshielded twisted pairs each consisting of insulated 24AWG solid (horizontal) enclosed with a flexible PVC jacket. Provide RJ-45 connectors at each end.

3.3 FIELD TESTING

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.

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 Contracting Officer 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 Contracting Officer. Final test data shall be provided to the Contracting Officer. Data shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Data - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

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SECTION 16065

GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

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SECTION 16065

GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY
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 B 3 (2001; R 2007) Standard Specification for Soft or Annealed Copper Wire

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) Normal Measurements

JOHN F. KENNEDY SPACE CENTER (KSC)

KSC-STD-E-0012E (2001) Standard for Facility Grounding and Lightning Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical Code - 2008 Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-889 (Rev B, Notice 3) Dissimilar Metals

UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Standard for Grounding and Bonding Equipment

1.2 GENERAL REQUIREMENTS

Section 16003 GENERAL ELECTRICAL PROVISIONS applies to work specified in this section.

1.3 SUBMITTALS

Government approval is required for all submittals. Grounding shall comply with John F. Kennedy Space Center (KSC) KSC-STD-E-0012E. Submit the following in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit material, equipment, and fixture lists for Grounding Systems including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

SD-02 Shop Drawings

Submit Record Drawings in accordance with paragraph entitled, "Drawings," of this section.

SD-03 Product Data

Submit equipment and performance data for the following items including life, test, system functional flows, safety features, and mechanical automated details.

Submit Manufacturer's catalog data for the following items:

Ground Rods
Ground Wires
Connectors and Fasteners
Bonding

SD-06 Test Reports

Submit Test Reports for the following tests on grounding systems in accordance with the paragraph entitled, "Field Tests," of this section. Within the report include certified record of ground-resistance tests on each driven ground rod, ground rod assembly, and other grounding electrodes. Include within the record the number of rods driven and their depth at each location to meet the required resistance-to-ground measurements specified. Include a statement describing the condition of the soil at the time of measurement.

Bond Resistance Test
Ground Resistance Tests
Ground Isolation Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions for the Grounding Systems including special provisions required to install equipment components and system packages. Within special notices, detail impedances, hazards and safety precautions.

1.4 DRAWINGS

Record Drawings must indicate the location of ground rods, mats, grids, building ground bus, supplementary grounding electrodes, steel building columns, and other metal structures connected to the grounding system.

Identify the location of each ground rod and ground-rod assembly and other grounding electrodes by letter in alphabetical order and keyed to the record of ground-resistance tests.

PART 2 PRODUCTS

2.1 GROUND RODS

Ground rods must conform to the requirements of NFPA 70 and UL 467.

Ground rods must be copper-clad steel rods not less than 3/4 inch in diameter and not less than 10-feet long per section. Minimum copper thickness shall be 0.1 inches on any point on the cylindrical surface. Ground rods must be clean and smooth and have a cone-shaped point on the first section and be die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in feet. Minimum length of installed ground rod shall be 20 feet.

2.2 GROUND WIRES

Ground and bond wires for substations, main panels and distribution points, and ground rod connections must be annealed bare copper conforming to ASTM B 3, stranded, with 98 percent conductivity. Wire size must be in accordance with the grounding requirements of NFPA 70.

Ground wires for equipment receptacles for noncurrent carrying hardware, installed in conduit must be soft drawn copper, in accordance with ASTM B 3, stranded, with green insulation. Note wire size.

2.3 CONNECTORS AND FASTENERS

Grounding and bonding fasteners and connectors must conform to the requirements of UL 467.

Grounding and bonding fasteners must be copper.

Bonding straps and jumpers must be copper and have a cross-sectional area of not less than No. 6 AWG.

PART 3 EXECUTION

3.1 BONDING AND GROUNDING

Bonding and grounding requirements must be in accordance with NFPA 70.

3.2 GROUNDING ELECTRODES

Grounding electrodes must include ground rods installed expressly for grounding systems. Install ground rods using a water jetting procedure.

Minimum ground rod section must be 10 feet. Thread sections together and exothermically fusion weld.

Install ground rods so that the top of the rod is not less than 18 inches below finished grade.

3.3 GROUND GRIDS

Ground grids must consist of a series of ground rods installed with interconnecting grounding conductors between ground rods. Space ground

rods as noted.

Do not bury ground grid less than 18 inches below the finish grade. Grounding conductors must not be less than No. 4/0 AWG and must be exothermically fusion welded together at crossover points and to ground rods.3.4 EQUIPMENT GROUNDING

In addition to the green colored equipment grounding conductor required in each raceway and sized in accordance with Table 250.122 of the NEC, electrical equipment, addressed under this contract, must be bonded to the grounding system with a stranded copper conductor, routed external to the feeder raceway.

Metallic raceway systems must have electrical continuity with equipment individually and be directly connected to the building ground, independent of the raceway system.

Power circuit breakers and switchboard frames must be individually and directly connected to the building ground or the grounding electrode system.

Noncurrent carrying metallic parts of electrical equipment, including metallic cable sheaths, conduit, raceways, and electrical structural members, must be bonded together and connected to the ground grid or ground connection rods.

Install secure ground systems for power and instrumentation. Independently connect each system to the building counterpoise as shown.

3.5 GROUNDING CONNECTIONS

Ground connections must be bonded connections in accordance with paragraph entitled, "Bonding."

Weld ground connections that are buried or in inaccessible locations.

Bolt connections in accessible locations.

Clean, degrease, and remove foreign matter from ground connection surfaces. Do not penetrate clad material in the cleaning process. Make connection between like metals where possible. Where dissimilar metals are welded, brazed, or clamped, follow the weld kit manufacturer's instructions. Connections between dissimilar metals must not produce galvanic action in accordance with MIL-STD-889.

3.6 BONDING

3.6.1 Type of Bonds

Accomplish bonding of metal surfaces by welding and clamping .

3.6.1.1 Welding

Welding must be by the exothermic process. Within the welding procedure, include the proper mold and powder charge and conform to the manufacturer's recommendations.

Welding processes must be of the exothermic fusion type that will make a connection without corroding or loosening. Process must join all strands

and not cause the parts to be damaged or weakened. Completed connection or joint must be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor. Paint buried ground connections with a bitumastic paint.

3.6.1.2 Clamping

In external locations, use clamping only where a disconnect type of connection is required. Connection device may utilize threaded fasteners. Construct device such that positive contact pressure is maintained at all times. Use machine bolts with tooth-type lockwashers.

3.6.2 Cleaning of Bonding Surfaces

Thoroughly clean surfaces that comprise the bond before joining. Apply an appropriate abrasive with gentle and uniform pressure to ensure a smooth and uniform surface. Do not remove excessive metal from the surface. Clean clad metals in such a manner that the cladding material is not penetrated by the cleaning process. Then clean bare metal with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, and other contaminants. Bond to the cleaned area must be made within one hour after cleaning. Seal joint and refinish the exposed surfaces within two hours of exposure to prevent oxidation. When additional time is required, apply a corrosion preventive compound until the area can be refinished.

3.6.3 Bonding Straps and Jumpers

Install jumpers such that the vibration by the shock-mounted device will not change its electrical characteristics.

Weld bonds for outdoor locations unless a disconnect type of connection is required. When a disconnect is required, use clamping with bolts. Insert a tooth-type lockwasher between the strap and metallic member for each bolt.

Bond straps directly to the basic structure and do not penetrate any adjacent parts. Install straps in an area that is accessible for maintenance.

Use single straps for the bonds and install such that they will not restrict movement of structural members. Do not connect two or more straps in series.

Install straps such that they will not weaken structural members to which they are attached.

3.6.4 Equipment and Enclosure Bonding

Each metallic enclosure and all electrical equipment must be bonded to ground. At least one copper connection must be made from the system ground point to one or more enclosures in the area such that all enclosures and equipment provide a low-impedance path to ground when properly bonded together.

3.6.5 Bonding of Conduit and Raceway Systems

3.6.5.1 Rigid Metal Conduit and Terminations

Threaded connections must be wrench-tight and there must be no exposed threads. Ream all ends of the conduit to remove burrs and rough edges. Conduits entering boxes and enclosures must be bonded to the box with locknuts and grounding-type bushings. Locknuts that gouge into the metal box when tightened are not acceptable.

Conduit systems that are interrupted by PVC dielectric links must be bonded separately on either side of the link. Dielectric link must not be jumpered.

3.6.5.2 Liquidtight Flexible Metal Conduit

Liquidtight Flexible conduit must have an integral grounding conductor.

3.6.6 Cable Tray Bonding

Bond cable tray sections together. Cable tray sections in tandem assembly must be considered as having electrical continuity when these sections are bonded with the appropriate bolts. Install bond straps across expansion joints. Bond cable trays to the building ground system.

3.6.7 Protection of Finished Bonds

Protect finished bonds by painting to match the original finish after the bond is made.

3.7 FIELD TESTS

Perform the following tests in the Contractor in the presence of the Contracting Officer.

3.7.1 Bond Resistance Test

Resistance of any bond connection must not exceed 0.5 milliohm. Rework bonds that exceed this resistance at no additional cost to the Government.

3.7.2 Ground Resistance Tests

Test Grounding systems for ground resistance. Total resistance from any point on the ground network to the building counterpoise must not exceed 50 milliohms.

Ground resistance and counterpoise tests must be made during dry weather, and no sooner than 48 hours after rainfall. Conduct tests using the ratio method that measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Perform measurements in accordance with IEEE Std 81.

Indicating instrument must be self-contained and include a direct-current generator, synchronized current and potential reversers, crossed-current and potential coils, direct-reading ohmmeter, series resistors, and range-selector switch. Calibrate direct-reading ohmmeter for ranges of 0

to 20 ohms and 0 to 200 ohms.

Place auxiliary grounding electrodes in accordance with instrument manufacturer's recommendations but not less than 50 feet apart, in accordance with IEEE Std 81.

3.7.3 Ground Isolation Test

Test ground systems for isolation from other ground systems.

