AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
J	1 2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO.(If applicable)
0003	13-Jan-2003	W26GLG-2317-3482	MUHJ 023010

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than item 6)	CODE
CONTRACTING OFFICE (CA/CW) US ARMY ENGR DIST NORFOLK ATTN: CENAO-SS-C 803 FRONT STREET NORFOLK VA 23510-1096	DACA65	**See Item 6**	

8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)		
	X	9A. AMENDMENT OF SOLICITATION NO. DACA65-03-R-0007
	X	9B. DATED (SEE ITEM 11) 10-Dec-2002
		10A. MOD. OF CONTRACT/ORDER NO.
		10B. DATED (SEE ITEM 13)
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer [X] is extended, [ ] is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS.
IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

[ ] A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

[ ] B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).

[ ] C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

[ ] D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

AMENDMENT NO. 0003 to DACA65-03-R-0007, OPERATIONS SUPPORT CENTER, LANGLEY AIR FORCE BASE, VA.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) TEL: EMAIL:	
15B. CONTRACTOR/OFFEROR _____ (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY _____ (Signature of Contracting Officer)	16C. DATE SIGNED 13-Jan-2003

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

The following items are applicable to this modification:

CONTINUATION

1. DUE DATE FOR PROPOSALS IS HEREBY EXTENDED TO 30 JANUARY 2003 at NOON. Proposals to be delivered to U.S. Army Engineer District, Norfolk, 803 Front Street, ATTN: CENAO-SS-C, Norfolk, VA 23510-1096.

2. Technical plans and specifications are amended. Make appropriate changes in accordance with the attached.

SECTION 01005

PROJECT WORK REQUIREMENTS AND RESTRICTIONS
07/00

PART 1 GENERAL

1.1 DEFINITIONS

a. Facility: The facility is Langley Air Force Base, Virginia.

b. CO: Contracting Officer or his authorized representative.

1.2 COOPERATION WITH USING AGENCY AND OTHER CONTRACTORS

During the period of this contract, other contracts may be in force for the construction of other features of work on or adjacent to the site of work being accomplished under this contract. It shall be the responsibility of the Contractor on this contract to be fully informed of the extent of the limits of work to be performed by other Contractors. Should there be any conflict between these limits, it shall be brought to the attention of the Contracting Officer and the CO's decision shall be final. Also, prior to completion of work under this contract, members of the Using Agency may be performing work or occupying facilities on or adjacent to the area. The Contractor shall arrange his plant and shall schedule and perform this work so as to effectively cooperate with all other Contractors and Government agencies.

1.3 PERSONNEL RESTRICTIONS

Personnel are limited to the immediate site areas and shall not enter buildings or facilities not involved in the work. All employees of the Contractor will be subject to all rules and regulations of the Facility which pertain to personnel. The Contractor shall erect fences and signs as specified and be responsible for the restrictions of all personnel. The Contractor's plans for restricting personnel access to the project site shall be submitted for approval as a part of the Safety Plan (Accident Prevention Plan).

1.4 TRANSPORTATION FACILITIES

The Facility is served by an all weather surfaced road network. Road(s) within the Facility proposed to be used by the Contractor shall be subject to prior approval of the Facility authorities and such roads, if used, shall be maintained throughout construction and shall be restored to as good condition as existed prior to their use. The Contractor shall also construct, subject to approval, such temporary haul roads and bridges as may be necessary for conducting his work. Any such temporary construction shall be removed and the affected area restored to its original condition. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration shall be borne by the Contractor.

1.4.1 Use of Roads

The Contractor shall keep all roads clear of all obstructions and free of mud and other foreign materials resulting from operations. The Contractor's vehicles shall at no time follow a vehicle closer than 50 feet, and all vehicles shall pull off the road and come to a complete stop

when meeting emergency vehicles and vehicles with flashing lights. Facility speed limits and traffic controls will be observed. Contractor haul route shall be provided by the Contracting Officer at the Preconstruction Conference. Base access will be through the Lasalle Gate or through the West Gate at the Governments disposition.

1.4.2 Road Restrictions

The movement of all vehicles within the Facility shall be confined to the roads designated and shall comply with traffic regulations within the Facility. Other roads may be used only with the approval of the CO.

1.4.2.1 Cleated Vehicles

Cleated vehicles shall not be moved over surfaced roads except at the immediate site of the area where they are to be used.

1.5 COORDINATION IN WORK AREAS

1.5.1 Unoccupied Work Area

The area where the Contractor is scheduled to perform the work will not be occupied during the work, however, the Contractors work activities may affect other area(s) that are occupied. All work shall be in accordance with the Contractor's work plan.

1.5.2 Maintenance of Utilities

Any active utilities, including but not limited to electricity, gas, water, sewer, heating, air conditioning, or any like service, that will require interruption or replacement in any occupied area affected as a result of the Contractors scheduled work activities, shall be temporarily provided by the Contractor at his own expense until the affected service is fully and permanently restored. All temporary method(s) of service replacement the Contractor proposes for use on this contract shall be approved by the Contracting Officer prior to commencing the work.

1.5.3 Hours of Work

The normal work hours for construction shall be from 7:00 a.m. to 5:00 p.m., Monday through Friday of each week. Any request to change these hours shall be made in writing to the Contracting Officer at least two calendar days prior to the desired day on which the change is to go into effect. The changed hours shall not go into effect until written permission has been received from the Contracting Officer.

1.5.4 Digging Permits

Contractor is responsible for obtaining all digging permits, including associated locating and marking services, in accordance with installation and local requirements, at no additional cost to the Government.

1.6 PHASING

This project shall be accomplished in two phases to allow for continued use of Buildings 18, 20, and 21 until the proposed OSC Building is constructed and occupied.

Phase 1 includes installation of Erosion and Sediment Control measures,

initial site preparation, the demolition of an underground bunker, removal of a parking area south of Building 18, installation of roadway barriers and the removal of a section of Rickenbacker Road, clearing and grubbing of trees within the construction area and the surrounding Force Protection Zone and the removal of several minor structures within the planned construction limits all as shown on the plans. During the demolition process, the Contractor shall take care to protect the existing 10-inch water main on the south side of Rickenbacker Road until the water main is re-routed as shown on the plans. The existing high voltage overhead electrical service on the north side of Rickenbacker Road and the underground communications lines along Elm Street and Rickenbacker Road shall be protected and maintained until the proposed OSC Building is occupied and operation. The OSC Building shall be constructed and accepted by the Government during Phase 1. Removal and replacement of Building 15 loop road and construction of drainage system shall also be completed during Phase 1. The Contractor shall allow for a 60 day period from the Completion of Phase 1 to the start of Phase 2 for the Government to move into the OSC Building and vacate the buildings to be demolished in Phase 2.

Phase 1A includes the portion of west parking lot associated with the OSC Building. Construction of this parking area shall not commence until six months after notice to proceed is issued but shall be completed no later than the remainder of Phase 1.

