

PCN 97967	DOCUMENT RELEASE AUTHORIZATION KENNEDY SPACE CENTER, NASA	PAGE 1 OF 3
ESR		REV/DATE
DIR	DRA NO. A-01FS142- 1060	SIGNATURE
EFF	TITLE Design to Replace Chilled Water Controls, Industrial Area	VEN CODE
EQ. LOC. KSC - SEE REMARKS		CONTRACT NNK10CA44D
SDL 81K04971		

DOCUMENTS

#	PREF	DOCUMENT NUMBER	ISSUE	SIZE	SHTS	B/L NO.	SS	MODEL NUMBER	WUC
1	DR	79K38825 1-94	NEW	F	94	353.85	S1	K61-3098	S1FACAB000
						356.50	S1	K61-3784	S1FHV00000
						360.05	S1	K61-4414-15D7	S1FUCSEN000
						353.04	OC	K61-0553-01	OCFACCL000
						356.50	OC	K61-3784	OCFHV00000
						360.05	OC	K61-4414-3019	OCFUCU0000
						353.05	LO	K61-0506-01	LOFAC90000
						356.50	LO	K61-3784	LOFHV00000
						360.05	LO	K61-4414-1502	LOFUC15020
						353.05	FQ	K61-0556	FQFAC6L000
						356.50	FQ	K61-3784	FQFHV00000
						353.05	IC	K61-0504-01	ICFAC1L000
						356.50	IC	K61-3784	ICFHV00000
						360.05	IC	K61-4414-1508	ICFUC15080
						353.05	SB	K61-0560-01	SBFACXL000
						356.50	SB	K61-3784	SBFHV00000
						353.05	DI	K61-0518-01	DIFAC9L000
						356.50	DI	K61-3784	DIFHV00000
						353.05	AU	K61-0552-01	AUFAC9L000
						356.50	AU	K61-3784	AUFHV00000
						353.05	K8	K61-3427	K8FAC6L000
						500.05	K8	K61-3418	K8FHVDC000
						360.05	K8	K61-4414-1600	K8FUC16000

TECHNICAL REMARKS

INITIAL RELEASE TO EDC

EQ. LOC. M7-0360 (SSPF), M7-0355 (O&C), M6-0399 (HQ), M7-0409A (EDL), M6-0342 (CIF), M7-0505 (PS), M6-0495 (OHF), M7-0351 (TA), M7-0407 (IACP).

This design removes the legacy SX-8000 Andover Control System and replaces it with a PLC, Citect SCADA based control system.

APPROVALS

TECHNICAL CONTACT L. Kiel, 867-3780 <i>L. Kiel</i>	MAIL CODE TA-B3B	DATE 9/16/11	R&QA C. Miller <i>C. Miller</i>	MAIL CODE SA-E3	DATE 9/20/11
TECHNICAL P. Bennardo <i>P. Bennardo</i>	MAIL CODE TA-B3B	DATE 9/16/11	OTHER		
SPACE AND WEIGHT N/A			JOINT RELEASE		
PROCUREMENT PKG.			RELEASE <i>L. Kiel</i>	MAIL CODE TA-B3B	DATE 9/16/11

9-20-2011

PCN: 97967

EQ. LOC.

KSC - SEE REMARKS

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

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DRA NO.

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DOCUMENTS

I#	PREF	DOCUMENT NUMBER	ISSUE	SIZE	SHTS	B/L NO.	SS	MODEL NUMBER	WUC
2	SP	79K38826 1-201	NEW	A	201	"	"	"	"
3	SW	79K38825	NEW	M	1	"	"	"	"
4	SW	79K38826	NEW	M	1	"	"	"	"
5	DM	KSC-TA-11326 cover, 1-341	NEW	A	342	"	"	"	"
6	SW	KSC-TA-11326	NEW	M	1	"	"	"	"
7	RD	KSC-TA-11569 cover, 1-18	NEW	A	19	"	"	"	"
8	SW	KSC-TA-11569	NEW	M	1	"	"	"	"

DISTRIBUTION NUMBER	DOCUMENT RELEASE AUTHORIZATION DISTRIBUTION KENNEDY SPACE CENTER, NASA	PAGE 3 OF 3
	DRA NO. A-01FS142- 1060	

QUANTITY	MAIL CODE	NAME	QUANTITY	MAIL CODE	NAME
DRA	TA-B3B	P. Bennardo	2P	JLRD, INC	M. DAVILA
DRA	TA-B3B	J. Davies		1450	
DRA	TA-B3B	S. Hunt		CENTREPARK	
DRA	TA-B3B	A. Lopez-Estrada		BLVD #350	
DRA	ISC-4220	A. Moroni		WEST PALM	
DRA	ISC-4410	F. Gui		BEACH, FL	
1P	TA-B4A	J. Rymkos		33401	
1P	TA-B3B	J. Miller			
1P	ESC-25	J. Eaton	1P	OP-CS	S. Gasaway
1P	ISC-2200	T. Reardon	3P	TA-B3B	L. Kiel
DRA	ISC-4013	A. Elting	1P	ISC-2212	J. Kerr
DRA	ISC-4300	G. Rottler	DRA	ISC-2200	J. Hall
DRA	ISC-2510	V. Allpiste	DRA	SA-E3	C. Miller
1P	TA-B3D	G. Villa	DRA	SA-E3	B. Sorenson
DRA	ISC-4410	P. Nguyen			
1P	TA-B4A	T. Sizemore			
DRA	ISC-2200	B. Orrison			
1P	ISC-4300	P. Kroning			
DRA	TA-B4A	J. King			
DRA	TA-B4A	W. Martin			
DRA	ISC-4011	L. Johnson			
DRA	ISC-2200	B. Brong			
DRA	ISC-2510	M. Cressy			
DRA	TA-B4B	J. Dehler			
DRA	IHA-4100	M. McDonnell			
DRA	ISC-2020	M. Denyer			
DRA	ISC-4320	P. Kroning			
DRA	ISC-4011	T. Strasters			
DRA	ISC-4300	D. Nowicki			
DRA	ISC-4011	S. HINTZ			
DRA	IT-B	H. Yu			
DRA	ISC-1500	F. Arismendi			
DRA	ISC-1500	M. Ellet			
DRA	ISC-1500	N. Shelby			
DRA	SA-E3-MSRS	J. LeBlanc			
DRA	ISC-4220	J. Bowen			
DRA	IMCS-147	S. Murphy			

REPRODUCTION AND DISTRIBUTION INSTRUCTIONS

P = 1/2 SIZE DRAWINGS (REDUCE "F" SIZE TO "C" SIZE) + SPECIFICATIONS + REQUIREMENTS DOCUMENT
 F= FULL SIZE DRAWINGS + SPECIFICATIONS + REQUIREMENTS DOCUMENT
 DRA = DRA NOTICE ONLY
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APPLICATION		PART NO.	MF	REVISIONS			
NEXT ASSY	USED ON			SYM	DESCRIPTION	DATE	APPROVAL

TECHNICAL SPECIFICATIONS FOR DRAWING 79K38825

SENSITIVE BUT UNCLASSIFIED (SBU)

Instructions: This item must be reviewed under the requirements for "Sensitive But Unclassified Information" as described in NPR 1600.1. Material that is export-sensitive is automatically considered to contain SBU and does not require an SBU Reviewer signature. Material that is not export-sensitive must be reviewed for SBU as required per NASA Form 1686.

	Yes	No	SBU Reviewer's Signature	Date
Contains SBU?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<i>Phil Bennardo</i>	9/16/11

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Instructions: Once it is determined the document includes EC data, contact the KSC ECO Help Desk at 867-9209 (or your directorate Export Control Rep) for a determination of the proper export category.

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ECO Reviewer's Name and Organization	ECO Reviewer's Signature	Date
PHIL BENNARDO TA-B3B	<i>Phil Bennardo</i>	9/16/11

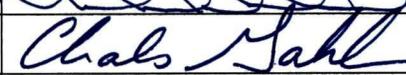
	Determination (Check only one box) and Category	
EAR 99 NLR (No EC)	<input checked="" type="checkbox"/> EAR 99 NLR	The information contained in the document is technical in content, but is not technical data as defined by the ITAR or the EAR, and therefore is EAR 99 NLR (no export license required). [General Prohibition Six (Embargo) applies to all items subject to the EAR, i.e. items on the CCL and within EAR 99 NLR. You may not make an export or re-export contrary to the provisions of part 746 (Embargos and Other Special Controls) of the EAR and 22 CFR part 126.1 of the ITAR.]
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THIS DRAWING CREATED ON THE CAD/CAE INTERACTIVE GRAPHICS SYSTEM MUST BE REVISED ONLY ON THAT SYSTEM. FILE:

UNLESS OTHERWISE SPECIFIED - DIMENSIONS ARE IN FEET / INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	ORIGINAL DATE OF DRAWING September 9, 2011	Replace Chilled Water Controls, Industrial Area TECHNICAL SPECIFICATION JLRD # 110055	JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER, FLORIDA	
MATERIAL	DRAFTSMAN TRACER			CHECKER CHECKER
HEAT TREATMENT	ENGINEER MICHAEL D. DAVILA, P.E.			ENGINEER CHARLES C. GABLEMAN, P.E.
FINAL PROTECTIVE FINISH	SUBMITTED <i>Harry Kal</i> 9/16/11	SCALE PCN 97967	DWG SIZE A	
	APPROVED <i>Phil Bennardo</i> 9/16/11		SHEET 1 OF 201	

**Architect/Engineer of Record
Certification**

Project Title:	Replace Chilled Water Controls, Industrial Area
Project Control Number:	97967
Project Drawing Number:	79K38825
Project Specification Number:	79K38826
Project Calculations/Data Manual Number:	KSC-TA-11326

Discipline	Name	ST	License No.	Signature
Mechanical	Michael D. Davila	FL	36066	 9/9/11
Electrical	Charles C. Gableman	FL	51936	 9.9.11

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 11 00.00 98

SUMMARY OF WORK

10/07

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- 1.2 DESCRIPTION
- 1.3 CONTRACT DRAWINGS/PUBLICATIONS

PART 2 PRODUCTS

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SECTION 01 11 00.00 98

SUMMARY OF WORK
10/07

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the labor, equipment, and materials to replace existing DDC-based Building Automation System (BAS) controls with a supervisory control and data acquisition (SCADA) PLC-based controls primarily associated with chilled water production and distribution for facilities served by and including the Industrial Area Chiller Plant (IACP) at Kennedy Space Center, Florida.

1.2 DESCRIPTION

The work consists of, but is not limited to, selective demolition of existing control system elements including controllers, sensors and wiring, demolition of selected mechanical, electrical and communications systems, cutting, patching and painting, documentation of existing conditions including point-to-point wiring/verification of existing control wiring systems, providing new Programmable Logic Controller (PLC) based control systems, sensors, wiring, network communications, programming, SCADA software and hardware, operators workstations, servers, Human Machine Interface (HMI) panels, replacement of the IACP manual control panel, checkout/verification, commissioning and interface to Legacy Control Systems; and all associated and incidental work as called for in the specifications and drawings.

The work is to be performed on an actively functioning HVAC system, the continued uninterrupted operation of which is paramount to the Governments on-going activities. There will be extremely limited opportunities for system outages during construction. The Contractor shall execute the work to avoid outages and unplanned disruption to services, and to closely work with the Government to plan, staff and execute the work to take advantage of available outages.

1.3 CONTRACT DRAWINGS/PUBLICATIONS

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

Drawing No. 79K38825

Sheets 1 through 94

The publications of the issues of referenced documents in effect on the date of issuance of invitation for bids form a part of this specification and, where referred to herein by basic designation only, are applicable to the extent indicated by the references thereto. In the event of difference between this specification or its accompanying drawings and the referenced document, this specification and its accompanying drawings must govern to the extent of such difference.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 00

SUBMITTAL PROCEDURES

06/10

PART 1 GENERAL

1.1 DEFINITIONS

- 1.1.1 Submittal Descriptions (SD)
- 1.1.2 Approving Authority
- 1.1.3 Work

1.2 SUBMITTALS

1.3 PREPARATION

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1.4 QUANTITY OF SUBMITTALS

- 1.4.1 Number of Copies

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 01 33 00

SUBMITTAL PROCEDURES

06/10

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-01 Preconstruction Submittals

Submittals which are required prior to issuance of notice to proceed

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction Progress Schedule

Submittal register

Schedule of prices

Health and safety plan

Work plan

Quality control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

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

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

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

SD-03 Product Data

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

portion of the work. Submittal data shall be clearly marked in red ink to indicate options provided, and non-applicable data shall be crossed out. On each item, provide a box in the upper right hand corner identifying the specification section and the paragraph number under which the item is being submitted.

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.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

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

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

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

SD-09 Manufacturer's Field Reports

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

Factory test reports.

SD-10 Operation and Maintenance Data

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

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

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 Approving Authority

Office or designated person authorized to approve submittal. Approval of components and shop drawings does not take away from or reduce the responsibility of the Contractor to provide a complete, finished, fully functional BAS which complies with the intent of the design documents and the sequences of operation.

1.1.3 Work

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register; G

1.3 PREPARATION

1.3.1 Transmittal Form

Transmit submittals from the approved Submittal Register with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled, "Identifying Submittals," of this section.

1.3.2 Identifying Submittals

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

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

- a. Project title and location.
- b. Construction contract number.
- c. Date of the drawings and revisions.
- d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.
- e. Section number of the specification section by which submittal is required.
- f. Submittal description (SD) number of each component of submittal.
- g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.
- h. Product identification and location in project.

1.3.3 Format for SD-02 Shop Drawings

All drawings shall be prepared in electronic format, AutoCAD Release 2009 or later, and provided in the native file format (.dwg) as well as Adobe .pdf. Workstation and HMI graphics shall be prepared using the application specific graphic development program. Drawings shall be submitted in hard copy with not less than 2 electronic copies submitted on digital video disks (DVD's).

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

Present 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.

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

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

Reserve a blank space, no smaller than 5-1/2 inches wide by 3 inches tall on the right hand side of each sheet for the Government disposition stamp.

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

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

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

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

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

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

Provide product data in English (inch-pound) dimensions.

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

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

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will be accepted for expedition of construction effort. Where the Contractor elects to provide partial submittals, he accepts the risk that subsequent submittals could impact the requirements of a previously approved partial submittal, and will make any necessary revisions at no cost to the Government.

Submit manufacturer's instructions prior to installation.

Clearly mark data to indicate applicable information and cross out information that does not apply.

1.3.5 Format of SD-04 Samples

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

- a. Sample of Equipment or Device: Full size.
- b. Sample of Materials Less Than 2 by 3 inches: Built up to A4 8 1/2 by 11 inches.
- c. Sample of Materials Exceeding A4 8 1/2 by 11 inches: Cut down to A4 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
- d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.
- e. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.
- f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.
- g. Sample Panel: 4 by 4 feet.
- h. Sample Installation: 100 square feet.

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

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

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

project.

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

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

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

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

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

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

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

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

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

1.4 QUANTITY OF SUBMITTALS

1.4.1 Number of Copies

Number of copies shall be as directed by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

05/09

PART 1 GENERAL

1.1 REFERENCES

1.2 ORDERING INFORMATION

PART 2 PRODUCTS

PART 3 EXECUTION

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SECTION 01 42 00

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.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
Ph: 312-670-2400
Fax: 312-670-5403
Publications: 800-644-2400
E-mail: pubs@aisc.org
Internet: <http://www.aisc.org>

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
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Fax: 404-321-5478
E-mail: ashrae@ashrae.org
Internet: <http://www.ashrae.org>

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Fax: 847-768-3434
E-mail: customerservice@asse.org
Internet: <http://www.asse.org>

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550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
E-mail: info@aws.org or customerservice@awspubs.com
Internet: <http://www.aws.org>

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Ph: 800-854-7179 or 800-843-2763
Fax: 212-591-7674
E-mail: infocentral@asme.org
Internet: <http://www.asme.org>

ASTM INTERNATIONAL (ASTM)
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West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: <http://www.astm.org>

BUILDING COMMISSIONING ASSOCIATION (BCA)
1400 SW 5th Ave., Suite 700
Portland, OR 97201
Ph: 877-666-2292
Fax: 503-227-8954
Internet:

COMPRESSED GAS ASSOCIATION (CGA)
4221 Walney Road, 5th Floor
Chantilly, VA 20151-2923
Ph: 703-788-2700
Fax: 703-961-1831
E-mail: cga@cganet.com
Internet: <http://www.cganet.com>

CONSUMER ELECTRONICS ASSOCIATION (CEA)
2500 Wilson Blvd.
Arlington, VA 22201-3834
Ph: 866-858-1555 or 703-907-7600
Fax: 703-907-7675
E-mail: cea@CE.org
Internet: <http://www.CE.org>

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
2500 Wilson Boulevard
Arlington, VA 22201-3834
Ph: 703-907-7500

Fax: 703-907-7501
Internet: <http://www.eia.org>

FLORIDA ADMINISTRATIVE CODE (FAC)
Florida Department of State
RA Gray Building
Mail Station 22
Tallahassee, FL 32399-0250
Ph: 850-245-6270
Fax: 850-245-6282
E-mail: administrationcode@dos.state.fl.us
Internet:

FLORIDA STATUTES (FL-STAT)
Division of Legislative Information Services
Room 704 Claude Pepper Building
111 West Madison Street
Tallahassee, FL 32399-1400
Ph: 850-488-8403
E-mail: stat.rev@leg.state.fl.us
Internet:

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

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
Ph: 770-830-0369
Fax: 770-830-8501
Internet: <http://www.icea.net>

INTERNATIONAL CODE COUNCIL (ICC)
5360 Workman Mill Road
Whittier, CA 90601
Ph: 562-699-0541
Fax: 562-699-9721
E-mail: webmaster@iccsafe.org
Internet: www.iccsafe.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
1, rue de Varembe'
Case Postale 56
CH-1211 Geneve 20 Switzerland
Ph: 41-22-749-0111
Fax: 41-22-733-3430
E-mail: central@iso.ch
Internet: <http://www.iso.ch>

JOHN F. KENNEDY SPACE CENTER (KSC)
Florida 32899
Ph: 321-861-2666 (Option 3)
Internet:

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA 22180-4602
Ph: 703-281-6613
Fax: 703-281-6671
E-mail: info@mss-hq.com
Internet: <http://www.mss-hq.com>

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)
16712 elm Circle
Omaha, NE 68130
Ph: 800-747-6422
Fax: 402-330-9702
E-mail: info@micainsulation.org
Internet: <http://www.micainsulation.org>

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)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000
Fax: 617-770-0700
E-mail: webmaster@nfpa.org
Internet: <http://www.nfpa.org>

PORTLAND ENERGY CONSERVATION, INC. (PEC)
1400 SW 5th Ave., Suite 700
Portland, OR 97201
Ph: 503-248-4636
Fax: 503-295-0820
E-mail: info@peci.org
Internet:

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
Mail Stop C-13
4676 Columbia Parkway
Cincinnati, OH 45226-1998
Ph: 800-356-4674
Fax: 513-533-8573
E-mail: pubstaff@cdc.gov
Internet: <http://www.cdc.gov/niosh/homepage.html>

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
2500 Wilson Blvd, . Suite 300
Arlington, VA 22201
Ph: 703-907-7700
Fax: 703-907-7727
Internet: <http://www.tiaonline.org>

UNDERWRITERS LABORATORIES (UL)
333 Pfingsten Road

Northbrook, IL 60062-2096
Ph: 847-272-8800
Fax: 847-272-8129
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Internet: <http://www.huduser.org>

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E-mail: contactcenter@gpo.gov
Internet: <http://www.gpoaccess.gov>

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration
1800 F Street, NW

Washington, DC 20405
Ph: 202-501-1021
Internet: www.GSA.gov

Obtain documents from:
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Ph: 215-697-6396 - for account/password issues
Internet: <http://assist.daps.dla.mil/online/start/>; account
registration required

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
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Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: <http://www.gpoaccess.gov>

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

-- End of Section --

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QUALITY CONTROL

02/10

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-- End of Section Table of Contents --

SECTION 01 45 00.00 40

QUALITY CONTROL
02/10

PART 1 GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Submit the following items in accordance with paragraph entitled, "Records," of this section.

Quality Control Data

Quality Control Coordinating Actions

Quality Control Training

Inspection Records

Letters of Authority or Delegation

Field Tests

Factory Tests

Inspection System Narrative; G

SD-07 Certificates

Submit a detailed written statement describing procedures that will be implemented to achieve quality on the project according to the paragraph entitled, "Quality Assurance (QA) Plan," of this section.

Submit the following in accordance with paragraph entitled, "Qualifications," of this section.

Contractor's Quality Representative Qualifications

Special Certifications

1.2.1 Quality Assurance (QA) Plan

Address the following within the QA Plan:

Description of the authority, responsibilities and coordinating

procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.

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

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

Contractor's organization that handles construction contract activities.

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

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

Description of on-site personnel training.

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

Nondestructive testing requirements.

Identification of independent certifying and testing laboratories.

1.2.2 Records

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

Furnish legible copies of the test and inspection records to the Contracting Officer. Cover work placement traceable to the contract schedule, specifications and drawings, and must be verified by the Contractor.

Submit for approval, the inspection system narrative which provides for compliance with the quality requirements and technical criteria of the contract within 14 calendar days after notice to proceed.

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

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

In-process inspection records and control away from the job site may be

used as evidence of quality of materials/work and may reduce further inspection or testing after delivery to the job site.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the specifications, obtain necessary approvals or special certifications prior to starting the work.

1.3.2 Quality Control Requirements

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

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

1.3.2.1 Management and Organization

Designate an individual within the on-site organization whose sole responsibility is the day-to-day on-site management and direction of the Quality Program. The Contractor's Quality Representative Qualifications shall be submitted.

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

1.3.2.2 Identification and Data Retrieval

Provide an identification and data retrieval system.

Records, drawings, submittals, and equipment must be identified by referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System.

1.3.2.3 Procurement

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

1.3.2.4 Receiving Inspection System

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

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

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

1.3.2.5 Nonconforming Articles and Material Control

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

- a. Prepare a "nonconformance" report for each instance comprising:
 - (1) A unique and traceable number.
 - (2) Identification of the nonconforming article or material.
 - (3) A description of the nonconformance and the applicable requirement.
 - (4) Cause or reason for the nonconformance.
 - (5) Remedial actions taken or recommended.
 - (6) Disposition of the nonconforming article or material.
- b. Identify and mark each nonconforming article for removal from the work area.
- c. Monitor and correct deficient operations.

1.3.2.6 Fabrication, Process, and Work Control

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

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

Special processes may include, but are not limited to, plating, anodizing, nondestructive testing, welding, and soldering.

1.3.2.7 Quality Control Records

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

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

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

1.3.2.8 Drawings, Programs and Graphics Change Control

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

Clearly annotate and identify drawing, programs and graphics changes and associated drawings, programs and graphics for implementation that are to

be revised accordingly. Use for drawings, programs and graphics that have been approved, or approved as noted, by the Contracting Officer.

1.3.3 Quality Inspections

1.3.3.1 Government Inspections

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

When the Contracting Officer determines that inspected work needs to be corrected, the Contracting Officer will be allowed 48 hours to complete reinspection of the corrected work.

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

Contractor's program is subject to continuous evaluation, review, and verification by the Contracting Officer. Contractor will be notified in writing of any noncompliance and will be given 14 calendar days to correct identified deficiencies.

1.3.3.2 Contractor's Quality Inspections

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

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

- a. Single Contractor's representative responsible for on-site communication and operation of the inspection program.
- b. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.
- c. Receiving inspection system documenting inspections for each procurement.
- d. Documentation for handling and disposing of nonconforming components and materials.
- e. Inspection records for each specific section of the specification and drawings.
- f. Identification of test(s) to be performed, test procedures, records, and independent organizations used.
- g. Documenting and maintaining certification or re-certification of procedures.
- h. Management of government-furnished equipment, components, and materials.
- i. Calibration of gages, tools, measuring instruments, control sensors and independent laboratories used.

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

1.3.4 Field Services

1.3.4.1 Responsibility for Inspection, Calibration and Testing

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

1.3.4.2 Inspection and Test Records

Provide on-site records of each inspection and test performed throughout the life of the contract including, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Inspection records, test procedures, test results, and associated forms be verified by and provided to the Contracting Officer. Final test data must have a cover letter/sheet clearly marked with the system name, date, and the words "Final Test Data".

1.4 HANDLING AND STORAGE

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

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

1.5 SEQUENCING AND SCHEDULING

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

Provide 48 hour notice to the Government of the date when the contract work will begin at the site.

When Contractor suspends work for 7 calendar days or longer prior to completion notify the Contracting Officer. Do not resume work without notification of the Contracting Officer.

Notify the Contracting Officer at least 48 hours in advance of backfilling or encasing any underground utility.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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05/10

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PART 2 PRODUCTS

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SECTION 01 78 00

CLOSEOUT SUBMITTALS

05/10

PART 1 GENERAL
1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials; G
As-Built PLC and SCADA Programming; G
Copies and licenses for all software; G
Warranty Management Plan
Warranty Tags
Spare Parts Data

SD-08 Manufacturer's Instructions

Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Record Drawings; G

1.2 PROJECT RECORD DOCUMENTS

1.2.1 Record Drawings

Drawings showing final as-built conditions of the project. This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions. The final CADD record drawings must consist of two sets of electronic CADD drawing files on a CD Rom in the specified .dwg format and black-line prints.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file record drawings.

1.2.1.2 Working Record and Final Record Drawings

Revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Keep these working

as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Prepare final record (as-built) drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final record (as-built) drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final record drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. Show on the working and final record drawings, but not limited to, the following information:

- a. The location and dimensions of any changes within the building structure.
- b. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, existing wire terminations, control point assignments, control output action (modulating versus two-position), color-coding, sensor locations, panel locations.
- c. Changes or modifications which result from the final inspection.
- d. Where contract drawings or specifications present options, show only the option selected for construction on the final as-built prints.
- e. Systems designed by the Contractor, such as HVAC controls.
- f. Modifications (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.
 - (1) Follow directions in the modification for posting descriptive changes.
 - (2) Place a Modification Delta at the location of each deletion.
 - (3) For new details or sections which are added to a drawing, place a Modification Delta by the detail or section title.
 - (4) For minor changes, place a Modification Delta by the area changed on the drawing (each location).
 - (5) For major changes to a drawing, place a Modification Delta by the title of the affected plan, section, or detail at each location.
 - (6) For changes to schedules or drawings, place a Modification Delta either by the schedule heading or by the change in the schedule.

- (7) The Modification Delta size shall be 1/2 inch diameter unless the area where the delta is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and must be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only employ personnel proficient in the preparation of CADD drawings to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings must be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols must be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, prepare them using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final record drawings must be identical to that used on the contract drawings. Accomplish additions and corrections to the contract drawings using CADD files. The Contractor will be furnished "as-designed" drawings in AutoCAD Release 2009 or later format compatible with a Windows XP or Windows 7 operating system. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). Provide all program files and hardware necessary to prepare final record drawings. The Contracting Officer will review final record drawings for accuracy and return them to the Contractor for required corrections, changes, additions, and deletions.