-- End of Section --

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115KV SUBSTATION

05/09

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- 3.6 Transformer Radiator Replacement
 - 3.6.1 Perform all final transformer insulation power factor, TTR, megger and resistance tests, transformer oil tests and any other final tests required by the transformer manufacture
 - 3.6.2 Check all radiators to determine that all connections are installed to the proper torque as required by the Manufacturer's specifications, all drain plugs are tight and there are no visible oil leaks.
 - 3.6.3 Check for proper cooling fan operation and fan blade rotation.
 - 3.6.4 Provide copies of all final test documentation to the NASA Contracting Officer.

-- End of Section Table of Contents --

SECTION 16310

115KV SUBSTATION

05/09

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS L-P-387 (1994) Plastic Sheet, Laminated,
Thermosetting (for Designation Plates)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; Errata 2007; INT 2008) National
Electrical Safety Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2009) Standard for Acceptance Testing
Specifications for Electrical Power
Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 5 (1996) Thermoplastic-Insulated Wire and
Cable for the Transmission and
Distribution of Electrical Energy

NEMA WC 7 (1998) Cross-linked
Thermosetting-Polyethylene-Insulated Wire
and Cable for the Transmission and
Distribution of Electrical Energy (ICEA
S-66-524)

NEMA Z535.1 (2006) Standard for Safety Colors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical
Code - 2008 Edition

1.3 GENERAL REQUIREMENTS:

General requirements include those specified in Section 16003, "General Electrical Provisions", and as specified herein. The work consists of additions and modifications to the existing C5/C5A 115/13.8kV substation, including 115kV circuit breakers. The work also includes the addition of equipment foundations, bus section upgrade work, replacement of the

transformer radiators on T9 and T10 at the C5 substation, control switchboard modifications, equipment control systems, relays and all other equipment as required for a complete installation. The power circuit breakers shall be furnished, assembled on foundations provided or modified by the Contractor, and connected by the Contractor. Materials not normally furnished by the manufacturer, with the equipment, are specified in other sections of these specifications as referenced herein. Additional relay upgrades shall be performed on the control panels at the existing Orsino 115/13.2kV substation.

The work will also consist of integrating all of the relays provided under this project with the existing operator workstation using CITECT software and the existing Government library of symbols, genies and super genies. If the new relays contain monitor and control elements that are not in the Government library, development of the new CITECT interface elements (screens, symbols, genies and super genies) and the communication connection to the KCCS controls network will also be required.

Additionally, the work will consist of programming the relay communication processor and entering all the new relays provided in the project into the existing Schweitzer Engineering Laboratories (SEL) Relay Management System (RMS).

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

- 115 kV Group Operated Switches
- Test Switches
- Lockout Relays
- Bus Differential Relays
- Breaker Failure Relays
- Transformer Differential Relays
- Auxiliary Relays
- Feeder Protection Relays
- Transformer Radiators
- Communication Interconnection Diagrams
- Communication Processors

SD-03 Product Data

- 115 kV Group-Operated Switches
- Communication Processors (SEL 2032)
- Control cables
- Switchboard wiring
- Communication Cables
- Control, Transfer and Selector Switches
- Indicating Lights
- Miscellaneous devices
- Bus Differential Relays (SEL 587Z)
- Breaker Failure Relays (SEL 501)
- Transformer Differential Relays (SEL 787)
- EGX-100 Protocol Converter

- Transformer Radiators
- Auxiliary Relays
- Test Switches
- Lockout Relays
- Ethernet Switch
- DC Power Supply
- Feeder Protection Relays (SEL 751A)
- Desktop Computer
- Wire Markers

SD-06 Test Reports

- Insulation Resistance Test
- Continuity Test
- Transformer Oil Tests
- TTR, Megger and Winding Resistance tests
- Winding Insulation Power Factor

SD-07 Certificates

Certification of the CITECT integrator shall be submitted showing the integrator has experience with CITECT use in power systems. Submittal shall include sample CITECT development screens that include power systems related elements.

SD-10 Operation and Maintenance Data

Operation and Maintenance Data shall be submitted for the following:

- 115 kV Group-Operated Switches
- Bus Differential Relays
- Breaker Failure Relays
- Transformer Differential Relays
- Auxiliary Relays
- Feeder Protection Relays
- Communication Processors

1.5 SPARE PARTS DATA

As soon as practicable after approval of materials and equipment, furnish spare parts product data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source of supply. The foregoing shall not relieve the Contractor of any responsibilities under the guaranty.

1.6 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Provide the services of manufacturer representatives to train the owner's personnel in operation of the switchboard and programming of the relay systems. The manufacturer representatives shall be factory-trained and shall have a thorough knowledge of the switchboard, all protective devices,

metering, hardware and system programming. The training session on the IEDs and all controls shall include:

1. Two Days - Modified Control Switchboard and Protective Relays on-site training for 7 people each day.
 - a) Full operation demonstrations of all functions.
 - b) Explanations and instructions for all protective devices.
2. Two Days Classroom on-site training for programming the relays and KCCS Scada Interface System for 7 people each day.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

In every instance, products, equipment and materials furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such products.

2.2 115KV GROUP-OPERATED SWITCHES

Shall be three pole, all copper switch, group operated, double end break, rated 115kV nominal voltage, 138kV maximum design voltage, 1200 amperes continuous, 61,000 amperes momentary. Impulse withstand shall be 650kV BIL. Contacts shall be silver-to-silver, self-cleaning; maintenance and adjustment free. Blade open stops shall be 90 degrees open. TR-22 post insulators and hot-dipped galvanized double mounting channels shall be provided. A manual switch operator mechanism shall also be provided.

2.3 GRAVEL

Provide gravel (crushed stone) as indicated in the substation enclosure. Stone shall be composed of clean, durable rock and shall be placed, as indicated on the drawings. The crushed stone shall comply with Section 901, "Course Aggregate", of the 2004 Florida Department of Transportation Standard Specifications for Road and Bridge Construction. The gradations shall be Size 57 as listed in Table 1 and as follows:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u> <u>Square-Opening Laboratory Sieve</u>	
1-1/2 inch	100	
1 inch	95	100
1/2 inch	25	60
No. 4	0	10
No. 8	0	5

2.4 CONTROL SWITCHBOARDS

2.4.1 Control Panel Modifications

Existing control panel 5 at the C5 substation Control Building will be modified for breaker failure protection. The panel is to be modified by removing the existing door and equipment, installing the existing and new equipment on a new door. The new equipment consists of: a Schweitzer SEL-501 overcurrent relay (50BF3), a lockout relay (86BF4), test switches and reconnecting the existing Schweitzer SEL-751A relay for breaker TS8 overcurrent protection and replacing the door, re-installing the existing Schweitzer SEL-2032 communication processor and accessories and adding a Schweitzer SEL-2032 communication processor and accessories at control

panel 2.

Existing control panel 15A at the C5 substation control building will be modified for the installation of new 13.8kV bus differential relays. The panel is to be modified by removing the existing rear mounted differential relays, removing the existing door and equipment and installing a new door with Schweitzer SEL-587Z high impedance differential relays and an 8 point annunciator.

Relays presently mounted on the rear of panels 15A shall be removed and returned to the government. The relay cut out area shall be modified to accept a blank, 11 gauge, steel plate cover.

Existing control panels 1F through 4F at the C5A substation control building will be modified for transformer and bus differentials and breaker control and failure protection. The panels will be modified by installing Schweitzer SEL-787A differential relays at panels 1F and 3F (87T9, 87T10), a Schweitzer SEL-587Z high impedance bus differential relay at panel 4F (87C), Schweitzer SEL-501 overcurrent relays at panels 1F and 3F (50BF1, 50BF2), lockout relays at panels 1F, 2F, 3F, and 4F (86BF1, 86BF2, 86BF3, 86BF5), a lockout relay at panel 4F (86c), breaker control switches at panels 2F and 4F (CS/HBT1, CS/HBT2), test switches, indicating lights and installing Schweitzer SEL-2032 communication processors at 13.8kV switchgear cubicle 9A..

All 13.8kV and 13.2kV main, tie and feeder breaker control panels associated with the C5, C5A and Orsino substations shall have the existing overcurrent relays (KCGG, MMCO, Microshield) disconnected and removed and replaced with Schweitzer SEL-751A feeder protection relays.

Remove all existing cables that will be abandoned as part of the required work under this contract. It is to be noted that some existing cables may be routed through panels that will remain in service. These cables shall not be disturbed during the modification process. Existing terminal blocks and wiring channels in the interior of the panels may be re-used, with additional terminal blocks to be provided as required to terminate control cables entering from below. All cables terminating in the control panels shall be neatly routed and tied off. Existing wiring channels, where available, shall be utilized as far as possible for routing new control cables terminating in the cabinets. Additional wiring channels are to be provided as required. All wiring to devices to be mounted on the hinged panel doors shall be bundled neatly, with adequate allowance for cable movement and flexibility when the panel doors are opened and closed.

2.4.2 Nameplates

Provide laminated plastic nameplates for each relay, switch and device to identify its function and, where applicable, its position. Laminated plastic: 1/8-inch thick Melamine plastic conforming to FS L-P-387 white with black center core. Surface: matte finish; corners: square with beveled edges. Accurately align lettering and engrave into the black core. Size of nameplates: 1-inch by 3-inches minimum or as noted on drawings; lettering: minimum 3/16-inch high normal block lettering. Provide number, location and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two stainless steel screws.

2.4.3 Drawings for Control Switchboard Modifications

Drawings for control switchboard modifications shall include three line diagrams, elementary diagrams, and wiring and interconnection diagrams

having all devices and terminals identified. Provide complete AC schematic diagrams, DC schematic diagrams, connection diagrams, interconnection diagrams, internal device diagrams and layout drawings showing all modifications to the existing control panel.

Drawing files shall be provided in Microstation or AutoCad format (.dgn, .dwg, .dxf). In addition, four sets of "ANSI D" size drawings shall be submitted.