Phase 1B includes all work associated with drawings labeled as Dormitory Loop Road. Construction of this Dormitory Loop Road shall be completed no later than four months after notice to proceed.

Phase 2 includes the demolition of Buildings 18, 20, and 21 and the surrounding parking areas and the remaining sections of Rickenbacker Road. Utilities serving the buildings shall be disconnected and capped or removed as shown on the plans and in accordance with the specifications. The overhead high voltage lines and poles along the north side of Rickenbacker Road shall be removed. New work includes placing additional fill; widening a section of Elm Avenue; construction of re-aligned Rickenbacker Road and several paved parking areas together with the associated storm drainage; installation of landscaping and an irrigation system, all as shown on the plans.

1.6.1 Electrical and Communications Phasing Sequence

The following sequence is provided as a guide to assist the Contractor in phasing the construction work in relation to the electrical and communications systems. The Contractor shall submit a detailed phasing sequence plan for approval by the Contracting Officer, including but not limited to specific items of phasing, dates and/or timeline for each, complete details on items requiring temporary services and/or rerouting existing services.

a. The following shall be accomplished under Phase 1:

(1) All work at the existing main electrical station on the corner of Elm Street and Sweeney.

(2) Provide new 22KV ductbank and cabling system down Elm Street, new 4 way MV pad mounted switch adjacent courtyard, new electrical secondary unit substation, new packaged generator, new outdoor walk-in main electrical switchgear, feeders and manholes within the Phase 1 lines indicated on the civil plans, and all related work.

(3) Provide part of the exterior lighting and related underground circuitry up to the Phase 1 limit line.

(4) Upgrade the existing overhead to three phase, new underground 4.16 KV ductbank and cabling system reroute; demolish part of the existing overhead 4.16 KV system back to the Phase 1 line limits.

(5) Provide the exterior communications ductbank system up to the Phase 1 limit lines.

(6) Provide the exterior communications ductbank to Building 19, complete.

(7) All interior and perimeter work for the new operations support center building.

(8) Buildings 18 and 21 shall remain completely operational until required to be demolished under Phase 2.

b. The following shall be accomplished under Phase 2:

(1) Demolish the remaining portion of the existing overhead 4.16 KV circuit as indicated.

(2) Provide remainder of 22 KV system work indicated, including new 4 way MV switch, new feeders to Building 15 transformer, new portions of 22 KV cabling in existing ducts, and associated demolition, etc.

(3) Remove services from and provide demolition of existing Buildings 18 and 21, complete.

(4) Provide the remaining of the exterior lighting and related underground circuitry.

(5) Encase existing underground communications ductbank.

(6) Provide the reaming underground communications ductbank system indicated.

(7) All remaining work.

1.7 INTERRUPTIONS OF UTILITIES

1.7.1 Approval

Utility services shall not be interrupted by the Contractor to relocate, make connections, or interrupt for any purpose, without written approval of the Contracting Officer.

1.7.2 Request

Request for permission to shut down services shall be submitted in writing to the Contracting Officer not less than 10 calendar days prior to date of proposed interruption. The request shall give the following information:

a. Nature of Utility (Gas, L.P. or H.P., Water, Elec.)

b. Size of line and location of shutoff.

c. Buildings and services affected.

d. Hours and date of shutoff.

e. Estimated length of time service will be interrupted.

1.7.3 Service Interruptions

Services shall not be shut off until receipt of approval of the proposed hours and date from the Contracting Officer.

1.7.4 Timely Disconnections

Shutoffs which will cause interruption of Government work operations as determined by the Contracting Officer shall be accomplished during regular non-work hours or non-work days of the Using Agency without any additional cost to the Government.

1.7.5 Utilities Operation

Operation of valves on water mains will be by Government personnel. Where shutoff of water lines interrupts service to fire hydrants or fire sprinkler systems, the Post Fire Department shall be notified by the Contractor in writing 72 hours prior to the proposed interruption. The Contractor shall arrange his operations and have sufficient material and personnel available to complete the work without undue delay and shall restore service without delay in event of emergency.

1.7.6 Gas

Flow in gas mains which have been shut off shall not be restored until the Government inspector has determined that all items serviced by the gas line have been shut off.

1.8 PHYSICAL DATA

The physical conditions indicated on the drawings and in the specifications are the result of borings. See Section 01055 SOIL BORING DATA for boring logs and data.

1.9 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the Contract Clause entitled "Default: (Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

a. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

1.9.1 Schedule

The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Langley AFB	9	9	9	6	7	6	7	7	5	6	7	9

1.9.2 Records

Upon acknowledgement of the Notice to Proceed and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

1.9.3 Impacted Days

The number of actual adverse weather days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day in each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in the schedule of monthly anticipated adverse weather delays, above, the contracting officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the Contract Clauses entitled "Default (Fixed Price Construction)".

1.10 SITE CONTAMINATION

This site is designated a Category I site and is defined as a site that is located in a traditional non-hazardous location, such as in an administrative, recreation, or housing area and that the Government has no reason to suspect contamination.

1.10.1 Compliance Requirements

The Contractor shall comply with applicable Federal, state and local laws, codes, ordinances and regulations (including the obtaining of licenses and permits) in connection with any hazardous material, substance or waste.

1.10.2 Requirements

The requirements of this clause and any act or failure to act by the Government shall not relieve the Contractor of any responsibility or liability for the safety of Government, Contractor or subcontractor personnel or property.

1.10.3 Contamination

In the event that contamination beyond that shown or specified is encountered, the Contracting Officer shall be advised immediately. The contamination shall be removed as directed and replaced with satisfactory material. Payment therefor will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES.

1.11 WORK IN QUARANTINED AREA

The work called for by this contract involves activities in counties quarantined by the Department of Agriculture to prevent the spread of certain plant pests which may be present in the soil. The Contractor agrees that all construction equipment and tools to be moved from such counties shall be thoroughly cleaned of all soil residues at the construction site with water under pressure and that hand tools shall be thoroughly cleaned by brushing or other means to remove all soil. In addition, if this contract involves the identification, shipping, storage, testing, or disposal of soils from such a quarantined area, the Contractor agrees to comply with the provisions of ER 1110-1-5 and attachments, a copy of which will be made available by the Contracting Officer upon request. The Contractor agrees to assure compliance with this obligation by all subcontractors.