- a. Provide CADD "base" colors of red, green, and blue. Color code for changes as follows:
 - (1) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.
 - (2) Additions (Green) - Added items, lettering in notes and leaders.
 - (3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.
- b. Rename the Contract Drawing files in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Use only those renamed files for the Marked-up changes. All changes shall be made on the layer/level as the original item.
- c. When final revisions have been completed, show the wording "RECORD DRAWINGS / AS-BUILT CONDITIONS" followed by the name of the Contractor in letters at least 3/16 inch high on the cover sheet drawing. Mark all other contract drawings either "Record" drawing denoting no revisions on the sheet or "Revised Record" denoting one or more revisions. Date original contract drawings in the revision block.

d. Within 21 days after Government approval of all of the working record drawings for a phase of work, prepare the final CADD record drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 21 days revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 21 days of substantial completion of all phases of work, submit the final record drawing package for the entire project. Submit one set of electronic files on compact disc, read-only memory (CD-ROM), two sets of blue-line prints and one set of the approved working record drawings. They must be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final record drawing files and marked prints as specified will be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final record drawings must be accomplished before final payment is made to the Contractor.

1.2.1.5 Payment

No separate payment will be made for record drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.2.2 As-Built Record of Equipment and Materials

Furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 21 days after final inspection with Government comments. Submit two sets of final record of equipment and materials 15 days after final inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used
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1.2.2.1 As-Built PLC and SCADA Programming

Provide 2 electronic copies of the final as-built programming on compact or digital versatile disk (CD or DVD).

1.2.3 Final Approved Shop Drawings

Furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.3.1 Wiring Diagrams

As-built point-to-point wiring diagrams shall be provided for all control systems installed under this contract. Where new systems tie into existing, the existing wiring configuration shall be documented and fully depicted in the as-built wiring diagrams. As-built drawings shall be prepared in an electronic format; the Government shall be provided with not less than 2 compact disks of the data both in the original native format and in an Adobe .pdf format (minimum of 4 CD's). At a minimum, the drawings shall capture as-built wire terminations, labeling, wire colors, properties of the conductors and similar information.

1.2.3.2 Programming Code and Configuration Settings

As-built electronic copies of programming code and configuration settings for all hardware shall be furnished, a minimum of 2 copies of the data shall be provided on compact disks.

1.2.3.3 SCADA and HMI Graphics

As-built electronic copies of all SCADA and HMI graphics shall be provided in the native format and either an Adobe .pdf or .jpg file.

1.2.3.4 Software

Provide not less than 2 Copies and licenses for all software and configuration tools.

1.2.4 Real Property Equipment

Furnish a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Furnish a draft list at time of transfer. Furnish the final list 30 days after transfer of the completed facility.

1.3 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

- a. 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 WARRANTY MANAGEMENT

1.4.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel,

whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of project acceptance and continue for the full product warranty period. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Include within the warranty management plan, but not limited to, the following:

- a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.
- b. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.
- c. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include controllers, sensors, and control systems, etc.
- d. A list for each warranted equipment, item, feature of construction or system indicating:
 - (1) Name of item.
 - (2) Model and serial numbers.
 - (3) Location where installed.
 - (4) Name and phone numbers of manufacturers or suppliers.
 - (5) Names, addresses and telephone numbers of sources of spare parts.
 - (6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
 - (7) Cross-reference to warranty certificates as applicable.
 - (8) Starting point and duration of warranty period.
 - (9) Summary of maintenance procedures required to continue the warranty in force.
 - (10) Cross-reference to specific pertinent Operation and Maintenance manuals.
 - (11) Organization, names and phone numbers of persons to call for warranty service.
 - (12) Typical response time and repair time expected for various warranted equipment.
- e. Procedure and status of tagging of all equipment covered by extended warranties.
- f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.4.2 Performance Bond

The Contractor's Performance Bond must remain effective throughout the construction period.

- a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.
- b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.
- c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.4.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, be continuously available, and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.4.4 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

- a. Type of product/material_____.
- b. Model number_____.
- c. Serial number_____.
- d. Contract number_____.
- e. Warranty period_____ from_____ to_____.

f. Inspector's signature_____.

g. Construction Contractor_____.

Address_____.

Telephone number_____.

h. Warranty contact_____.

Address_____.

Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.5 MECHANICAL CONTROLS AND COMMISSIONING

All contract requirements of Section 23 09 23.13 20, "PROGRAMMABLE LOGIC CONTROL (PLC) SYSTEMS FOR HVAC" must be fully completed, including all testing, prior to contract completion date. In addition, all contract requirements of Section 01 91 00, "COMMISSIONING" must be fully completed, including testing and inspection, prior to contract completion date. The time required to complete all work and testing is included in the allotted calendar days for completion.

1.6 OPERATION AND MAINTENANCE MANUALS

Submit 6 hard copies and 2 electronic copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.6.1 Configuration

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The exact product used in the construction shall be represented. Data sheets which contain multiple products/items or contain option variations shall be clearly marked with red ink. Bind information in manual format and grouped by technical sections. Test data must 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 must have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

Electronic copies shall be in Adobe .pdf format and on CD/DVD media, with the disc provided with a permanent adhesive paper or plastic label adhered to the disc identifying it as the O&M Manual, contract number and in the case of multiple discs, the volume number. The .pdf files shall be organized in the same fashion as the hard copy with sections bookmarked and a table of contents.

1.6.2 Training and Instruction

Submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Contracting Officer will be given 14 calendar days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, must be made available to the Contracting Officer.

1.7 CLEANUP

Leave premises "broom clean." Remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces. Clean equipment and fixtures to a sanitary condition. Remove waste and surplus materials, rubbish and construction facilities from the site.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
07/06

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

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

The scope of O&M data is for the BAS control system components inclusive of networked communication systems (hardware, software, programming, wiring) installed under this project. Providing O&M information for existing control components and the controlled equipment is not included.

1.1.1 Package Quality

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

1.1.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission.

1.1.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.1.4 Review and Approval

The Contractor shall review the systems and equipment submittals for completeness and applicability. The Contractor shall verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

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

1.2.1.1 Safety Precautions

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

1.2.1.2 Operator Prestart

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

1.2.1.3 Startup, Shutdown, and Post-Shutdown Procedures

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

1.2.1.4 Normal Operations

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

1.2.1.5 Emergency Operations

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

1.2.1.6 Environmental Conditions

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

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system.

1.2.2.1 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly,

monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

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

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

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

1.2.3.2 Wiring Diagrams and Control Diagrams

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

1.2.3.3 Maintenance and Repair Procedures

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

1.2.3.4 Removal and Replacement Instructions

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

1.2.3.5 Spare Parts and Supply Lists

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

1.2.4 Corrective Maintenance Work-Hours

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

1.2.5 Appendices

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

1.2.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections, ensure the data provided matches the installed product exactly in all respects and non-applicable information is crossed out.

1.2.5.2 Manufacturer's Instructions

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

1.2.5.3 O&M Submittal Data

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

1.2.5.4 Parts Identification

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

1.2.5.5 Warranty Information

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

1.2.5.6 Personnel Training Requirements

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

1.2.5.7 Testing Equipment and Special Tool Information

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

1.2.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test

forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.2.5.9 Contractor Information

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

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

Include Data Package 5 and the following for control systems:

- a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.
- b. Full as-built sequence of operations.
- c. Copies of all checkout tests, loop verification and calibrations performed by the Contractor (not Cx tests).
- d. Full points list. A listing of points shall be provided with the following information for each point:
 - (1) Location
 - (2) Point number
 - (3) Point description
 - (4) Reference drawing number
- e. Full print out of all schedules and set points after testing and acceptance of the system.
- f. Full as-built print out of software program.
- g. Electronic copy on CD or DVD of the entire program for this facility.
- h. Marking of all system sensors on the as-built floor plan and mechanical drawings with their control system designations.
- i. As-built point-to-point wiring diagram with wire tags, wire identifier, wire color, terminal block designations and terminal number complete from the new PLC controller out to the controlled device or sensor.
- j. As-built network wiring diagrams to show all devices connected to the BAS communication network and the type of media (fiber optic, coaxial, cable) between devices and the communication protocol

(ethernet, modbus, ect.) being employed.

1.4 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

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

1.4.1 Data Package 5

- a. Safety precautions
- b. Operator prestart
- c. Start-up, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring and control diagrams
- i. Maintenance and repair procedures
- j. Removal and replacement instructions
- k. Spare parts and supply list
- l. Product submittal data
- m. Manufacturer's instructions
- n. O&M submittal data
- o. Parts identification
- p. Testing equipment and special tool information
- q. Warranty information
- r. Testing and performance data
- s. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 91 00

COMMISSIONING
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PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE GUIDELINE 1 (1996) The HVAC Commissioning Process

BUILDING COMMISSIONING ASSOCIATION (BCA)

BCA 1 (Second Edition) The Building Commissioning Handbook

PORTLAND ENERGY CONSERVATION, INC. (PEC)

PEC 1 (V2.05) Model Commissioning Plan and Guide Specification

1.2 SUBMITTALS

Generally, commissioning documentation shall have been submitted to the Government under other specification sections. The following shall be submitted in accordance with Section 01 33 00, "Submittal Procedures", in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

A Start-Up Plan and Schedule, G shall be provided in accordance with paragraph entitled, "Equipment Start-Up".

SD-09 Manufacturer's Field Reports

Completed start-up checklists; G shall be provided for each item of equipment in accordance with paragraph entitled, "Equipment Start-Up".

Installation and Checkout Sheet forms; G shall be submitted in accordance with the paragraph entitled, "SUBMITTALS".

1.3 ABBREVIATIONS

The following are common abbreviations used in the Specifications and the Commissioning Plan:

A/E - Architect and Design Engineers
BAS - Building Automation System
Cx - Commissioning
CxA - Commissioning Agent

Cx Plan - Commissioning Plan document
CC - Controls Contractor (Building Automation System Contractor)
CO - Contracting Officer
EC - Division 26 and 27 Electrical Contractor
FT - Functional Test
GC - General Contractor (prime)
HMI - Human Machine Interface
MC - Division 23 Mechanical Contractor
O&M - Operation and Maintenance
PT - Performance Test
SOO - Sequence of Operation
Subs - Subcontractors (CC, EC, MC, TAB)

1.4 RELATED DOCUMENTS

Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

Specification Section 23 09 23.13 20, "Programmable Logic Control (PLC) Systems for HVAC" contain requirements that apply to this section.

1.5 SCOPE

Cx is a systematic process of ensuring that all building systems perform interactively according to the SOO. This is achieved by documenting the SOO, the graphic display of information at the HMI's, and continuing through construction, acceptance, and the warranty period with actual verification of performance. The Cx process shall encompass and coordinate the separate functions of system documentation, control equipment start-up, control system calibration, performance testing and training.

Cx during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

- a. Verify that control equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and each point has been checked-out and calibrated.
- b. Validate equipment is under control in each mode of operation according to the SOO.
- c. Verify system graphical display of data at the OWS and HMI interfaces.
- d. Verify all system alarms, trending, graphing, printing, and similar functionality as specified in Section 23 09 23.13 20.

The following systems will be commissioned. All general references to equipment in this document refer only to equipment that is to be commissioned.

- a. Mechanical Systems (Division 23):
 - (1) BAS (controlled devices, control loops and systems integration)
- b. Electrical Systems (Division 26):
 - (1) Power Systems

c. Communication Systems (Division 27)

(1) Networked Equipment

The Cx process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning project. Cx is essentially the process of observing and documenting that the control equipment and systems operate and perform as intended.

The Cx testing shall be based upon the following reference standards: BCA 1; ASHRAE GUIDELINE 1, PEC 1.

1.6 COMMISSIONING AGENT

The CxA services will be provided by a Government led team. The Division 1, 23, 26 and 27 Contractors are responsible to execute the Cx process according to this specification section.

The CxA shall be the duly appointed representative of the Contracting Officer.

1.7 ROLES AND RESPONSIBILITIES

1.7.1 Cx Team

The members of the Cx Team consist of the CxA, the CO, the GC or Contractor, the A/E, the MC, the EC, the CC, any other installing subcontractors or suppliers of equipment. The Government's building or plant operator/engineer and users are also members of the CX team.

The Cx responsibilities of the Contractor are provided in this section. The responsibilities of various other parties on the Cx team will be listed in the CX plan that will be written by the CxA when construction is near 30-percent complete for informational purposes only.

1.7.2 All Parties

All parties follow the Cx Plan.

All parties attend the Cx kick-off meeting and additional meetings, as necessary.

1.7.3 General Contractor

1.7.3.1 Construction and Acceptance Phase

- a. Facilitate the coordination of the Cx work by the CxA, and ensure that Cx activities are being scheduled into the master project schedule.
- b. Review the Cx Plan.
- c. Review the test procedures submitted by the CxA.
- d. Provide completed construction checklists to the CxA for installation verification.
- e. Coordinate the resolution of non-compliance deficiencies identified in all phases of Cx with the various Contractors.
- f. Coordinate the training of Government personnel.
- g. In each purchase order or subcontract written, include requirements for Cx tasks and training.

- h. Ensure that all subcontractors execute their Cx responsibilities according to the Contract Documents and schedule.
- i. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to As-Built conditions.

1.7.3.2 Warranty Period

- a. Assist the CxA as necessary in testing and deficiency corrections required by the specifications.

1.7.4 Division 23, 26 and 27 Contractors

Include scope to complete Cx requirements for mechanical and electrical systems in the contract price.

Ensure cooperation and participation of specialty subcontractors.

Ensure participation of major equipment manufacturers in appropriate training and testing activities.

Prepare schedule for mechanical and electrical system Cx related activities. Include time in the project schedule for equipment start-up, FT's, and PT's. Include time for resolution of deficiencies found during Functional and Performance tests. Provide for a period of not less than 60-days between Government issue of FT's and PT's and the start of FT and PT to allow adequate time for subcontractor review and incorporation of subcontractor comments in final FT's and PT's.

Executing the Functional and Performance tests while the CxA witnesses and documents.

1.7.5 Controls Contractor

Performs calibration of control sensors and devices and Performance Verification Testing as required under Section 23 09 23.13 20 prior to the start of commissioning FT's and PT's.

Include scope for Cx requirements in the contract pricing. The CC will execute most of the Division 23 Functional and Performance testing. Provide up-to-date sequences, alarms and trend data that has been developed to the CxA for development of FT's and PT's.

Review the FT's and PT's developed by the CxA to ensure that control system points are in place to execute the tests. Recommend test revisions to streamline or improve the test procedures.

Demonstrate building automation system performance to CxA during the Functional and Performance tests including all modes of system operation and explanation/definition of variable names for each piece of equipment and each system.

Establish trend logs and graphs as directed by the CxA both prior to, and during testing to demonstrate the system is operating per the sequences of operation and PID loops are stable and operate without hysteresis.

Provide controls system technician and programmer, intimately familiar with the system, for use during execution of the Functional and Performance testing.

1.7.6 Tasks

The following responsibility matrix outlines the major tasks of the Cx process and the parties responsible to carry out the tasks. In general, the CxA writes the tests and documents the test results. The Contractor's are responsible to execute the tests. The CC is typically responsible for the majority of the Division 23 test execution.

Task/Action	Responsibility				
	CxA	CO	GC	EC&MC	CC
Cx Kick-off Meeting. - Early to mid const. phase.	Lead	Att.	Att.	Att.	Att.
Write FUNCTIONAL tests	Review Approve				Write Refine
Write PERFORMANCE tests. (PT)	Write				
Review and refine PT's	Refine		Rev.	Rev.	Rev.
CxA visit site to review process.	Observe				
Equipment START-UP and Check Out.	Review			Perform	
Functional Tests - also see Ref 23 09 23.13 20	Obs., Doc. APPRV	Obs.	Sched.	Part.	Exe.
PERFORMANCE Tests	Obs., Doc. APPRV	Obs.	Sched.	Part.	Exe.
Deficiency List	Write		Verify Compl.	Corr.	Corr.
Final Cx Report	Write				

Note: Att. - Attend; Rev. - Review; Obs. - Observation; Doc. - Documentation; Sched. - Schedule; Part. - Participate; Exe. - Execute; Corr. - Correct; Compl. - Compliance; APPRV - Approve

1.8 COMMISSIONING PROCESS

The following narrative provides a brief overview of the typical Cx tasks during construction and the general order in which they occur.

Cx during construction begins with a kick-off meeting conducted by the CxA where the Cx process is reviewed with the Cx team members.

Additional site visits and meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities, resolve issues and

verify installation.

Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.

The subcontractors develop start-up plans and start-up documentation/checklists to be completed, during the start-up process.

The CxA uses submittals and shop drawings to develop specific equipment and system FT and PT procedures. The subcontractors shall provide documentation/checklists from the start-up process to the CxA.

The subcontractors, under their own direction, perform start-up and initial checkout. The subcontractors shall provide documentation/checklists from the start-up process to the CxA.

The FT procedures are executed by the Subs under the observation of, and documented by the CxA. The Subs resolve FT deficiencies prior to performance testing.

The PT procedures are executed by the Subs under the observation of, and documented by the CxA. The Subs resolve any deficiencies.

Items of non-compliance in material, installation or setup are corrected at the subcontractor's expense and the system re-tested.

The CxA reviews the O&M documentation for completeness.

Cx is completed before Substantial Completion.

The CxA reviews the training provided by the subcontractors and verifies that it was completed.

1.9 DEFINITIONS

Commissioning Agent (CxA): The CxA coordinates the Cx activities.

Commissioning Plan: An overall project specific plan developed by the CxA, that provides direction for the Cx Process during construction.

Equipment Start-Up: Primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g. labels affixed, sensors calibrated, etc.). However, some start-up items entail simple testing of the function of a component, a piece of equipment or system (such as verifying of communication through the network and control panel/point visibility). Equipment start-up checklists augment and are combined with the manufacturer's start-up checklist. The CxA requires that the procedures be documented in writing.

Functional Test (FT): Tests of individual components of the control system to make sure that the wiring and setpoints are acceptable, and individual points operational. All control input and output points will have FT's. The functional tests shall be conducted by the Contractor performing the controls installation under the requirements of this section and those contained in Section 23 09 23.13 20, "Programmable Logic Control (PLC) for HVAC". The CxA will witness the actual functional testing, which is performed by the installing Contractor or vendor.

Performance Test (PT): Test of the dynamic function and SOO of equipment

and systems using both manual (direct observation) and operator workstation and HMI graphical monitoring, trending and control methods. Performance testing is the dynamic testing of systems (rather than just components) under full operation (e.g. the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested in manual and automatic modes and the systems are verified to be responding as the sequences state. The CxA develops the PT procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is performed by the installing contractor or vendor. PT's are performed after the FT's are complete.

Trend Tests: Tests required by the CxA to demonstrate/document the dynamic system response to one or more system variables. Trend tests will be required in both FT's and PT's.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

All standard testing equipment required to perform start-up and initial checkout and required functional and performance testing shall be provided by the Division contractor for the equipment being tested.

The Contractor shall provide all instrumentation required to demonstrate I/O has been properly calibrated. The same instrumentation used for the calibration shall be employed for the calibration verification. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 degrees F and a resolution of + or - 0.1 degrees F. Pressure sensors shall have an accuracy of + or - 2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available. Flow meters shall be calibrated using an ultrasonic flow meter attached to the pipe surface. For insulated piping this will require removal and replacement/patching of insulation and jacketing.

PART 3 EXECUTION

3.1 SUBMITTALS

The installation and checkout sheet forms to be used by the Contractor shall be submitted to the CxA as specified in Section 23 09 23.13 20.

3.2 COMMISSIONING PLAN

The purposes of the Cx Plan is to provide direction for the Cx Process during construction. This includes providing resolution for issues and details that cannot or were not fully developed during design (such as scheduling, participation of various parties of this particular project, actual lines of reporting and approvals, coordination, etc.). The CxA will submit a preliminary Cx Plan to the Cx Team for review near 30 percent construction progress. The preliminary Cx Plan will include the following:

- a. Brief overview of the Cx process.
- b. List of all systems to be commissioned.
- c. Identification of the Cx Team and its responsibilities.
- d. Overview of the Cx process.
- e. Indicate expected work products.
- f. Schedule indicating key commissioning process milestones.

3.3 EQUIPMENT START-UP

After the control panel is installed and powered, the contractor shall perform a formal start-up procedure. Start-up checklists are completed by the contractors to ensure equipment and systems are installed, tested, and fully operational prior to proceeding with Functional and Performance Testing. Each panel is required to have a start-up form filled out by the Contractor. No sampling strategies are allowed. Proper equipment start-up must be successfully completed prior to Functional and Performance testing of that system.

The contractor shall submit a Start-Up Plan and Schedule for control panel start-up and submit the project specific equipment start-up checklists. The CxA shall review and approve the start-up checklists prior to the contractor performing equipment start-up.

The Contractor shall submit completed equipment start-up checklists to the CxA for record documentation.

Start-up checklists must be submitted for all control panels.

3.4 TEST METHODS

Functional and performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance), and/or by monitoring the performance and analyzing the results using the control systems trend log capabilities. The CxA will determine which method is most appropriate.

Setup: Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The subcontractor executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the subcontractor shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

Sampling: Each control point and sequence shall be functionally and performance tested; a sampling strategy will not be allowed.

3.5 FUNCTIONAL TESTING

Before the FT's are performed, the Contractors must have completed equipment start-up procedures, either on their own or with the manufacturer's representative and sensor calibration.

The wiring of each control loop shall have been physically verified from the field device terminals to the controller.

Cable, conductor, terminal board and terminal designations shall have been verified and marked off as such on a copy of the loop diagram or equivalent

schematic or wiring diagram. Verification should be by signal tracing, continuity verification, or "ringing out". Tags and labels placed during construction should not be considered adequate verification.

Objectives and Scope: The objective of Functional Testing is to demonstrate that each control point is visible at HMI's and OWS, output points are manually commandable, and system inputs are registering properly and obtaining data within the parameters which are expected (i.e. if a pump is running, the status input indicates a run state). Each control loop should be verified by injection of an appropriate pressure, voltage, or current signal. Use actual signals where available.

- (1) Closely observe controllers, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components. Make corrections as required. Following any corrections, retest the loop as before.
- (2) Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
- (3) Check all interlocks to the maximum extent possible. In addition to any other as-recorded documents, record all setpoint and calibration changes on all system documentation.

All analog loops should be tuned for optimum response using a closed-loop tuning method and the resulting gain, reset and rate recorded on the loop checkout sheet. During the testing process, areas of deficient operation or performance shall be identified to be corrected.

The functional testing called for in Section 23 09 23.13 20, "Programmable Logic Control (PLC) Systems for HVAC" shall be coordinated with the testing as spelled out in the above paragraphs. The Contractor will be required to demonstrate all points are properly calibrated, wiring physically verified, signal traced and identified, sensors reading properly, controlled devices responding properly, points are visible at the HMI/operator work stations graphics, and alarms and setpoints established.

3.6 PERFORMANCE TESTING

The CxA will write, observe and approve the PT's. Before the overall system performance can be tested (PT), it is necessary to ensure that each "component" of the system be tested (FT) and deficiencies resolved to prove that it is set up and adjusted to work within intended ranges.

To coordinate with project phasing, each building shall be tested independently, then the entire system will be tested as a complete system. The PLC system serving the IACP secondary pumps (PLC-3), as well as the chiller interface will be tested separately as they are brought on-line, and again when the IACP work is completed.

Objectives and Scope: The objective of Performance Testing is to demonstrate that each system is operating according to the Contract Documents with respect to the SOO in each mode of operation. During the testing process, areas of deficient performance are identified to be corrected by the Contractors, and changes to the SOO associated with improving the operation, functioning, and efficiency of the systems shall be provided as part of this effort. In general, each system should be operated through all modes of operation (on, auto, off at both part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to

such modes and conditions as power failure, no flow, equipment failure, etc., shall also be tested. Any changes made to the S00 shall be fully documented in writing by the Contractor. In addition, when changes are made in the PLC programming to correct operation or make operational enhancements, a full assessment as to how these changes may affect other tested sequences shall be conducted. Re-testing will be required where any doubt or concern exists as to the impact of S00 revisions.

The purpose of any given specific PT is to verify and document compliance with the stated criteria of acceptance given on the test form. The PT procedures will be written in simple pass/fail format.

Development of Test Procedures: The CxA will develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Prior to execution, the CxA will provide a copy of the test procedures to the Contractors who shall review the tests for feasibility, safety, equipment and warranty protection.

Specific test forms will be developed by the CxA during the Construction Phase and will include (but not be limited to) the following information:

- a. System and equipment or component name(s).
- b. Sequence(s) tested.
- c. Special cautions, alarm limits, etc.
- d. Specific step-by-step procedures to execute the test in a clear, sequential, and repeatable format.
- e. Acceptance criteria of proper performance with a Yes/No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
- f. A section for comments.

3.7 DOCUMENTATION

Equipment Start-up Checklists. The Contractor shall use a checklist type form during the start-up of each piece of equipment and submit to the CxA when complete. The start-up checklists will be included in the Cx Book as a record that the equipment was started up and operating per the Contractor's expectations.

Calibration: The Contractor shall submit field calibration checklists documenting calibration for each sensor. It shall include as a minimum a description of the sensor, its tag/description used within the PLC system, model number, range, value of the sensor reading, measured value and the calibration instrument used.

Functional Tests: The CxA will provide a FT form for each piece of equipment. The forms will be filled out by hand during the on-site tests. The forms will be included in the Cx Book. If the systems fail the test, a deficiency list will be prepared for the Contractor, outlining the failure. After the Contractors have addressed the deficiency, the CxA (or Contractor's with Contracting Officer) will execute the FT's again.

Performance Tests: The CxA will provide a performance test for each piece of equipment or system. The forms will be filled out by hand during the on-site tests. The pass/fail criteria will be included on the PT forms. If the systems fail the test, a deficiency list will be prepared for the Contractor, outlining the failure. After the Contractors have addressed the deficiency, the CxA (or Contractor's with Contracting Officer) will execute the PT's again.

Deficiency List: The CxA will document any non-conformance deficiencies observed during site visits, or during tests. The deficiency list will be distributed by the Contracting Officer.

Final Cx Report: The CxA will prepare a final report summarizing the Cx activities, the FT's, the PT's, and observed deficiencies. The final report will be submitted to the Government.

Cx Book: The CxA will manage the Cx Book. The Cx Book is a 3-ring binder containing all Cx related documents such as letters, memos, equipment start-up checklists, FT forms, PT forms, final Cx Report, etc.

3.8 NON-CONFORMANCE

The CxA will record the results of the Functional and Performance Tests. All deficiencies, non-conformance issues, or test failures will be noted and reported to the Contractor's in a deficiency list or in a punch-list format.

Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases, the deficiency and resolution will be documented on the procedure form.

Re-Testing:

- a. If a Functional or Performance Test fails, corrections shall be made to the deficient equipment or systems by the Contractors. The systems will be re-tested until they pass the Tests.
- b. Any required re-testing by any Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Prime Contractor.

3.9 DEFICIENCIES AND RE-TESTING

The CxA documents the results of each test. (Corrections of minor installation or sequence of operation deficiencies are made during tests at the discretion of CxA).

Deficiencies/non-conformance issues not corrected during testing are reported to the Contractors for corrective action. Upon completion, a request is made by the Contractors to CxA for re-test.