2.5 PROTECTIVE RELAYS

2.5.1 Relay Management System and KCCS Requirements

2.5.1.1 Relay Management System

The protective relays will be connected to the existing KSC Relay Management System (RMS) through a local SEL 2032 communications processor via the SEL 2701 Ethernet interface card. This system provides the user the ability to fully program the relay, including making setting changes, either locally or remotely and has the ability to verify and compare relay settings in the relay with the settings stored in the system database. The system is capable of viewing real-time power system parameters (including kW, kVAR, Voltage, Current, PF), collect relay status information (including relay health), read event reports from the relay (including faults, high or low Voltage, high current levels), and analyze event reports graphically, either locally or remotely. The system shall have a minimum communication baud rate of 19,200.

Integration of the protective relays into the existing RMS shall be performed by Schweitzer Engineering Services. The server for the RMS is located in the KSC Launch Control Center (LCC) and is loaded with SEL-5010, SEL-5040 and SEL-5601 application software programs. All of these programs shall be updated to incorporate the relays installed under this project.

2.5.1.2 Communication Processors and Equipment

The Communication Processors shall be a Schweitzer Engineering Laboratories 2032, and have the SEL-2701 Ethernet processor card installed in port 17. Each processor shall be supplied with a Square D EGX-100 Protocol Converter to connect to KCCS.

Additionally, an N-TRON 308TX 8 port Ethernet Switch or equivalent, and a 125VDC to 24VDC PS5R 30 watt DC Power Supply shall be supplied to integrate the Communication Processors .

2.5.1.3 Communication Integration

Integration of the relays and communication processors with the existing KCCS (CITECT) system shall be performed by Schweitzer Engineering Services in coordination with the contractor's specialist and the CITECT integrator.. This integration shall include, but not be limited to setting up each port on the 2032 processors and programming each 2032 to efficiently provide SCADA type data and control to KCCS via port 16 on the processor. "Efficiently" implies that data will be transmitted and received such that the response time to the KCCS workstation will be less than 4 seconds. This document will provide the minimum required data point list for the relays. Sample 2032 setting files from previous projects to assist in the integration effort will be provided by the Government.

The relays shall be able to communicate with KCCS via an ethernet

connection using MODBUS via TCP/IP (Citect standard Modnet driver). The communication shall occur via port 16 on the SEL-2032 communication processor. Port 16 shall be configured as a Modbus serial port and it shall be connected to an EGX gateway to convert Modbus serial to Modbus TCP/IP. The gateway shall connect to the KCCS network and provide the communication path to allow the KCCS servers to communicate to each protective relay with the Citect SCADA application software. The manufacturer shall provide, in writing, after communication integration is complete, that the communications system provided under this project will communicate efficiently with the Citect software. If problems are encountered Citect is located at 30,000 Mill Creek Avenue, Alpharette, GA 30022. Phone is 770-521-7511, facsimile is 770-521-7512. Sales email is sales-americas@citect.com, service email is support-americas@citect.com.

Provide Engineering and Technical Support for on-site modifications to the existing user interface screens used by the ISC power coordinators as part of the Kennedy Complex Control System (KCCS). The contractor shall provide technical support to develop additional screens and/or modifications to existing screens required to incorporate the new relays into the KCCS system. The additional screens will allow the ISC power coordinator to monitor and control each circuit breaker via Citect "Genies" and "Super-Genies". The Government will perform the final integration of the new screens, Genies, and Super-Genies into the existing KCCS file server. The existing KCCS system shall be modified to incorporate all the changes associated with the installation of the new relays. The modifications to the project shall include but not be limited to, adding/deleting variable tags, alarm tags and trend tags, modifying/building "genies and super genies" and modifying/creating user interface screens. All modifications to the Citect project shall comply with the KCCS Software Architecture Standard.

Coordinate all communication network interface equipment and software (if necessary) with the Citect integrator to ensure that the communication solution provided is efficient and compatible with the existing KCCS architecture. Provide manufacturer's cut sheets and interconnection drawings for additional equipment not specified herein but necessary to insure the relay data communication will be TCP/IP Modbus. Acceptance of additional equipment shall be subject to the approval of the Contracting Officer.

The communication system shall be capable of retrieving breaker status of all breakers and the minimum data points listed in this document. A Government library of Citect symbols, genies and super genies has already been developed and will be provided to the contractor to assist with the development of the new operator screens. This library includes the Citect interface for the SEL-351A and SEL-351-6 relays. It is recognized that this project is not installing the SEL-351A type relays, but the SEL-351 Citect interface libraries can be used as a "format template" for the development of the new relay interfaces.

A minimum of two KCCS integration design reviews shall be scheduled by the contractor to ensure that all of the parties involved in developing any new Citect interfaces (screens, alarms, trends, and data exchange methods) are properly coordinated. At the first meeting, an existing KCCS Citect sample project will be provided by the Government to assist in the development of new interfaces. At the second meeting the contractor shall provide a 60% developed Citect project that demonstrates the monitor and control functions associated with the new interface. The first meeting shall be scheduled within 75 days of the contract award.

Final acceptance testing of the developed Citect project shall be performed by the Contractor using their own laptop computer. The tests shall be performed on site on active equipment after the relays have been installed and fully integrated into the SEL-2032 communication processor.

Upon the completion of the contract, the Contractor shall provide to the Government a complete set of Communication Interconnection Diagrams depicting the the system as installed.

2.5.2 Transformer Differential Relays (87T)

Relays shall be three-phase , solid-state microprocessor Schweitzer Engineering Laboratories type SEL 787, current blocking, suitable for 125 VDC operating voltage, SEL part number 07871X1A1A0XA5850001. The minimum amount of KCCS relay communication points shall be as listed below. At the discretion of the Contracting Officer, the minimum points list may be expanded to include 50% additional points. (Communication points for the SEL 387 transformer differential relay are similar).

Function Name

TRIPPED, TP8CLOSED, TS8CLOSED, RELAYFAIL, COMMFAIL, NOVTRIP
DIFFTRIP, PADIFFTRIP, PBDIFFTRIP, PCDIFFTRIP, IA, IB, IC
MNIA, MNIB, MNIC, MXIA, MXIB, MXIC, DMIA, DMIB, DMIC
PKIA, PKIB, PKIC, MNCRTIME, MNCRDAY, MNCRYEAR, MNCRHR
MNCRMIN, MNCRSEC, DMCRTIME, DMCRDAY, DMCRYEAR, DMCRHR
DMCRMIN, DMCRSEC, RSMCMCND, RSDMCMD, DMCRHR, DMCRMIN
DMCRSEC, RSMCMCND, RSDMCMD, XFMR OIL TEMP, XFMR OIL LEVEL
XFMR FANS ON, XFMR GEN'L ALARM

2.5.3 Bus Differential Relays (87B)

Relays shall be three phase, high impedance, microprocessor Schweitzer Engineering Laboratories type SEL 587Z suitable for 125 VDC operating voltage, SEL part number 0587Z02325312XX. The minimum amount of KCCS relay communication points shall be as listed below. At the discretion of the Contracting Officer, the minimum points list may be expanded to include 50% additional points. Contracting Officer".

Function Name

87
A FAULT
B FAULT
C FAULT
G FAULT
RELAYFAIL
COMMFAIL

2.5.4 Feeder Protection Relays (50/51N)

Relays shall be three phase, solid state microprocessor Schweitzer Engineering Laboratories type SEL 751A suitable for 125 VDC operating voltage, SEL part number 751A51A1A0X0X850001. Twenty one (21) SEL 751 relays will be Government Furnished Equipment (GFE). The contractor shall provide twenty one (21) 5 amp CT input cards, Schweitzer Engineering Laboratories part number SEL 9724L851 to replace the existing 1 amp CT input cards. The replacement cards installation shall be done by the Contractor under the supervision of SEL personel.

The minimum amount of KCCS relay communication points shall be as listed below. At the discretion of the Contracting Officer, the minimum points list may be expanded to include 50% additional points.

Function Name

TRIPPED
50FAULT
51FAULT
RELAYFAIL
COMMFALL
52/a
Maintenance Setting On

2.5.5 Communication Processors

The Communication Processor shall be a Schweitzer Engineering Laboratories type SEL 2032 suitable for 125 VDC operation with ModBus Protocol. Software Management shall be SEL 5020 "Software Assistant", latest edition. The Communication Processors shall be installed in cubicle 9A of the 13.8kV switchgear (C5A control building), panel 2 (C5 control building) and in panel 7T (Orsino control building), SEL part numbers 2032032344H0XX (horizontal rack mount) or 2032332344H0XX (horizontal panel mount). Two (2) SEL 2032 horizontal panel mount processors will be Government Furnished Equipment (GFE).

2.5.6 Breaker Failure Relays (50BF)

Relay shall contain two sets of independent relays, each three phase, Schweitzer Engineering Laboratories type SEL 501 suitable for 125 VDC operating voltage, SEL part number 050100325613XB. The minimum amount of KCCS relay communication points shall be as listed below. At the discretion of the Contracting Officer, the minimum points list may be expanded to include 50% additional points.

Function Name

INST FAULT
X
Y
A FAULT
B FAULT
C FAULT
N FAULT
RELAYFAIL
COMMFALL

2.5.7 Auxiliary Relays:

Lockout auxiliary relays (Device 86T) shall be multi-contact, in dust tight cases, and suitable for switchboard mounting and shall have a rating adequate for the duty performed, but shall not be rated less than 20 amperes continuous. Relays shall be held in the tripped position by a positive latch until manually reset. Mechanical target shall indicate whether the relay is in the tripped or reset position. Auxiliary relays for alarm, telemetry, and supervisory control shall be self-reset, instantaneous drop-out and shall have a rating adequate for the duty performed, but shall not be rated less than 12 amperes continuous. Relay

coils shall operate on 125 VDC available in the control house.