1.12 HISTORICAL AND ARCHAEOLOGICAL FINDS

Federal legislation provides for the protection, preservation, and collection of scientific, prehistorical, historical, and archaeological data, including relics and specimens which might otherwise be lost due to alteration of the terrain or building features as a result of any Federal construction project. Should the Contractor, or any of the Contractor's employees, or parties operating or associated with the Contractor, in the performance of this contract discover evidence of possible scientific, prehistorical, historical, or archaeological data, the Contractor shall immediately cease work at that location and notify the Contracting Officer, giving the location and nature of the findings. The Contractor shall forward written confirmation to the Contracting Officer as directed. The Contractor shall exercise care so as not to disturb or damage artifacts or fossils uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition. Any person who, without permission, injures, destroys, excavates, appropriates, or removes any historical or prehistorical artifact, object of antiquity, or archaeological resource on the public lands of the United States is subject to arrest and penalty of law. Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

1.13 EQUIPMENT-IN-PLACE LIST:

The Contractor shall maintain a list of equipment installed under the terms of the contract. In the event that the contract includes more than one building or facility, a list must be maintained for each and delivered to the Contracting Officer upon acceptance of each building or facility. Forms to be used for this purpose shall be obtained from the Area Engineer's Office. The list shall include the following:

a. Contract number
b. Description of item

c. Model number
d. Serial number
e. Capacity
f. Name of manufacturer
g. Address of manufacturer
h. Condition of item
i. Replacement cost
j. Name of person who checked item

1.14 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

1.14.1 Allowable Costs

Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a Contractor or subcontractor at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region II. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

1.14.2 Rental Costs

Equipment rental costs are allowable, subject to the applicable provisions of the Federal Acquisition Regulations, and shall be substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-leaseback arrangements will be determined using the schedule except that rental costs leased form an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

1.14.3 Equipment Costs

When actual equipment costs are proposed and the total amount of the pricing action is over $25,000, cost or pricing data shall be submitted on the Standard Form 1411, "Contract Pricing Proposal Cover Sheet". By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

1.14.4 Marine Equipment

In determining the ownership expense for marine equipment as described in the Schedule, the average use per year shall be 8 months.

1.15 SUBCONTRACTS AND WORK COORDINATION

Contract Clauses "SUBCONTRACTS", "PERMITS AND RESPONSIBILITIES", and "MATERIAL AND WORKMANSHIP" are supplemented as follows:

a. Divisions or sections of specifications are not intended to control the Contractor in dividing the work among subcontractors, or to limit work performed by any trade.

b. Contractor shall be responsible for coordination of the work of the trades, subcontractors, and materials.

c. The Government or its representative will not undertake to settle any difference between the Contractor and Contractor's subcontractors, or between subcontractors.

d. The Government reserves the right to refuse to permit employment on the work or require dismissal from the work of any subcontractor who, by reason of previous unsatisfactory work on Corps of Engineers projects, or for any other reason is considered by the Contracting Officer to be incompetent or otherwise objectionable.

1.16 CONSTRUCTION MANPOWER AND EQUIPMENT REPORT

The Contractor shall submit daily reporting in accordance with the Resident Management System (RMS). The report shall include manpower and equipment for the general and subcontractors. See Section 01312, "Resident Management System (RMS)."

1.17 PROFIT

1.17.1 Weighted Guidelines

Weighted guidelines method of determining profit shall be used on any equitable adjustment change order or modification issued under this contract. The profit factors shall be as follows:

Factor	Rate	Weight	Value
Degree of Risk	20		
Relative difficulty of work	15		
Size of Job	15		
Period of performance	15		
Contractor's investment	05		
Assistance by Government	05		
Subcontracting	25		
	100		

1.17.2 Value

Based on the circumstances of each procurement action, each of the above factors shall be weighted from .03 to .12 as indicated below. The value shall be obtained by multiplying the rate by the weight. The value column when totalled indicates the fair and reasonable profit percentage under the circumstances of the particular procurement.

1.17.2.1 Degree of Risk

Where the work involves no risk or the degree of risk is very small, the weighting should be .03; as the degree of risk increases, the weighting should be increased up to a maximum of .12. Lump sum items will have, generally, a higher weighted value than the unit price items for which quantities are provided. Other things to consider: the portion of the work to be done by subcontractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, and whether the negotiation is before or after performance of work.

1.17.2.2 Relative Difficulty of Work

It the work is most difficult and complex, the weighting should be .12 and should be proportionately reduced to .03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider: the nature of the work, by whom it is to be done, where, and what is the time schedule.

1.17.2.3 Size of Job

All work not in excess of $100,000 shall be weighted at .12. Work estimated between $100,000 and $5,000,000 shall be proportionately weighted from .12 to .05.

1.17.2.4 Periods of Performance

Jobs in excess of 24 months are to be weighted at .12. Jobs of lesser duration are to be proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. No weight where additional time not required.

1.17.2.5 Contractor's Investment

To be weighted from .03 to .12 on the basis of below average, average, and above average. Things to consider: amount of subcontracting, mobilization payment item, Government furnished property, equipment and facilities, and expediting assistance.

1.17.2.6 Assistance by Government

To be weighted from .12 to .03 on the basis of average to above average. Things to consider: use of Government owned property, equipment and facilities, and expediting assistance.

1.17.2.7 Subcontracting

To be weighted inversely proportional to the amount of subcontracting. Where 80 percent or more of the work is to be subcontracted, the weighting is to be .03 and such weighting proportionately increased to .12 where all the work is performed by the Contractor's own forces.

PART 2 PRODUCTS (THIS PART NOT USED)

PART 3 EXECUTION (THIS PART NOT USED)

-- End of Section --

SECTION 13210

ABOVEGROUND FUEL OIL STORAGE TANKS
2/02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997; Rev. A) Carbon Structural Steel
ASTM A 569/A 569M	(1998) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum, Percent), Hot-Rolled
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

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

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996) Flammable and Combustible Liquids Code
NFPA 30A	(1996) Automotive and Marine Service Station Code
NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 142	(1993) Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 674	(1994; Bul. 1996, R 1997) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; R 1996) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 886	(1994; Bul. 1996, R 1997) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 2085	(1997) Protected Aboveground Tanks for Flammable and Combustible Liquids

1.2 SYSTEM DESCRIPTION

Provide aboveground storage tank systems and fuel piping systems complete and ready for operation. Fuel piping systems shall include aboveground piping, and connections to existing piping systems.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Aboveground storage tanks (AST) G.

Submit shop drawings for each size of AST for approval. Indicate types, sizes, locations, installation details, and other construction details.

SD-03 Product Data

Aboveground storage tanks (AST) G, AE.

Leak Detection System G, AE.

High level alarm system G, AE.

Tank Level Gage System G, AE.

Alarm Control Panel System G, AE.

Remote alarm system G, AE.

SD-06 Test Reports

Field acceptance test G, AE.

SD-08 Manufacturer's Instructions

Installation instructions

SD-10 Operation and Maintenance Data

Aboveground storage tanks(AST), Data Package 2 G, AE.

Alarm control panel system, Data Package 2 G, AE.

Accessories for AST's, Data Package 2 G, AE.

Submit in accordance with Section 01781N, "Operation and Maintenance Data".

1.4 DELIVERY AND STORAGE

Handle and store aboveground storage tanks and containment piping systems, to prevent distortions and other damage that could affect their structural, mechanical, or electrical integrity. Replace damaged items that cannot be restored to original condition. Store items subject to deterioration by exposure to elements, in a well-drained location, protected from weather, and accessible for inspection and handling.