3.10 DEFERRED TESTING

Unforeseen Deferred Tests: If any test can not be completed due to the Governments on-going use of the system and facilities it serves, execution of testing will be delayed based upon direction issued by the Contracting Officer. These tests will be rescheduled and conducted as soon as possible at no additional cost.

3.11 MEETINGS

3.11.1 Kick-Off Meeting

A Cx kick-off meeting is planned and conducted by the CxA near 30 percent construction progress. The CxA will distribute a preliminary Cx Plan. In attendance are the respective representatives of the GC, CxA, CO, A/E, MC, EC, and CC. At the meeting, Cx parties are introduced and the Cx process

reviewed, management and reporting lines determined. The flow of documents is also being discussed. The Cx Plan is reviewed, process questions are addressed, lines of reporting and communications determined, and the work products list discussed. Also covered are the general list of each party's responsibilities, who is responsible to develop the start-up checklist for each piece of equipment and the proposed Cx schedule. The outcome of the meeting is increased understanding by all parties of the Cx process and their respective responsibilities. The meeting provides the CxA additional information needed to finalize the Cx Plan.

3.11.2 Progress Meetings

Progress meetings will be planned and conducted by the CxA at appropriate intervals as construction progresses. These meetings will cover coordination, deficiency resolution, and planning issues with Divisions 1, 23, 26 and 27 Contractors. The CxA will plan these meetings in conjunction with regular project meetings to minimize unnecessary travel time.

3.12 PROJECT COMPLETION SCHEDULE

The Cx Functional and Performance tests are executed at the end of the project, after the Contractors have completed their work. It is possible to execute some tests, on completed systems, prior to final project completion. In general, the Cx tests are scheduled for AFTER the controls contractor has completed the graphics in the building automation system.

FT's shall be scheduled through the Contracting Officer and will commence once the Contractor has completed start-up and calibration. When uncovered, deficiencies will be documented by the Cx for correction by the Contractor. Once the Contractor remedies the deficiencies, FT's will be rescheduled. Once FT's are successfully completed, PT's can be scheduled through the Contracting Officer.

Since this is a fully functional system serving facilities operating 24-hours per day, 7-days per week, all testing will have to be carefully scheduled and any testing which results in a loss of service will need to occur during periods which will minimize disruption to the on-going operations.

3.13 O&M MANUALS

The specific content and format requirements for the standard O&M Manuals are detailed in Section 01 78 23.

CxA Review and Approval: Prior to substantial completion, the CxA will review the O&M manuals, documentation and redline As-Builts for systems that were commissioned to verify compliance with the specifications. The CxA will communicate deficiencies in the manuals to the CM, CO, or A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the CM, CO, or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated.

3.14 TRAINING AND ORIENTATION

The GC shall be responsible for training, including coordination and scheduling, and ultimately for ensuring that training is completed.

The CxA will be responsible for overseeing and approving the content and

adequacy of the training of Government personnel for commissioned equipment.

The GC and CxA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The CO, GC, and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The GC shall communicate the results to the subcontractors and vendors who have training responsibilities.

In addition to these general requirements, the specific training requirements of Government personnel by subcontractors and vendors are specified in Section 23 09 23.13 20.

The GC develops an overall training plan, and coordinates and schedules with the CM and CxA, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the CO using a standard form. The CO also signs the approval form.

-- End of Section --

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SELECTIVE DEMOLITION
05/10

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008) Safety and Health Requirements Manual

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

40 CFR 61 National Emission Standards for Hazardous Air Pollutants

1.2 PROJECT DESCRIPTION

1.2.1 Selective Demolition Plan

Prepare a Selective Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. The plan shall be broken down into construction project phases, and be specific to the actual work required under each phase. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with on-going generation, distribution and use of chilled water, a disconnection schedule of utility and control services, an estimate of the time frame for which automatic control will not be available, an estimate of the time for any proposed utility outages, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Coordinate with Waste Management Plan. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the building. The work includes selective demolition of existing DDC-based control systems, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational

safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor.

1.3.3 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.5 SEQUENCING OF WORK

Work shall be phased, sequenced and executed to prevent outages of the production, distribution and use of chilled water generated by the Industrial Area Chiller Plant (IACP). Generally, the existing to remain Legacy Andover equipment will be removed from the existing IACP Andover control system and connected to the KSC Ethernet-based ATXS Lan through the use of new Andover hardware. A new SCADA-based operators workstation will be established at the IACP, then controls will be replaced within the buildings served by the IACP one at a time and interfaced with the new SCADA, with the IACP controls being replaced under the last phase. No control system functions shall be interrupted without the approval of an utility outage by the Contracting Officer. Where the execution of the work will result in an outage of chilled water within any facility served by the IACP, it shall take place on an off-shift basis when the building is unoccupied and not in-use. The IACP is to operate continuously throughout the demolition, installation, checkout and commissioning of the control system.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit

the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions; G
Control Point Validation Report; G

SD-07 Certificates

Selective Demolition Plan; G
Notification; G

1.7 QUALITY ASSURANCE

Furnish timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.7.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, flooding, or pollution.

1.8 PROTECTION

1.8.1 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the system and equipment being demolished and take immediate action to protect all personnel working in and around the project site.

1.9 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

1.10 EXISTING CONDITIONS DOCUMENTATION

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of systems, equipment, components, raceways and wiring, and other facilities adjacent to areas of alteration or removal. Photographs will be acceptable as a record of existing conditions and shall be submitted on a CD ROM in a digital .jpg format. Include in the record possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the

Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document.

Selected existing conditions are depicted both graphically and photographically on the drawings. Graphical depictions are approximate in nature, do not indicate the exact size or location of the element shown, nor may they indicate surrounding work. Photographic depictions are accurate as of the date taken, but do not depict changes that have occurred afterwards. Drawings are diagrammatic in nature and shall not be scaled. The Contractor is solely responsible for confirming the actual existing conditions and making site measurements for the purpose of the production of shop drawings, procurement of equipment and materials needed to execute the work and coordinate with constraints imposed by the existing conditions.

The Contractor shall use the existing Andover operators workstation screens to validate which sensors are reporting and working, and which sensors are not a document through the use of photographs. He shall also verify all output control actions to include valve actuator response. A Control Point Validation Report shall be generated on a building-by-building basis following the general format used on the drawings including the point name, type, and input/output range and list any concerns or deficiencies.

The Contractor shall document all of the existing wiring from the existing DDC controller through any subpanels to the controlled device or sensor. All wiring circuit continuity shall be verified "wring-out" end to end. Existing wiring conditions shall be reflected on the Contractors point-to-point wiring diagram submittals required in Section 23 09 23.13 20, "Programmable Logic Control (PLC) Systems for HVAC".

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 EXISTING SYSTEMS TO BE REMOVED

Inspect and evaluate existing systems onsite which are to be demolished and portions of which are slated for reuse. Existing construction scheduled to be removed shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for salvage, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Utilities and Related Equipment

3.1.1.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.1.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.2 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture, sheen and finish. Patching shall be as specified and indicated, and shall include:

- a. Concrete and Masonry: Completely fill holes and depressions, left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.
- b. Drywall: Completely fill holes and depressions with drywall compound, smooth and sand when dry to match the surrounding surface.
- c. Coating: Where adjacent surfaces are coated, prime and paint surfaces to match surrounding.

3.1.3 HVAC Controls

Remove existing DDC controls to include, but not by way of limitation, panels, enclosures, controllers, power supplies, sensors, wiring, conduit, tubing supports and associated items. Existing DDC controllers, batteries, and enclosures shall be salvaged and turned over to the Contracting Officer.

Disconnect wiring to be reused at terminal strips and/or at the connection to the controller, sensor or end-device as indicated. Prior to disconnection, wring out the circuit by confirming circuit connectivity to the sensor and/or controlled end device. Remove existing identification labels and provide new labeling to match approved shop drawings.

Where control I/O devices are being removed and not replaced, remove all signal wiring and conduit to the extent possible without disturbance of existing signal wiring to remain. Where new control I/O devices are being installed that are not compatible with existing I/O wiring, remove existing I/O wiring to the extent possible without disturbance of existing I/O wiring to remain in shared raceways. Selectively demolish portions of control I/O conduit as required to coordinate with replacement devices, sensors and panels. Repair openings in walls, floors and panels which are slated to remain resulting from selective demolition.

3.1.4 Mechanical Equipment and Fixtures

3.1.4.1 Piping

Disconnect piping at unions, flanges and valves, and fittings as indicated.

3.1.5 Electrical Demolition

Perform electrical demolition in conjunction with removal of HVAC controls. Remove power feeds, uninterruptible power supplies, communication cabling and pathways as indicated.

3.1.5.1 Conduit and Miscellaneous Items

Consider conduit as scrap metal. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.2 DISPOSITION OF MATERIAL

3.2.1 Salvaged Materials and Equipment

Remove materials and equipment that are indicated on the drawings and/or specified to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site, as directed.

- a. Salvage items and material to the maximum extent possible.
- b. The Contractor has the first right to salvage all materials identified as scrap. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property as removal occurs. Material salvaged for the Contractor shall not be sold on the site.
- c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver the following items reserved as property of the Government to the areas designated.

3.2.2 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area at the KSC landfill located on Schwartz Road.

3.3 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials

resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan. Storage of removed materials on the project site is prohibited.

3.4.2 Burning on Government Property

Burning of materials will not be permitted on Government property.

3.4.3 Removal to Landfills/Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.4.4 Removal from Government Property

The Contractor shall not remove hazardous wastes from KSC property. All hazardous wastes shall be properly packaged and labeled by the Contractor per the PWQ/TRP process. Hazardous waste containers will be picked up and properly disposed of by the IHA Waste Management Group.

3.5 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

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ASBESTOS ABATEMENT
10/07

PART 1 GENERAL

1.1 SUMMARY

This section specifies the asbestos abatement requirements and the Contractor's applicable asbestos procedures, which include demolition or salvage of structures where asbestos is present, removal or encapsulation of materials containing asbestos, construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos, installation of products containing asbestos, asbestos spill/ emergency cleanup, transportation, disposal, storage, containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed.

Asbestos Abatement work is categorized into four classes:

Class I Work: Activities involving the removal of Thermal System Insulation (TSI) and surfacing of Asbestos Containing Materials (ACM) and Presumed Asbestos Containing Material (PACM).

Class II Work: Activities involving the removal of ACM that is not TSI or surfacing material. This includes wallboard, floor tile, roofing, sidings, mastics and other materials.

Class III Work: Repair and Maintenance operations where ACM, including TSI and surfacing material is likely to be disturbed. Class III work cannot exceed more than one glovebag of material.

Class IV Work: Maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean up dust, waste, and debris from Class I, II, and III activities.

Conduct abatement work in accordance with the Class I, II, III, or IV Methods of Compliance as required by 29 CFR 1926, 40 CFR 61-SUBPART M, 49 CFR 171, 49 CFR 172, FAC CHAPTER 62-257, and FL-STAT 469.

1.2 DEFINITIONS

FLAC - Florida Licensed Asbestos Consultant as defined within the FL-STAT 469 ASBESTOS ABATEMENT.

IH - Kennedy Space Center Industrial Hygienist. This person can be either a government civil servant or an authorized government contractor. This person is responsible for the oversight and approval of the abatement procedures and the health, safety and welfare of those it effects.

1.3 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.

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7.1 (2004) Commodity Specification for Air

FLORIDA ADMINISTRATIVE CODE (FAC)

FAC CHAPTER 62-257 (1999) Florida Administrative Code, Asbestos Program

FLORIDA STATUTES (FL-STAT)

FL-STAT 469 (2005) Asbestos Abatement

JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 1840.19 KSC Industrial Hygiene Programs

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 94-113 (1994; 4th Ed) NIOSH Manual of Analytical Methods

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

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1926 Safety and Health Regulations for Construction

29 CFR 1926.1101 Asbestos

40 CFR 61-SUBPART M National Emission Standard for Asbestos

40 CFR 763 Asbestos

49 CFR 171 General Information, Regulations, and Definitions

49 CFR 172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Work Schedule; G in accordance with the paragraph entitled, "Worker Protection," of this section.

Notification of Demolition/Renovation; G

SD-02 Shop Drawings

Submit items in accordance with the paragraph entitled, "Implementation Plan," of this section.

Coordination Drawings; G
Detailed Drawings; G

SD-06 Test Reports

Submit the following:

Initial Exposure Assessments; G in accordance with 29 CFR 1926

Notification of Demolition/Renovation; G
as part of the Implementation Plan.

Submit Air Monitoring Reports; G in accordance with paragraph entitled, "Air Monitoring Report" of this section.

Maintain Work Site entry logs; G of all personnel entering and leaving the regulated work area by the on-site competent person indicating the date and time of entry and egress.

Maintain Daily Site Inspection Logs; G by the on-site competent person indicating the date, time and results of the work area daily site inspections.

Maintain Waste Drum Inventory; G of all generated waste drums or containers indicating the location and approximate quantity of material in each container.

SD-07 Certificates

Submit the following certificates:

Asbestos Consultant's License from the State of Florida, Department of Business and Professional Regulation (DBPR)

Asbestos Contractor's License; G or other Contractor license approval from the State of Florida, Department of Business and Professional Regulation (DBPR).

Training Certification; G, and experience of Contractor's "Competent Person", supervisor, and workers.

Proficiency Analytical Test Certification

SD-08 Manufacturer's Instructions

Submit Material Safety Data Sheets; G in accordance with the paragraph entitled, "Licenses Permits, and Notices," of this section.

Submit Implementation Plan; G as identified in paragraph entitled, "Implementation Plan" prior to initial site set-ups or start of work.

SD-11 Closeout Submittals

Within 10 days after the completion of work, submit to the

Contracting Officer a written summary and copies of the following items:

Notification of Demolition/Renovation.

Waste Disposal Permit and all Disposal Shipping Manifests and Tickets.

Daily site inspection logs, negative pressure logs and other OSHA compliance inspection records.

Air Monitoring Reports or Independent Monitoring Data conducted during the abatement.

Calibration Records; G for sampling equipment taken before and after each air sample.

Entry logs and Waste Drum Inventory maintained during the abatement task.

1.5 LICENSES PERMITS, AND NOTICES

The FLAC must possess a current license and comply with all Federal, State and Local Regulations. Only those consultants who are certified and licensed by DBPR are permitted to perform Asbestos Surveys or abatement specifications and plans as per Florida Statute 469.

The Contractor must possess a current Asbestos Contractor's License and secure all necessary licenses and permits associated with asbestos removal, transportation, and disposal as may be required by Federal, State, and local regulations. Only those Contractors who are certified and licensed by the State of Florida DBPR will be permitted to perform asbestos abatement activities at Kennedy Space Center.

A Waste Disposal Permit and all Disposal Shipping Manifests and Tickets are to be obtained.

Submit the following certificates:

Certification of participation in a Proficiency Analytical Test (PAT) program such as or equivalent to the American Industrial Hygiene Association PAT or Asbestos Analytical Registry (AAR) accreditation certificate, and Interlab QA/QC Program participation for the independent air monitoring agency selected by the Contractor before starting work.

Training Certification and accreditation certificates for the independent air monitoring agency's on-site personnel and a copy of independent air monitoring agency's Quality Control Program.

Certification documents by the Contractor verifying that employees have been provided current respirator fit test, training, and medical examinations in compliance with 29 CFR 1926.

Material safety data sheets as required for materials to be used on the specified project.

1.5.1 Notification

A written notice and any required fee's to obtain a Permit to demolish friable asbestos is to be sent to the State Asbestos Coordinator in accordance with FAC CHAPTER 62-257 by the Contractor. A copy of the notification is to be provided to the Government as part of the Implementation Plan.

1.6 IMPLEMENTATION PLAN

Prepare and submit a detailed, written Implementation Plan created, signed and sealed by a FLAC to the Government for approval, prior to the start of work, that includes the following:

Coordination drawings including site specific drawings of proposed work areas, clean room/change areas, mini-enclosures, shower, equipment room, waste loading/staging areas, locations of High Efficiency Particulate Air (HEPA) filtered negative pressure devices and exhaust points, work areas, emergency routing and areas to be modified.

Detailed drawings for asbestos abatement systems consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents.

A copy of Notification of Demolition/Renovation.

Plan of Action, including proposed procedures to be used in complying with the requirements of this specification and 29 CFR 1926, sequence of asbestos abatement work, the interfaces of trades involved in the performance of work, posting of licenses, permits, etc., methods to be used to assure the safety of building occupants and visitors to the site, disposal plan including location of approved disposal site, a detailed description of the methods employed to control pollution and a detailed work schedule. Expand upon the method for removal of ACM, the use of portable HEPA ventilation systems, closing out of the buildings HVAC system, method of removal to prohibit visible emissions in the work area, and packaging of removed debris.

Details of the decontamination areas and procedures, locations of staging areas, posting of warning signs, and details of negative air system to be used in the work area.

Sketch(s) or drawing(s) of complete contract area(s) showing the shower room, clean room, drum staging area, decontamination and containment areas, the negative air system, and exits. Indicate designation of the "Competent Person", and Site Supervisor.

Provide a written Air Monitoring Plan to be prepared under the direction of and signed/stamped by a Certified Industrial Hygienist (C.I.H.) or FLAC specifying monitoring criteria and a resulting action plan for implementation by the Competent Person. The Plan must identify the Competent Person to be on site at all times (unless otherwise authorized by the Contracting Officer) during hazardous abatement operations. The FLAC or his/her representative/competent person is responsible for ensuring OSHA compliance during all phases of the abatement activities. Issue instructions which require this person, independently of production pressures, to stop non-conforming operations. Provide a qualified back-up person in the event that the Competent Person is absent from job site.

Provide certification that the Contractor, his staff and abatement workers (including supervisors) have attended and successfully completed asbestos abatement course(s) including refresher courses as set forth in FL-STAT 469 and in accordance with 29 CFR 1926, and 40 CFR 763.

Provide verification of a Respiratory Protection Program in accordance with 29 CFR 1910 including confirmation of worker training in the care, use, and maintenance of respirators and fit test certification.

Provide a written description of respiratory equipment and protective clothing provided the abatement workers.

Provide documentation that all personnel assigned to the abatement project have been examined annually by a physician. Submit the physician's written opinion containing the results of the medical examination in compliance with 29 CFR 1926 for each employee who will be employed on this project. Establish, maintain, and make readily available for review all Work site entry logs.

Procedures for enforcement of Personal Hygiene Practices.

Prepare and submit a Contingency Plan for emergencies including fire, accident, power failure, heating or cooling, negative air system failure, respirator supplied air system failure, or any other event that may require modification of the work area isolation procedures. Include in the plan specific procedures for decontamination or work area isolation, safe exiting and the need for medical attention in the event of an emergency.

Document all procedures and policies that are in effect to ensure that the worker safety and environmental plans are enforced.

Submit the Implementation Plan is to be submitted to the Government for review, revised by the Contractor where required, and resubmitted for approval. Commencement of work will not be permitted until the Implementation Plan is given final approval.

1.7 AIR MONITORING REPORTS

Obtain the services of an independent Air Monitoring Agency accredited by the American Industrial Hygiene Association (AIHA), for analysis of airborne asbestos concentration levels. Provide a copy of the monitoring agency's Quality Control Program to the contracting officer prior to commencement of the abatement activities. The individual performing the on-site air monitoring must meet the requirements as set forth in FL-STAT 469 and 40 CFR 763 and perform sample collections in accordance with the approved Air Monitoring Plan.

Air Monitoring must be done under the direction of the FLAC by an independent Air Monitoring Contractor and meet the Florida statute 469 requirements.

Calibrate pumps before and after each air sample and submit calibration records to the Government.

Submit Air Monitoring Reports daily logs (AMR) listing the airborne fiber concentration in fibers/cc. Include in AMR the following information for each sample:

Sample identification, Sample location,
 Employee Name, Social Security Number,
 Description of task being monitored,
 Exposure level results in (f/cc),
 Monitoring instrument identification number,
 Pre-calibration, post calibration and average flow rate of each sample,
 Sample date, start and stop times,
 Type of protective devices worn (if any),
 Project identification number, Facility number and name,
 Sampling and Analytical Methods used,
 Contact name and company, and name of individual performing the
 sampling.

Submit all Independent Monitoring Data.

1.7.1 Air Sample Analytical Method

Airborne fiber sampling and analytical procedures are to be by Phase Contrast Microscopy (PCM) in accordance with 29 CFR 1926 or the most current version of the NIOSH 94-113, Method 7400.

1.7.2 Air Sampling Rate, Volumes and Frequency

Conduct daily monitoring utilizing sample rates, volumes and frequency in accordance with 29 CFR 1926 and retain for final submittal at closeout. The minimum number of samples or sample volumes may not be less than those specified below:

<u>Type of Sample</u>	<u>Volume</u>	<u>Minimum No. Samples</u>	<u>Location</u>
Prior to set-up (within 24 hrs)	1200L	2	Regulated Area
Personal, During work	400L	2	Personal B.Z.
Area samples, Adjacent to work area.	1200L	2	Regulated Area
Area samples at Negative Air Unit Exhaust.	1200L	1	In area of outlets

1.8 WORKER PROTECTION

Perform Initial Exposure Assessments and Employee Exposure Monitoring in accordance with 29 CFR 1926.1101 with input and approval of the FLAC.

The Contractor's Competent Person must conduct an exposure assessment immediately before or at the initiation of the abatement work to ascertain expected exposures during the abatement work.

Select and provide respiratory protection to employees and ensure they are utilized in accordance with 29 CFR 1926.

Submit the Work schedule indicating the work days, hours, and the number of workers per shift. Include a bar chart to identify the individual milestones through to the completion of the project (i.e., number of days to complete work site preparation, number of days to complete ACM removal, number of days to complete final cleaning and lockdown, etc.).

Submit the OSHA compliance inspection records as part of the closeout documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES AND SERVICES

The Government will make available at the work site, water at hose bibs and 120 Volt AC at receptacles for the Contractor's use. Provide water proof safety lighting where necessary for safe, adequate illumination.

All electrical equipment to be used inside the work areas must be powered from an Underwriters Laboratory (UL) approved Ground Fault Circuit Interrupter (GFCI). Do not exceed the manufacturers limits per GFCI. Make all necessary connections and restore the site connections to their original condition or better prior to project completion.

Ensure all energized or pressurized systems inside the work area have been locked out, tagged out or otherwise rendered safe.

Provide temporary water from the existing building water source to control the generation of airborne dust, to allow for area, personnel, and equipment decontamination, and to supply decontamination unit needs. Also provide a backflow preventer at the source.

Provide temporary sanitary drainage piping to the decontamination unit sump and to the shower unit at a minimum slope of 2.0 percent, and temporary drainage piping to waste water pump and existing drain in accordance with local standards and as approved by the Contracting Officer.

3.2 WORK AREA PREPARATION

The Government will re-arrange equipment and storage areas to the extent of providing a direct and unobstructed path to the work area(s). During ACM removal, confine equipment and employees to the designated work area(s).

Unless otherwise directed by the Contracting Officer, the Contractor is to establish and maintain a 25-foot access control barrier zone(s) around the designated work area(s). Interference with the functional operation of the building occupants outside these areas is not be permitted.

All building supply and return air ducts from the mechanical system must be isolated to eliminate air flow into or out of containment area(s).

Any work area considered for asbestos removal which shows visual debris is to be interpreted as possible asbestos contamination. The designated work area must be pre-cleaned.

3.2.1 Pre-Cleaning

Shut down HVAC systems and seal all critical barriers prior to initiating pre-cleaning actions. Openings, including but not limited to, windows, corridors, doorways, elevator openings, skylights, ducts, grilles, diffusers, and any other penetrations between the contaminated work areas and uncontaminated areas, must be sealed with plastic sheeting with a

minimum thickness of 6 mil.

Pre-clean all movable objects identified as contaminated by the Contracting Officer or his representative within the work area using a HEPA filtered vacuum and wet cleaning methods as appropriate. Remove these objects after cleaning and store in a protected area.

Pre-clean all surfaces in the work area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Methods that would raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, are prohibited. Pay detailed attention to machinery or areas behind grilles and gratings.

Do not remove or otherwise disturb asbestos containing building materials during the pre-cleaning phase.

3.2.2 Work Area(s)

Inform all other Contractors on the site of the abatement work, of the nature of the Contractor's work with ACM and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other Contractor employers are not exposed to asbestos in accordance with 29 CFR 1926.

Use industry controls and work practice methods in accordance with 29 CFR 1926. Daily site inspection logs must be posted at the jobsite by the on-site competent person and signed/approved by the FLAC or his/her designated representative.

Use flame resistant, 6 mil polyethylene when constructing Negative Pressure Enclosures (NPE) or decontamination areas.

3.3 WASTE LOAD-OUT UNIT

Establish a waste load-out unit to provide for interim secure storage. Include an equipment room for storage of asbestos-contaminated items (drums, tools, equipment). All equipment and waste containers must be decontaminated prior to being taken out of the work area(s).

All asbestos-containing waste material is to be sealed in leak-tight disposal containers provided by the Contractor. Thoroughly wet all waste within the disposal containers.

Maintain proper labeling protocols and keep a running and final inventory of all filled disposal containers.

3.4 SIGNS AND MARKINGS

Post signs prior to commencing asbestos work as required in 29 CFR 1926. Post signs near the perimeter of the asbestos work areas, along the route of the temporary waste material holding (Drum Staging) area, around the perimeter of the temporary holding area, and at all entrances to areas containing asbestos fibers. Signs must be conspicuous and legible.

Post telephone numbers and locations of emergency services including, but not limited to, fire, ambulance, doctor, and hospital, at a designated telephone located near the regulated area.

Post one copy of all permits at the work site perimeter in a accessible

location outside the regulated area.

Post one copy of the Abatement Contractors current license at the work site perimeter in a accessible location outside the regulated area.

Hazard communication notification signs must be posted in accordance with KNPR 1840.19 requirements.

3.5 NEGATIVE AIR SYSTEM

Construct Negative Pressure Enclosures (NPE's) as required by 29 CFR 1926.

Duct each of the negative air units through the containment barrier walls to the outside of the work area(s). When the building is occupied, the ducts must exhaust into the outside air; otherwise, they may exhaust into an area of the building beyond the critical barriers. Never exhaust the units into the work area(s).

Provide each unit with temporary back-up electrical power (120 Volt AC) in the event of power failures or outages.

3.5.1 Testing

Design the negative air system to provide a minimum of four (4) air changes per hour and test before any work is begun. After the work area has been prepared, the decontamination unit set up, and the negative air units(s) installed, test the system. Prior to beginning abatement activities, a pre-work inspection using KSC Form 28-1230 is to be completed by the Contractor's independent air monitoring firm to verify the adequacy of the containment system. Once activated, the negative air exhaust unit(s) must remain in operation until final clearance air monitoring has been performed and the Contracting Officer has approved their shutdown/removal. Maintain daily negative pressure logs for review by the FLAC and submit as part of the closeout documents.

Install a differential pressure meter or manometer to continuously measure pressure differential between inside and outside the work area for all Class I activities which utilize an NPE. Maintain a minimum pressure differential of 0.02 inches of water.