2.5.8 Desktop Computer

The Contractor is required to provide to the Government a desktop computer containing at a minimum, the following features:

Intel Core 2 Duo E7400 2.8GHz dual-core processor, 4GB RAM, 640GB 3.0GB/s Serial ATA hard drive, dual-layer DVD burner, six USB ports, two audio ports, one FireWire port, wireless keyboard and mouse, and Windows XP Professional, 19-in LCD monitor a 4:3 aspect ratio.

2.6 MISCELLANEOUS DEVICES

2.6.1 Control, Transfer and Selector Switches

Shall be rotary cam operated devices with individual stages, a dust-tight cover and contacts with a positive wiping action. Contacts shall be silver-to-silver or an approved substitute which provides equal or superior performance. Contacts shall have a rating adequate for the duty performed, but shall not be less than 600 volts, 20 amperes continuous. Circuit breaker control switches shall have a red and green target. Red and green indicator lamps shall also be provided. Circuit breaker control switches shall have a combination of maintained action and spring return type of operation and pistol grip handles. All switches shall be equipped with engraved plastic escutcheons identifying its function and position.

2.6.2 Indicating Lights

Shall be 125 VDC resistor type, push to test, LED lamp, colored lens as indicated.

2.6.3 Auxiliary Control Relays

Provide as required to implement protective functions and interlocking as indicated. Auxiliary relays shall have contacts rated to carry 30 amperes for one minute and 12 amperes continuously. Coils shall be a long-life design with a projected service life of 40 years.

a) Auxiliary relays used for tripping circuit breakers shall be multi-contact, high-speed relays operating in one-half cycle or less.

b) Auxiliary relays for functions other than tripping circuit breakers shall be normal-speed relays operating in two cycles or less.

c) Auxiliary timing relays shall be electro-pneumatic relays with contacts rated for at least the load they are controlling.

2.6.4 Terminal Boards:

Shall have engraved plastic terminal strips and screw type terminals provided for all external wiring between components, and for all internal wiring between removable assemblies. Terminal boards associated with current transformers shall be short circuiting type. Terminal board identification shall be identical in all similar units. External wiring shall be color coded consistently for all similar terminal boards. All control, relaying and metering conductors shall be properly identified.

Factory installed switchboard wiring shall be identified by wire markers consisting of white plastic tubing heat embossed with black block type letters. All field installed wiring shall be identified by wire markers consisting of pre-printed polyvinyl chloride (PVC) sleeves. Each sleeve shall contain a single heat stamped black block type letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to insure satisfactory alignment with adjacent sleeves. Specific wire markings shall be provided using the appropriate combination of sleeves. Sleeves shall be Brady type "Omni-Grip" or an approved equivalent. Wire markers shall indicate the destination of the remote end of the wire; markings shall be consistent with the existing identifying system.

2.7 EQUIPMENT OPERATION & MAINTENANCE DATA

Operation and Maintenance Data for all furnished equipment, including 115kV power breakers, disconnect switches, panel mounted equipment, etc, shall include the following:

- a. Installation, start-up, and initial test instructions.
- b. Operating instructions, including but not limited to safety precautions and operating limits.
- c. Maintenance procedures, routine adjustments, and preventive maintenance schedules.
- d. Parts illustrations, including parts lists adequate for the purpose of identifying and ordering replacement parts and designation of the number required per component, and lists of recommended spare parts.
- e. Wiring diagrams for electrical equipment.
- f. Diagrams for hydraulic and/or pneumatic equipment, if applicable.
- g. Detailed descriptions of the functions of each component of each system.
- h. Performance and nameplate data.
- i. Alignment instructions and actual as-aligned data.
- j. Safety precautions.
- k. Maintenance instructions, which shall include detailed assembly drawings with parts numbers, parts lists, instructions for ordering spare parts, and complete preventive maintenance instructions required to help ensure satisfactory performance and longevity of the equipment involved.
- l. Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade and temperature range of lubricants, and shall recommend frequency of lubrication.
- m. Lists of electrical relay settings and control and alarm contact settings.

2.8 MISCELLANEOUS WIRE AND CABLE:

Wire and cable shall be neatly formed and trained in wireways, conduit and enclosures. All wiring shall be continuous from terminal to terminal, no splices will be permitted. All terminals shall be fitted with pre-insulated barrel type compression ring-tongue lugs in a manner to ensure permanently tight but easily removable connections. Extra flexible construction shall be used for all swinging panels. All external wiring shall be color coded consistently for all similar terminal boards. Self-adhesive cable/conductor support systems shall not be permitted.

2.8.1 Switchboard Wiring

Shall be 600 volt, 90 degrees C switchboard type type SIS wire, bound by waxed twine or plastic cable straps into tight workmanlike harnesses. Minimum size shall be #14 AWG. Voltage and current transformer wiring shall be minimum size #10 AWG.

2.8.2 Control Cables

Shall be multiconductor and shall be small-diameter construction suitable for installation in conduit, cable tray, and underground duct. Conductors shall be seven-stranded soft copper wire with overall foil shield and insulation of 600-volt Type THWN/THHN nylon-jacketed polyvinyl chloride (PVC). Conductors shall be color-coded in accordance with NEMA WC 7, Method 1. Conductors shall be cabled-round, with fillers used where necessary to give the completed cable a substantially circular cross section. Fillers, when used, shall be nonhygroscopic, flame-retardant material. The overall assembly shall be wrapped with a helically applied nonhygroscopic tape and shall be covered with an outer jacket of extruded PVC. Overall jacket shall be flame-retardant, high-temperature PVC. The cable shall conform to NEMA WC 5 or NEMA WC 7. Cable shall be UL-listed Type TC for cable tray use and shall be marked in accordance with the National Electrical Code. The individual cable conductors shall be rated for operation at 90 degrees C in dry locations and 75 degrees C in wet locations. The cable shall be installed in continuous lengths. Minimum size shall be #10 AWG for CT leads and #12 AWG for control wiring.

2.8.3 Communication Cables

Relay communication cables shall be nine conductor, #22AWG, 7/30 stranded tinned copper with an overall aluminum/polyester tape foil shield, a #24AWG, 7/32 stranded tinned copper drain wire and PVC jacket.

2.9 Power Transformer Radiator Replacements

The existing transformer radiators, associated fans and hardware on the T9 and T10 transformers at the C5 Substation, shall be removed and replaced as a part of the Contractor's work. The Contractor shall obtain the services of ABB /Kuhlman Field Engineering Services personnel to perform the radiator replacement work in including final oil processing requirements. The Contractor shall provide replacement radiators as manufactured by the original transformer manufacturer, Kuhlman Electric. Contract Drawing 79K38551, Sheet 37, includes the Manufacturer's transformer outline drawing and other pertinent information required to furnish the replacement fans and radiators for the existing two transformers. Replacement radiators and fans shall be provided which supply the same cooling capacity as the

original units and shall not require any de-rating of the existing transformer nameplate ratings. The Contractor shall coordinate the schedule of the transformer radiator replacements with other station outages required during the project. The Contractor shall be responsible for, and provide, the following:

Six(6) galvanized radiators and ten (10) Fans with stainless steel guards per transformer.

All equipment and material for the wiring of fan controls to the new radiator fans.

The Government will provide recent DGA, PCB and fluid quality tests to the Contractor prior to commencing any work. The Contractor shall provide all additional, independent, oil testing services and analysis as required by the transformer manufacturer prior to the removal of the existing radiators and after the replacement radiators have been installed, prior to re-energization of each transformer. Oil samples shall be taken with the units de-energized and shall be sent to an independent lab for oil quality and DGA testing. Certified test results shall be provided to the Contracting Officer for review.

Electrical testing shall include Winding Insulation Power Factor, TTR, Megger and Winding Resistance tests as a minimum, and other field tests as recommended by the transformer manufacturer. Testing shall be performed both prior to removal and after the replacement of the radiators. Testing shall be performed in accordance with applicable NETA transformer test procedures.

Removal of the oil from the existing radiators and storage of the oil for re-use while replacing the radiators. Provide all equipment and any additional insulating oil required to complete the radiator replacements. This shall include providing the necessary equipment for the complete and continuous vacuum processing of the oil in the main tank and radiators, and re-establishment of a positive nitrogen gas blanket in the main tank, as required by the transformer manufacturer. The transformer manufacturer's Field Service personnel shall certify that each transformer is suitable for re-energization after the radiator replacement work has been completed.

Removal, handling and disposal of solid wastes and any waste oil generated during the removal and installation of the radiators. Removal, handling and disposal shall be in accordance with NASA Environmental requirements. See "Contract Solicitation/Delivery Order".

Provide copies of all field reports and field testing results to the Contracting Officer at the completion of the project.

PART 3 EXECUTION

3.1 EXECUTION:

IEEE C2, NFPA 70,NEMA Z535.1 and to the requirements specified herein.

Any equipment with externally powered wiring shall be marked with a laminated plastic nameplate having 3/16 inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Safety color coding for identification or warning signs shall conform to NEMA Z535.1.

3.2 SUB STATION ERECTION

Erecting equipment shall be suitable for the work and shall be in first-class condition. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or of deformation due to handling or transportation, such condition shall be reported immediately to the Contracting Officer and his approval of the method of correction obtained. The correction shall be made in his presence. The straightening of plates and angles or other shapes shall be done by approved methods or replaced.

3.3 FOUNDATION FOR EQUIPMENT

Provide reinforced concrete foundations for equipment as indicated. Provide conduit turn-ups and cable entrance space as required by the equipment to be mounted. Seal voids around conduit openings in slab with caulking or sealant which is both water and oil resistant. Concrete work shall be as specified in Section 03305, "Cast-In-Place Concrete (Short Section)".

3.4 EQUIPMENT GROUNDING:

Provide grounding as indicated. Copper cable not smaller than No. 4/0 AWG shall be provided not less than 12 inches below grade connecting to the new ground grid utilizing exothermic welded connections.