PART 2 PRODUCTS

2.1 ABOVEGROUND STORAGE TANKS (AST)

Tanks provided shall be either of the two specified tank types. Each provided AST shall be UL listed for compliance with UL 2085, as an insulated, secondary containment aboveground storage tank, protected type. Each tank shall bear the UL label in compliance with UL 2085. Each tank shall have a minimum capacity of 8,000 gallons.

2.1.1 Concrete Vaulted Tank

a. Tank System: tank, thermal protection, secondary containment, and its enclosure (concrete vault) shall be shipped as a completed unit, that is, completely fabricated in manufacturer's factory.

b. Primary Tank: Listed under UL 142; in compliance with NFPA 30; ASTM A 569/A 569M or ASTM A 36/A 36M carbon steel; warranted for a minimum of 20 years by the manufacturer.

c. Concrete Vault: Minimum 6 inches thick; minimum design strength of 4000 psi at 28 days; encases and protects both primary and secondary containment; steel re-inforcing bars; vault shall be either monolithic, or be provided with one horizontal joint or seam for the removeable top of vault. No vertical joints or seams will be allowed.

d. Corrosion Protection: Coating on steel components exterior to the concrete encasement shall meet requirements of ASTM B 117

e. Spill and Overfill Containment: UL listed 7 gallon spill/overfill container manufactured as an integral part of the primary tank, surrounding the fill tube and protected by the 2 hour fire rating of the encasement; container shall have a stick port and normally closed valve to release spilled fluid into primary tank.

f. Overspill Protection: One or more of the following methods:

(1) Direct reading level gauge visible from the fill pipe access.

(2) Audible and visible high level alarm.

g. Exterior Finish: Exposed aggregate with cementious sealer, or vault surface sealed with cementious sealer and then coated with gloss urethane finish coat..

h. Signage: Signage shall be recessed in exterior of concrete to ensure against damage.

i. Venting: NFPA 30; 2 inch atmospheric vent and emergency vent.

j. Anti-spill Valves: Where product piping extends below the top of the primary tank, piping shall include shutoff valve and a normally closed safety valve; safety valve shall be an approved anti-siphon valve or an electric solenoid valve.

2.1.2 Double-wall Steel Tank, Concrete Insulated

a. Primary tank, its outer steel tank (outer enclosure), interstitial insulation, and the exterior fiberglass coating, all shall be shipped as a completed unit, that is, completely constructed in manufacturer's factory.

b. Primary Tank and Outer Steel Tank: Listed under UL 142; in compliance with NFPA 30; ASTM A 569/A 569M or ASTM A 36/A 36M carbon steel; warranted for a minimum of 20 years by the manufacturer.

c. Interstitial Insulation (Concrete): Concrete bounded by primary steel tank and outer steel tank; encases and protects primary tank; concrete placement shall be monolithic, that is, without seams; tank system provides the support legs which provide minimum of 3 inch clearance under outer tank.

d. Corrosion Protection: Provide a fiberglass impregnated cladding on the exterior surface of the outer tank. This cladding shall be factory applied in the tank manufacturer's factory or an in factory acceptable to the tank manufacturer. The cladding shall be provided to a minimum thickness of 1/8 inch in compliance with the instructions of the cladding system manufacturer.

e. Secondary Containment: Outer steel tank.

f. Spill and Overfill Containment: UL listed 7 gallon spill/overfill container manufactured as an integral part of the primary tank, surrounding the fill tube and protected by the 2 hour fire rating of the encasement; container shall have a stick port and normally closed valve to release spilled fluid into primary tank.

g. Overspill Protection: One or more of the following methods: (a) direct reading level gauge visible from the fill pipe access,(b) audible and visible high level alarm.

h. Venting: NFPA 30; 2 inch atmospheric vent and emergency vent.

i. Anti-spill Valves: Where product piping extends below the top of the primary tank, piping shall include shutoff valve and a normally closed safety valve; safety valve shall be an approved anti-siphon

valve or an electric solenoid valve.

j. Outer Steel Tank Exterior Finish: manufacturer's fiberglass impregnated coating with total dry thickness a minimum of 1/8 inch thick.

2.2 ACCESSORIES FOR AST's

Provide the following accessories coordinated with each tank design: Leak detection sensor, high level alarm switch, fill port with overfill spill box, fuel outlet with anti-siphon foot valve, leak detection sensor, and vent with whistle alarm.

2.2.1 Leak Detection System

Provide continuous surveillance probe type leak detection system. System shall be suitable for operation in NFPA 70, Class 1, Group D environment. Locate the leak detection system in the leak containment space between the primary tank and the secondary containment. Leak detection system shall electronically detect fluid leakage into containment space.

Sensor output and transmission shall be electronic. Probe mounting system shall not restrict the flow of liquid to the sensing area of the probes. Sensor output shall provide control signal to the alarm control panel system specified in this section.

Probe configuration shall be brass or stainless steel components with BUNA-N float. System shall give alarm condition when no more than 1/2 inch of liquid leakage is present.

2.2.2 High Level Alarm System

Provide each tank with a vertical float type high level switch with alarm setting at 95 percent tank capacity. Switch output shall provide control signal to the alarm control panel system specified in this section.

2.2.3 Tank Level Gage System

Provide tank manufacturer's standard cataloged level gage system

2.2.4 [Enter Appropriate Subpart Title Here]2.2.4.1 Controller For Automatic Operation

a. Level transmitter for installation in 2 inch tank fitting.

b. 90 percent tank level visual alarm.

c. 95 percent tank level visual alarm.

d. Tank leak alarm.

e. Audible alarm horn activated by alarms specified above.

f. Power available indicator.

g. Control power on-off switch.

h. Pump start/stop push-buttons.

i. top-off/hose drain mode push-button.

j. Pump starter.

k. Explosion proof controller enclosure.

2.3 PIPING SYSTEMS

2.3.1 Copper Tubing System

Provide ASTM B 88, Type K or Type L copper tubing with ASME B16.26 flared fittings or compression type fittings for fuel oil supply, fuel oil return, and secondary (controls) piping.

2.3.2 Gate Valves

MSS SP-80, Class 125.

2.3.3 Check Valves

MSS SP-80, Class 125, swing check.

2.3.4 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Indicated hangers which do are not covered by MSS SP-69 configurations, shall meet the applicable design requirements of MSS SP-58, and the hanger spacing requirements of MSS SP-69. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

2.3.5 Dielectric Connections

Provide dielectric connections at piping connections of dissimilar metals.

2.4 ELECTRICAL REQUIREMENTS

Provide switches and devices necessary for the tank electrical systems system; wiring, fittings, and components shall be explosion-proof in compliance with applicable requirements of UL 674, UL 698, and UL 886 for Class I, Division l, Group C and D hazardous locations. Electrical installations shall conform to requirements of NFPA 70.