3.6 RESPIRATORY PROTECTION

All personnel engaged in the asbestos removal work in the Work Area must at all times wear respirators in accordance with 29 CFR 1926. Instruct and train each worker involved in asbestos abatement in proper respirator use, and require that each worker in the work area always wear a respirator from the start of any operation which may cause airborne asbestos fibers until the Work Area is released for re-occupancy. All respirators must be fitted by approved qualitative or quantitative test. Use respiratory protection appropriate for the fiber level encountered in the Work Area and as specified herein, or as required for other situations encountered.

3.6.1 Air Quality for Supplied Air Respiratory Systems

The Contractor is to provide air used for breathing in Type "C" supplied air respiratory systems that meets or exceeds CGA G-7.1, standards for Grade D air.

3.7 REMOVAL OF ASBESTOS

Use industry controls and work practices for all operations in accordance with 29 CFR 1926 Methods of Compliance for Class I, II, III, or IV asbestos work. The FLAC or his/her representative are responsible for these practices.

All Class I and II work must be supervised by an on site Competent Person at all times that work is in progress. All class III and IV work must be supervised by a Competent Person.

Following removal of contaminated items and asbestos material, seal the edges of adjacent surfaces, which were exposed when asbestos was removed, with an asbestos bridging sealant/encapsulant.

3.8 DAILY HOUSEKEEPING

Maintain a clean work area in accordance with 29 CFR 1926. Perform the following housekeeping functions at the end of each shift or prior to leaving the work site unattended:

- a. Prepare contaminated waste for disposal by packaging the waste and removing it from the work area.
- b. HEPA vacuum the work area.
- c. Visually inspect polyethylene in the work area and other high traffic areas.

3.9 CLEANING PROCEDURES

Clean the work area at the end of each day's abatement activities. Designate a separate, secured area within the work area for storage of debris until it can be properly disposed. Secure the work area after termination of the work day to prevent entry. Regularly dispose and replace disposable supplies, such as mop heads, sponges, and rags. Clean all equipment by HEPA vacuuming and wet wiping.

Clean all work areas in which abatement operations have been completed, starting at the ceiling and working down to the floors, by HEPA vacuuming and wet wiping. Prior to removal of worksite access controls and re-occupancy inspection by the Government, and upon satisfactory final clearance air sampling, and removal of polyethylene sheeting,, perform a final cleaning (wet wipe) of all surfaces within the work area.

3.10 INSPECTION

Do not commence removal of asbestos materials prior to satisfactory completion of the pre-work inspection using Form 28-1230. Inspection is to be completed by the Contractor's independent air monitoring firm.

3.10.1 Initial Inspection

The Contractor and the Government will conduct a walk-through of the work area prior to beginning the abatement work to review existing conditions and ensure safe and practical conditions for the work to be implemented. Any damage to structures, surfaces, and equipment, which could be misconstrued as damage resulting from work is to be documented by the Contractor and submitted to the Contracting Officer at least one day prior

to start of work.

Take background samples for work areas in accordance with 29 CFR 1926 prior to beginning the abatement work.

3.10.2 Daily Inspection

Maintain an access log of all personnel who enter the regulated work area. Through continuous surveillance and inspections of the worksite the Contractor must ensure the integrity of containment, proper function of the negative pressure system, and posting of signs and labels. The Contractor must also ensure, through frequent inspections during each work shift, that negative pressure is maintained, appropriate work practices are followed, appropriate protective clothing and equipment are used, and worker decontamination procedures are being followed.

Ensure that critical barriers and negative pressure enclosures remain effectively sealed and taped. Take immediate action to remedy defects immediately upon discovery. Details of the inspections are to be included in the Contractor's daily inspection log and posted in an accessible location outside the regulated area.

Provide updated copies of the Air Monitoring Reports, Daily Site Inspection Logs and Waste Drum Inventory to the Government at the end of each week of the abatement work.

NASA/Kennedy Space Center reserves the right to conduct periodic inspections and air monitoring in the work area(s). If the work area is unsafe as determined by the contracting officer, NASA/Kennedy Space Center will require the Contractor to stop work until the unsafe conditions are corrected.

3.10.3 Final Inspection

The thoroughness of asbestos removal is to be evaluated by visually inspecting the affected surfaces for residual asbestos material and accumulated dust and by air sampling. Evidence of residual asbestos or asbestos debris on any adjacent surfaces upon completion of the work is not acceptable.

Upon completion of the work, a thorough visual inspection of the work area must be conducted by the Abatement Contractor and their independent air monitoring firm to ensure no residual asbestos material, dust or debris remains. Final inspections must be documented on KSC FORM 28-1231 provided by the Government.

Final aggressive air sampling is to be performed by the Contractor's independent air monitoring firm for each NPE work area after completion of a satisfactory visual inspection. The clearance criteria is 0.01 fibers per cubic centimeter (f/cc) of air as determined by PCM. Satisfactory fiber counts from all final samples are to be less than 0.01 f/cc. If any of the final air samples contain greater than 0.01 f/cc the Contractor must repeat the final cleaning operation and the area re-tested until satisfactory clearance levels can be obtained.

Collect five (5) PCM final air samples for the first 5,000 square feet of containment plus one (1) additional PCM final air sample for each additional 5,000 square feet or one (1) air sample per room, whichever is greater. The number of final air samples may be reduced for small

enclosures of less than approximately 2500 square feet. In no case may fewer than two (2) final samples be collected for any enclosure.

Clearance air sample volumes must meet the minimum volumes as indicated for analysis by NIOSH 94-113, Method 7400.

3.11 ASBESTOS WASTE AND CONTAMINATED MATERIALS

3.11.1 Removal of Asbestos Waste Materials

For purposes of this paragraph, asbestos waste materials are defined as those materials which contain or have been contaminated by asbestos and are not planned to be encapsulated and remain at the job site. They are primarily removed asbestos, disposable clothing and safety equipment, masking sheets, contaminated amended water, vacuum cleaner contents and filters.

Contain all asbestos waste material in two 6-mil polyethylene disposal bags, or two 6-mil disposal bags and a sealed leak-tight container such as, but not limited to, a steel or fiberboard drum. Pack the asbestos waste material while still wet. Clean the external surface of the waste containers by HEPA vacuuming and wet wiping before moving from the work area. Protect the interior of truck or dumpster with two layers of polyethylene sheeting.

Label and clearly mark all disposal containers, dumpsters and trucks, including the inside bags in accordance with 40 CFR 61-SUBPART M, 29 CFR 1910 of OSHA's Hazard Communications Standard, and 49 CFR 171 and 49 CFR 172, Hazardous Substances.

The labels must be conspicuous, legible, and affixed to plastic bags and drums indicating the name of the waste generator and the location (facility name & number) where the waste was generated.

Also provide a Waste Shipment Record (WSR) to the waste site owner in accordance with the instructions in "Figure 4" of 40 CFR 61-SUBPART M.

3.11.2 Work Area Disposal

After final inspection has been completed and the work area is released for occupancy, shut off and remove the Negative Air System units. Unseal all entrances and exits. Dispose of all plastic sheeting, tape, and any other trash and debris, except for critical barriers, in sealable plastic bags, or in drums and moved to the staging area. After final wet wipe of the work area and satisfactory clearance air sampling, dismantle critical barriers and the decontamination unit.

3.11.3 Decontamination Area And Support Area Disposal

Dismantle the decontamination area after the work area is released by the Contracting Officer for re-occupancy. Vacuum all surfaces of the decontamination unit before it is disassembled.

3.12 WASTE TRANSPORTATION AND DISPOSAL

Transport and dispose of asbestos waste in full compliance with 40 CFR 61-SUBPART M, SUBPART A, 49 CFR 171 and 49 CFR 172. The KSC landfill located on Schwartz Road only accepts non-friable asbestos waste. All friable asbestos waste shall be transported by the abatement contractor

to an appropriate landfill such as Brevard County. Copies of the waste shipment and disposal records shall be sent to the Contracting Officer.

3.13 ASBESTOS ABATEMENT NOTICE AND CHECKLIST

A Pre-Work Inspection form (KSC Form 28-1230) and a Clearance Reoccupancy Inspection form (KSC Form 28-1231) will be provided to the Contracting Officer upon satisfactory completion of the work. The completed forms are to be used to establish approval of the containment, work practices and final acceptance/re-occupancy of the work area(s).

3.14 FINAL ACCEPTANCE

The work will not be considered complete until the asbestos materials identified herein have been abated, the areas cleaned, satisfactory clearance air monitoring completed, all asbestos contaminated waste has been properly disposed of, and all project close out documents have been received by the Contracting Officer.

-- End of Section --

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LEAD IN CONSTRUCTION
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2 (1992) Respiratory Protection

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

HUD 6780 (1995; Errata Aug 1996; Rev Ch. 7 - 1997)
Guidelines for the Evaluation and Control
of Lead-Based Paint Hazards in Housing

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

29 CFR 1910.1000	Air Contaminants
29 CFR 1926.103	Respiratory Protection
29 CFR 1926.1127	Cadmium
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and

Disposal Facilities

40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	(1996; Rev thru Aug 2008) Standard for High-Efficiency Particulate, Air Filter Units
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1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

1.2.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).

1.2.3 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations and has the authority to take prompt corrective actions to control the lead hazard. A Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

1.2.4 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.5 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.6 High Efficiency Particulate Arrestor (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

1.2.7 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds, but includes Resource Conservation and Recovery Act (RCRA) metals silver, arsenic, barium, selenium, cadmium, chromium, and mercury, as well as PCB's. The use of the term, "lead" shall be deemed to include these other metals and substances.

1.2.8 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.9 Lead Permissible Exposure Limit (PEL)

For lead, fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. For cadmium, 5 micrograms per cubic meter of air as an 8-hour time weighted average as determined by 29 CFR 1926.1127. For other metals, comply with requirements in the Lead Standard. PCB's shall be limited to 0.5 milligrams per cubic meter and mercury limited to 2 milligrams per cubic meter in accordance with 29 CFR 1910.1000, Table Z.1. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

$$\text{PEL (micrograms/cubic meter of air)} = 400/\text{No. hrs worked per day}$$

1.2.10 Material Containing Lead/Paint with Lead (MCL/PWL)

Any material, including paint, which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint or MCL using laboratory instruments with specified limits of detection (usually 0.01%). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.11 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of and centered at the nose or mouth of an employee.

1.2.12 Physical Boundary

Area physically roped or partitioned off around lead control area to limit

unauthorized entry of personnel.

1.3 DESCRIPTION

1.3.1 Description of Work

Construction activities impacting PWL or material containing lead which are covered by this specification include the demolition and/or removal of material containing lead in coatings of existing walls, ceilings, building structural steel, similar painted surfaces. If materials can be removed or modified during the demolition/installation process without disturbance of coatings, no abatement is necessary. All coatings shall be assumed to contain lead, PCB's and other heavy metals as defined in the paragraph entitled, "Lead", and as indicated on the drawings.

Work includes sampling and analysis of coatings to determine the control measures to be used, as well as their suitability for recycling and where they may be disposed.

1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Occupational and Environmental Assessment Data Report (if objective data is used to justify excluding the initial occupational exposure assessment); G

Lead Compliance Plan including CP approval (signature, date, and certification number); G

Competent Person qualifications; G

Training Certification of workers and supervisors; G

lead waste management plan; G

Certification of Medical Examinations; G

SD-06 Test Reports

sampling results; G

Occupational and Environmental Assessment Data Report; G

SD-07 Certificates

Testing laboratory qualifications; G

Third party consultant qualifications; G

Clearance Certification; G

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility; G

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Competent Person (CP)

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide documented construction project-related experience with implementation of OSHA's Lead in Construction standard (29 CFR 1926.62) which shows ability to assess occupational and environmental exposure to lead, experience with the use of respirators, personal protective equipment and other exposure reduction methods to protect employee health. Submit proper documentation that the CP is trained and licensed and certified in accordance with federal, State and local laws. The competent person shall be a licensed lead-based paint abatement Supervisor/Project Designer in the State of Florida.

1.5.1.2 Training Certification

Submit a certificate for each worker and supervisor, signed and dated by the accredited training provider, stating that the employee has received the required lead training specified in 29 CFR 1926.62(1) and is certified to perform or supervise deleading, lead removal or demolition activities in the state of Florida.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe analysis, testing, and reporting of airborne concentrations of lead. Use a laboratory participating in the EPA National Lead Laboratory Accreditation Program (NLLAP) by being accredited by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

1.5.1.4 Third Party Consultant Qualifications

Submit the name, address and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

- a. Verify training meets all federal, State, and local requirements.
- b. Review and approve Lead Compliance Plan for conformance to the applicable referenced standards.
- c. Continuously inspect PWL or MCL work for conformance with the approved plan.
- d. Perform (or oversee performance of) air sampling. Recommend upgrades or downgrades (whichever is appropriate based on exposure) on the use of PPE (respirators included) and engineering controls.
- e. Ensure work is performed in strict accordance with specifications at all times.
- f. Control work to prevent hazardous exposure to human beings and to the environment at all times.
- g. Supervise final cleaning of the lead control area, take clearance wipe samples if necessary; review clearance sample results and make recommendations for further cleaning.
- h. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead Compliance Plan

Submit a detailed job-specific plan of the work procedures to be used in the disturbance of PWL or MCL. The plan shall include a sketch showing the location, size, and details of lead control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, work practices, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking, hygiene facilities and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside of the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training and strategy, sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan.

The plan shall be developed by a certified planner/project designer in the State of Florida.

In occupied buildings, the plan shall also include an occupant protection program that describes the measures that will be taken during the work to protect the building occupants.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental

sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Compliance Plan.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62 and 29 CFR 1926.103. Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62. Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

1.5.2.5 Training

Train each employee performing work that disturbs lead, who performs MCL/PWL disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations. and address:

- a. Identification and classification of wastes associated with the work.
- b. Estimated quantities of wastes to be generated and disposed of.
- c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of USEPA and local hazardous waste permits, manifests and USEPA Identification numbers.
- d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.
- e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
- f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.
- g. Work plan and schedule for waste containment, removal and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Wastes shall be cleaned up and containerized daily.
- h. Include any process that may alter or treat waste rendering a hazardous waste non hazardous.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, State, and local authorities regarding lead. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

Licensing and certification in the state of Florida is required.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the Lead Waste Management Plan and the Lead Compliance Plan, including procedures and precautions for the work.

1.6 EQUIPMENT

1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust, fume and mist. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable or uncontaminated, reusable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during PWL or MCL handling and disposal, notify the rental agency in writing concerning the intended use of the equipment.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the lead removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better as determined by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any lead work.

3.1.1.2 Lead Control Area

a. Physical Boundary - Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside of the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Furnishings

Furniture and equipment will remain in the lead control area. Protect and cover furnishings or remove furnishings from the work area and store in a location approved by the Contracting Officer. Protect equipment in the work area.

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.1.7 Mechanical Ventilation System

a. To the extent feasible, use local exhaust ventilation or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

b. Vent local exhaust outside the building and away from building ventilation intakes or ensure system is connected to HEPA filters.

c. Use locally exhausted, HEPA filtered, power actuated tools or manual hand tools.

3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by completely establishing barriers and physical boundaries around the area or structure where PWL or MCL removal operations will be performed that do not create airborne dust.

Where demolition creates airborne dust, provide full containment or contain removal operations by the use of critical barriers and/or HEPA filtered exhaust, a negative pressure enclosure system with decontamination facilities and with HEPA filtered exhaust if required by the CP.

3.3 APPLICATION

3.3.1 Lead Work

Perform lead work in accordance with approved Lead Compliance Plan. Use procedures and equipment required to limit occupational exposure and environmental contamination with lead when the work is performed in accordance with 29 CFR 1926.62, and as specified herein. Dispose of all PWL or MCL and associated waste in compliance with federal, State, and local requirements.

3.3.2 Paint with Lead or Material Containing Lead Removal

Manual or power sanding or grinding of lead surfaces or materials is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for removing lead in the Lead Compliance Plan. Select lead removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this removal process in the Lead Compliance Plan.

3.3.2.1 Paint with Lead or Material Containing Lead - Indoor Removal

Perform manual or mechanical removal in the lead control areas using enclosures, barriers or containments and powered locally exhausted tools. Collect residue and debris for disposal in accordance with federal, State, and local requirements.

3.3.2.2 Paint with Lead or Material Containing Lead - Outdoor Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the Lead Compliance Plan. The worksite preparation (barriers or containments) shall be job dependent and presented in the Lead

Compliance Plan.

3.3.2.3 Alternative Removal

If disturbance of coatings could occur through means such as saw cutting, drilling or torch cutting, chemical removal of all coatings on all surfaces to a minimum extent of 4-inches beyond the area of the disturbance is acceptable in lieu of establishing lead control areas. All waste generated by chemical removal shall be considered as hazardous and be cleaned up and disposed of as specified herein.

3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn in the control area:

- a. Vacuum all clothing before entering the contaminated change room.
- b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.
- c. Shower.
- c. Change to clean clothes prior to leaving the clean clothes storage area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Conduct sampling for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

- a. The CP shall be on the job site directing the air and wipe sampling and inspecting the PWL or MCL removal work to ensure that the requirements of the contract have been satisfied during the entire PWL or MCL operation.
- b. Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least twenty-five percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
- c. Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken.
- d. Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the condition(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the

Contracting Officer give approval.

e. Before any work begins, a third party consultant shall collect and analyze baseline wipe and soil samples in accordance with methods defined by federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead disturbance or removal.

f. Surface Wipe Samples - Collect surface wipe samples on floors at a location no greater than 10 feet outside the lead control area at a frequency of once per day while lead removal work is conducted in occupied buildings. Surface wipe results shall meet criteria in paragraph "Clearance Certification.

3.4.1.2 Sampling After Removal

After the visual inspection, conduct soil sampling if bare soil is present during external removal operations and collect wipe and soil samples according to the HUD protocol contained in HUD 6780 to determine the lead content of settled dust in micrograms per square meter foot of surface area and parts per million (ppm) or for soil.

3.4.1.3 Testing of Material Containing Lead Residue

Test residue in accordance with 40 CFR 261 for hazardous waste, or dispose of as hazardous waste.

3.5 CLEANING AND DISPOSAL

3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the Lead Compliance Plan. Reclean areas showing dust or debris. After visible dust and debris is removed, wet wipe and HEPA vacuum all surfaces in the controlled area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before clearance testing.

3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

Certify surface wipe samples are not significantly greater than the initial surface loading determined prior to work.

For exterior work, soil samples taken at the exterior of the work site shall be used to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the operation. If soil lead levels either show a statistically significant increase above soil lead levels prior to work or soil lead levels above any applicable federal or state standard for lead in soil, the soil shall be remediated.

3.5.2 Disposal

a. All material, whether hazardous or non-hazardous shall be disposed in accordance with all laws and provisions and all federal, State or local regulations. Ensure all waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

b. Contractor is responsible for segregation of waste. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261.

c. Dispose of lead-contaminated material classified as hazardous waste at the KSC approved hazardous waste landfill on Government property.

d. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with 40 CFR 262 during the accumulation/collection timeframe. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

e. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility.

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SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS
01/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM B 117 (2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2008; AMD 1 2008) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 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.

1.3.4 Modification of References

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

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 05 00.00 40, "COMMON WORK RESULTS FOR ELECTRICAL".

1.6 ELECTRICAL INSTALLATION REQUIREMENTS

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

1.6.1 New Work

Provide electrical power for HVAC control systems under Division 26.

1.6.2 Modifications to Existing Systems

Where existing mechanical systems require modifications, provide electrical

components under Division 26.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

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

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

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COMMON PIPING FOR HVAC
02/09

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2005) Steel Construction Manual

AMERICAN WELDING SOCIETY (AWS)

AWS WHB-2.9 (2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASME INTERNATIONAL (ASME)

ASME B16.22 (2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.3 (2006) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.39 (2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300

ASME B16.5 (2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.9 (2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.3 (2008) Process Piping

ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A 197/A 197M (2000; R 2006) Standard Specification for Cupola Malleable Iron

ASTM A 234/A 234M (2010a) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

ASTM A 307 (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile

Strength

- ASTM A 53/A 53M (2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A 563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts
- ASTM A 580/A 580M (2008) Standard Specification for Stainless Steel Wire
- ASTM B 209 (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- ASTM B 32 (2008) Standard Specification for Solder Metal
- ASTM B 43 (2009) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
- ASTM B 88 (2009) Standard Specification for Seamless Copper Water Tube
- ASTM C 534/C 534M (2008) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
- ASTM C 547 (2007e1) Standard Specification for Mineral Fiber Pipe Insulation
- ASTM C 552 (2007) Standard Specification for Cellular Glass Thermal Insulation
- ASTM D 774/D 774M (1997; R 2007) Bursting Strength of Paper
- ASTM E 84 (2010b) Standard Test Method for Surface Burning Characteristics of Building Materials
- ASTM E 96/E 96M (2005) Standard Test Methods for Water Vapor Transmission of Materials
- ASTM F 104 (2003; R 2009) Standard Classification System for Nonmetallic Gasket Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

- MSS SP-58 (2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
- MSS SP-69 (2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
- MSS SP-72 (2010) Ball Valves with Flanged or

Butt-Welding Ends for General Service

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds (1999) National Commercial & Industrial Insulation Standards

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- CID A-A-1922 (Rev A; Notice 2) Shield, Expansion (Caulking Anchors, Single Lead)
- CID A-A-1923 (Rev A; Notice 2) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
- CID A-A-1924 (Rev A; Notice 2) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors)
- CID A-A-1925 (Rev A; Notice 2) Shield Expansion (Nail Anchors)
- CID A-A-55614 (Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)
- CID A-A-55615 (Basic; Notice 2) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)

UNDERWRITERS LABORATORIES (UL)

- UL 723 (2008; Reprint Sep 2010) Test for Surface Burning Characteristics of Building Materials

1.2 GENERAL REQUIREMENTS

Submit Records of Existing Conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Document existing conditions using digital photography and submit .jpg files on a DVD or CD. Commencement of work constitutes Contractor's acceptance of the existing conditions.

Submit Catalog Data for pipes, valves and specialties consisting of fabrication and assembly details to be performed in the factory.

Submit Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work if the work under Fixed Price Option 1 is performed. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit the following for pipes, valves and specialties showing conformance with the referenced standards contained within this section.

Coordination Drawings; G
Record Drawings

SD-03 Product Data

Submit Manufacturer's Catalog Data for the following items:

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Insulation Materials
Jacketing
Sealants
Supporting Elements

SD-06 Test Reports

Submit test reports on the following tests in accordance with paragraph entitled, "Piping Installation," of this section.

Hydrostatic Tests
Valve-Operating Tests
System Operation Tests

SD-07 Certificates

Submit Records of Existing Conditions by the Contractor prior to start.

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been

substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.2.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.2.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work.

Give instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

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

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

1.8 SCOPE

The scope of work to be performed under this section is generally described as modifications to existing piping systems in support of the installation of new control system sensors/devices, replacement of existing sensors/devices, removal of existing sensors/devices and relocation of existing "loop" control valves under the fixed price option(s). New materials shall match existing; where uncertainty exists as to the existing material characteristics, request clarification from the Contracting Officer prior to proceeding with the work.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Type BCS, Black Carbon Steel

Pipe 1/8 through 10 inches shall be Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M, Type E, Grade B (electric-resistance welded) or Type S (seamless). Grade A should be used for permissible field bending, in both cases.

Pipe 12 through 24 inches shall be 0.375-inch wall seamless black carbon steel, conforming to ASTM A 53/A 53M, Type E, Grade B (electric-resistance welded) or Type S (seamless).

Fittings 2 inches and under shall be 150-pounds per square inch, gage (psig) working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3. Reducing fittings shall be of the tapered type except where bushings are specifically called for. Fittings for controls instrumentation devices shall be brass pipe nipples and fittings conforming to ASTM B 43, regular wall thickness or Type 304/316 stainless steel.

Unions 2 inches and under shall be 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39. Unions for controls instrumentation shall be brass, Class 250, ASTM A 197/A 197M, or 304/316 stainless steel, Class 150.

Fittings 2-1/2 inches and over shall be Steel butt weld, conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness.

Flanges 2-1/2 inches and over shall be 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

Outlets for branch connections for control instrumentation shall be of the forged carbon steel welded-on type, Class 3000, with butt weld, threaded or socket type outlet as required to coordinate with the sensor.

2.1.2 Type CPR, Copper

2.1.2.1 Type CPR-A, Copper Above Ground

Tubing 2 inches and under shall be seamless copper tubing, conforming to ASTM B 88, Type L hard-drawn.

Fittings 2 inches and under shall be 150-psigwsp wrought-copper solder joint fittings conforming to ASME B16.22.

Unions 2 inches and under shall be 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

Solder must be 60-40 tin-antimony, alloy Sb-5, conforming to ASTM B 32.

2.2 PIPING SPECIALTIES

2.2.1 Pressure Snubbers

303 stainless steel housing NPT female by male porous 316 stainless steel metal disk type for use with liquids; capacity of 3.0 cubic feet per hour at 1 psi pressure differential, rated for not less than 5,000 psi, basis of design OMEGA.

2.3 VALVES

2.3.1 Ball Valves

Ball valves shall conform to MSS SP-72 for Figure 1B, vertically split (two-piece) body and shall be rated for service at not less than 175 psig at 200 degrees F. Valve bodies in sizes 2 inches and smaller shall be screwed-end connection-type constructed of Class A copper alloy. Balls and stems of valves 2 inches and smaller shall be stainless steel, balls shall be full port type. Valves shall be suitable for flow from either direction and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. Stems shall be blow-out proof type. Seats and seals shall be tetrafluoroethylene.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Bolting

Flange and general purpose bolting shall be hex-head and must conform to ASTM A 307, Grade B (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

2.4.2 Flange Gaskets

Compressed non-asbestos sheet, conforming to ASTM F 104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.4.3 Pipe Thread Compounds

Use tetrafluoroethylene tape not less than 2 to 3 mils thick in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips. Tetrafluoroethylene dispersions and other suitable compounds shall be used for all other applications upon approval by the Contracting Officer; however, no lead-containing compounds shall be used in potable water systems.

2.5 SUPPORTING ELEMENTS

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and

spring-cushion, variable, or constant supports. All supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, MSS SP-58, and MSS SP-69 except as noted.

Supporting elements exposed to weather shall be hot-dip galvanized or stainless steel. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614, and CID A-A-55615. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

2.5.1 Building Structure Attachments

2.5.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614, and CID A-A-55615

Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2.5.1.2 Beam Clamps

Beam clamps shall be center-loading MSS SP-58 Type 20, 21, 28, 29 or 30.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 Type 19, 20, 25 or 27 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, rod diameter shall be determined in accordance with referenced standards.

2.5.1.3 C-Clamps

Do not use C-clamps.

2.5.2 Horizontal Pipe Attachments

2.5.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that split-band-type rings shall be used in sizes up to 1-inch ips.

Support piping in sizes through 8-inch ips inclusive by MSS SP-58 Type 1 attachments.

MSS SP-58 Type 1 assemblies shall be used on vapor-sealed insulated piping and shall have an inside diameter larger than pipe plus insulation being supported to provide adequate clearance during pipe movement.

Support piping in sizes larger than 8-inch ips with MSS SP-58 Type 41, or 44 through 46, pipe rolls.