3.5 FIELD TESTS AND INSPECTIONS:**3.5.1 Relay Technician**

Provide certification for relay technician indicating the technician is skilled and actively engaged in the business of testing and calibrating protective relays in accordance with section 16960, paragraph titled "Testing Firm Requirements". Provide this certification of experience in writing ten days before the actual testing is proposed.

3.5.2 Acceptance Checks

Perform acceptance checks, settings, and tests in accordance with the latest IEEE standards under supervision of the specialist specified in Section 16960, "Apparatus Coordination, Inspection and Testing." Perform work in a careful and safe manner so as not to endanger personnel or equipment. Perform tests in such a way as to obtain information about the performance of the breakers, relays, meters, wiring, and instrument transformers together as a unit, as well as separately.

3.5.3 Acceptance Checks and Tests

Acceptance checks and tests shall include, but not be limited to the following:

- a) Compare actual connections with wiring and schematic diagrams. If differences are found, determine if error is in diagram or in actual wiring and correct as necessary.

- b) Inspect all devices, equipment, etc. for damage or maladjustment caused by shipment or installation.
- c) Assure that tightness of bolted bus joints are in accordance with manufacturer's recommendations (use calibrated torque wrench).
- d) Assist manufacturer's representative in performing all mechanical operator and contact alignment tests on breakers and operating mechanisms in accordance with manufacturer's recommendations. Make adjustments as necessary.
- e) Make electrical continuity checks of all current, potential, and control circuits, referring constantly to the diagrams.
- f) KCCS CITECT integration verification
- g) RMS relay configuration verification

3.5.3.1 Field Testing

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 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 100 Megohms for 600 volt rated cable.

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.

3.5.3.2 Field Test Equipment

Provide evidence of calibration to Contracting Officer prior to initial tests.

Date of last calibration and certification shall conform to NETA ATS and consist of:

1. The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within

rated accuracy for each test instrument calibrated.

2. The firm providing calibration service shall maintain up to date instrument calibration instructions and procedures for each test instrument calibrated.

3. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

4. Instruments shall be calibrated in accordance with the following frequency schedule:

- a) Field instruments: Analog and Digital, 12 months maximum.
- b) Laboratory instruments: 12 months maximum.
- c) Leased specialty equipment: 12 months maximum.

5. Dated calibration labels shall be visible on all test equipment.

6. Records, which show date and results of instruments calibrated or tested, must be kept up to date.

7. Calibrating standard shall be of better accuracy than that of the instrument tested.

3.6 Transformer Radiator Replacement

Radiator replacements shall be coordinated with other planned transformer outages. The following items of work shall be completed, as a minimum, subsequent to radiator and fan replacements on each unit.

3.6.1 Perform all final transformer insulation power factor, TTR, megger and resistance tests, transformer oil tests and any other final tests required by the transformer manufacture

3.6.2 Check all radiators to determine that all connections are installed to the proper torque as required by the Manufacturer's specifications, all drain plugs are tight and there are no visible oil leaks.

3.6.3 Check for proper cooling fan operation and fan blade rotation.

3.6.4 Provide copies of all final test documentation to the NASA Contracting Officer.

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SECTION 16472

121 KV POWER CIRCUIT BREAKERS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below as well as the standards referenced therein form a part of this section to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI C37.04 (1988) Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Base (Including Supplements C37.04c-1985, IEEE C37.04f-1990 and IEEE C37.04i-1991).
- ANSI C37.06 (2000) Standards for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities (Including Supplement C37.06a-1989).
- ANSI C37.09 (1999) Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis; (Including Supplements C37.09e - 1985, IEEE C37.09c - 1984, and IEEE supplement C37.09g-1991).
- ANSI C37.12 (1991) Guide to Specifications for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis and a Total Current Basis.
- ANSI C57.12.28 (2005) Pad-Mounted Equipment - Enclosure Integrity
- ANSI C57.12.29 (1999) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

ASTM INTERNATIONAL (ASTM)

- ASTM D-2472 (2000) Standard Specifications for Sulfur Hexafluoride

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- FED-STD-595 (Rev C; Am 1) Colors Used in Government Procurement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE C57.13 (2008) Standard Requirements for Instrument Transformers

IEEE C57.19.00

(2004) Standard General Requirements and
Test Procedures for Outdoor Power
Apparatus Bushings

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS

(2009) Standard for Acceptance Testing
Specifications for Electrical Power
Equipment and Systems

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,
"Submittal Procedures," in sufficient detail to show full compliance with
the specification:

SD-02 Shop Drawings

Drawings, diagrams and instructions shall be as outlined paragraph entitled
"DRAWINGS" in this specification.

Typical Performance Curves for bushing current transformers
Outline drawings
Wiring and Schematic Diagrams
Mounting details
Nameplates with Nameplate Data

SD-03 Product Data

Bushing Current Transformers
Outdoor Apparatus Bushings

SD-09 Manufacturer's Field Reports

Outdoor Apparatus Bushings

Submit six copies of test reports for all routine tests required by
IEEE C57.19.00.

Power Circuit Breakers:

The manufacturer shall fully assemble each breaker completely with its own
bushings and test it to insure the workability and reliability of all
parts. Six certified copies of test reports shall be submitted to the
Contracting Officer for the following as soon as the tests are completed:

Impact Recorder tape or recorded data and full report of shipping.

Design Tests required by ANSI C37.09. Design tests previously
made for equipment of the same design will be acceptable.

Manufacturer Shop tests, including complete wiring and control
circuit test and check of each breaker and verification of all
circuits prior to shipment.

SD-10 Operation and Maintenance Data

Submit four copies of OPERATION AND MAINTENANCE DATA Manuals to the

Contracting Officer for approval. Operation and Maintenance Manuals shall include the following requirements:

Installation, start-up, and initial test instructions.

Operating instructions, including but not limited to safety precautions and operating limits.

Maintenance procedures, routine adjustments, and preventive maintenance schedules.

Parts illustrations, including parts lists adequate for the purpose of identifying and ordering replacement parts and designation of the number required per component, and lists of recommended spare parts.

Wiring diagrams for electrical equipment.

Diagrams for hydraulic and/or pneumatic equipment, if applicable.

Detailed descriptions of the functions of each component of each system.

Performance and nameplate data.

Alignment instructions and actual as-aligned data.

Safety precautions.

Maintenance instructions, which shall include detailed assembly drawings with parts numbers, parts lists, instructions for ordering spare parts, and complete preventive maintenance instructions required to help ensure satisfactory performance and longevity of the equipment involved.

Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade and temperature range of lubricants, and shall recommend frequency of lubrication.

Lists of equipment failure/lock-out settings and alarm settings, if applicable.

1.3 FIELD SERVICES

Provide one or more manufacturer's field service engineering representatives, competent and experienced in commissioning the circuit breakers, to check the equipment for proper installation and operation prior to and during energization and field testing.

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

PART 2 PRODUCTS

2.1 POWER CIRCUIT BREAKERS

The power circuit breaker shall be three phase, general purpose outdoor type normally used for AC substation purposes with line-to-line voltage rating of 121 KV manufactured in accordance with ANSI C37.04 and ANSI C37.12. The breaker shall be designed for three pole gang tripping and closing. Sulphur hexafluoride (SF6) gas shall be the dielectric and interrupting medium. The breaker shall be of dead tank design using puffer type SF6 gas circuit breaking mechanism with each phase interrupter in its own gas tank. All equipment shall be new and of standard, commercial, first-grade quality as to materials, workmanship and design.

2.1.1 Circuit Breaker Characteristics

2.1.1.1 Voltage Rating

The circuit breaker shall be suitable for use on an effectively grounded system with a maximum line-to-line voltage of 121 KV. The nominal system voltage is 115 KV, 60 hertz, three phase. The circuit breakers are intended to protect substation type tap-changing-under-load transformers rated 18/24/30 MVA .

2.1.1.2 Current Rating

- a. Rated continuous current at 60 hertz shall be not less than 1200 amperes.
- b. Rated short circuit current at rated maximum KV shall be not less than 20 KA.
- c. Rated interrupting capability and rated short-time current shall be not less than 40 KA.
- d. Rated closing and latching capability shall be not less than 54 KA.

2.1.1.3 Insulation Rating:

- a. Basic impulse level (BIL withstand) - 550 KV
- b. Low frequency withstand - 260 KV

2.1.1.4 Control Voltages

- a. Closing Voltage - 125 VDC
- b. Tripping Voltage - 125 VDC
- c. Motor and Heaters - 120/208 VAC, single phase, 60 hertz
- d. Light and receptacle - 120 VAC, single phase, 60 hertz

2.1.1.5 Rated Interrupting Time

- a. 3 cycles

2.1.1.6 Rated Duty Cycle

- a. CO - 15 sec - CO

2.1.1.7 Other Ratings

Unless otherwise indicated, the breakers shall have the preferred ratings as listed in ANSI C37.06 for 121 KV outdoor circuit breakers.

2.1.2 Circuit Breaker Control

2.1.2.1 Trip Circuit Requirements

- a. Each circuit breaker shall be equipped with two (2) electrically and mechanically independent trip coils. The failure of one trip coil shall not damage or impair operation of the other coil. The design must be such that simultaneous energizing of both trip coils shall not prevent the breakers from tripping.
- b. Provide a fused disconnect switch or circuit breaker for each of the trip circuits.
- c. Trip circuit operating voltage shall be 125 volts DC. Trip circuits shall operate properly within a range of 70 to 140 volts DC as measured at the circuit breaker.

2.1.2.2 Closing Circuit Requirements:

- a. Closing circuit operating voltage shall be 125 VDC. Closing circuit shall operate properly within a range of 90 to 140 VDC as measured at the circuit breaker.
- b. A fused disconnect switch or circuit breaker shall be provided for the closing circuit.