2.4.1 Alarm Control Panel System

Control panel shall be in NEMA 4X enclosure, suitable for the environment, and the panel shall include solid state circuitry, and visual alarms. Locate each panel at indicated spot. Panel shall incorporate a manual, self-test system which permits verification of proper operation of high level alarm audible and visual alarm equipment. Provide a reset button to silence the audible alarm, but at the same time maintaining the lit alarm light until the alarm condition is corrected.

2.4.2 Remote Alarm System

System shall be in NEMA 4X enclosure, suitable for the environment, and shall include an audible alarm. Locate each enclosure at indicated spot.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Fuel Storage Tanks

Install vault type fuel storage tanks, vents, and other connections in accordance with NFPA 30 and NFPA 30A and published installation instructions of the manufacturer.

3.2 FIELD TESTING.

Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a calibrated test gage in the system. Maintain test pressure for at least one hour on all new piping work. In the event of leakage, locate and repair leak and repeat test. Submit a field acceptance test report for each new AST system installation and each new piping system installation.

3.2.1 Piping System Test

After tank erection and installation of valves and piping, test piping. Perform hydrostatic test of new fuel piping work at 100 psig for one hour. Replace defective material disclosed by pressure test and repeat test until results are satisfactory.

3.2.2 Storage Tank Test

Pressure test tanks at not less than 5 psig or more than 7 psig and as recommended by the manufacturer.

3.3 INSTRUCTION TO GOVERNMENT PERSONNEL

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 AST system, accessories for the AST, and the associated piping system. Instruction shall be given during the a regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Schedule instruction time with Contracting Officer. The number of man-days (8 hours per day) of instruction furnished shall be one. Use approximately half of the time for classroom instruction. Use other time for instruction in the field at the equipment or system.

-- End of Section --

SECTION 13722

SOUND MASKING SYSTEM
04/02

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 basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

1.2 SYSTEM DESCRIPTION

The sound masking system shall consist of, but not be limited to, electronic noise generators, mixers, amplifiers, wiring, equalizers, controls, transducers, speakers, and auxiliary components to generate, amplify, distribute, and reproduce digitally synthesized and stabilized pink background noise for sound masking for security in zones of coverage. Provide all equipment and devices that is required for a complete sound masking system as specified herein and in accordance with the the Defense Intelligences Agency criteria.

1.2.1 Definitions

A. Test and Calibration Conditions: Spaces completely furnished but unoccupied, lights and HVAC systems on, HVAC system testing and balancing completed, ceiling components in place.

B. Covered Spaces: Exterior windows where tranducers are installed. Work spaces. Spaces above drop ceilings. Spaces below raised access flooring.

C. Pink Noise: Random noise signal with equal energy in each octave.

D. Sound Masking: Covering up of one sound by another.

1.2.2 Multi-Channel System

The system shall provide two channels for distribution over an audio network to speakers and glass transducers as indicated. Each channel shall be separate, and equipment for each channel shall be identical, except for alternate program inputs which shall be suitable for the alternate source specified. The system shall include electronic noise generators, mixers, amplifiers, wiring, equalizers, controls, transducers, and auxiliary components and all accessories required.

1.2.3 System Performance

The system shall provide even sound distribution throughout the designated area and zones. The system shall be capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) to any location in the area at an acoustic distortion level below 5

percent total harmonic distortion (THD).Additional performance shall be:

A. Signal Levels: Individually adjustable for each of 14 one-third octave bands centered at 200 through 4000 Hz, for sound-masking noise channels.

B. Sound-Power Level Produced by System: Match NC 40 contour between 400 and 2000 Hz, with smooth roll-off above and below those frequencies.
1. Initial Level: 40 dB, A-weighted.
2. Final Adjusted Level: 40 to 50 dB, A-weighted. Determine final level for each space individually by measurement as specified in Part 3.
3. Measurements: Made under calibration conditions.

C. Maximum Local Variance of Sound-Power Level: 6 dB for the 500-Hz octave band and 3 dB for the 1000-, 2000-, and 4000-Hz octave bands for 75 percent of the locations in covered spaces.

D. Maximum Average Range of Sound-Power-Level Deviation: 2 dB in the 250-, 2000-, and 4000-Hz octave bands and 1.5 dB for the 500- and 1000-Hz octave bands for all locations.

E. Directional Effect: People in covered spaces under calibration conditions cannot determine source of masking sound.

G. Uniformity with Respect to Time: One-minute time-averaged sound-pressure level of any octave band of masking sound from 250 to 8000 Hz remains constant in any space to within a standard deviation of 2 dB when measured over a 30-minute period.

H. Sound Quality: No audible hum or noise from this system in covered spaces when noise generators are off and power amplifiers are on with input volume controls set at 50 percent.

1.3 CONTRACTOR QUALIFICATIONS

The system shall be installed by an experienced firm regularly engaged in the installation of high secured installation sound masking systems for the Department of Defense. The contractor shall have a minimum of five years experience installing, testing, and calibrating high secured installations sound masking systems on at least ten different systems. The Contractor must be certified by the manufacturer of the sound masking equipment to install, calibrate and test the complete system. Certification shall be submitted to the Contracting Officer for approval. Submit a list of recent projects and point of contacts with telephone numbers, a minimum of ten, for reference and verification of contractor qualifications.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sound Masking System; G, AE

Detail drawings consisting of a complete list of equipment and

material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical speakers and transducers. The Contractor shall check the layout based on the actual speakers and transducers to be installed and make necessary revisions in the detail drawings. Detail drawings shall also contain complete point to point wiring, schematic diagrams and other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Spare Parts; G, RE

Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-06 Test Reports

Approved Test Procedures; G, AE

Test plan and test procedures for the acceptance tests. The test plan and test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements specified. The procedure shall also explain methods for simulating the necessary conditions of operation to demonstrate system performance.

Acceptance Tests; G, AE

Test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports shall include the manufacturer, model number, and serial number of test equipment used in each test. Each report shall indicate the final position of controls and operating mode of the system.

SD-07 Certificates

Components; G, AE

Copies of current approvals or listings issued by UL, or other nationally recognized testing laboratory for all components.

Materials and Equipment; GA.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of

Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Sound Masking System Installer Qualification;; GA, AE

A certification that contains the names and the qualifications of people recommended to perform the sound masking system installation, testing, and calibrating, under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in the same types of installation. The Contractor shall provide at least one on site person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Sound Masking System, Data Package 3; G
, AE

Submit data package in accordance with Section 01781, OPERATION AND MAINTENANCE DATA

1.5 DELIVERY AND STORAGE

Equipment placed in storage until installation shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.6 VERIFICATION OF DIMENSIONS

The Contractor shall become familiar with the details of the work and working conditions, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancies before performing the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Material and equipment to be provided shall be the standard products of a manufacturer regularly engaged in the manufacture of such products, and shall essentially duplicate material and equipment that have been in satisfactory use at least 5 years. All components used in the system shall be commercial designs that comply with the requirements specified. Equipment shall be supported by a service organization that is within 100 miles of the site.

2.2 Component Modularity

Modular plug-in, heavy-duty, industrial-grade integrated circuit devices.