MSS SP-58 Type 40 shields shall be used on all insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

2.5.3 Vertical Pipe Attachments

Vertical pipe attachments shall be MSS SP-58 Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.5.4 Hanger Rods and Fixtures

Only circular cross section one-piece rod hangers shall be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved by the Contracting Officer.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.5.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

2.6 INSULATING SYSTEMS

Pipe Insulation Materials shall be limited to those listed herein and shall meet the following requirements:

2.6.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

- a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier, in equipment/mechanical rooms, provide with PVC or aluminum jacket.
- b. Flexible Elastomeric Cellular Insulation (limited to use for cold surfaces of instrumentation sensors extending beyond pipe insulation): ASTM C 534/C 534M, Grade 1, Type I or II. Type II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation.

2.6.2 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

- a. Mineral Fiber (Indoor): ASTM C 547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.6.3 Jackets

2.6.3.1 Aluminum Jackets

Aluminum Jacketing shall be embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

Elbow jackets shall be 0.016-inch thick, deep-drawn, die-shaped, two-piece components for long-radius, butt-weld elbows manufactured from the same materials as specified for jackets, with factory-attached vapor-seals on underside of the aluminum. Preinsulated, voidless, jacketed components conforming to these specifications shall be used. Preinsulated fittings shall have a 2-inch overlay beyond route for weld bead.

2.6.3.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.6.4 Vapor Barrier All Service Jacket (ASJ)

For cold piping, the vapor barrier shall be a multi-ply laminate -white vapor barrier jacket- superior performance (less than 0.02 permeability when tested per ASTM E 96/E 96M). Vapor barrier shall meet UL 723 or ASTM E 84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 65 psi per ASTM D 774/D 774M. Tensile strength 40 lb/inch width (PSTC-1000).

2.6.5 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.6.6 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance

with ASTM E 84.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Test reports for Hydrostatic Tests, Valve-Operating Tests, and System Operation Tests shall be provided by the Contractor, in compliance with referenced standards contained within this section. Hydrostatic testing of new instrumentation wells and take-offs may be made at system normal operating pressure and shall be performed prior to reinsulation. Under the fixed price option to relocate the loop control valves, piping shall be hydrostatically tested at 150 psi for 2 hours with no loss in pressure. Either provide a means of system isolation, or at the Contractors option, existing valving where present may be used, but the Government is not responsible for the valves ability to close off properly.

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-69, and AWS WHB-2.9.

Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric couplings (or unions) or flanged with gaskets rated for the service.

Ream all pipe ends before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Provide screwed unions, or bolted flanges as indicated and wherever required to permit convenient removal of equipment, valves, control sensors/devices, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Field welded joints shall conform to the requirements of the AWS WHB-2.9, ASME B31.3, and ASME BPVC SEC IX.

3.2 VALVES

Provide valves at instrumentation equipment and where indicated and as specified.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

3.3 SUPPORTING ELEMENTS INSTALLATION

Provide supporting elements in accordance with the referenced codes and standards. Generally, existing piping supports are to remain in-place with no modification, except under the fixed price option to relocate the existing loop control valves, either temporary supports shall be erected to support sections of cut piping, or permanent supports provided.

Support piping from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Load rating for all pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, the allowable span must be reduced proportionately:

<u>PIPE SIZE</u> <u>INCHES</u>	<u>ROD SIZE</u> <u>INCHES</u>	<u>STEEL PIPE</u> <u>FEET</u>	<u>COPPER PIPE</u> <u>FEET</u>
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	10	8
2-1/2 to 3-1/2	1/2	12	12
4 to 5	5/8	16	14
6	3/4	16	16
8 to 12	7/8	20	20
14 to 18	1	20	20
20 and over	1-1/4	20	20

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, provide only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

3.4 INSULATION APPLICATION

3.4.1 INSULATION APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and

equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.4.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.4.2 Pipe Insulation Material and Thickness

TABLE 1
Insulation Material For Piping (°F)

Service	Material	Spec.	Type	Class	Vapor Retarder/ Vapor Barrier Required
Chilled Water (Supply & Return)	Cellular Glass	ASTM C 552	II	2	Yes
Heating Hot Water Supply & Return,	Mineral Fiber	ASTM C 547	I	1	No

TABLE 2
Piping Insulation Thickness (inch and °F)

Service	Material	Tube And Pipe Size (Inches)					
		<1	1- <1.5	1.5- <4	4- <8	>or = to 8	
Chilled Water (Supply & Return)	Cellular Glass	1.5	2	2	2	3	
Heating Hot Water	Mineral Fiber	1.5	1.5	2	2	2	

TABLE 2
Piping Insulation Thickness (inch and °F)

Service	Material	Tube And Pipe Size (Inches)					
		<1	1- <1.5	1.5- <4	4- <8	>or = to 8	

Supply & Return,

3.4.3 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated per Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

- a. Chilled water.

3.4.3.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2, except where existing thickness varies, request direction from the Contracting Officer.

3.4.3.2 Jacket for Mineral Fiber, Cellular Glass, Insulated Pipe

Exterior insulation shall be provided with an aluminum jacket. Piping in mechanical rooms shall be provided with a jacket to match the existing.

3.4.3.3 Installing Insulation for Straight Runs of Cold Pipe

- a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints. Match adjacent jacketing.
- c. Breaks and punctures in non-metal jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or greater than 3 ply laminate jacket - less than 0.02 perm adhesive tape. The patch shall extend not less than 1-1/2 inches past the break.
- d. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating.
- e. Cold surfaces such as thermowells, RTD sensors and flow meters extending beyond the specified insulation thickness shall be insulated with flexible elastomeric type insulation, thickness as required to prevent condensation. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the device whenever possible. All seams and butt joints shall be secured and sealed with adhesive. Self seal products shall not be used. Insulation

shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted.

3.4.3.4 Insulation for Cold Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating.
- b. Precut or preformed insulation shall be placed around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter.
- c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation shall be protected by factory vapor retarder jackets aluminum preformed fitting covers or PVC fitting covers to match existing. Where FSK or glass-fab jacketing is present, new insulation shall receive two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Where fitting insulation butts to hot water fiberglass pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.
- d. Items attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

3.4.4 Hot Pipelines

3.4.4.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated per Table 2. This includes but is not limited to the following:

- a. Hot water heating.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket, field applied aluminum, or seal welded PVC to match existing.

3.4.4.2 Insulation for Fittings and Accessories

- a. General. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the

location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

b. Precut or Preformed. Precut or preformed insulation shall be placed around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

c. Rigid Preformed. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter.

3.5 PAINTING

Where existing insulated surfaces are painted, new insulation shall be painted to match.

-- End of Section --

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PROGRAMMABLE LOGIC CONTROL (PLC) SYSTEMS FOR HVAC
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PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

- ASME B16.18 (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
- ASME B16.22 (2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- ASME B16.26 (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
- ASME B31.1 (2007; Addenda a-2008) Power Piping

ASTM INTERNATIONAL (ASTM)

- ASTM B 117 (2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
- ASTM B 32 (2008) Standard Specification for Solder Metal
- ASTM B 75 (2002) Standard Specification for Seamless Copper Tube
- ASTM B 88 (2009) Standard Specification for Seamless Copper Water Tube
- ASTM D 1238 (2004c) Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D 1693 (2008) Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- ASTM D 635 (2006) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
- ASTM D 638 (2008) Standard Test Method for Tensile Properties of Plastics
- ASTM D 792 (2008) Density and Specific Gravity

(Relative Density) of Plastics by
Displacement

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO/IEC 8802-3 (2000) Information Technology -
Telecommunications and Information
Exchange Between Systems - Local and
Metropolitan Area Networks - Specific
Requirements - Part 3: Carrier Sense
Multiple Access with Collision Detection
(CSMA/CD) Access Method and Physical Layer
Specifications

JOHN F. KENNEDY SPACE CENTER (KSC)

80K02217 (March 2007) KCCS Software Architecture

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2008; AMD 1 2008) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 508 (1999; R thru 2008) Industrial Control
Equipment

UL 508A (2001; R 2003 thru 2009) Standard for
Industrial Control Panels

1.2 DEFINITIONS

1.2.1 BAS

Building Automation Systems, including PLC (Programmable Logic Controls)
used for facility supervisory control and data acquisition (SCADA).
Inclusive of all components, devices, wiring, and interfaces which comprise
the system.

1.2.2 BAS Owner

The regional or local user responsible for managing all aspects of the BAS
operation, including: network connections, workstation management,
submittal review, technical support, control parameters, and daily
operation. The BAS Owner for this project is NASA.

1.2.3 Bridge

Network hardware that connects two or more network segments at the physical
and data link layers. A bridge may also filter messages.

1.2.4 Broadcast

A message sent to all devices on a network segment.

1.2.5 Cablefast Terminal Block (Fastblock)

A pre-wired multi-cable connector between a PLC I/O card and the I/O signal
wiring consisting of a multi-pin plug for connection to the I/O card at one

end and a din-rail mount terminal block at the other.

1.2.6 Central Processing Unit (CPU) Module

Digital high speed processor modules designed for in-rack mounting with internal battery backed internal RAM, LED status lights and built-in communication ports.

1.2.7 Communications Module

Ethernet TCP/IP and modbus TCP-based module designed for in-rack mounting, 10/100 Mbps data transfer rate with either copper or fiber optic conductor.

1.2.8 Device

Any control system component.

1.2.9 Ethernet

A family of local-area-network technologies providing high-speed networking features over various media.

1.2.10 Firmware

Software programmed into read only memory (ROM), flash memory, electrically erasable programmable read only memory (EEPROM), or erasable programmable read only memory (EPROM) chips.

1.2.11 Functional Test

Functional Test (FT): Test of individual components/elements of the control system to make sure the wiring is completed, setpoints and similar parameters are fully defined and acceptable, individual points are operational in all modes and the OWS/HMI graphical interfaces are functioning. The Contractor shall write and refine the FT's based upon input and approval of the CxA who shall witness all FT's. The Contractor performs the FT's.

1.2.12 Gateway

Communication hardware connecting two or more different protocols, similar to human language translators. The Gateway translates one protocol into equivalent concepts for the other protocol. In PLC applications, a gateway has Modbus on one side and non-Modbus (usually proprietary) protocols on the other side.

1.2.13 Human Machine Interface (HMI)

A device that allows for system interrogation, monitoring and access to system operating parameters generally at the "floor" level (i.e. on the PLC).

1.2.14 Hub

A common connection point for devices on a network.

1.2.15 Internet Protocol (IP, TCP/IP, UDP/IP)

A communication method, the most common use is the World Wide Web. At the

lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.2.16 Input/Output (I/O)

Physical inputs and outputs to and from a device, although the term sometimes describes software, or "virtual" I/O. See also "Points". PLC I/O reside in discrete modules which plug into slots on racks. Remote I/O refers to input/output modules located in racks without an integral CPU, but are interconnected to racks with a CPU.

1.2.17 IP subnet

Internet protocol (IP) identifies individual devices with a 32-bit number divided into four groups from 0 to 255. Devices are often grouped and share some portion of this number. For example, one device has IP address 209.185.47.68 and another device has IP address 209.185.47.82. These two devices share Class C subnet 209.185.47.00

1.2.18 Local-Area Network (LAN)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.2.19 Modbus

A communication protocol for use with PLC-based controllers available in different versions including RTU (serial), ASCII (serial), TCP/IP and Plus versions.

1.2.20 Master-Slave/Token-Passing (MS/TP)

ISO/IEC 8802-3. MSTP uses twisted-pair wiring for relatively low speed and low cost communication (up to 4,000 ft at 76.8K bps).

1.2.21 Network

Communication technology for data communications. Approved network types are Ethernet TCP/IP, Modbus TCP and other Modbus protocols.

1.2.22 Peer-to-Peer

Peer-to-peer refers to devices where any device can initiate and respond to communication with other devices.

1.2.23 Functional Test (FT)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The FT is performed after installation, testing, and balancing of mechanical systems. Typically the FT is performed by the Contractor in the presence of the Government.

1.2.24 PID

Proportional, integral, and derivative control; three parameters used to

control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

1.2.25 Programmable Logic Controller

An electronic digital controller, consisting of power, communications, processor and input/output modules with internal programming logic, which performs control functions.

1.2.26 PLC System

A network of programmable logic controllers, communication architecture, and user interfaces. A PLC system may include programming, sensors, actuators, switches, relays, factory controls, operator workstations, human machine interface, and various other devices, components, and attributes.

1.2.27 Power Supplies

Modular components for PLC racks, provide power for the system rack components (CPU, communications and I/O modules) and provide for adequate shutdown time upon a loss of power.

Panel power supplies provide conversion of 120 volt AC input power to regulated 24 VDC output for powering PLC power and supplies and control panel devices/circuits.

1.2.28 Points

Physical and virtual inputs and outputs. See also "Input/Output".

1.2.29 Rack

A physical piece of hardware with a specific number of slots which accepts PLC automation platform modules such as power supplies, CPU's, communication network, and discrete input/output modules. It distributes the power and provides communication to all modules located in the rack, also referred to as a chassis or backplane.

1.2.30 Repeater

A network component that connects two or more physical segments at the physical layer.

1.2.31 Router

A router is a component that joins together two or more networks using different LAN technologies.

1.2.32 Signal Wiring

Signal and/or device wiring is wiring between controllers and end devices (input/output devices). It includes multi-conductor cabling and wiring between devices such as switches, indicators, displays, relays and similar items.

1.2.33 Wiring

The term wiring is inclusive of all types of wiring and cabling, inclusive of power, communication, and signal systems, and includes associated

conduit and raceway systems.

1.3 PROGRAMMABLE LOGIC CONTROL PLC SYSTEMS FOR HVAC DESCRIPTION

- a. Remove portions of the existing Andover Infinity based Arcnet Network DDC system as indicated, including but not by way of limitation, controllers, cabinets, supports, communication, signal and power wiring/conduit, transducers, devices and accessories; replace with new PLC based controls including but not by way of limitation, racks, processors, power supplies, input/output modules, remote I/O, chiller gateways, HMI's, servers, enclosures, communications, signal and power wiring/conduit, transducers, devices and accessories, and a SCADA based operators workstation; connection of Legacy Andover Infinity based DDC system controller to the base-wide LAN (ATXS).
- b. The existing DDC system is manufactured by Andover. The server and operator workstation are located at M7-407, the Industrial Area Chiller Plant (IACP).
- c. The existing manual control panel is to be removed and a new panel fabricated and installed as part of the work to be performed.

1.3.1 Design Requirements

The Contractor is solely responsible for the detailed field verification, design, installation, programming, graphics, performance verification testing, commissioning, and training associated with providing a complete, fully functional replacement PLC-based control system which meets the requirements of the design documents and the sequences of operation. Approval of individual components and drawings shall not relieve the Contractor of the responsibility to coordinate with existing conditions, the characteristics and wiring configuration of existing sensors and controlled devices and provide all necessary engineering, components, programming, testing, verification and calibration.

Cabinet layouts are shown on the documents for the purpose of demonstrating the general intent of coordination with existing conditions and conductors which are to be reused; the panel layouts are not intended nor suitable for fabrication, nor do they contain or illustrate all of the equipments or elements required to meet the project requirements. The design of the panels inclusive of determining and sizing power supplies, heat dissipation considerations, the type and quantity of PLC components and accessories, layout configuration and mounting is the exclusive responsibility of the Contractor.

Software development/system architecture shall be coordinated with the requirements of KSC document 80K02217, "KCCS Software Architecture", except I/O point naming should be consistent with existing equipment designations and nomenclature.

Graphics development shall be in accordance with the requirements of document KSC-TA-11569 and standard Government furnished Citect graphic libraries which will be made available to the Contractor.

All necessary wiring within panels and between panels and input/output devices shall be provided; this wiring is not shown on the documents. Generally 120-volt power and communications will be extended to control panels under Division 26 and 27. All other wiring including extension of power wiring to input/output devices is the responsibility of this section.

1.3.1.1 Control System Drawings Title Sheet

Provide a title sheet for the control system drawing set. Include the project title, project location, contract number, the controls contractor preparing the drawings, an index of the control drawings in the set, and a legend of the symbols and abbreviations used throughout the control system drawings.

1.3.1.2 List of I/O Points

Also known as a Point Schedule, provide for each input and output (I/O) point physically connected to a digital controller: point name, point description, point type (Analog Output (AO), Analog Input (AI), Binary (discrete) Output (BO/DO), Binary (discrete) Input (BI/DI)), point sensor range, point actuator range, point address, and point connection terminal number. Unique schedules for each PLC shall be provided. Where remote I/O is used, provide a unique schedule for each grouping (rack) of I/O points.

1.3.1.3 Control System Components List

Provide a complete list of control system components installed and existing devices interfaced with, on this project, to include both existing and new devices. Include for each controller and device: control system schematic name, control system schematic designation, device description, manufacturer, and manufacturer part number and identify whether it is new or existing. For sensors, include point name, sensor range, and operating limits. For valves, include body style, Cv, design flow rate, pressure drop, valve characteristic (linear or equal percentage), and pipe connection size. For actuators, include point name, spring or non-spring return, modulating or two-position action, normal (power fail) position, nominal control signal operating range (0-10 volts DC or 4-20 milliamps), and operating limits.

1.3.1.4 Control System Schematics

Provide control system schematics. Unique schematics for each PLC and remote I/O panel, DDCP-2 backplane and manual panel shall be provided. Include the following:

- a. Building floor plan showing location of each input and output device, controlled equipment, controllers, starter, variable frequency drive, PLC and remote I/O cabinets, and networking devices coordinated with nomenclature used for the component wiring diagrams and PLC communication architecture schematic. The intent of this drawing is to provide the physical location of all components, both new and existing, shown in the component wiring diagram and PLC communication architecture schematic.
- b. Flow diagram for each system illustrating the HVAC equipment and I/O sensors/devices
- c. Name or symbol for each control system component, such as V-1 for a valve
- d. Setpoints, with differential or proportional band values
- e. Written sequence of operation for the HVAC equipment

- f. Valve Schedules, with normal (power fail) position
- g. Complete parts list with description, manufacturer, model number and quantity.

1.3.1.5 Component Wiring Diagrams

Point-to-point wiring diagrams shall be provided for the BAS SCADA/PLC control system inclusive of communications networking, power sources and I/O points. The diagram(s) shall be comprehensive and include both wiring being installed under this contract, as well as existing wiring and devices being interfaced with, refer to specification section 02 41 00, "SELECTIVE DEMOLITION", paragraph entitled "Existing Conditions". Organize wiring diagrams by PLC, remote PLC I/O, DDCP-2 and manual panel.

Provide a wiring diagram for each type of input device and output device typical schematics for identical equipment is not allowed. Indicate how each device is wired and powered; showing typical connections at the digital controller and power supply. Show for all field connected devices such as control relays, motor starters, variable frequency drives, actuators, sensors, and transmitters.

1.3.1.6 Terminal Strip Diagrams

Provide a diagram of each new and existing terminal strip. Indicate the terminal strip location, termination numbers, wire color, wire tag designation and associated point names. These diagrams may be contained within the component wiring diagrams.

1.3.1.7 Communication Architecture Schematic

Provide a schematic showing the project's entire Ethernet communication network, including addressing used for LANs, LAN devices including routers and bridges, modbus networks and connection to remote I/O gateways, controllers, workstations, and field interface devices. If applicable, show connection to existing networks.

1.3.1.8 Software

On the communication architecture schematic provide a listing of all of the software including the version number installed on each device. Provide a summary table/legend with a numeric-alphabetic identifier for each type of software and mark each device with the appropriate software identifier(s).

1.4 SUBMITTALS

Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item listed, that clearly show compliance with the project specifications.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following according to 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

existing control device conditions; G

Documenting the existing condition and functionality of all existing control devices slated to remain.

Provide a sensor location summary;G

SD-02 Shop Drawings

Shop drawings shall be produced in AutoCAD Version 2009 or later; graphics shall be produced in AutoCAD Version 2009, Visio or other protocol as approved by the Contracting Officer.

Include the following in the project's control system drawing set:

Control system drawings title sheet; G

List of I/O Points; G

Control System Components List; G

Control system schematics; G

Point-to-point wiring diagrams; G

Component wiring diagrams; G

PLC panel layout drawings; G

Remote I/O panel layout drawings; G

Manual Panel layout drawings; G

DDCP-2 Panel layout drawings; G

Terminal strip diagrams; G

Communication architecture schematic; G

Software 10%; G Provide an initial software submittal including an overview of the proposed system architecture, identifying program locations, purpose, language and rudimentary logical flow charts showing the interaction between sub-systems. Initiate an I/O point description listing showing each point, it's naming convention, units of measure, properties, range, alarm value(s), failed state, and password level accessibility. Identify areas/fields where government input is needed to provide clarification or establish requirements. Provide specific examples of programming and text-based commentary defining variables, the program purpose, SOO and purpose. The intent of this submittal is for the Contractor to provide a high level overview of the proposed system, as well as seek input from the Government to enable the Contractor to proceed with software development in an effort to minimize rework effort on the part of the Contractor.

Software 50%; G Build upon the information presented in the 10% submittal. Submit documentation for PLC and Citect Cicode programming in both hard copy and electronic copy in the application program format. Include an on-site meeting to review the submitted information with the Contracting Officer's

representative.

Software 90%; G Submit documentation incorporating 50% submittal comments for PLC and Citect Cicode programming in both hard copy and electronic copy in the application program format. Include an on-site meeting to review the submitted information with the Contracting Officer's representative.

Graphics 10%; G Provide an initial graphics submittal identifying the number, type and format of the graphic screens to be provided, and the "look and feel" of the graphics interface for both the PLC HMI's and the operators workstation. Identify areas where additional information is needed from the Government for further graphic development. Provide a color hard copy and arrange for an on-site follow-up meeting to present the graphics on a PC in a dynamic format.

Graphics 50%; G

Submit documentation for each graphical screen (data and pictorial) for each PLC mounted HMI and for the CITECT Operators Workstation, as well as PLC programming. Provide a color hard copy and arrange for an on-site follow-up meeting where the graphics can be presented on a PC in a dynamic format.

Graphics 90%; G

Submit documentation for each graphical screen (data and pictorial) for each PLC mounted HMI and for the CITECT Operators Workstation, fully incorporating the 50% review comments. Provide a color hard copy and arrange for an on-site follow-up meeting where the graphics can be presented on a PC in a dynamic format.

SD-03 Product Data

Programmable Logic Controllers; G

Include PLC components including modules (CPU's, power supplies, communications/network, input/output cards, remote input/output cards), racks, display units/terminals, HMI's and modular wiring connectors.

Legacy Communication/Network Devices; G

PLC and System Software; G

Operator Workstation; G

Operating System Software; G

SCADA Software

HMI Configuration Software; G

Sensors and Input Hardware; G

Output Hardware; G

Surge and transient protection; G

Indicators; G

Electrical Devices; G

Pneumatic tubing; G

Programmable Logic Controller Network; G

Cabinets; G

Cable Management Systems; G

Cable Identification; G

Chiller Interface; G

server; G

Power Supplies; G

Cablefast Terminal Block; G

SD-05 Design Data

Functional Testing Plan; G

calibration report; G

Pre-Functional Testing Checklist; G

SD-06 Test Reports

PLC Panel Test; G

Functional Testing Report; G

SD-07 Certificates

Contractor's Qualifications; G CITECT training

SD-09 Manufacturer's Field Reports

Pre-Functional Test Checklist; G

SD-10 Operation and Maintenance Data

Comply with requirements for data packages in Section 01 78 23
OPERATION AND MAINTENANCE DATA, except as supplemented and
modified in this specification.

Controls System Operators Manuals, Data Package 4; G

SD-11 Closeout Submittals

Training documentation; G

Software documentation and licenses; G, refer to 01 78 00,
"Closeout Submittals"

1.5 RELATED WORK

Related work specified elsewhere that applies to the work of this section includes:

Section 01 78 00	"CLOSEOUT SUBMITTALS"
Section 01 78 23	"OPERATION AND MAINTENANCE DATA"
Section 01 91 00	"COMMISSIONING"
Section 02 41 00	"SELECTIVE DEMOLITION"
Section 23 03 00.00 20	"BASIC MECHANICAL MATERIALS AND METHODS"
Section 26 05 00.00 40	"COMMON WORK RESULTS FOR ELECTRICAL"
Section 27 10 00	"BUILDING TELECOMMUNICATIONS CABLING SYSTEMS"

1.6 QUALITY ASSURANCE

1.6.1 Standard Products

Provide material and equipment that are standard manufacturer's products currently in production and supported by a local service organization.

1.6.2 Delivery, Storage, and Handling

Handle, store, and protect equipment and materials to prevent damage before and during installation according to manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6.3 Operating Environment

Protect components from humidity and temperature variation, dust, and contaminants. If components are stored before installation, keep them within the manufacturer's limits.

1.6.4 Finish of New Equipment

New equipment finishing shall be factory provided. Manufacturer's standard factory finishing shall be proven to withstand 125 hours in a salt-spray fog test. Equipment located outdoors shall be proven to withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be according to ASTM B 117, with acceptance criteria as follows: immediately after completion of the test, the finish shall show no signs of degradation or loss of adhesion beyond 0.125 inch on either side of the scratch mark.

1.6.5 Verification of Existing Conditions

The Contractor shall document the existing control device conditions to include verification of proper functionality of system I/O devices which are to remain. The Contractor shall use the existing Andover OWS to verify

points in conjunction with field observations. Provide a listing of all points arranged by facility to include point identifier, name, output or input type (voltage/current), range and the results of the testing (pass/fail). Coordinate with the requirements of Section 02 41 00, "SELECTIVE DEMOLITION", paragraph, "Existing Conditions Documentation."

1.6.6 Verification of Dimensions

The contractor shall verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing work. PLC panel size and layout shown on the drawings is diagrammatic in nature and intended to only show a conceptual general layout of selected cabinet components. The control panel designer shall verify available cabinet space, minimum clearances between components and is solely responsible for sizing of cable management systems. Overall panel sizes shall be considered as minimum size and shall not be reduced in size and layout shall follow the conceptual arrangement to the extent possible. Where alternate panel sizes or component locations are required or suggested/desirable submit a block diagram prior to development of full PLC panel layout drawings and Remote I/O panel layout drawings.

1.6.7 Contractor's Qualifications

Submit documentation certifying the controls Contractor performing the work has completed at least three PLC systems installations utilizing Schneider Electric "Quantum" PLC's, with at least as many points, and programmed sequences of operation.

The Contractor shall have at least 1 individual proficient in the use of CITECT SCADA software. Proficiency will be exhibited by satisfactory completion of not less than 3 projects utilizing CITECT, and authorized CITECT training including "Cicode Fundamentals" and "CITECT HMI/SCADA Configuration".

1.6.8 Modification of References

The advisory provisions in ASME B31.1 and NFPA 70 are mandatory. Substitute "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.6.9 Project Sequence

The control system work for this project shall be performed in phases and proceed in the following order:

- a. Perform phase-by-phase field verification of existing conditions, submit and receive approval for system as-built documentation.
- b. Submit and receive approval on the Shop Drawings, Product Data, and Certificates specified under the paragraph entitled "SUBMITTALS."
- c. Fabricate PLC/RIO/manual panels and perform factory testing,
- d. Perform the control system installation work in phases, including all field check-outs and tuning.
- e. Submit and receive approval of the Functional Testing Plan and the Pre-Functional Test Checklist for each project phase as specified

under the paragraph "FUNCTIONAL TESTING." Calibrate all devices and submit calibration report.