2.1.2.3 Breaker Wiring:

- a. All control devices and alarms shall be connected to terminal blocks located in the breaker control cabinet.
- b. Current transformer leads shall be connected to short circuiting type terminal blocks located in the breaker control cabinet. The short circuiting strips of these blocks shall be grounded. All CT leads shall be AWG #10.
- c. All terminal blocks shall have screw type connectors and wiring terminations shall be made using ring tongue connectors.
- d. All terminal blocks shall be adequate to receive #10 wire control cable terminals.
- e. All control wiring shall be #14 AWG minimum type SIS.
- f. Legible sleeve type wire marks shall be provided at each end of wires over six inches in length.

2.1.2.4 Auxiliary Switches

- a. The manufacturer shall supply multi-contact auxiliary switches.

- b. Eight "a" and eight "b" contacts shall be made available for future use.

2.1.2.5 Trip and Close Devices:

- a. A local trip and close control switch shall be provided in the breaker control cabinet. Also, provide terminals for remote trip and close devices. Do not provide a mechanical trip which would override safety lock-out.
- b. The breaker shall be equipped with a position indicator which is visible from the outside of the breaker.
- c. The breaker shall have a mechanical operation counter which is visible from the outside of the breaker.

2.1.2.6 Control Cabinet

- a. The breaker control cabinet shall be outdoor weatherproof corrosion resistant design, fabricated from type 316 stainless steel, including gasketed hinged doors for full opening with provisions for either removal during maintenance or for holding doors in the open position and a handle with three point latch and padlocking provisions for holding doors in closed position.
- b. All breaker controls, terminal blocks, etc., shall be consolidated in the control cabinet, including current transformer secondaries.
- c. 208/120 Vac, single phase, 3 wire, 60 Hertz power is available for breaker control power. The manufacturer shall furnish appropriate terminals in the control cabinet for terminating the single phase service and circuit breakers or fused switches for the heater circuit, lighting and receptacle circuit and air compressor circuit, if an air compressor is used.
- d. The control cabinet shall be furnished with suitable strip heaters, with thermostat, and humidstat control to prevent condensation. Thermostat shall be industrial type, high limit to maintain cabinet within the range of 60 to 90 degrees Fahrenheit. Humidstat shall have a range of 30% to 60% relative humidity.
- e. The control cabinet shall have internal, incandescent lighting controlled from a door switch, and a 120 VAC, 15A, single phase, GFI receptacle. The receptacle shall be mounted inside the cabinet.
- f. The control cabinet shall be in an accessible location mounted at a convenient operating height.
- g. All wiring and connections within the control cabinet shall be readily accessible for maintenance.

2.1.3 Bushing Current Transformers

The circuit breaker shall have a quantity of twelve 1200/5 ampere multi-ratio, bushing-type current transformers, two per bushing. Bushing current transformers shall conform to IEEE C57.13. The accuracy shall be C400. All taps from each bushing current transformer shall be brought out,

routed to the control cabinet through rigid conduit, identified, and terminated on marked short-circuiting terminal blocks in the control cabinet. Provide current transformer performance curves for each transformer rating. All CT's shall have a thermal rating factor of 1.5.

2.1.4 Operating Mechanism:

The breaker operating mechanism shall be electrically, mechanically, pneumatically or hydraulically trip-free with anti-pump feature. The energy storage system shall be the Manufacturer's standard design and shall comply with 8.4 of ANSI C37.12. Working parts of the mechanism shall be of corrosion-resisting material. Bearing pins, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker. The mechanism shall be strong, rigid, positive and fast, and shall not have objectionable rebound or require critical adjustment.

2.1.5 Outdoor Apparatus Bushings

Bushings shall be hollow, one-piece porcelain, 550 KV BIL, filled with SF6 gas common to the breaker tanks. Bushings shall be ANSI #70 light gray in color. Terminals shall be 4-hole NEMA pads suitable for customer connections with cable connectors to be furnished by others. Porcelain shall be wet process, homogeneous and free of cavities or other flaws. The glazing shall be uniform in color and free of blisters or other defects.

2.1.6 Other Features and Accessories

2.1.6.1 Structural Features:

Structural features shall conform to 9.1 of ANSI C37.12 and shall be corrosion resistant. Each circuit breaker shall be painted to ANSI #70 light gray color. Breakers shall have all three poles mounted on a common steel frame with legs which bolt directly to the foundation.

2.1.6.2 Special Tools:

- a. All special tools required for installation and maintenance of the circuit breaker shall be furnished by the Manufacturer. Metric size wrenches or sockets are not considered as special.
- b. The breaker shall have provisions for connecting a travel recorder.

2.1.6.3 Pressure Gauges and Pressure Switches:

The breakers shall be equipped with oil filled, dial-type pressure gauge(s) to show SF6 gas pressure and operating gas pressure, if applicable, as well as temperature compensated pressure switches to actuate the following:

- a. Low SF6 gas alarm (125V DC contacts)
- b. Prevent breaker operation at abnormally low SF6 gas pressure (125V DC contacts)
- c. Alarms and controls required by Table 1 of ANSI C37.12.

2.1.6.4 Nameplates

- a. A breaker nameplate mounted inside the control cabinet with the

following data:

- 1) Manufacturer's name and address.
- 2) Breaker type and model number.
- 3) Breaker serial number.
- 4) Rated nominal and maximum voltages.
- 5) Rated voltage K factor.
- 6) Rated continuous current.
- 7) Rated symmetrical interrupting capacity at maximum rated voltage.
- 8) Rated frequency.
- 9) Rated BIL.
- 10) Quantity of insulating medium.
- 11) Operating ranges of control circuit voltages.
- 12) Date of manufacture.

b. Current transformer nameplate, also inside the control cabinet, with the following data:

- 1) CT ratios.
- 2) CT location identification (ANSI bushing number).
- 3) CT connections.
- 4) CT thermal rating factor

2.2 MANUFACTURER TESTING

The manufacturer shall perform the following minimum routine Design Tests required in ANSI C37.09 and Manufacturer Shop Tests, including complete wiring and control circuit test and check of each breaker and verification of all circuits prior to shipment

2.2.1 SHOP DRAWINGS

Six (6) sets of the manufacturer's shop drawings shall be submitted for approval. Record drawing files, incorporating any changes required during the approval process, shall be submitted in a Bently Microstation, AutoCAD or .DXF electronic file format. These sets shall be blue or black line prints or legible copies of catalog sheets. Drawings shall include the following:

- a. Outline drawings, dimensions, Mounting details, and Nameplates with Nameplate Data.
- b. Wiring and Schematic Diagrams. Wiring diagrams shall be of the point-to-point type. Terminal point tabulations are not acceptable.
- c. Details of Manufacturer's Standard Paint Procedures.
- d. Detail drawings, diagrams and instructions for installation, operation and maintenance data of all equipment provided.

2.2.1 OPERATION AND MAINTENANCE DATA MANUALS

Submit four copies of Operation and Maintenance Data Manuals to the Subcontract Administrator for approval. Operation and Maintenance Manuals shall include the following requirements:

1. Installation, start-up, and initial test instructions.

2. Operating instructions, including but not limited to safety precautions and operating limits.
3. Maintenance procedures, routine adjustments, and preventive maintenance schedules.
4. Parts illustrations, including parts lists adequate for the purpose of identifying and ordering replacement parts and designation of the number required per component, and lists of recommended spare parts.
5. Wiring diagrams for electrical equipment.
6. Diagrams for hydraulic and/or pneumatic equipment, if applicable.
7. Detailed descriptions of the functions of each component of each system.
8. Performance and nameplate data.
9. Alignment instructions and actual as-aligned data.
10. Safety precautions.
11. Maintenance instructions, which shall include detailed assembly drawings with parts numbers, parts lists, instructions for ordering spare parts, and complete preventive maintenance instructions required to help ensure satisfactory performance and longevity of the equipment involved.
12. Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade and temperature range of lubricants, and shall recommend frequency of lubrication.
13. Lists of equipment failure/lock-out settings and alarm settings, if applicable.

2.3 EQUIPMENT FINISH

2.3.1 Equipment Finish (Protective Coatings)

Adequate consideration shall be given to the intended location of equipment and materials and to continuous exposure to the KSC corrosive environment. The equipment finish shall meet the requirement of ANSI C57.12.28 and ANSI C57.12.29. There will not exist any holidays, sags, pinholes, blistering, solvent popping or rust as part of the finish. The finish will be smooth and even, resistant to corrosion, sunlight and abrasion resistant with a high impact strength.

2.3.2 Surface Preparation

Steel parts shall be free of weld slag and mill scale. The breaker shall be chemically cleaned, rinsed, phosphate coated, rinsed, and deionized in preparation for the powder coat.

2.3.3 Powder Coating

The breaker shall be coated with a corrosion resistant thermosetting polyester coating applied by electrostatic powder spray. The applied

coating shall be uniform and pinhole free with a minimum of 2.5 mils.

2.3.4 Final Coating

Following the application and cure of the powder coat and the manufacturing assembly of the unit, the breaker shall be coated with a silicone enamel as a final coating. This coating shall be free from surface defects with a 1.5 mil minimum dry film thickness. The color of the final coating shall be No. 70 light gray in accordance with FED-STD-595

In addition, after the final coating, on the bottom 3-inches of the breaker, a rubberized or coal tar protective coating at least 1/32-inch thick shall be applied on top of the final coating.

PART 3 EXECUTION

3.1 SHIPPING

Breakers shall be shipped fully assembled, except for the extension legs and air tank, when applicable. The breakers shall have at least 5 psig SF6 gas during shipment. Breakers shall not require evacuation at site during commissioning of the breaker. Manufacturer shall supply a sufficient quantity of SF6 gas for filling each tank, bushing and other gas-filled devices to proper pressure for operation. Provide one additional spare cylinder of SF6 gas with appropriate regulator and other tools required for maintaining the breakers with SF6 gas after the breaker has been placed in service. SF6 gas shall conform to requirements of ASTM D-2472. All auxiliary components shipped separately shall be clearly identified and a detailed packing list shall be provided. Each crate shall be clearly labelled with the manufacturer's control number, project name, purchase order number, and equipment destination/substation name. Touch up paint shall be furnished with each breaker.