2.3 AC Power Supply

AC Supply Voltage Tolerance: 105 to 130 V with no degradation of system performance.

2.4 Power Line Surge Protection

Protection from Power Line Surges: Integral surge suppressors listed under UL 1449; complying with IEEE C62.41, Category B; and with the following features:
1. Suppression Level: 300 V.
2. Maximum Response Time: 5 nanoseconds.
3. Circuit: Multistage, using inductors and silicon-avalanche zener diodes or equivalent.
4. Indicator Lamp: Neon or light-emitting diode located on control panel and arranged to extinguish on failure of protection.
5. Fuses: Externally accessible.

2.5 System Components Mounting

All electronic components (i.e. amplifiers, equalizers, volume controls, etc.) shall be suitable for mounting in standard 19-inch racks, with connections at rear and controls front of the rack panel and protected by a full length, plastic or glass side hinged door.

2.6 NOISE GENERATOR AND FILTER UNITS

Noise generator and filter unit shall have the following minimum characteristics:

A. Pink Noise Generator: Output octave bands from 30 to 4000 Hz.

B. Filters for One-Third Octave Bands: Adjustable from 10 dB of boost to 10 dB of cut at each center frequency.

C. High-Pass Filter: Approximate range of cutoff adjustment is 37 to 400 Hz.

D. Low-Pass Filter: Approximate range of cutoff adjustment is 3.4 to 20 kHz.

E. High-Cut Filter: Approximate range of cutoff adjustment is 180 to 9000 Hz with slope varying to 12 dB per octave.

2.7 PROGRAMMABLE AUDIO-LEVEL CONTROL UNIT

The programmable audio-level control shall have the following minimum characteristics:

A. Automatic Sound-Power-Level Changes: Six system channel changes, four times per day, and capable of different time settings for each day of week.

B. Level Changes: Programmable from front panel of unit, and automatically incremented over a period long enough for sound-level variations to be imperceptible to occupants of covered spaces.

C. Program Memory: Nonvolatile for one year, minimum, without power. When re-energized after a power outage, control starts at zero level and automatically advances system sound level at same rate used for programmed level changes.

2.8 MIXER-PREAMPLIFIER

Mixer-preamplifier shall as a minimum conform to the following specifications:

Rated Output:	18 dB
Frequency Response:	Plus or Minus 1 dB, 20 - 20,000 Hz
Distortion:	Less than 0.2 percent, 20 - 20,000 Hz
Signal to noise:	Microphone - 60 dB Aux - 70 dB
Inputs:	5 independent balanced low-impedence, transformer-isolated
Input Sensitivity:	Microphone - 0.003 volts Aux - 0.125 volts Magnetic Cartridge - 0.0005 volts
Input Channel	
Isolation:	80 dB minimum
Tone Controls:	Plus or Minus 10 dB range at 50 and 15,000 Hz
Power Requirement:	110-125 Vac 60 Hz

2.9 EQUALIZER

The equalizer shall be catalog number SMS200 as manufactured by Biamp or approved equal.

2.10 POWER AMPLIFIERS

Power amplifiers as a minimum conform to the following specifications:

Rack mounted type in standard 19 inch rack.

Rated power output:	250 watts RMS
Frequency Response:	Plus or Minus 2 dB, 60-13,000 Hz
Distortion:	Less than 2 percent at RPO, 600-13,000 Hz
Input Impedance:	50 k ohm unbalanced
Signal to Noise Ratio:	60 dB or greater, at rated output.
Output Impedance:	83.3, 10.4, 8.0, and 4.0 ohms
Output voltage:	70.7, 25, 22, and 15.5 volts
Power Requirement:	110-125 Vac 60 Hz

2.11 TRANSDUCERS

2.11.1 WINDOW GLASS TRANSDUCERS

Provide piezo type window mounted glass transducers as manufactured by Atlas-Soundolier or approved equal, for resonting.

2.7 LOUDSPEAKERS

2.12 Cone Speaker

The cone speaker shall as a minimum conform to the following specifications:

Minimum Axial Sensitivity: 45 dB.

Size: 8 inches with 1-inch (25-mm) voice coil

Dispersion Angle: 100 degrees.

Application:	Ceiling or Pendant
Frequency range:	60 to 12,000 Hz
Power Rating:	Normal - 10 watts
Voice Coil Impedance:	8 ohms
Line Matching Transformer Type:	25/70 volt line
Capacity:	2 watts
Magnet:	8 ounces or greater
Primary Taps:	0.5, 1, and 2 watts
Primary Impedance:	25 volts - 1250, 625, and 312 ohms 70 volts - 10k, 5k, and 2.5k ohms

Frequency Response: 30 - 20,000 Hz

Insertion Loss: Less than 1 dB

2.13 SPEAKER ENCLOSURES

Provide speakers mounted in ceiling mounted backcans, flush in ceiling with baffle and trim or mount pendant mounted above ceiling as specified, in backcan, baffle and trim.

2.14 SWITCHES AND CONTROLS

2.14.1 REMOTE TRANSDUCER CONTROLS

Provide remote volume controls with detented 3 dB steps and an OFF position. Provide with VU meter. The controls shall be rack and gang mounted and labelled respective to the transducer controlled. Insertion loss of the controls shall not exceed 0.6 dB and the power-handling capacities of the control shall be 10 watts. Low-voltage priority override relays shall be furnished as part of these controls with all wiring to the racks to allow override of the volume controls for priority announcements.

2.14.2 REMOTE LOUDSPEAKER VOLUME CONTROLS

Provide remote volume controls shall be an auto transformer type with detented 3 dB steps and an OFF position. Provide with VU meter. The controls shall be rack and gang mounted and labelled respective to the speaker controlled. Insertion loss of the controls shall not exceed 0.6 dB and the power-handling capacities of the control shall be 10 watts. Low-voltage priority override relays shall be furnished as part of these controls with all wiring to the racks to allow override of the volume controls for priority announcements.

2.15 EQUIPMENT CABINETS

Cabinets, freestanding modular type, 16 gauge steel construction treated to resist corrosion. Cabinet shall have removable and lockable side panels, front and rear doors, and have adjustable feet for leveling. Cabinet shall be vented in the roof and rear door. Cabinet shall have cable access in the roof and base and be compatible with 19 inch panel mounting. Provide cabinet with grounding bar, rack mounted 550 CFM fan with filter and a surge protected power strip with 6 duplex 20 amp receptacles.

2.16 SPEAKER AND TRANSDUCER CABLE

Cables shall be of the gauge required depending upon the cable run length. In no case shall any cable be used which is smaller than 20 AWG. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.009 inch. Cables shall be shielded with a 34-gauge tinned soft copper strand formed into a braid. Cables shall be jacketed with a Fluoropolymer compound. The jacket thickness shall be 0.0200 inch minimum.