- f. Complete the Pre-Functional testing checklist and submit for approval. Once approved, perform the Functional Testing for each project phase.
- g. Submit and receive approval on the Functional Testing Report for each project phase. Participate in system commissioning.
- h. Submit and receive approval on the Training Documentation specified under the paragraph "INSTRUCTION TO GOVERNMENT PERSONNEL". Submit at least 30 days before training.
- i. Submit and receive approval of the Controls System Operators Manual specified under the paragraph "CONTROLS SYSTEM OPERATORS MANUALS."
- j. Deliver the final Controls System Operators Manuals.
- k. Conduct the Phase I Training.
- l. Conduct the Phase II Training.
- m. Submit and receive approval of Closeout Submittals.

PART 2 PRODUCTS

2.1 PLC SYSTEM

- a. Provide a networked PLC system for stand-alone control. Include all programming, objects, and services required to meet the sequences of operation. Provide Ethernet communication between the PLC system and new chiller gateways (Chillers 3 through 6), Chillers 1 and 2 and the power meters. With the exception of the chiller interface, all PLC equipment, software and HMI's shall be of the same manufacturer to ensure compatibility.
- b. Provide 2 (1 redundant) operator workstations and 2 (1 redundant) servers with complete interface software capable of programming, configuring, and monitoring the controllers and networked equipment. The server and workstation shall be located at M7-407, the Industrial Area Chiller Plant.

2.1.1 Programmable Logic Controllers

Programmable logic controllers shall be UL 508 rated, and shall be as manufactured by Schneider Electric, Modicon Quantum. PLC's shall be of customizable modular construction including racks, CPU's, power supplies, networking/communications and input/output modules and related components.

For chiller one and two control panels, new PLC Ethernet controllers are to be provided to match the existing PLC as manufactured by Allen Bradley. Provide Model 1785-L20E Ethernet/IP PLC-5/20 controller with 16K word SRAM.

2.1.1.1 Racks

Racks shall include a metal frame connectors for module/rack connection, tapped module mounting holes, rack mounting holes and grounding terminals. Racks shall have between 3 - 16 slots as required for the application.

Racks shall include internal bus for distribution of power and controls signals, slots shall be universal/unassigned type with no assigned or reserved slots and shall be capable of use as local I/O, remote I/O and distributed I/O. Accessories shall be provided as required for the hardware configuration including rack extension modules, cables for extension racks and rail type mounting brackets.

2.1.1.2 Environmental Limits

PLC modules shall be suitable for, or placed in protective enclosures suitable for the environment (temperature, humidity, dust, and vibration) where they are located.

Store PLCs according to manufacturer's requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

2.1.1.3 Central Processing Units

CPU modules shall be microprocessor-based computational processors designed and selected to support the processing, input/output, memory and logic programming requirements. Integral Modbus and Modbus plus communication ports shall be provided. Modules shall include lithium battery memory back-up. Programming languages shall include sequential functional chart, functional block, ladder logic, structured text, and instruction list. Modules shall be identified with the model number and color code, include a LED status array, removable hinged door with customizable identification label, battery slot, slide switches for memory write protection and start-up communications parameters and communications port. Provide sufficient memory to store programs in the CPU, as well as data as required by the system architecture. The CPU shall be compatible with Concept Version 2.6, and be provided with the latest firmware revision.

2.1.1.3.1 Internal Clock

Provide integral internal clocks for all CPU modules. Automatically synchronize system clocks daily. Store time of day information in addresses 4:1 through 4:8, with automatic time synchronization provided through the SCADA system via KCCS referenced to local eastern standard time, with automatic connection for daylight savings time.

2.1.1.3.2 Memory

Provide sufficient memory for each CPU to support the required control, communication, and programming documentation to allow the control programs to be stored for future upload to a laptop. Protect programs residing in memory with EEPROM, flash memory, or internal battery with a minimum service life of 8 years.

2.1.1.4 Power Supply Modules

Power supply modules shall be of the standalone, summable or redundant type as indicated or as required. Power supplies shall provide power to the system rack modules and protect the system from noise and voltage swings. Power supplies shall accept 24VDC input power and provide to +5 volts DC for the requirements of the CPU, the communication and I/O modules. Power supplies shall be selected to power the rack modules inclusive of

anticipated power demand of empty slots.

Control panel designer shall provide independent line fuses or circuit breakers, per the manufacturer's recommendation, for each power Supply, Input Module, Output Module, and other modules with separately derived power requirements.

Control panel designer shall insure that communication signals, 4-20mA signals, embedded HART signals, etc. are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.

2.1.1.5 Wiring Terminations

Use screw terminal wiring terminations for all field-installed devices. Use cable fast terminal block (fastblock) wiring systems consisting of DIN rail mounted terminal blocks, multi-conductor cables with "D" pin terminal block connectors, between I/O modules and terminals.

2.1.1.6 Input and Output Modules

Provide UL 508 listed input and output modules for all PLC's as follows:

- a. Provide discrete input/output modules as required to satisfy the points lists indicated on the drawings. Size modules to provide the larger of 10-percent spare of each type, or 2 spares.
- b. Binary Input Modules: Binary input modules shall have up to 32 24-volt inputs.
- c. Analog Input Modules: Analog input modules shall provide up to 8 inputs and monitor low-voltage (0-10 VDC), current (4-20 mA), or resistance (thermistor or RTD) signals.
- d. Binary Output Modules: Binary output modules shall have up to 32 24-volt outputs or up to 8 relay outputs.
- e. Analog Output Modules: Analog output modules shall send up to 8 modulating 0-10 VDC or 4-20 mA signals to control output devices.
- f. Modules shall be identified on the front with the model number and color-coded, have status indicating LED lights and a removable hinged door with customizable identification label.
- g. Provide accessory items required to interface modules to wiring systems including screw terminal blocks, jumpers, and fast block connector cables.

2.1.1.7 Programmable Logic Controller Network

Provide a Ethernet TCP/IP internetwork with control products, communication media, connectors, repeaters, hubs, and routers. In the IACP both an Ethernet network, as well as a peer-to-peer Modbus plus network is to be provided. Refer to the 'E' series drawings and Section 27 10 00, "Building Telecommunications Cabling Systems". Network connectivity between buildings is being provided by the Government; wiring within buildings and to outdoor mounted switchgear shall be provided and installed as indicated on E-series drawings.

2.1.1.8 Communication Modules

Single format Ethernet network modules for rack mounting, accepting twisted pair or optical medium, 10/100 Mbps data rate, 10 Base-T/100 Base-TX (RJ45) or 100 Base-FX (MT/RJ) physical interface, factory cast configurable web server with web page editor and page hosting, provide with the latest firmware revision.

2.1.1.9 Human Machine Interface

2.1.1.9.1 PLC Enclosure Panels

Provide backlit color STN LCD touch screen, 7.5 inches diagonal screen, 32 MB flash EPROM, screw clamp fastened, flush mounted on each PLC panel, with a serial link type interconnecting cable to PLC. HMI shall be Magelis XBT GT4230.

2.1.1.9.2 Existing Chiller Control Panels

Replace existing Allen Bradley HMI mounted on the control panels on Chillers 1 and 2 in the IACP with new Allen Bradley graphic terminals, panel view plus 6, 1500, keypad and touch, 15-inch TFT color display, memory to support display requirements (65MB flash/64MB RAM) with RS232/Ethernet communication capability, Model 2711P-B15C4A8 and interconnecting cabling.

2.1.1.9.3 Manual Control Panel

The HMI for the manual control panel shall be backlit color touch screen, 12.1 inch diagonal screen, 32 MB flash EPROM, screw clamp fastened, flush mounted on the manual control panel, with a modbus plus connection to the IACP PLC indicated on the drawings. HMI shall be Magelis XBT GT 6330.

2.1.1.10 Cabinets

Provide each PLC, remote I/O and the manual panel in a factory fabricated cabinet enclosure. Cabinets located indoors shall protect against dust and have a minimum NEMA 12 rating, except where indicated otherwise and be UL 508A listed. Cabinets shall be of the free-standing floor or wall mount type as indicated. Cabinet shall be of the general size and arrangement indicated; size and style shown on the documents are conceptual, final size and type shall be coordinated with existing conditions and shown on the approved panel layout drawings. Floor mount cabinets shall be manufactured from not less than 12-gauge steel, wall mount cabinets shall be manufactured from not less than 16-gauge steel; all seams continuously welded and ground smooth, have integral lifting eyes, 3-point latches, latch rod rollers, oil resistant door gasket, continuous door hinge, and a thermoplastic data pocket shall be included on the inside of the front door. Cabinet shall include internal mounting channels affixed by welding to the top center and bottom of side and rear panels with rear and side solid interior panels provided. Wall mounted cabinets shall be provided with the manufacturers wall mount brackets. Exterior finish for all cabinets and enclosures shall be polyester powder paint, light blue color S020 with a white interior; interior panels shall have a white enamel finish. Provide custom cutout for front door flush mounting of the HMI. Cabinets shall have a hinged lockable door and an offset removable metal back plate. Provide like-keyed locks for all hinged panels provided and a set of two keys at each panel, with one key inserted in the lock.

Other cabinets and enclosures shall be as called for on the drawings. Provide accessory items as called for on the drawings.

2.1.1.11 Cable Management Systems

Provide pre-manufactured PVC cable management/wire duct systems for organizing, routing, and managing cable/wiring within panels. Troughs shall be 4-sided with slotted sides, solid cover and back and include all mounting hardware as required for screw mounting to the back or side plane; double back tape and/or adhesive systems shall not be used.

Size to provide no more than 50-percent fill.

2.1.1.12 Cable Identification

Each cable or wire within a panel shall be uniquely identified using a heat shrink laser printable radiation cross-linked polyolefin material, with a shrink ratio of 3 to 1, suitable for both indoor and outdoor use. Identification labels shall be rated for use from -67 - 275 degrees F, be 0.53 mil wall thickness sleeve length to suit identification text field.

2.1.1.13 Main Power Switch and Receptacle

Provide each control cabinet with a main external power circuit breaker located inside the cabinet. Also provide each cabinet with a separate 120 VAC power strip with a minimum of 4 receptacles.

2.1.1.14 Rack Extension Module

Backplane (rack) extension module which allows extension of the primary backplane to a secondary backplane (generally within the same enclosure). Modules fit in a standard rack slot, are powered by the rack bus with 1 extension module provided in the primary backplane with an interconnecting cable to a second backplane; length of cable to suit panel layout.

2.1.1.15 Remote I/O Modules

Rack mounted single channel, single cable topology modules for providing remote I/O consisting of a head-end module located in the rack with the CPU and a remote drop adapter module located in each rack with remote I/O. The head-end module may connect up to 31 remote drop adapters utilizing an RG-11 quad shield coaxial trunk cable with RG-6 quad shield coaxial drops operating at 1.544 Mbps. Provide necessary connection accessories including 'T' connectors, end of line terminators, 'F' connectors, earth blocks and similar items.

2.1.2 Chiller Interface

For existing chillers 3 through 6, gateways shall be provided for interfacing the BAS with the existing chiller control panels through an Ethernet connection. The chiller gateway communication protocol shall convert the chiller panel data to Modbus Remote Terminal Unit (RTU). Gateway shall be Johnson Controls (York) E-Link, Model YK-ELNK100-0. A Modbus to Ethernet gateway shall be provided to convert the Modbus RTU signal and bring the chiller information into the BAS; basis of design is MGATE MB3170. Suitable 24VAC/24VDC power supplies shall be provided. Items shall be enclosure mounted as indicated on the drawings.

2.1.3 Legacy Communication/Network Devices

For existing Andover equipment to remain, a new communications interface panel shall be provided to allow connection of the existing Andover RS 485 "INFINET" network to the KSC ATXS Ethernet LAN provide Andover Continuum Net Controller II. Provide with a continuum power supply module with integral UPS (model PS 120/240 AC 50-U), interconnecting cables, and two 12-volt 7.0 amp hour sealed lead acid type batteries, similar and equal to Power Sonic. Items shall be enclosure mounted as indicated on the drawings.

2.1.4 PLC and System Software

Except where the Government has site licensed versions of software, provide not less than 2 licensed copies of all software, configuration and installation tools, plug-ins, service tools and databases necessary to configure the BAS system. Software documentation and licenses are to be turned over at the end of construction. The Government has licensed copies of Concept XL.

2.1.4.1 Programming

Provide programming to execute the sequence of operation indicated. Provide all programming to configure and program all programmable logic controllers, human/machine interface (HMI) and operators workstations. Provide programming routines in simple, easy-to-follow logic with detailed text comments describing what the logic does and how it corresponds to the project's written sequence of operation. All PLC platforms shall be programmed using the same programming software. Programmable/set-up of PLC's will utilize the manufacturers programming software "Concept XL" Version 2.6, including specialist tools, function block libraries, and maintenance and diagnostic packages as required to configure, test, and diagnose the controllers to accomplish the specified sequences of operation. Supervisory Control and Data Acquisition (SCADA) software shall be as manufactured by Citect, Version 6.1 Service Pack 2. HMI configuration software for PLC cabinet screens shall be "Vijeo Designer"; HMI configuration software for chillers 1 and 2 shall be "Factory Talk View Studio".

- a. To the maximum extent possible, PLC graphic-based programming shall be used consisting of a library of function blocks made from pre-programmed code suitable for BAS control. Function blocks shall be assembled with interconnecting lines, depicting the control sequence in a flowchart. Graphic programs shall be viewable in real time showing present values and logical results from each function block. Other programming languages are acceptable on a case-by-case basis but must be specifically reviewed and approved by the Contracting Officer prior to deployment.
- b. Menu-based programming shall be done by entering parameters, definitions, conditions, requirements, and constraints.
- c. For line-by-line instruction list and structured text-based programming, provide initial commentary as to the programs purpose referencing the SOO, declare variable types (local, global, real, integer, etc.) at the beginning of the program. Use descriptive comments frequently to describe the programming and operations being performed within each program and sub-program.
- d. For ladder logic programs, utilize contacts, coils, compares timers,

special blocks and similar devices represented diagrammatically.

- e. Software programming shall be successfully factory tested by the Contractor prior to delivery of Contractor fabricated/configured PLC control cabinets to the project site. Testing shall include simulated I/O to demonstrate the specified sequences, including but not limited to, control actions, modes of operation, alarms, safeties, failures, trending, HMI's and graphic displays. The Contractor is responsible for providing all services and hardware/software necessary for testing at the panel fabrication site. Each fabricated and assembled control panel shall be successfully tested with a PLC panel test affidavit provided attesting to the full functionality of the panel. At the Governments option, testing may be witnessed in-person by at least 6 Government representatives at the place of fabrication/testing. Provide not less than 14 days notice of each test to the Contracting Officer.
- f. Provide Software 10%, Software 50% and Software 90% submittals. Provide separate submittals for the buildings (1 submittal) for all buildings and the IACP (1 submittal for the plant). Provide hard copy submittals and schedule a live demonstration to be performed at KSC within 10 days of the submittal. Approval of the submittal allows for further development and submittal of the next specified level. Non-approval will necessitate a resubmittal and follow-up demonstration on-site.

2.1.4.2 Parameter Modification

Parameter setpoints (time delays, set points, minimums, maximums, PID loop tuning parameters, etc.) shall not be embedded in programs, they shall be adjustable at the PLC HMI and at operator's workstation. Setpoint access and allowable range of adjustment shall be restricted through the use of password protection.

2.1.4.3 Short Cycling Prevention/System Protection

Provide adjustable setpoint differentials, min/max positions, and minimum on/off times to prevent equipment short cycling, and to protect systems from low/high pressure/flow conditions. Configure systems such that if control variable information fails or is otherwise unavailable, the system reverts to a safe condition or freezes in-place as appropriate.

2.1.4.4 Equipment Status Delay

Provide an adjustable delay from when equipment is commanded on or off and when the control program looks to the status input for confirmation.

2.1.4.5 Run Time Accumulation

Use the Elapsed Time Property to provide re-settable run time accumulation for each Binary Output Object connected to mechanical loads greater than 1 HP, electrical loads greater than 10 KW, or wherever else specified. Accumulate run-hours in the PLC memory.

2.1.4.6 Time Synchronization

Provide time synchronization, including ability for operator time adjustments.

2.1.4.7 Object Property Override

Allow writeable object property values to accept overrides to any valid value. Where specified or required for the sequence of control, the Out_Of_Service property of Objects shall be modifiable. When documented, exceptions to these requirement are allowed for life, machine, and process safeties.

2.1.4.8 Alarms and Events

Alarms and events shall be capable of having programmed time delays and high-low limits. Generally alarms will be generated at the PLC level; critical alarms shall be generated at the PLC. Alarms/events shall report to the local HMI screen, as well as the operator workstation computer, and based on the SCADA software, be displayed and optionally printed, as defined at the workstation and be stored on the server. Where the communications network is inoperable, alarms/events shall be stored within a device on the PLC network until connected to a user interface device or the network restored. Provide alarms/events in agreement with the point schedule, and sequence of operation. At a minimum, provide programming to initiate alarms/events any time a piece of equipment fails to operate, a control point is outside normal range or condition, communication to a device is lost, a device has failed, or a controller has lost its memory.

2.1.4.9 Trending/Graphing

Trend data collected by the PLC shall be broadcast over the network and stored in the server. Trends shall be viewable at the OWS.

2.1.4.10 Device Diagnostics

Each controller shall have diagnostic LEDs for power, communication, and device fault condition. The PLC system shall recognize and report a non-responsive controller.

2.1.4.11 Power Loss

Upon restoration of power, the PLC system shall perform an orderly restart and restoration of control.

2.1.5 Operator Workstation

The workstation shall run the SCADA software, be capable of accessing all PLC system devices and communicate using the Ethernet TCP/IP protocol. The workstation shall be capable of displaying, modifying, creating, archiving, and deleting (as applicable): all points, objects, object properties, programming, alarms, trends, messages, schedules, and reports. Two workstations shall be provided.

2.1.5.1 Operator Workstation Hardware

Configure according to system manufacturer's specifications. Install to permit complete monitoring and troubleshooting of the PLC system.

At a minimum the workstation hardware shall include: primary and redundant desktop personal computers with Operating System Software Microsoft Windows XP Professional SP3 or Windows 7 Professional W XP Mode 32 Bit operating system or equal, Intel Core i7 processor, minimum 3.1 GHZ, and RAM exceeding capability and speed required by operating system and application

software, solid-state type hard drive capacity exceeding software requirements minimum of 128 GB, 8X internal DVD ROM drive with archive creator software, 4 USB 2.0 ports, 10/100 network interface card, Ethernet card, 26-inch LCD monitor, sound card with speakers, 101 character keyboard, optical mouse, separate black and white and color laser printers with USB port and cable (or wireless), 3 matching color and black toner cartridges, 120-volt 800 VA uninterruptible power supply with automatic voltage regulation and 4 minimum battery back-up outlets and 2 surge protected outlets, Microsoft Office bundled software, Adobe Acrobat Writer, and Symantec Ghost disk imaging software or equal. Provide all original licenses, installation media, documentation, and recovery CDs capable of restoring the original configuration. Provide a manufacturer's 3-year next business day on-site warranty with the Government listed as the warranty owner.

At a minimum, the server hardware shall include: primary and redundant servers, Intel Xeon 2.40 GHz processor, 12M cache, 5.86 GT/s QPI, tower chassis, 24GB memory (6 x 4GB), 1333 MHz single ranked LV UDIMMs, DVD Rom optical drive, Windows 2008 R2 enterprise operating system with 10 client access licenses, 4 - 1 TB 6 GPS hotplug hard drives, redundant power supplies, wireless keyboard, mouse and 19" LCD color monitor.

2.1.5.2 Password Protection

Provide at least 3 levels of password protection for operator interfaces. The lowest level, manager, only allows viewing graphics. The second level, operator, allows viewing graphics, creating trend logs/graphs, commanding equipment on/off, acknowledging alarms, assigning maintenance status and changing selected setpoints and alarm values. The highest level, system administrator, provides all administrator rights and allows full access to all programming, including setting new passwords and access levels. Provide automatic log out if no keyboard or mouse activity is detected after a user-defined time delay.

2.1.5.3 SCADA Software

Provide the workstations (Citect) software with the manufacturer's installation CDs and licenses, each server and operators workstation will require a software "key" to be provided by the Government (4 total). Configure the software according to the SCADA system manufacturer's specifications.

The workstation software shall permit complete monitoring, modification, and troubleshooting interface with the PLC system. The operator interface with the software shall be menu-driven with appropriate displays and menu commands to manipulate the PLC system's objects, point data, operating schedules, control routines, system configuration, trends, alarms, messages, graphics, and reports. Trends shall be capable of graphic display in real time, with multiple variables plotted as functions of time. Each alarmed point shall be capable of displaying its alarm history, showing when it went into alarm, if and when it was acknowledged, and when it went out of alarm. The modification of PLC system parameters and object properties shall be accomplished with "fill in the blank" and/or "point and drag" methods. Modifications shall download to the appropriate controllers at the operator's request.

Provide trend services capable of trending all object present values set points, and other parameters indicated for trending on project schedules. Trends may be associated into groups, and a trend report may be set up for

each group. Trends are stored with trend intervals from 10 seconds up to 60 minutes as programmed in the server. The minimum number of consecutive trend values stored at one time shall be 10,000 per variable. When trend memory is full, the most recent data shall overwrite the oldest data.

Graphic representation shall include column, line, bar, scatter or area format on an X, Y axis as standard with the SCADA software. Axis shall be fully scaleable, and include an option for both left and right hand (dual) axis. Not less than 5 sets of data points shall be capable of being displayed graphically, with unique color assignment capability for each data set. Graphics shall include a legend to identify each data set.

2.1.5.4 Graphics Software

Graphics software at the OWS shall be configured to allow for display of both tabularized data and pictorial graphics; for the PLC cabinet mounted HMI's only tabularized data shall be displayed. The present value/status of all points shall be captured both in tabular and pictorial formats. Refer to Kennedy Space Center Document KSC-TA-11569 for project specific examples of existing screens and project requirements.

Provide Graphics 10% submittal, Graphics 50% submittal and Graphics 90% submittals. Provide separate submittals for the buildings (1 submittal for all buildings) and the IACP (1 submittal for the plant). Provide hard copies and schedule a live demonstration to be performed at KSC within 10 days of the submittal. Approval of the submittal allows for further development and submittal of the next specified level. Non-approval will necessitate a resubmittal and follow-up on-site demonstration.

The Government has developed standard Citect graphic libraries of selected symbols, screens, pages, trends, and alarm conventions that shall be used to the extent possible and as applicable in the development of the workstation graphics and are available in a sample Citect project. The Contractor shall submit a request to the Contracting Officer for the sample project and this project shall be used as a reference guide for the initial development of the new screens.

Pictorial graphics shall be provided by the Contractor for each system and item of equipment. Each tabularized data page shall be provided with a corresponding pictorial graphic page, displaying the same data. Multiple pictorial graphics pages shall be provided where necessary due to the amount of information. Arrange point values and names on the pictorial graphic displays in their appropriate physical locations with respect to the floor plan or equipment graphic displayed. Tabularized data shall utilize color coding to distinguish equipment states (on-off-auto-maintenance), as well as alarms. Data shall be grouped and organized on screens to mimic that currently in use at the facilities. The appearance, "feel" and functionality of the screens shall capture and resemble the existing screens, to include hidden icons and symbols used to alert the operators of current conditions, status and alarms. Graphics shall allow the operator to monitor current status, view zone and equipment summaries, use point-and-click navigation between graphic pages, and edit setpoints and parameters directly from the screens. Items in alarm shall be displayed using a different color or other obvious visual indicator. Provide graphics with the following:

- a. Pictorial Graphic Types: Provide at least one graphic display for each piece of HVAC equipment, and system and/or sub-system. Indicate dynamic point values, operating statuses, alarm conditions, and

control setpoints on each display. Provide summary pages where appropriate.

- (1) HVAC Equipment: Provide a graphic display for each piece of HVAC equipment, such as a pump, chiller or cooling tower. Equipment shall be represented by a two or three-dimensional drawing. Where multiple pieces of equipment combine to form a system, such as a central chiller plant, provide one graphic to depict the entire plant. Indicate the equipment, piping and control valves in the installed location. Include labels for equipment, piping, and control valves. Show the direction of water flow. Include dynamic display of applicable object data with clear names in appropriate locations. Provide tabular style screens of equipment room data to emulate the screens on the current workstation. After award of the contract, arrange a visit to view the existing OWS graphics to understand their capabilities and functions.
 - (2) System: Provide at least 1 graphic display for each system (i.e. chilled water, condenser water, compressed air, power monitoring). For large systems, provide sub-system displays (such as secondary pumps) and include all sensors used as the basis of control and status monitoring of that system.
 - (3) Sequence of Operation: Provide a graphic screen displaying the written out full sequence of operation for each piece of HVAC equipment. Provide a link to the sequence of operation displays on their respective equipment graphics. Include dynamic real-time data within the text for setpoints and variables.
- b. Graphic Title: Provide a prominent, descriptive title on each graphic page.
 - c. Dynamic Update: When the workstation is on-line, all graphic I/O object values shall update with change-of-value services, or by operator selected discrete intervals.
 - d. Graphic Linking: Provide forward and backward linking between sub-plans, and equipment.
 - e. Graphic Editing: Provide installed software to create, modify, and delete the BAS graphics. Include the ability to store graphic symbols in a symbol directory and import these symbols into the graphics.
 - f. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on the graphics.

2.2 SENSORS AND INPUT HARDWARE

Where new sensors are to be installed in existing locations, verification of existing physical constraints shall be performed prior to ordering of devices. Submit a sensor location summary for each facility documenting the following information:

For temperature sensor; the well location, material of construction, bore size, bore depth and process connection size.

For flow meters; the tap location, diameters of upstream and downstream piping provided, diameter of the pipe and size of the ball valve.

For pressure sensors; the tap location, and the isolation valve size.

In most cases immersion temperature sensor wells are existing and to be reused; the Contractor must coordinate replacement temperature sensor dimensions with the existing wells. Similarly, insertion type flow meters are to be replaced with new; the Contractor has to ascertain existing mounting distances to ensure new meters are properly located within the pipe; magnetic based meters are very sensitive to proper upstream and downstream pipe lengths. Where the Contractor fails to verify existing constraints, he shall provide new temperature wells and/or flow meter taps at no additional cost to the Government.

2.2.1 Field-Installed Temperature Sensors

Provide the same sensor type throughout the project, unless otherwise approved by the Contracting Officer.

2.2.1.1 Resistance Temperature Detectors (RTDs)

Provide 1000 ohm platinum 4-wire RTD sensors with matched transmitters with a range of -328 to 608 degrees F with an accuracy of +/- 0.18 degrees F or better. Sensors shall have hermetically sealed teflon insulated lead wires, 316 stainless steel sheath, response time less than 5 seconds to 63.2-percent temperature change with a stability of 0.2 degrees C after 10,000 hours. Transmitters shall be of the Smart HART programmable loop powered type which converts the RTD signal to an isolated, scaleable 4 to 20 mA, includes an LCD display with not less than 2 rows of five alphanumeric characters at least 1 row shall be 0.4 inches tall, the second 0.22 inches, NEMA 4X, explosion-proof enclosure with 2, 1/2-inch entry points and clear glass cover. Basis of design is Moore Industries Model TDZ2.