3.2 IMPACT RECORDER

Shipments shall include a two axis impact recorder with sufficient tape to show if the breaker is handled roughly during shipment. The tape must record the entire trip or, if not, the breakers may not be accepted at their destination. The recording of impact measuring device will be removed by the Contracting Officer at the project site. The manufacturer shall notify the Contracting Officer should he desire to participate in the removal.

3.3 UNLOADING

The Contractor shall unload the breakers and prepare them for service. The seller shall provide complete detailed instructions for checking for damage, unloading and placing the equipment on their foundations and assembling all parts removed for shipment.

3.4 INSTALLATION

Bolt the equipment to the foundation(s). Connect primary jumpers, current and control wiring as indicated or required for a complete and operable installation.

3.5 FIELD SERVICES

Provide field service engineering representatives, competent and

experienced in commissioning the breakers to check the equipment for proper alignment, installation and operation prior to and during initial energization and field testing. The field service engineering representative shall supervise any final alignments or adjustments deemed necessary during the commissioning of the equipment.

3.6 FIELD TESTS

Field tests shall be performed by the Contractor upon the breaker after installation for the purpose of verifying the overall performance of the equipment against applicable specifications and system requirements. Manufacturer shall provide a factory service representative to witness the tests and testing procedures.

Contractor shall notify Contracting Officer not less than 10 days prior to performing acceptance testing so that Contracting Officer may be present to witness tests, if desired. Contractor shall provide a factory service representative to witness the tests and testing procedures.

- a. Final acceptance tests shall be in accordance with NETA ATS (2009), section 7.6.4 for SF6 circuit breakers, including optional tests.
- End of Section --

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DIVISION 16 - ELECTRICAL

SECTION 16960

APPARATUS COORDINATION, INSPECTION AND TESTING

11/04

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SECTION 16960

APPARATUS COORDINATION, INSPECTION AND TESTING
11/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2009) Standard for Acceptance Testing
Specifications for Electrical Power
Equipment and Systems

1.2 INTENT

The intent of this Section is to insure that all electrical workmanship and equipment, whether Government -furnished or Contractor-furnished, is installed and performs in accordance with the design specifications, drawings, manufacturer's instructions and all applicable codes and requirements. It is also intended to provide, insure, or determine the following:

- a. If the equipment has been subjected to damage during shipment or installation;
- b. If the equipment being provided by the Contractor is in accordance with specifications;
- c. Provide initial acceptance tests and recorded data that can be used as a bench mark for future routine maintenance and trouble shooting by Government operating forces.
- d. Determine whether the equipment and systems are suitable for energization and placing into normal operating service.
- e. Provide assurance that each system component is not only installed satisfactorily, but that it performs and will continue to perform its function in the system with reasonable reliability, and that all new and modified portions of the system are coordinated with each other and with existing system.
- f. Provide for the development of necessary equipment and system detail drawings which will become the final system Record drawings. The system drawings shall include all equipment electrical interconnections, equipment AC and DC schematics, and system AC and DC control wiring and associated schematics required to cover all electrical aspects of the electrical installation.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330,

"Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Submit the following documents to the Contracting Officer.

- Specialist's name (company and individuals)
- Specialist's experience similar work
- Florida Registered PE
- Experience with the development of electrical system drawings
- List of projects completed in last 3 years
- Experience with development of electrical system Drawings
- Testing Firm's Florida Registered PE, Experience and Background
- Testing experience record
- Instrument calibration program
- List of test equipment

SD-02 Shop Drawings

Submit the following documents to the Contracting Officer.

System Drawings to include the following:

1. Power system One Line Diagrams
 2. 3-Line AC Schematics of the power system
 3. AC and DC Schematics for all power circuit breakers, transformers and associated controls and protection schemes being installed
 4. Equipment Interconnection Drawings
 5. Control Panel point-to-point Wiring Drawings

SD-06 Test Reports

Submit the following documents to the Contracting Officer.

System Checkout Procedures (The procedures must provide specific instructions, in accordance with equipment manufacturer's recommendations, for the checking and testing of each component in addition to the system functional checks).

- Site Visits
- Report of Damage
- Faulty Equipment
- Certified copies of all inspection reports

SD-07 Certificates

Submit the following documents to the Contracting Officer.

- Certified copies of all inspection reports
- Test results
- Specialist's Certification Statement of document review and approval
- NETA ATS Certification certificates for all Technicians
- System Checkout Procedures

SD-11 Closeout Submittals

Record Drawings for all items listed in SD-02

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS FOR ALL APPARATUS COORDINATION, INSPECTION AND TESTING

3.1.1 Definitions

3.1.1.1 Contractor

For the purposes of this Section, the term "Contractor" is defined as the Prime Electrical Contractor responsible, overall, for all aspects related to the completion of construction contract.

3.1.1.2 Specialist

Specialist: An independent firm or individual, whose services have been secured by the Contractor, to prepare required system installation drawings, required for the specific implementation of system modifications and/or new equipment installations.

3.1.1.3 Independent Testing Firm

Independent Testing Firm: An independent firm, or individual, whose services have been secured by the Contractor to provide for apparatus testing, relay and equipment calibration tests, development of "system" functional testing procedures, and for certifying that all electrical systems are suitable for operation as designed.

Note: The Independent Testing Firm and the Specialist may be the same firm as long as the firm meets all of the experience requirements of both.

3.1.2 Contractor General Responsibilities

3.1.2.1 Qualified Independent Specialist and Qualified Testing Company

Throughout the construction project, and particularly during the installation and energization of new electrical systems, the Contractor shall provide the services of a qualified independent Specialist and a qualified Testing company for the purposes of insuring that the completed and documented equipment or systems are suitable for operation. The Contractor shall primarily be responsible for coordinating with the Specialist and/or the Testing firms, as required, in gathering any required field information, for the procurement of all required equipment, and in the development of required system drawings for systems installations.

3.1.2.2 Contractor's Responsibility

The Contractor's engagement of the testing firm to perform inspections and tests of the facilities in no way relieves the Contractor of the responsibility for the performance of the many and varied tests, checkouts, and inspections required during the various stages of construction, nor does it relieve the Contractor of any of his obligations set forth in this

contract.

3.1.3 Specialist

3.1.3.1 Qualifications and Responsibilities

The specialist shall be an individual or a firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the field), which is regularly engaged in, and which maintains a regular force of engineers and technicians skilled in the development of electrical system control drawings, interconnection drawings, AC and DC schematics, and control panel point-to-point wiring diagrams. The Specialist shall not be a subsidiary Division nor Department of either the installing Contractor or the manufacturer of the equipment, materials or systems being inspected and tested.

The following information shall be submitted to the Contracting Officer:

- Specialist's name (company and individuals)
- Specialist's experience similar work
- Florida Registered PE
- Experience with the development of electrical system drawings
- List of projects completed in last 3 years
- Experience with development of electrical system Drawings
- Specialist's Certification Statement of document review and approval

The Specialist shall employ at least one Florida Registered PE, with a minimum of 10 years experience in the area of protective relaying and electrical power system protection and control system design.

The Specialist shall be available throughout the contract period and shall not be changed throughout the work unless approved by the Contracting Officer.

The Specialist shall be responsible for working with the Contractor in obtaining all required apparatus drawings, from approved shop drawings, and field information required for preparation of all of the various types of drawings listed below. Each drawing type shall be provided on one or more individual sheets as required to describe the electrical system. Drawing types shall not be combined. Completed System drawings shall be submitted to the Contracting Officer for approval prior to any equipment installation.

Required system drawing types are as follows:

1. Power system One Line Diagrams
2. 3-Line AC Schematics of the power system
3. AC and DC Schematics for all power circuit breakers, transformers and associated controls and protection schemes being installed
4. Equipment Interconnection Drawings
5. Control Panel point-to-point Wiring Drawings

Upon final approval of the System drawings for construction from the Government, the Specialist and the Contractor shall work together to install the electrical systems accordingly.

The Specialist shall be responsible for updating the system drawings to reflect any approved field changes that are made during construction. A complete set of Record Drawings shall be submitted at the completion of the

project.

3.1.4 Testing Firm Requirements

The testing firm shall not be a subsidiary Division or Department of either the installing Contractor or the manufacturer of the equipment, materials or systems being inspected and tested. The Testing Firm and the Specialist Firm may be the same company. The above does not preclude the Contractor from engaging the services of manufacturer's field engineers for checking, commissioning, etc., of equipment of specialized nature. The testing firm proposed for use by the Contractor must be approved by the Contracting Officer within a forty-five day period after contract award.

The following information shall be submitted to the Contracting Officer :

- Testing Firm's Florida Registered PE, Experience and Background
- Testing experience record
- Instrument calibration program
- Copies of the NETA ATS Certification certificates for all Technicians to be used on the project.
- Test Results of all system tests

3.1.4.1 Testing Firm Compliance

The testing firm shall comply with the following:

1. The testing firm shall have at least one full time Professional Electrical Engineer, registered in the State of Florida. Additional staffing must include two or more technicians with a minimum of 4000 hours experience in electrical testing.
2. The testing firm shall have an instrument calibration program which maintains all applicable test instrumentation within rated accuracy. The test equipment shall have accuracy traceable to the National Bureau of Standards. The frequency of the calibration program shall not exceed six months.
3. The testing firm shall provide a list of test equipment that is planned to be used on the project, including manufacturer, model, serial number and year.

The Testing firm shall be responsible for coordinating with the Contractor and the Specialist for the review of the system drawings and in the joint development of the required equipment checkout procedures prior to equipment energization.

System Checkout Procedures shall be developed for each major phase of construction completion prior to the energization of any new equipment or busses where new work has been performed.