2.17 LAPTOP TUNER

The contractor shall provide a complete portable "laptop" type computer/tuner to tune and equalize the system. Provide all required software and license to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

All equipment shall be installed as indicated and specified, and in accordance with the manufacturer's recommendations and in accordance with Defense Intelligence Agency and Langley Air Force Base Security requirements. All electronic components shall be rack mounted type. Volume controls shall be ganged , labelled and rack mounted in the rack with the electronic components. Equipment mounted out-of-doors or subject to inclement conditions shall be weatherproofed.

3.1.1 Speaker Assemblies

Above ceiling speakers: Suspend with chains from building structure above ceilings so bottom of assembly is 6 to 8 inches above upper plane of finished ceiling material. Ceiling mounted speakers: Flush mount in drop ceiling complete with trim, backcan and accessories. Use eyebolts on speaker assemblies for attachment. Suspend independently of supports for components of other building systems.

3.1.2 Speaker Connections

For two- or three-channel systems, connect speaker assemblies alternatively so masking sound is redundant throughout zones of coverage.

3.1.3 Impedance Matching

Impedance Matching: For system components, including connecting cable, provide end-to-end level and impedance-matched signal paths. Use matching networks and balancing devices at connections where necessary to avoid mismatches.

3.1.4 Equipment Cabinets

Cabinets, freestanding modular type. When cabinets are connected together, remove adjoining side panels for cable routing between cabinets. Cabinets, wall-mounted modular type. Mount cabinet so height of highest panel does not exceed 78 inches above floor.

3.1.5 Wiring

Wiring shall be installed in rigid steel conduit, intermediate metal conduit, cable trays, or electric metallic tubing as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring for grounding, line level, speaker, transducers and power cables shall be isolated from each other by physical isolation and metallic shielding. Shielding shall be terminated at only one end.

3.2 GROUNDING

All grounding practices shall comply with NFPA 70. Equipment shall be grounded to the serving panelboard ground bus through a green grounding conductor. Metallic conduits serving the equipment shall be isolated on the equipment end with an insulating bushing to prevent noise from being transferred to the circuit. Equipment racks shall be grounded to the panelboard ground bus utilizing a #8 conductor. Grounding conductor shall be terminated to the rack using connector suitable for that purpose.

3.3 Field Testing, Installation and Report

The contractor shall field test and report and make all necessary adjustments to the system, to provide a complete sound masking system. Provide written reports of all test and adjustments to the Contracting Officer. Include the following as a minimum:

1. Operational Test: Start system to confirm proper operation. Remove malfunctioning units, re-place with new units, and retest. Make initial sound spectrum and sound level adjustments for each zone.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

4. Pretesting: Tune, align, and adjust system and pretest components, wiring, and functions to verify they comply with specified material, installation, and performance requirements. Correct deficiencies and retest until satisfactory performance and conditions are achieved.

5. Masking Sound-Power-Level Adjustments: Adjust independently for each space to minimum level between 40 and 50 dB that will provide speech privacy between adjacent workstations while complying with other system requirements.

3.4 ACCEPTANCE TESTS

After installation has been completed, the Contractor shall conduct acceptance tests, utilizing the approved test procedures, to demonstrate that equipment operates in accordance with specification requirements. The Contractor shall notify the Contracting Officer 15 days prior to the performance of tests. In no case shall notice be given until after the Contractor has received written Contracting Officer approval of the test plans as specified. The acceptance tests shall include originating and receiving messages at specified stations, at proper volume levels, without cross talk or noise from other links or nondesignated units. Schedule tests after pretesting has been successfully completed. Include the following:

1. Perform tests as specified below, as required by ASTM E 1041, and as required to verify performance specified in "System Description" Article in this Section.

2. Instrumentation: Use a professional-quality, sound-level meter with octave-band filters and documentation of recent calibration against recognized standards.

3. Record test observations, readings, and corrective actions.

4. System Tests: Include the following for each system zone:

a. Transducer Circuit Impedance Test: Measure impedance at 1 kHz with amplifier disconnected, using a professional impedance meter or bridge. Locate and correct faults denoted by abnormal readings.

b. Ambient Sound-Level Tests: With system off, measure ambient sound level in one-third octave bands. Also measure ambient sound level as a single, wide-band, A-weighted reading.

c. Amplifier Noise Test: Check for performance specified in "System Description" Article with masking noise generator off and amplifiers on.

d. System Noise Test: With masking noise signal on and amplifiers adjusted at a working level 10 dB above ambient sound level, check for hum, buzz, rattle, or other operating deficiencies.

e. Spatial Uniformity Test: Measure sound level at locations no greater than 15 feet (4.6 m) o.c. throughout covered spaces to determine compliance with specified performance level.

f. Frequency Response Adjustment and Test: Adjust one-third octave frequency bands and other unit filters to provide response. Coordinate with NC 40 contour defined below be-tween 200 and 2000 Hz, with smooth natural roll-off from those frequencies.

	RELATIVE SOUND-POWER LEVEL - dB	
BAND	OPEN PLAN AREAS	ENCLOSED OFFICES
200	Plus 4	Minus 2
250	Plus 3	Minus 2
315	Plus 2	Minus 2.5
400	Plus 1	Minus 3
500	0	Minus 4
630	Minus 1	Minus 5
800	Minus 2	Minus 6
1000	Minus 3	Minus 7
1250	Minus 4	Minus 8.5
1600	Minus 5	Minus 10
2000	Minus 6	Minus 12

5. Adjust level of masking sound for each space so one-third octave band centered at 500 Hz has final selected sound-power level for that space. Measure deviation from listed values in one-third octave bands from 400 to 2000 Hz. Measured values must not deviate from those listed by more than 4 dB for open plan areas and 8 dB for enclosed offices. The total of individual band deviations in eight bands must not exceed 16 dB for open plan areas and 30 dB for enclosed offices.

6. Walk-through Test: Transducers shall be low profile and blend in with the decor.

7. Temporal Stability Test: Check for uniformity of time by measuring sound level in each of 14 octave bands at one-minute intervals over a 30-minute test period. Deviations must not exceed limits specified in "System Description" Article in Part 2.

E. Retest: Correct deficiencies identified by tests and observations and retest until meeting specified requirements.

F. Recording Control Settings and System Adjustments: Record final control settings and programming, and final tap setting of transducer and speaker matching transformers. Record final sound-level measurements and observations.

ADJUSTMENTS

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to

suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose without additional cost.

3.5 TRAINING

The Contractor shall conduct a training course for 4 members of the operating and maintenance staff as designated by the Contracting Officer. The training course will be given at the installation during normal working hours for a total of 4 hours and shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operating and maintenance manuals, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to the start of the training course.

-- End of Section --

SECTION 16175

ANALOG ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM
07/98

PART 1 GENERAL

1.1 OVERVIEW

The new equipment shall be properly installed, completely interconnected and placed in operation. The system shall provide electrically supervised fire alarms of coded type as specially listed below. The Base Fire Chief shall direct codes.

1.1.1 OPERATION

Operation shall be as described in Part 3.