Provide and turn over to the Government 2 hand-held portable modular SMART HART calibration/communicator tool with LCD display, NIST traceable accuracy of +/-0.025% for pressure and current/voltage equal to Yokogawa Model YPC4000.

Where documents indicate direct connection of RTD sensors to PLC's, transmitters are not required; provide PLC RTD input modules to accept inputs.

2.2.1.2 Temperature Sensor Details

Pipe Immersion Type: For replacement sensors, match existing well immersion depth, or at the Contractors option, a field configurable flexible type RTD sensor utilizing a spring mechanism which can adapt to differing well depths, similar and equal to Moore Industries, "The Worm" may be used. For new sensors provide minimum three-inch immersion. Provide each new sensor with a corresponding pipe-mounted sensor well. Sensor wells shall be stainless steel when used in steel piping, and brass when used in copper piping. Provide the sensor well (new and existing) with a heat-sensitive zinc oxide transfer agent between the sensor and the well interior.

2.2.2 Pressure Transmitter

Pressure transmitter shall be of the thin-film strain gauge bridge and stainless steel diaphragm type, range of 0 - 100 psi, watertight stainless

steel housing, accuracy of +/- 1 percent of full scale or better, 4-20 mA output, overpressure rating of not less than 200-percent of range, operating temperature between -40 to 200 degrees F. Basis of design is Kele PTX1 Series. Provide with a porous metal disk type pressure snubber suitable for use with water media with a capacity of 3 cubic feet per hour at 1 psi pressure differential.

Configure with separate isolation and calibration ball valve as indicated on the drawings.

2.2.3 Water Flow Measurement Stations

2.2.3.1 Magnetic

Water flow measurement stations shall be of the insertion electromagnetic type with no moving parts; accuracy of +/- 1.0% of reading between 2 to 20 feet per second, flow range between 0.25 to 20 feet per second, fluid temperature between 15 to 250 degrees F, 4-20mA output, 316 stainless steel wetted metal components, weathertight NEMA 4 aluminum enclosure. All meters shall be wet calibrated in a NIST traceable flow laboratory. Basis of design is Onicon F-3500.

2.2.3.2 Dual Turbine

Water flow measurement stations shall be of the insertion dual turbine type; accuracy of +/- 1.0% of reading between 3 to 30 feet per second, fluid temperature up to 180 degrees F continuous, 4-20 mA isolated output, 316 stainless steel wetted parts, and weathertight aluminum enclosure. All meters shall be wet calibrated in a NIST traceable flow laboratory. Basis of design is Onicon F-1211.

2.2.4 Pneumatic to Electric Switch

Pressure switch, Type 400, watertight enclosure NEMA 4, UL listed, 15A 120VAC SPDT contacts range of 0 - 30 psi, 500 psi proof pressure, diaphragm sealed piston actuator, +/- 1 percent of range repeatability; basis of design ASHCROFT "B-Series".

2.3 OUTPUT HARDWARE

2.3.1 Output Signal Conversion

2.3.1.1 Electronic-to-Pneumatic Transducers

Two wire (loop powered) current to pressure (I/P) transmitter; 4-20 mA input, 3-15 psig output with 20 psi supply pressure. Output flow rate of 5 SCFM (8,640 SCIM) at 20 psi inlet, 0 psi outlet. Accuracy of +/- 0.25 percent of span including linearity, hysteresis and repeatability.

Air consumption not to exceed 0.10 SCFM at 15 psig output/20 psig input. Aluminum housing with polyester cover; NPT pneumatic and conduit ports. Provide with optional 0.30 psig output gauge. Basis of design is Moore Industries IPH2.

2.3.1.2 Electric to Pneumatic Solenoid Switch

Three-way spring return 24 VDC coil solenoid valve, 6.0 CFM at 100 psig, rated for 100 psig, similar and equal to Humphrey "Mini-Myte". Provide with accessory mounting bases, plugs, bushings and exhaust metering as

required.

2.3.2 Electrical Devices

2.3.2.1 Control Relays

Relays shall be double pole, double throw, UL listed, with contacts of the type and rating for the intended application, indicator light, and dust proof enclosure. The indicator light shall be lit when the coil is energized and off when coil is not energized. Relays shall be the socket type, plug into a fixed base, and replaceable without tools or removing wiring.

Modular type "Relay in a Box" (RIB) type devices may be used for stop/start control of A/C motor start circuits where specifically approved by the Contracting Officer.

2.3.2.2 Wire Splices

Wire to wire splices shall be of the heat shrinkable, nylon insulated, crimp type with adhesive lining. Operating temperature of -67 to 257 degrees F, 2:1 shrink ratio, cut through resistance of 70 pounds, pullout minimum of 25 pounds, UL listed. All splices shall be made with a calibrated crimping tool. Basis of design is Raychem D-406 Series.

2.3.2.3 Terminal Blocks

Screw type, board mount, dual row, tin plated brass, number of circuits as required.

2.3.2.4 LCD Displays

3.5 digit DC ammeter, LED display 1/8 DIN case, adjustable decimal point, similar and equal to Newport Q 2000 Series. A RTD type meter may be used when connecting directly to RTD type temperature sensors.

2.3.2.5 Signal Isolation

DIN rail mount, single channel signal splitter, 4-20 mA input, 4-20 mA output, accuracy of +/- 0.05 percent of span, zero and span calibration pots, UL listed. Basis of design Moore Industries ECT-DIN.

2.3.2.6 Transformers

120/24 VAC UL listed Class 2 transformer, foot mounting, built-in circuit breaker, minimum volt-amp capacity of 150-percent of the connected load.

2.4 ELECTRICAL POWER AND DISTRIBUTION

2.4.1 Power Supplies

2.4.1.1 PLC and Remote I/O

Provide intelligent, supervised power supply / charger to energize PLC and associated components, fiber switch, end-devices, and other related equipment. Unit shall be installed in enclosure which is sized to accommodate two 12VDC batteries and field installed DIN rail with 8 terminals in addition to the control panel. Batteries shall be sized to operate power supply at full load for a minimum of 30 minutes. The

following features are required:

1. Input 115VAC @2.7 amp / 24VDC output.
2. 10 amp supply current.
3. Filtered and electronically regulated outputs.
4. Short circuit and thermal overload protection.
5. Built-in charger for sealed lead acid or gel type batteries.
6. Automatic transfer to standby battery when AC fails (zero voltage drop).
7. AC fail supervision (form 'C' contacts).
8. Low battery supervision (form 'C' contacts).
9. Power on-off switch.
10. AC input and DC output LED indicators.
11. Power supply, enclosure, cam lock & battery leads.
12. Power supply / charger unit basis of design is Altronix SMP10PMC24X or equivalent.
13. Batteries shall be rechargeable, sealed lead acid type, 12-volts, connected in series, not less than 10 amp-hour capacity, quick disconnect tab type terminals, UL recognized, basis of design is Power Sonic PS-12120.

2.4.1.2 York Gateway

120 VAC to 24 VDC DIN rail mounted power supply, minimum 60 watt (2.5 amp) output capacity, internally fused, 83-percent efficient, +/- 10-percent output voltage adjustment, auto reset overcurrent protection, overvoltage protection, LED indication of operation. Basis of design is IDEC P55R-SD24.

2.4.2 Surge and Transient Protection

Provide each PLC and remote I/O controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.

2.4.2.1 Power Line Surge Protection

Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, third edition. Devices shall be provided with the lowest clamping voltage for a 120V application (or other if used). Unit may be wired in parallel and shall have LED status indicator(s).

2.4.2.2 Controller Input/Output Protection

Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection. Protection shall be listed for PLC control circuit applications.

2.4.3 Wiring

Provide complete electrical wiring for the BAS System, including wiring to transformer primaries. Unless indicated otherwise, provide all normally visible or otherwise exposed power, signal and device wiring and cabling in conduit. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Section 26 05 00.00 40, COMMON WORK RESULTS FOR ELECTRICAL. Run all circuits in conduit, metallic tubing, covered metal raceways, or armored cable.

2.4.3.1 Power Wiring

The following requirements are for field-installed wiring:

- a. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.
- b. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.

2.4.3.2 Analog Signal Wiring

Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

2.5 INDICATORS

2.5.1 Pressure Gauges for Pneumatic Controls

Provide a pressure gauge at each pneumatic control input and output. Gauges shall have a 2-inch diameter face and a 0 to 30 psi scale with 1 psi graduations.

2.6 PNEUMATIC POWER SUPPLY AND TUBING

2.6.1 Air Compressors

Air compressors for pneumatic control systems are existing to remain.

2.6.2 Pneumatic Tubing

2.6.2.1 Copper Tubing

Provide ASTM B 75 or ASTM B 88 rated tubing. Tubing 0.375 inch outside diameter and larger shall have minimum wall thickness equal to ASTM B 88, Type M. Tubing less than 0.375 inch outside diameter shall have minimum wall thickness of 0.025 inch. Exposed tubing and tubing for working pressures greater than 30 psig shall be hard copper. Fittings shall be ASME B16.18 or ASME B16.22 solder type using ASTM B 32 95-5 tin-antimony solder, or ASME B16.26 compression type.

2.6.2.2 Polyethylene Tubing

Polyethylene tubing may only be used in systems with working pressure of 30 psig or less which is located within PLC enclosures. Provide flame-resistant, multiple polyethylene tubing in flame-resistant protective sheath with mylar barrier, or unsheathed polyethylene tubing in rigid metal, intermediate metal, or electrical metallic tubing conduit for areas where tubing is exposed. Single, unsheathed, flame-resistant polyethylene tubing may be used within control panels. Provide compression or brass barbed push-on type fittings. Extruded seamless polyethylene tubing shall conform to the following:

- a. Minimum Burst Pressure Requirements: 100 psig at 75 degrees F to 25 psig at 150 degrees F.

- b. Stress Crack Resistance: ASTM D 1693, 200 hours minimum.
- c. Tensile Strength (Minimum): ASTM D 638, 1100 psi.
- d. Flow Rate (Average): ASTM D 1238, 0.30 decigram per minute.
- e. Density (Average): ASTM D 792, 57.5 pounds per cubic feet.
- f. Burn rate: ASTM D 635

2.7 SEQUENCES OF OPERATION (SOO)

Sequences of operation are contained in the drawing package. Provide programming necessary to implement the sequences. Include and coordinate ranges, setpoints, deadband, alarms and similar items not specifically called for in the sequences but required for stable operation.

PART 3 EXECUTION

3.1 INSTALLATION

Perform the installation under the direct supervision of system integrators regularly employed in the installation of PLC systems, with specific experience with the hardware (Modicon) and software (Citec) specified. The new PLC processor and HMI touch screens for Chillers 1 and 2 shall be as manufactured by Rockwell Automation/Allen-Bradley to be compatible with the existing equipment in-place. Existing PLC's and panel view HMI's to be replaced, interconnecting serial cable provided and existing PLC/Panel View code shall be downloaded into the new PLC and modified to accommodate the replacement equipment. Work shall be performed by a Factory Authorized Representative. Chiller information is to be transmitted to and displayed at the IACP operator workstation.

Gateways to existing York chillers 3 through 6 shall be as manufactured by York to be compatible with the new equipment. The existing York-Talk control enclosure shall be removed and replaced with a new enclosure to accommodate the new E link gateway, DC power supply and modbus to Ethernet gateway. Chiller information is to be transmitted to and be displayed at the IACP operator workstation.

Integrate chiller interfaces of all machines with the OWS to allow for display of all information and modification of available operating parameters through the workstation via the chiller interface as further developed during the software reviews.

Follow requirements of section 23 03 00.00 20, "BASIC MECHANICAL MATERIALS AND METHODS", as applies to work to be performed under this section.

Equipment shall be installed as indicated and in accordance with the manufacturer's recommendations, including conduit, wiring, controllers, wiring devices, sensors, and miscellaneous devices as required and necessary to provide a completely functional and operational system, to include all points defined on the drawings, specified herein and as required to execute the sequence of operation.

Devices shall be securely attached to the equipment, panel and/or structure as appropriate, conduit shall be properly supported. Attachment of din rails, wiring troughs, and similar items shall only be by mechanical means (self-tapping screws).

All networked devices PLC's, servers and workstations shall be time synchronized through a signal provided by KCCS, the Government shall provide details at the 50 percent software development review.

3.1.1 Naming and Addressing

Provide unique naming and addressing for networks and devices, where possible, follow existing naming convention. PLC IP addresses will be as assigned by the Government. Network installation shall be performed as specified in section 27 10 00, "BUILDING TELECOMMUNICATIONS CABLING SYSTEMS".

a. MAC Address

Every network device shall have an assigned and documented Media Access Control (MAC) Address unique to its network. For Ethernet networks, document the MAC Address assigned at its creation.

b. Network Numbering

Assign unique numbers to each new network installed on the internetwork. Provide ability for changing the network number; either by device switches, network computer, or field operator interface.

c. Device Object Identifier Property Number

Assign unique Device tags for each device on the internetwork. Provide for future modification of the device tag; either by device switches, network computer, or field interface.

d. Assign Field Interface Control (FIC) numbers to all PLC's, following standard convention used for the Kennedy Complex Control System (KCCS).

3.1.2 Local Area Networks

Obtain Government approval before connecting new networks with existing networks. Network numbers and device instance numbers shall remain unique when joining networks. Do not change existing network addressing without Government approval.

3.1.3 Routers, Bridges, and Switches

Provide the quantity of routers, bridges, and switches necessary for communications shown on the Communication Architecture schematic. Configure each device and bridge, router, or switch to communicate on its network segment.

3.1.4 Wiring Criteria

- a. Run circuits in conduit parallel or at right angles to the building structure.
- b. Do not run binary control circuit wiring in the same conduit as power wiring over 50 volts. Where analog signal wiring requires conduit, do not run in the same conduit with AC power circuits or control circuits operating at more than 50 volts.
- c. Provide circuit and wiring protection required by NFPA 70.

- d. Run all wiring located inside M7-0355 (O&C), M7-0407 (IACP) and outdoors in rigid conduit, in other facility mechanical rooms, within buildings and above ceilings, EMT may be used and cable tray may be used for communication circuits where available.
- e. Do not use aluminum-sheathed cable or aluminum conduit.
- f. Input/output identification: Permanently label each field-installed wire, cable, and pneumatic tube at each end with descriptive text using a commercial heat shrink type wire marking system that fully encircles the wire, cable, or tube. Locate the markers within 2 inches of each termination. Match the names and I/O number to the project's point list. Similarly label all power wiring serving control devices, including the word "power" in the label. Label each pneumatic tube. Label all terminal blocks with alpha/numeric labels. All wiring and the wiring methods shall be in accordance with UL 508A.
- g. For controller power, provide 120 VAC circuits, with ground. Provide each circuit with a dedicated breaker, and run wiring in its own conduit, separate from any control wiring. Connect the controller's ground wire to the electrical panel ground; conduit grounds are not acceptable.
- h. Surge Protection: Install surge protection according to manufacturer's instructions. Multiple controllers fed from a common power supply may be protected by a common surge protector, properly sized for the total connected devices.
- i. Grounding: Ground controllers and cabinets to a good earth ground as specified in Section 26 05 00.00 40, "COMMON WORK RESULTS FOR ELECTRICAL". Conduit grounding is not acceptable; all grounding shall have a direct path to the building earth ground. Ground sensor drain wire shields at the controller end.
- j. The Contractor shall be responsible for correcting all associated ground loop problems.
- k. Run wiring in panel enclosures in a cable management system sized for no more than 50-percent fill.
- l. Fill conduit to maximum of 40-percent of area and include 1 pull string in each conduit.
- m. Make all final terminations to equipment. Tighten per manufacturer's recommendations.
- n. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment, without stress to wiring or terminations.
- o. All wiring connections to the PLC shall be made at terminal strips or fast-blocks. No more than 2 wires shall be landed onto 1 terminal.
- p. Wire connections to sensors shall be at its termination point, soldered, or using crimp splice connectors or wire nuts. Wire nuts may only be used at connection to sensors.
- q. All wiring within enclosures shall be run in wire trough, neatly

bundled and anchored with screws to prevent restriction to devices and terminals. Devices shall be anchored to panels using self-tapping screw connectors. Panels shall be labeled on the exterior with engraved phenolic nameplates.

- r. Install wiring in sleeves where wiring passes through walls and patch holes made.
- s. Wire splices shall only be used on existing wiring which is to be reused and only as specifically approved by the Contracting Officer to coordinate with existing conditions. Where approved, splices shall be of the heat shrink sleeve type and be crimped with a calibrated crimping tool. Where wire-to-wire splices are used, the wire on both sides of the splice shall have the same color insulation.

3.1.5 Accessibility

Install all equipment so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install PLC controllers, data ports, and like equipment in locations freely accessible through access doors.

3.1.6 Programmable Logic Controllers, Manual Panels, DDCP-2 Backplane, and Remote I/O

- a. Shop fabricate panels and install internal devices, wiring and components. Arrange and select panel components to meet the project specifications, paying particular attention to coordinating with reuse of sensor wiring where possible without the use of wire splices. Test panel operability in the presence of the Contracting Officer representatives prior to delivery to KSC. Install cabinets generally as depicted on the drawings, coordinating with the final dimensions of the approved panel layout drawings prepared by the Contractor.
- b. Locate control cabinets at the locations shown on the drawings. Secure to floor, walls and /or steel framework, provide miscellaneous strut-type framework as necessary for secure mounting.
- c. Provide cabinets for remote I/O and install in locations shown on the drawings.
- d. Provide cablefast terminal blocks for landing of I/O with interconnecting cables between cablefast terminal blocks and PLC I/O cards.
- e. Provide interconnecting cabling between processor and HMI screens, and other components, devices and remote panels as required.
- f. Provide for 24V cabinet power supplies; coordinate 120 VAC panel power and communication cabling with Division 26 and 27.
- g. All connections to the cabinets (conduits and control piping) shall be firmly affixed and made in a neat and good workmanship manner. Where coordinating with existing conduits, gutters and pneumatic tubing, take precautions to ensure such openings are properly located. Provide bulkhead type copper fittings for pneumatic piping, and insulated throat type conduit fittings.

3.1.7 Temperature Sensors

Replace existing and install new temperature sensors in locations as indicated and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

3.1.7.1 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping where new locations are shown. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Provide thermal conductivity material within the well to fully coat the inserted sensor.

3.1.8 Pressure Sensors

Locate pressure sensors as indicated.

3.1.9 Pneumatic Tubing

Run tubing exposed in unfinished areas like mechanical rooms. Run tubing parallel and perpendicular to building walls. Use 5 foot maximum spacing between tubing supports. With the compressor turned off, test each tubing system pneumatically at 1.5 times the working pressure and prove it air tight, locating and correcting leaks as applicable. Caulking joints is not permitted. Do not run tubing and electrical power conductors in the same conduit.

3.1.10 Component Identification Labeling

Provide a unique heat shrink-sleeve type identification label on each cable/conductor. Provide black plastic labels with engraved bold white block lettering permanently attached to each control panel and manual panel displays. Have the labels and wording approved by the Contracting Officer prior to installation.

3.1.11 Network and Telephone Communication Lines

When network connections by the Government are required, provide the Contracting Officer at least 60 days advance notice of need.

3.1.12 Operators Workstation/Servers

Install redundant operators workstations in the IACP control room, coordinate layout/location of PC's, monitors, printers and UPS with plant operations personnel and provide cable lengths to suit hardware locations. Coordinate location of peripheral equipment such as servers, routers and hubs.

3.1.13 Software/Programming

Install all software and provide for all programming for the BAS system. For custom programs controlling similar equipment such as building loop valve control, keep program structure consistent for each building to the extent possible.

For custom programming provide commentary as to the program purpose, SOO reference from the original contract documents, and definition of all

variables/points used.

For programs that include PID control of a valve or pump, provide for an initial start-up timer routine which opens the valve/starts the pump at a minimum position/speed then ramps up based on the timer function, or similar strategy to control ramp-up/ramp-down. Tune all PID loops to provide for stable operation.

Do not use data obtained from chiller control panels (CCP) for operational sequences; only use hard connected points. Data from the CCP may be used for monitoring purposes only, it shall not be used for any command (start/stop) or to determine the equipment status (on/off).

Capture and document all programming changes during initial testing, performance verification and commissioning.

3.1.14 Flow Meters

Install flow meters in the general locations indicated on the drawings. Identify proposed locations for new flow meters in the field on piping systems for approval by the Contracting Officer. Pay particular attention to the manufacturers requirements for upstream/downstream straight pipe lengths for both new and existing meter locations and alert Contracting Officer where these requirements cannot be met, prior to submission of flow meter shop drawings. In those instances where the manufacturers requirements cannot be met, the Government may direct the Contractor to use dual turbine type meters.

3.1.15 DDCP-2 Backplane

Fabricate and install a new backplane for DDCP-2 as depicted on the drawings, and as shown in the approved DDCP-2 Panel layout drawings. Providing all new devices, wiring and components. Remove all gauges, wiring, devices and components not required for re-use. Properly seal off panel openings with plugs or plates which are mechanically fastened into place, and remove identification nameplates no longer in use.

3.1.16 Manual Panel

Fabricate and install a replacement manual panel as detailed on the drawings, and as shown in the approved Manual Panel layout drawings. Where not otherwise noted for re-use in the new panel, provide all new devices, wiring and components. Wiring between the manual control panel the manual control panel interface shall be removed, where no longer needed and new wiring and conduit provided for new manual panel sensors. Mount panel in existing panel in the same location. Provide engraved type phenolic nameplates for all displays and affix using silicon adhesive.

3.2 CONTROLS SYSTEM OPERATORS MANUALS

Provide electronic and printed copies of a Controls System Operators Manual, coordinate with requirements of Sections 01 78 00, "CLOSEOUT SUBMITTALS", and 01 78 23, "OPERATION AND MAINTENANCE DATA". The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.

Provide with each manual: CDs of the project's control system drawings,

control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types. When approved by the Government, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders.

Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the controls contractor name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:

- a. A copy of the as-built control system (shop) drawings set, with all items specified under the paragraph "Submittals." Indicate all field changes and modifications. Point-to-point wiring diagrams shall be an exact representation of the installed conditions.
- b. A copy of the project's design drawings, including any official modifications and revisions.
- c. A copy of the project's approved Product Data submittals provided under the paragraph "Submittals."
- d. A copy of the project's approved Performance Verification Testing Plan and Report.
- e. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.
- f. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.
- g. A table entitled "AC Power Table" listing the electrical power source for each programmable logic controller. Include the building electrical panel number, panel location, and circuit breaker number.
- h. The PLC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation software.
- i. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.
- j. A written statement entitled "Technical Support" stating the control system manufacturer or authorized representative will provide toll-free telephone technical support at no additional cost to the Government for a minimum of two years from project acceptance, will be furnished by experienced service technicians, and will be available during normal weekday working hours. Include the toll-free technical support telephone number.

- k. For all software not currently under Government license, a written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request at no additional cost to the Government for a minimum of two years from contract acceptance. Include a table of all PLC and SCADA system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.

In each PLC and remote I/O cabinet, provide laminated copies of the point-to-point wiring diagram for that panel, inside of a plastic pouch mounted inside the door.

3.3 FUNCTIONAL TESTING (FT)

3.3.1 General

The FT shall demonstrate compliance of the control system work with the contract requirements. The FT shall be performed by the Contractor and witnessed and approved by the Government and CxA. Provide separate testing for each building phase and index by building. Prior to FT, the Contractor shall perform his own Pre-Functional Testing. A meeting to review the Functional Testing is required to coordinate all aspects of the FT and shall include the Contractor's QA representative, the Contractor's FT administrator, the Contracting Officer's representative prior to the start of FT. FT shall be performed in conjunction with commissioning work specified in Section 01 91 00, "COMMISSIONING". In general these requirements are intended to be the initial function tests (FT's) performed as a precursor to the Commissioning Performance Tests (PT's).

3.3.2 Functional Testing Plan

Submit a detailed FT Plan of the proposed testing for Government approval. Develop the FT Plan specifically for the control system in this contract. The FT Plan shall be a clear list of test items arranged in a logical sequence. Include the intended test procedure, the expected response, and the pass/fail criteria for every component tested. The list which is to be used shall be submitted for approval prior to performing any testing.

The plan shall clearly describe how each item is tested, indicate where assisting personnel are required, and include what procedures are used to simulate conditions. There shall be a separate sheet for each item to be tested. Include a separate column for each checked item and extra space for comments. Where sequenced control functions are tested, insert the routine from the projects sequence of operation. For each test area, include signature and date lines for the Contractor's FT administrator, the Contractor's QA representative, the CxA, the Contracting Officer's representative to acknowledge successful completion. Refer to the paragraph entitled, "FUNCTIONAL TESTING" in Section 01 91 00, "COMMISSIONING" for additional requirements. Submit copies of the proposed Functional Tests in electronic format (Microsoft Work or Excel files) for review, commenting and editing by the Governments CxA as part of the shop drawing review process.

3.3.3 Calibration

Prior to starting FT's, calibrate all I/O points, new and existing.

All testing equipment shall be of sufficient quality and accuracy to test

and/or measure system performance with the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 degrees F. Pressure sensors shall have an accuracy of + or - 2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

Submit a calibration report for each device, one page per device. Group and identify data by building, type of device, and device point name.

As part of the FT's, include a check of each points calibration.

3.3.4 FT Sample Size

Test all sensors, flow meters, valves, transducers, equipment and building pumps/bridge valves unless otherwise directed (100% testing).

The Government and CxA will witness all testing, the CxA will approve all tests.

3.3.5 Pre-Functional Testing Checklist

Prior to the start of Functional Testing to be witnessed by the CxA, the Contractor shall have verified complete system functionality by completion of Pre-Functional Testing checklist. Submit the following for Government approval documenting satisfactory completion of the Pre-FT's as a list with items checked off once verified. Provide a detailed explanation for any items that are not completed or verified.

- a. Verify all required installation work is successfully completed, and all HVAC control equipment is working correctly.
- b. Verify all required control system components, wiring, and accessories are installed.
- c. Verify the installed control system architecture matches approved drawings.
- d. Verify all control circuits operate at the proper voltage and are free from grounds or faults.
- e. Verify all required surge protection is installed.
- f. Verify the A/C Power Table specified in "CONTROLS SYSTEM OPERATORS MANUALS" is accurate.
- g. Verify all network communications function properly, including uploading and downloading programming changes.
- h. Verify communications are error free.
- i. Verify each programmable logic controller's programming is backed up.
- j. Verify all wiring, components, and panels are properly labeled.
- k. Verify all required points are programmed.

- l. Verify all sensor readings are accurate and calibrated.
- m. Verify each control valve and actuator goes to normal position upon loss of power.
- n. Verify all control loops are tuned for smooth and stable operation. View trend data where applicable.
- o. Verify each controller works properly in stand-alone mode.
- p. Verify all workstations, human machine interfaces, all system and database software is installed, and graphic pages are created for each workstation and HMI.
- q. Verify the as-built (shop) control drawings are completed.

The completed Pre-Functional Test Checklist shall be submitted for approval, documenting satisfactory completion of the tests, and that the Contractor is ready to begin Functional Testing.