3.2 COORDINATION REQUIREMENTS

3.2.1 General

The Contractor shall provide complete, coordinated and operational packages of electrical equipment to the Government for approval. Recognizing that different manufacturers require differing installation requirements, relaying, and auxiliary accessories in order to provide an operating system, the Contractor shall provide the services of the Specialist to

coordinate the interfaces required between and among the various items of equipment, such that a complete, coordinated, and operational system is provided. Any additional items required to provide a complete, coordinated, and operational system shall be provided by the Contractor at no additional cost to the Government.

3.2.2 Preparation of Procedures and Schedules

The Contractor, Testing Firm and Specialist shall work together to prepare proposed system checkout procedures and schedules for all inspections, tests, settings and calibrations specified or otherwise required. This work shall be coordinated, and shall be compatible with both the work of other crafts, other related projects, electric system outage constraints and the project schedule. Proposed testing and checkout procedures shall be organized and submitted with all proposed testing and checkout forms for the review and approval of the Contracting Officer. The procedures must provide specific instructions, in accordance with the equipment manufacturer's recommendations, for the checking and testing of each system component, and in addition, provide complete system functional checks. Tests and inspections shall also be scheduled as the job progresses and may require repetition in greater detail at a later stage of construction. Prior approval of the Contracting Officer is required before any tests are conducted.

Functional testing of each electrical system component and associated protection schemes shall be provided and documented by the Contractor, in coordination with the Specialist and the System Testing Company. The following is a list of the specific component and/or System Functional Tests that shall be provided by the Contractor, as a minimum:

Power Circuit Breakers:

Test trip and close each circuit breaker via each breaker control switch and protective relay or auxiliary relay wired in the Trip and Close circuits. Verify correct operation of the device and all interconnecting contacts, i.e. 52a, 52b, device alarm contacts, remote status indication, etc. that are being used.

Verify correct red/green panel status lights and indication

Power Disconnect Switches:

Check for proper alignment and clearances in the open and closed positions. Operate each switch throughout its full operational range as designed to verify complete compliance with the manufacturer's instructions.

Control Panels:

Check for proper installation, operation and indication of all devices mounted in or on the panel.

Where panel doors are being replaced, check for proper fit, alignment and final device labeling as required.

Bus Differential Protection Schemes:

Check for proper relay operation by current or voltage injection into the relay terminals to simulate internal and external bus faults. Verify proper operation of each of the relay's output contacts for the fault simulated. Verify proper local and remote indication of the relay. Verify that the relay operates in accordance with the protection settings provided by the Government.

Verify that each power circuit breaker associated with the bus differential protection scheme being tested is tripped and that its closing circuit is properly blocked for the simulated fault condition.

Verify that all associated 86B Bus Lockout relays, new or existing, operate as per the system design requirements. Verify that each lockout relay contact performs the desired Trip and Block Close operations per the system design requirements.

With the system energized and load currents flowing through associated breaker CTs, test and verify proper CT ratio connections and polarity as wired to Bus Differential scheme involved. Verify currents/voltages into the relay are in accordance with the manufacturer's recommendations under normal operation (Non-fault) conditions.

Transformer Differential Protection Schemes:

Check for proper relay operation by current injection into the relay terminals to simulate internal and external transformer faults. Verify proper operation of all of the relay's input and output contacts for the fault simulated. Verify proper local and remote indications of the relay. Verify that the relay operates in accordance with the protection settings provided by the Government.

Verify that the associated 86T Transformer Lockout relay, new or existing, operates as per the system design requirements. Verify that the lockout relay contact performs the desired Trip and Block Close operations of the primary and secondary breakers as per the system design requirements. Verify that the primary and secondary power circuit breakers, associated with the transformer differential protection scheme being tested, are tripped and that each closing circuit is properly blocked for the simulated fault condition.

Verify correct CT ratio and polarity connections to the transformer differential relay per design requirements.

With the transformer energized, and load currents flowing through the connected breaker CTs, test and verify proper and expected phase angles and magnitudes of currents into and out of the differential relay. Verify currents/voltages into the relay are in accordance with the manufacturer's recommendations under normal operation (non-fault) conditions.

Breaker Failure Protection Schemes:

Check for proper 115kV breaker failure scheme operation by simulation of a "stuck" breaker condition under Bus fault and Transformer Fault conditions locally generated and those initiated from FPL breaker failure initiation inputs. Simulation shall include current injection into the breaker failure relay associated with each 115kV power circuit breaker. The simulation shall be carried out for each of the breaker failure relay's breaker failure initiation contacts. Verify that the operation of the relay's breaker failure timing function and trip output contact closure is in accordance with the relay settings provided by the Government. Verify that the 86BF Lockout Operation and associated power circuit breaker tripping and blocking functions, are in accordance with the design requirements.

Overcurrent Relay Protection Schemes:

All overcurrent relays shall be tested by injecting proper currents and voltages into the relay terminals to verify that the relays operate in accordance with the settings supplied by the Government. Relays shall be tested with both the "Normal" and "Maintenance" settings enabled. Verify the proper operation of all relay inputs, outputs and alarm functions, both local and remote indications.

System Communications Processors:

Detailed requirements for programming the communications processors being installed on this project are covered in Section 16310. Verification of the desired local and remote operation of these devices shall be determined as various relay components are commissioned to service as generally described

above.

The above functional tests are the minimum that shall be required. The omission of any tests otherwise determined to be required, in order to verify complete operation of the system design, shall not relieve the Contractor from providing the additional testing.

3.2.3 Scheduling Tests

Tests shall be scheduled so that the time period between the test completion and equipment energization will be held to a minimum. In switchgear compartments where tests have been completed, adequate heating shall be provided to keep all components dry until circuit energization.

3.2.4 Contractor Support of the Testing Firm

The Contractor shall assist the independent testing firm in performing its work. The Contractor shall obtain required settings of all protective devices, drawings, wiring diagrams and any other information required by the testing firm to do their work.

3.2.5 Interface Design and Record Drawings

As described in paragraph above entitled "Specialist Qualifications and Responsibilities", the Specialist shall complete all apparatus engineering interface design work and review the various manufacturer's shop drawings to verify that all necessary auxiliary items required for the performance of the functions specified are provided. The Specialist shall ensure that proper coordination among the shop drawings from the various manufacturers is accomplished. During development of the system drawings, the Specialist shall provide submittal drawing packages to the Contractor for submittal to the Government for approval. The Contractor's submittals shall include the Specialist's certification statement of document review and approval. Interface design drawings shall be submitted as a complete set of drawings, for each portion of the work, prior to construction. The interface design drawings shall incorporate all of the types of drawings as listed under the Specialist Qualifications and Responsibilities portion of this Section. Drawings shall incorporate all equipment shop drawings after they have been approved.

Record drawings shall be prepared based on manufacturer's shop drawings for the actual equipment being provided, the system drawings prepared by the Specialist, including existing system drawings and field verified control wiring. These drawings shall also incorporate any approved field changes made subsequent to the Government's previous approval. Final record drawings shall be furnished in Bentley MicroStation, AutoCAD, or .DXF electronic file format and in accordance with the requirements of Section 01780, "Project Record Documents".

3.3 SITE VISITS

Contractor shall engage the Specialist to make periodic site inspections (not less than ten separate visits and no less than one week apart) to verify that the equipment is being installed in accordance with the system drawings. The Specialist, and the Testing firm representative as required, shall be present prior, during and after major portions of the power system are commissioned for temporary or permanent service. Certified copies of all inspection reports shall be submitted to the Contracting Officer no less than ten days after each inspection. The report shall contain the

date of inspection, the equipment inspected, deficiencies noted, and recommended corrective action. As a minimum, the Specialist shall perform checks and tests as indicated in Section 16310, "115 KV Substation." The Electrical Design Engineer may be present during the periodic site inspections and final testing. Notify the Contracting Officer in writing at least ten working days prior to date of Specialist site inspections and checkout.

3.4 FIELD TESTS AND INSPECTIONS

3.4.1 General

The Contractor shall provide all labor, equipment, and incidentals required for testing, except that the Government will provide electric power as required. All acceptance checks, settings, and tests shall be performed in accordance with the manufacturer's recommendations, in accordance with the latest IEEE recognized standards and under the supervision of the Testing Firm representative and the Specialist. All work shall be performed in a careful and safe manner so as not to endanger personnel or equipment. Testing shall be performed in such a way as to obtain information about the performance of the breakers, relays, meters, wiring, and instrument transformers together and as a unit, as well as separately. The Testing Firm shall review and approve the results of all tests and recommend corrective action when test results are not acceptable.

3.4.2 Inspection of Purchased Equipment

Equipment purchased by the Contractor or furnished by the Government for Contractor installation shall be inspected and tested to determine its condition. See other applicable sections of the specifications and contract documents for required Contractor checks and responsibilities.

3.4.3 Report of Damage

At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty or requiring repairs shall be reported to the Contracting Officer.

3.4.4 Identification of Equipment and Wiring and Miscellaneous Checks

Prior to checkout and testing, the Contractor shall insure that all equipment and wiring is properly and permanently identified with nameplates and other identification. The Contractor shall also check and tighten all terminals and connection points, repair all damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions for delivery to the Contracting Officer. The Contractor shall also make routine checks and tests as the job progresses and as necessary to insure that all wiring and equipment is properly installed and wired.

3.4.5 Faulty Equipment

Any system component or workmanship which is found defective on the basis of acceptance tests, whether the test is witnessed by the Government Inspector or not, shall be reported in writing on the day of the occurrence. Using an appropriate form, the testing firm shall report the nature of the problem and recommend corrective action if applicable. Original and duplicate shall be submitted to the Contractor and Government

representative. The testing firm shall retain a copy. All copies shall be signed by persons witnessing the test. Corrective action shall be performed by the Contractor, at no additional cost to the Government. Contractor shall also bear the costs of additional tests until satisfactory results are obtained.

3.4.6 Remote Control/Indication Interface Wiring

Prior to closeout of the contract, the Contractor shall demonstrate that all of the KCCS interface status points are operating correctly from their origination points to the respective Communication Processor racks located in the C5, C5A and Orsino control buildings.

-- End of Section --