3.3.6 Conducting Functional Testing

- a. Conduct Government-witnessed FT after approval of the FT Plan and the completed Pre-FT Checklist. Notify the Contracting Officer of the planned FT at least 15 days prior to testing. Provide an estimated time table required to perform the testing. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of the FT. Ensure that testing personnel are regularly employed in the testing and calibration of PLC systems. Using the project's as-built control system (shop) drawings, the project's mechanical design drawings, the approved Pre-FT Checklist, and the approved FT Plan, conduct the FT.
- b. During testing, identify any items that do not meet the contract requirements and if time permits, conduct immediate repairs and re-test. Otherwise, deficiencies shall be investigated, corrected, and re-tested. Document each deficiency and corrective action taken.
- c. If re-testing is required, follow the procedures for the initial FT. The Government may require re-testing of any control system components affected by the original failed test. If in the sole opinion of the Contracting Officer, with input from the CxA determines the failure rate of the FT's is unacceptably high, the FT will be suspended and the Contractor will be directed to re-perform the Pre-Functional testing and resubmit the checklist. Repetitious type failures/unmet requirements will be evidence that the Contractor has not demonstrated due diligence in performing Pre-Functional testing.
- d. All FT's shall be witnessed and approved by the CxA; provide a column for the CxA to sign off on each FT.

3.3.6.1 Programmable Logic Controller Capability and Labeling

Test the following for each controller:

- a. Memory: Demonstrate that programmed data, parameters, and trend/ alarm history collected during normal operation is not lost during power failure.

- b. Direct Connect Interface: Demonstrate the ability to connect directly to each type of controller with a portable electronic device like a notebook computer. Show that maintenance personnel interface tools perform as specified in the manufacturer's technical literature.
- c. Stand Alone Ability: Demonstrate controllers provide stable and reliable stand-alone operation using default values or other method for values normally read over the network.
- d. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the Communication Architecture Schematic and floor plans.
- e. Nameplates and Tags: Show the nameplates and tags are accurate and permanently attached to control panel doors.

3.3.6.2 Workstation and Software Operation

For every user workstation:

- a. Show points lists agree with naming conventions.
- b. Show that graphics are complete.
- c. Show the UPS operates as specified.

3.3.6.3 Communications and Interoperability Areas

Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. If available or required in this specification, use a protocol analyzer to assist with identifying devices, viewing network traffic, and verifying interoperability. These requirements must be met even if there is only one manufacturer of equipment installed. Testing includes the following:

- a. Data Presentation: On each Operator Workstation, demonstrate graphic display capabilities.
- b. Reading of Any Property: Demonstrate the ability to read and display any used readable object property of any device on the network.
- c. Setpoint and Parameter Modifications: Show the ability to modify all setpoints and tuning parameters in the sequence of control or listed on project schedules. Modifications are initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
- d. Peer-to-Peer Data Exchange: Show all devices are installed and configured to execute sequences (without the need for operator or workstation intervention), to implement the project sequence of operation, and to share global data.
- e. Alarm and Event Management: Show that alarms/events are installed and prioritized. Demonstrate time delays and other logic is set up to avoid nuisance tripping. Show that operators with sufficient privilege can read and write alarm/event parameters. Show that

operators with sufficient privilege can change routing for each alarm/event including the destination, priority, day of week, time of day, and the type of transition involved.

Archival Storage of Data: Show that data archiving is handled by the operator workstation/server.

g. Modification of Trend Log Object Parameters: Show that an operator with sufficient privilege can change the logged data points, sampling rate, and trend duration.

. Device and Network Management: Show the following capabilities:

- (1) Display of Device Status Information
- (2) Display of Object Information
- (3) Silencing Devices that are Transmitting Erroneous Data
- (4) Time Synchronization
- (5) Remote Device Reinitialization
- (6) Backup and Restore Device Programming and Master Database(s)

3.3.6.4 Control Loop Stability and Accuracy

For all control loops tested, give the Government trend graphs of the control variable over time, demonstrating that the control loop responds to a 20 percent sudden change of the control variable set point without excessive overshoot and undershoot. If the process does not allow a 20 percent set point change, use the largest change possible. Show that once the new set point is reached, it is stable and maintained. Control loop trend data shall be in real-time with the time between data points 30 seconds or less.

3.3.6.5 Functional Testing Report

Upon successful completion of the FT, submit a FT Report to the Government and prior to the Government taking use and possession of the facility. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated FT Plan used during the FT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements. Once the FT is submitted and approved, participate in Commissioning Functional Testing to verify sequences of operation.

3.3.7 Execution of Sequence of Operation

As part of the work and Performance Tests (PT's) specified in Section 01 91 00, "COMMISSIONING", demonstrate that the HVAC system operates properly through the complete sequence of operation, interactions between sequences and systems are accounted for, "bumpless" operation between modes, and ability to globally read and modify parameters over the internetwork.

3.4 TRAINING REQUIREMENTS

Provide a qualified instructor (or instructors) with two years minimum field experience with the installation and programming of similar PLC systems. Orient training to the specific systems installed. Coordinate training times with the Contracting Officer and BAS Owner after receiving approval of the training course documentation. Training shall take place at the job site and/or a nearby Government-furnished location. A training day shall occur during first and second shift hours, last no longer than 8 hours (4 hours per shift) and include 2 15-minute breaks. The project's approved Controls System Operators Manual shall be used as the training text. The Contractor shall ensure the manuals are submitted, approved, and available to hand out to the trainees before the start of training.

3.4.1 Training Documentation

Submit training documentation for review 30 days minimum before training. Documentation shall include an agenda for each training day, objectives, a synopsis of each lesson, and the instructor's background and qualifications. The training documentation can be submitted at the same time as the project's Controls System Operators Manual.

There will be two distinct organized training milestones; the first one will be after the first building is converted from DDC to PLC operation; the second one will be towards the conclusion of the project once the IACP is converted. The two distinct training milestones will each consist of fundamentals followed by operations.

3.4.2 Phase I Training - Fundamentals

The Phase I training session shall last 2 days for the first milestone (first building converted to PLC), 3 days for the second milestone (IACP) and be conducted in a classroom environment with complete audio-visual aids provided by the contractor. Provide each trainee a printed 8.5 by 11 inch hard-copy of all visual aids used. Upon completion of the Phase I Training, each trainee should fully understand the project's PLC system fundamentals. The first day training session shall include the following:

- a. PLC and SCADA fundamentals
- b. This project's list of control system components
- c. This project's list of I/O points
- d. This project's device and network communication architecture
- e. This project's sequences of control, and:
- f. Alarm capabilities
- g. Trending capabilities
- h. Troubleshooting communication errors
- i. Troubleshooting hardware errors

The second day training session shall consist of an open question and answer discussion between the Contractor's programmers and the Government maintenance and system engineers.

3.4.3 Phase II Training - Operation

Provide Phase II Training shortly after completing Phase I Training. The Phase II training session shall last 2 days for the first milestone (first building converted to PLC), and 3 days for the second milestone (IACP). and be conducted at the PLC system workstation, at a panel HMI, and at other site locations as necessary. Upon completion of the Phase II Training, each trainee should fully understand the project's PLC system operation. The first and second day training session shall include the following:

- a. A walk-through tour of the mechanical system and the installed PLC components (controllers, surge protection, switches, sensors, etc.)
- b. A discussion of the components and functions at each PLC panel
- c. Logging-in and navigating at each operator interface type
- d. Modifying setpoints
- e. Creating, editing, and viewing trends
- f. Creating, editing, and viewing alarms
- g. Demonstrate switching between manual and automatic at the OWS
- h. Discussion of the components and functions at the manual panel

The third day training session shall include the following:

- a. Using each operator interface to find, read, and write to specific controllers
- b. Modifying and downloading control program changes
- c. Backing-up and restoring programming and data bases
- d. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics
- e. Creating new graphics and adding new dynamic data displays and links
- f. Alarm and Event management
- g. Adding and removing network devices

The third day training session shall also include an open question and answer discussion between the contract programmers and the Government maintenance and system engineer.

-- End of Section --

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SECTION 26 05 00.00 40

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.

ASTM INTERNATIONAL (ASTM)

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

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480 (1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1 (2003; Errata 2007) Accessible and Usable Buildings and Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1 (2006) American National Standard for Safety--Color Code

ANSI/NEMA OS 1 (2008) Standard for Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA FB 1 (2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

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) Conduit

NEMA TC 3 (2004) Standard for Polyvinyl Chloride

(PVC) Fittings for Use With Rigid PVC
Conduit and Tubing

NEMA WD 1 (1999; R 2005) Standard for General Color
Requirements for Wiring Devices

NEMA WD 6 (2002; R 2008) Dimensions for Wiring
Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2008; AMD 1 2008) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1 (2005; R 2003 thru 2007) Standard for
Flexible Metal Conduit

UL 489 (2009) Molded-Case Circuit Breakers,
Molded-Case Switches and Circuit-Breaker
Enclosures

UL 6 (2007) Electrical Rigid Metal Conduit-Steel

UL 797 (2007) Electrical Metallic Tubing -- Steel

UL 870 (2008) Standard for Wireways, Auxiliary
Gutters, and Associated Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for information only. Submit
the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material and Equipment for the following:

Conduits, Raceway sand Fittings; G
Wire and Cable; G
Splices and Connectors; G
Switches; G
Receptacles; G
Outlets, Outlet Boxes, and Pull Boxes; G
Circuit Breakers; G

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceways and Fittings; G
Wire and Cable; G
Splices and Connectors; G
Switches; G
Receptacles; G
Outlets, Outlet Boxes, and Pull Boxes; G
Circuit Breakers; G
Power monitor; G

Spare Parts

SD-06 Test Reports

Continuity Test
Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

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. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, enclosures shall be rated for the environment they are installed in, NEMA 4x-ss minimum. 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 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 and Equipment 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.

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. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 WARNING SIGNS

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

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with 2 coats of bitumastic.

Fittings for rigid steel conduit shall be threaded. Where PVC coated rigid steel conduit is used, fittings shall also be PVC coated.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run

where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 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.

2.1.4 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.1.5 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to UL 870.

2.1.6 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to NFPA 70. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN or THWN. All conductors AWG No. 10 and larger, shall be stranded. All conductors smaller than AWG No. 10 shall be solid.

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 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved insulated electrical type.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools. Joints shall be wrapped with an

insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.

2.4.2 Toggle Switches

Toggle switches shall comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be commercial grade toggle type, single double-pole, three or four-way two-position devices rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 10,000/14,000 amperes root-mean-square (rms) symmetrical at 208/480 volts, respectively. 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. Provide updated, typewritten panelboard schedules to match loads.

2.8 POWER MONITOR

Power monitor device shall be industrial grade, compact enclosure with integrated front display for visual readout of electrical characteristics. Equipment shall be capable of accurate 3-phase energy and power measurement

with data logging, power quality analysis, alarm and I/O capabilities. Provide Ethernet communication module for connectivity to the dedicated PLC control network system for real-time COP calculations of the Industrial Area Chiller Plant. The following characteristics are required:

1. Power and Energy Measurements
 - a. Current, voltage, power (demand, per-phase, total), energy (real, reactive, apparent), power factor, and frequency.
2. Basic THD (31st harmonic).
3. Onboard data logging with time/date stamp - 80kB memory.
4. Battery backed-up internal clock.
5. 1 DO / 1 DI.
6. Alarm function.
7. RS-485 serial communications.
8. Ethernet communications card - 10/100 Base-T supporting Modbus TCP/IP.
9. Integral web browser access to meter.
10. Backlit LCD front panel display.
11. Current and potential transformers - (480V source).
12. Device shall be mounted in enclosure, made by device manufacturer for wall mounting equal to Square D, Part #9761E0820Y1C3G1C Series. Enclosure shall be fabricated to allow user to observe and interact with visual display without opening cover. Devices may be group mounted.
13. Control power transformer.
14. Input fusing.
15. Shorting blocks.

Power monitor device shall be Square D PM820 or equivalent.

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.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

Paint conduits of various systems to existing color scheme in the IACP.

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. Conduits installed for future use shall be

terminated with a coupling and plug set flush with the floor.

All raceways in the IACP and O&C shall be rigid.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

EMT shall not be installed where exposed below 48-inches.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, 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.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

3.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70.

3.1.6 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Wireways for overhead distribution and control circuits shall be supported at maximum 3-foot intervals.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 10 feet long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

<u>CONDUCTOR</u>	<u>COLOR AC-120V</u>	<u>Color AC-277V</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White
Equipment Grounds	Green	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.

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.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC/ANSI A117.1 and as follows:

<u>LOCATION</u>	<u>MOUNTING HEIGHT</u>
Receptacles in offices	18 inches
Receptacles in corridors	18 inches
Receptacles in shops & laboratories	48 inches

3.6 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.7 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted per manufacturer's recommendations.

3.8 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. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform Continuity Test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to-end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

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SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

01/08

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SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM
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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 D 709 (2001; R 2007) Laminated Thermosetting Materials

CONSUMER ELECTRONICS ASSOCIATION (CEA)

CEA-310-E (2005) Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596 (2001) Optical Fiber Premises Distribution Cable

ICEA S-90-661 (2006) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 66 (2001; Errata 2003) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2008; AMD 1 2008) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607-A (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA-455-21-A (1988) FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices

TIA-526-14-A	(1998) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-568-C.1	(2009) Commercial Building Telecommunications Cabling Standard
TIA-568-C.3	(2008e1) Optical Fiber Cabling Components Standard
TIA/EIA-568-B.2	(2001) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components
TIA/EIA-569-A	(1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces
TIA/EIA-598-B	(2001) Optical Fiber Cable Color Coding
TIA/EIA-604-2	(2004) FOCIS 2 Fiber Optic Connector Intermateability Standard, Type ST
TIA/EIA-606-A	(2002) Administration Standard for the Telecommunications Infrastructure

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)
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UNDERWRITERS LABORATORIES (UL)

UL 1666	(2007) Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	(2004; R 2008) Standard for Communication Circuit Accessories
UL 444	(2008; R 2008) Communications Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 514C	(1996; R 1998 thru 2009) Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 910	(1998) Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 969	(1995; R 1998 thru 2008) Standard for Marking and Labeling Systems

1.2 RELATED REQUIREMENTS

Section 26 05 00.00 40, "COMMON WORK RESULTS FOR ELECTRICAL" apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA/EIA-568-B.2, TIA-568-C.3, TIA/EIA-569-A, TIA/EIA-606-A and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.4 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.5 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.6 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.7 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for

splicing, terminating, and interconnecting cabling necessary to transport data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the building distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star. This backbone will be addressed by IMCS for intra-building communications from each remote facility, to the IACP, by way of the CD & SC. Provide telecommunications pathway systems referenced herein as specified in Section 26 05 00.00 40, "COMMON WORK RESULTS FOR ELECTRICAL". The telecommunications contractor must coordinate with the Base Operations contractor, IMCS, concerning access to and configuration of telecommunications spaces. The telecommunications contractor may be required to coordinate work effort within the telecommunications spaces with the Base Operations contractor.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G

Patch panels; G

Telecommunications outlet/connector assemblies; G

Equipment enclosure; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test plan; G

SD-09 Manufacturer's Field Reports

Factory reel tests; G

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

SD-11 Closeout Submittals

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00, SUBMITTAL PROCEDURES, submit shop drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved, drawings in accordance with TIA/EIA-606-A. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA/EIA-606-A. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's and, BD's, and FD's to the telecommunications work area outlets. The following drawings shall be provided as a minimum:

- a. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.
- b. T4 - Typical Detail Drawings - Faceplate Labeling, Cabinet Elevations/Configurations with Equipment, and Firestopping. Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation

procedures, detail racking, supports, and raceways.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Contractor shall utilize BICSI TDMM Standards for all telecommunications work.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the

referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 5 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA/EIA-568-B.2 and TIA-568-C.3.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

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

1.6.5 Standard Products

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

1.6.5.1 Alternative Qualifications

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

1.6.5.2 Material and Equipment Manufacturing Date

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

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 WARRANTY

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

1.10 MAINTENANCE

1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system. Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION.

PART 2 PRODUCTS

2.1 COMPONENTS

UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, 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. The certificate shall state 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. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and

pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA/EIA-569-A and as specified in Section 26 05 00.00 40, "COMMON WORK RESULTS FOR ELECTRICAL".

2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568-C.1, TIA/EIA-568-B.2, TIA-568-C.3 and NFPA 70. Provide a labeling system for cabling as required by TIA/EIA-606-A and UL 969. Ship cable on reels or in boxes bearing manufacture date for UTP in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Backbone Cabling

2.3.1.1 Backbone Optical Fiber

Provide in accordance with ICEA S-83-596, TIA-568-C.3, UL 1666 and NFPA 70. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches.

2.3.1.1.1 Multimode Optical Fiber

ITU specification G.651.1, multimode, 50/125-um diameter, loose tube fiber optic cable. Provide multimode fiber optic cable of counts as indicated on drawings. Provide nonconductive optical fiber riser cable (OFNR) flame retardant, indoor/outdoor suitable for use in aerial, duct and riser application rated cable in accordance with NFPA 70 and UL 910. Cable shall utilize water sellable yarns, both inside and surrounding buffer tubes and water swellable tape for fully blocking without the use of gels. The cable cordage jacket, fiber, unit, and group color shall be in accordance with TIA/EIA-598-B. Optic fiber shall not exceed 2.0 db loss per km and an optical return loss (ORL) 20 db or better.

2.3.1.1.2 Optical Single Mode

ITU specification G.652d, single mode, 8.2/125-um diameter loose tube fiber optic cable. Cable characteristics shall be same as those specified in the multimode optical fiber.

Single mode cable shall not exceed 1.0 db/km and an optical return loss (ORL) of 30 db or better. Cable shall be equal to Corning SMF-28e.

2.3.2 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568-C.1.

2.3.2.1 Horizontal Copper

Provide horizontal copper cable in accordance with TIA/EIA-568-B.2, UL 444, NEMA WC 66, ICEA S-90-661 UTP (unshielded twisted pair), 100 ohm. Provide four each individually twisted pair, conductors, Category 6, with a blue thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular intervals not to exceed 3.3 feet. The word "FEET" or the abbreviation "FT" shall appear after each length marking. Provide communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.

Category 6 cabling routed exterior to the facility or below grade shall be water resistant using water swellable tape or similar, without the use of gels.

2.3.2.2 Horizontal Optical Fiber

Requirements are the same as those listed under Backbone Optical Fiber.

2.3.2.3 Horizontal Coax Cable

2.3.2.3.1 Trunk Cable

Trunk cable must be 0.5 inch control cable, semi-flexible coax, or where the bend radius is less than 4-inches, Type RG-11. Cable jacket must be factory marked at regular intervals, indicating verifying organization and performance level. Cable shall be rated plenum (CMP) per NFPA 70 when installed in environmental air spaces. For cable subject to moisture from flooding or to atmospheric contamination, use cable protected by a black polyethylene jacket with a flooding or other water migration deterrent compound between the jacket and the aluminum shield. Underground, flooded cable must have sequential footage marking on the outer jacket.

The 0.5 inch semi-flexible coaxial cable must be compatible with PLC manufacturers recommendation, i.e. Belden 3094A ControlBus Quad Shield or approved equal with the following characteristics:

1. No. 14 AWG bare copper-clad steel center conductor.
2. Gas expanded polyethylene dielectric with nominal 0.28 inches outer diameter.
3. Aluminum Foil - Polypropylene-aluminum laminated tape shield with overlap bonded to the dielectric.
4. Wire shield with 100-percent coverage.
5. 75 ohms impedance.
6. 82 to 85-percent nominal velocity of propagation.
7. PVC jacket with nominal diameter of 0.405 inches.
8. Maximum attenuation characteristics:

Frequency (MHz)@68-degrees F (20-degrees C)	dB/100 ft
1	0.33
5	0.44

Frequency (MHz)@68-degrees F (20-degrees C)	dB/100 ft
10	0.66
100	1.32
200	1.87
300	2.29
400	2.64

2.3.2.3.2 Drop Cable

Coax drop cable must be control cable, Type RG-6. Cable jacket must be factory marked at regular intervals, indicating verifying organization and performance level.

RG-6 coaxial cable must be compliant with PLC manufacturers recommendation, i.e. Belden 3092A Coax-ControlNet Quad Shielded Coax or equivalent with the following characteristics:

1. No. 18 AWG copper-clad steel center conductor.
2. Aluminum foil-polyester tape inner shield with 100-percent coverage and aluminum foil/braid outer shield with 95-percent coverage.
3. Characteristic impedance of 75 ohms.
4. Foam FEP dielectric.
5. Nominal capacitance, conductor to shield, of 16.2 pf per 100 ft.
6. Nominal attenuation characteristics:

Frequency (MHz)@68-degrees F (20-degrees C)	dB/100 ft
1	0.35
5	0.45
10	0.59
50	1.37
100	1.97
200	2.82
300	3.48
400	4.04

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility and telecommunication equipment rooms to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA/EIA-606-A.

2.4.1 Patch Panels

Provide ports for the number of horizontal and backbone cables terminated on the panel plus 25-percent spare. Provide pre-connectorized copper patch cords for patch panels. Provide patch cords, as complete assemblies, with matching connectors as specified. Patch cords shall meet minimum performance requirements specified in TIA-568-C.1, TIA/EIA-568-B.2, for cables, cable length and hardware specified.

2.4.2 Optical Fiber Distribution Panel

Wall mounted optical fiber distribution panel (OFDP) shall be constructed in accordance with CEA-310-E utilizing 16 gauge steel minimum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides, splice tray and shall be lockable, user section shall have a cover for patch cord protection. Each panel shall provide multimode pigtails and adapters. Provide adapters as ST with metallic alignment sleeves. Provide dust covers for adapters. Provide patch cords as specified in the paragraph PATCH PANELS.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68TIA-568-C.1, and TIA/EIA-568-B.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA/EIA-568-B.2 Category 6 requirements. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired as indicated. UTP outlet/connectors shall comply with TIA/EIA-568-B.2 for 200 mating cycles. UTP outlet/connectors installed in outdoor or marine environments shall be jell-filled type containing an anti-corrosive, memory retaining compound.

2.5.2 Optical Fiber Adapters

Provide optical fiber adapters suitable for ST in accordance with TIA/EIA-604-2 with metallic alignment sleeves as indicated. Provide dust cover for adapters. Optical fiber adapters shall comply with TIA-455-21-A for 500 mating cycles.

2.5.3 Optical Fiber Connectors

Provide in accordance with TIA-455-21-A. Optical fiber connectors shall be ST in accordance with TIA/EIA-604-2 with metallic ferrule, epoxyless crimp style compatible with 62.5/125 multimode fiber. The connectors shall provide a maximum attenuation of 0.3 dB @ 850 or 1300 nm with less than a 0.2 dB change after 500 mating cycles.

2.5.4 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568-C.1, TIA/EIA-568-B.2, TIA-568-C.3; flush oversized design constructed of high impact thermoplastic material ivory in color. Provide labeling in accordance with the paragraph LABELING in this section.

2.5.5 Coax Connecting Hardware

2.5.5.1 Trunk and Drop Cable Connectors

Connectors and cable terminators shall be compliant with the controller manufacturer's recommendations. Connectors are T-tap connector type and are to be housed in j-box assemblies outside of the controller enclosures.

2.6 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA J-STD-607-A, and NFPA 70. Components shall be identified as required by TIA/EIA-606-A. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 05 00.00 40, COMMON WORK RESULTS FOR ELECTRICAL.

2.7 FIRESTOPPING MATERIAL

Provide rated assembly in accordance with the existing wall's UL listing per the as-built documentation.

2.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.9 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified 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 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

2.10 TESTS, INSPECTIONS, AND VERIFICATIONS

2.10.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568-C.1, TIA-568-C.3, and TIA-526-14-A for all telecommunication cables.

2.11 SURGE PROTECTIVE DEVICES

2.11.1 Copper Cable Protectors

All copper communication cables routed exterior to the facility shall be provided with surge protective devices which do not degrade the performance of the communications circuit and provides protection for all conductors of the cable. For Category 5e/6 applications, device shall be UL Listed 497 equal to Emerson Cat 5-75-RJ45 (wall mount).

Coaxial applications shall be a gas filled tube and two in-line splice connections. Device shall be recommended by the PLC manufacturer for

remote I/O applications.

Bond all surge protective devices to the communications ground system as recommended by the surge manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with TIA-568-C.1, TIA/EIA-568-B.2, TIA-568-C.3, TIA/EIA-569-A, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 05 00.00 40, COMMON WORK RESULTS FOR ELECTRICAL. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

3.1.1 Cabling

Install Category 6 UTP, and optical fiber telecommunications cabling system as detailed in TIA-568-C.1, TIA/EIA-568-B.2, and TIA-568-C.3. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not untwist Category 6 UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide service loop on each end of the cable, 10 feet in the telecommunications room, and 12 inches in the work area outlet. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Backbone Cable

- a. Optical fiber Backbone Cable. Install intrabuilding and interbuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with manufacturer's recommendations.

3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings between the campus distributor, building distributors and the telecommunications outlet

assemblies at workstations.

3.1.2 Pathway Installations

Provide in accordance with TIA/EIA-569-A and NFPA 70. Provide building pathway as specified on the drawings.

3.1.3 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 26 05 00.00 40, COMMON WORK RESULTS FOR ELECTRICAL.

3.1.4 Work Area Outlets

3.1.4.1 Terminations

Terminate UTP cable in accordance with TIA-568-C.1, TIA/EIA-568-B.2 and wiring configuration as specified. Terminate fiber optic cables in accordance with TIA-568-C.3.

3.1.4.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.4.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.4.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.5 Telecommunications Space Termination

Install termination hardware required for Category 6 and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.5.1 Patch Panels

Patch panels shall be mounted in equipment cabinets with sufficient ports to accommodate the installed cable plant plus 25 percent spares.

- a. Copper Patch Panel. Copper cable entering a patch panel shall be secured to the panel with cable ties or as recommended by the manufacturer to prevent movement of the cable.
- b. Fiber Optic Patch Panel. Fiber optic cable loop shall be 3 feet in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.5.2 Equipment Support Frames

Install in accordance with TIA/EIA-569-A:

- a. Cabinets, wall-mounted modular type. Mount cabinet to plywood backboard in accordance with manufacturer's recommendations. Mount cabinet so height of highest panel does not exceed 78 inches above floor.

3.1.6 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as required to preserve existing assembly rating.

3.1.7 Grounding and Bonding

Provide in accordance with TIA J-STD-607-A, NFPA 70 and as specified in Section 26 05 00.00 40, COMMON WORK RESULTS FOR ELECTRICAL.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA/EIA-606-A. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using laser printer.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA/EIA-606-A.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA/EIA-606-A.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be per manufacturer's recommendations.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, TIA/EIA-568-B.2, TIA-568-C.3. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from

project site upon attenuation test failure. Upon installation, provide loss and ORL data in text format per location and per fiber. Optical traces shall be performed in both directions in electronic format using the 'EXFO.trc' format.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA/EIA-568-B.2, TIA-568-C.3. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connected.

For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 using Method A, Optical Power Meter and Light Source for multimode optical fiber. Perform verification acceptance tests. Perform Method B, OTDR if testing of Method A yields discrepancies in results.

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

- a. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA/EIA-568-B.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.
- b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3.

3.5.1.4 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

- b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

-- End of Section --