1.1.2 INSTALLATION

The installation shall confirm in all respects to the current NFPA Fire Code. The Contractor shall contact Contract Management before beginning installation. The contractor shall provide all required equipment and connections for a complete installation as required by NFPA 72 and NFPA Codes, even thought not explicitly indicated on the drawings.

1.1.3 RECORD DRAWINGS

Detailed as-built, reproducible (mylar) drawings shall be provided by the Contractor and shall include: The exact location of all existing and installed fire alarm devices, including the order of wiring for all new devices; and detailed wiring diagrams showing the hook-up and interconnection of all alarm devices, number and size of wire used, color coding, and the type, amount, manufacturer, model, and a part number of all fire alarm devices.

1.1.4 INSTRUCTION MANUALS

There copies of instruction manuals shall be provided by the Contractor and shall include assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked and all documents previously submitted and approved. A brief description of all equipment and their basic operating features shall also be included. Documents shall be bound in a suitable binder adequately marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information. Tabs shall be provided to separate differ ant types of documents, such as catalog ordering information, drawings, instructions, and a spare parts warranted by the quantity of documents included under separate tabs or dividers.

1.2 MATERIALS AND EQUIPMENT

1.2.1 GENERAL REQUIREMENTS

The fire alarm system shall be a class A programmable fully analog addressable type fire alarm system. Materials and equipment shall be standard products of the manufacturer's latest design and suitable to the functions, they shall be duplicates produced any one manufacturer. The name of the manufacturer and the serial numbers shall appear on all major components. Locks for similar devices shall be keyed alike. Alarm devices shall be installed complete with standard boxes and mounting hardware. Devices installed outside shall be weatherproof. Provide a class A looped conduit (outgoing and returning conduits) system for all circuits (NAC and SLC).

1.2.2 QUALITY REQUIREMENTS

All materials and equipment shall be UL listed. The Contractor shall submit proof that the items furnished under this specification conform to this requirement. Only currently manufactured equipment shall be installed. Availability of replacement parts shall be guaranteed for a minimum of one year after installation.

1.2.3 SPARE-PARTS DATA

As soon as practicable after approval of the list of equipment, and prior to the final inspection, the Contractor shall furnish five (5) copies of spare-parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies are that are either normally furnished at no extra cost with the purchase of the equipment or specified below to be furnished as part of the contract; and a list of additional items recommended by the manufacture to assure efficient operation for a period of 120 days at the particular installation.

1.3 CONTRACTOR QUALIFICATIONS

The system shall be installed by an experienced firm regularly engaged in the installation of automatic fire detection and alarm systems in accordance with NFPA standards. The Contractor must be certified by the manufacturer of the fire alarm equipment to install and test the alarm system. Certification or proper installation in accordance with NFPA standards shall be submitted by the Contractor or representative of the manufacturer of the alarm upon completion of the installation. The contractor shall have a minimum of five years experience at installing addressable fire alarm systems.

1.4 SUBMITTALS

Shop Drawings shall be submitted by the Contractor and approved before installation. Submit seven copies of shop drawings for approval. These drawings shall consist of a complete list of equipment and materials, complete wiring schematic diagrams for the equipment furnished, equipment layout and connection, and other details required to demonstrate that the system has been coordinated and will properly function as a unit. One copy of each submittal shall be retained by the Engineering Department. The Contractor shall submit the record drawings and instruction manuals 7 days prior to conducting the operational test.

PART 2 PRODUCTS

2.1 SIGNALING DEVICES

Audible signaling devices shall be heavy-duty type, 24 volts DC, mounted on the wall, below the ceiling, at least seven feet above the floor. Actual locations shall be adjusted as necessary to provide the required sound coverage. Devices shall be red in color. Horns shall produce a sound output rating of at least 90 decibels at 10 feet.

2.1.3 FIRE ALARM HORNS/STROBES

Horns/Strobes shall be supervised, modular DC type with adjustable sound output. Grill Type shall be installed unless otherwise noted on drawings. Strobes shall be 15/75-candela type with clear lens.

2.2 MANUAL FIRE ALARM BOXES

Pull Stations shall be of the non-coded, non-break glass type, with a key operated test-reset lock, and shall be located near exits in the approximate locations shown, semi-flush mounted 42 inches above floor. Stations shall be metal finished in red, with instructions of contrasting color. Wording shall not include "LOCAL ALERT".

2.3 FIRE DETECTION EQUIPMENT

Fire detection equipment shall be installed as shown. Actual locations shall be adjusted to avoid obstructions and to comply with NFPA standards. Areas with raised floors or suspended ceilings shall have detectors installed to provide protection of these concealed areas.

2.3.1 SMOKE DETECTORS

Smoke detectors shall be multi-chambered ionization type or photoelectric type with a dual chambers and LED lamp source. The sensitivity shall be adjustable within UL specifications to compensate for conditions under which it is to operate. All components shall be corrosion resistant and vibration shall have no effect on detector actuation. The detector shall be mounted on a firmly supported four inch outlet box. Detectors shall be 2-wire type, 24 volt DC.

2.3.2 HEAT DETECTORS

Heat detectors shall be fixed temperature 135 degrees F type unless otherwise indicated or specified. Heat detectors installed in mechanical rooms, attics, or other non-cooled areas as specified shall be fixed temperature 190 degrees F. Exposed detectors in other than mechanical rooms or attics shall be of the low silhouette type. Detectors shall not be supported from suspended acoustical tile ceilings.

2.3.3 DUCT DETECTOR

In air handling systems, smoke detectors approved for duct installation shall be provided and arranged to automatically shut down fans as required by NFPA 90A. Provide duct smoke detectors in both return and supply side of all air handling units of 2000 CFM and greater. Required detectors shall be installed so as to allow convenient access for testing and cleaning. The detectors shall be re-settable at the fire alarm panel. Power for the detector shall be supplied from the fire control panel. All wiring and

controls required for compliance with this specification shall be furnished, installed, and connected by the Contractor. Each air handler shall be individually zoned for annunciation in the control panel.

2.4 CONTROL PANEL

Control panel shall be installed as part of the system in the building and shall be approved for use with the fire-detecting equipment, manual fire-alarm boxes or stations, and indicating appliances and all other devices. The control panel shall be located where indicated and shall be housed in a substantial steel cabinet with lock and key. The control panel shall be painted red inside and out. The control panel shall include a suitable means for testing the system through each electrically supervised circuit. The panel shall be arranged so as to operate the alarm signaling devices in the event of fire and to continue operation until silenced by a switch within the unit cabinet. The control panel shall operate to allow an alarm from any device to be silenced, but allows subsequent alarms from other /devices to resound the alarm. Status indicators (LEDs and/or LCD's) shall be plainly visible when the cabinet of the control panel is closed. Circuit boards shall be the modular plug-in type. All cabinet knockouts or holes shall be patched and sealed. Supervision of all alarm devices, including pull stations, signaling devices and detectors shall be maintained. Circuitry and zoning modules shall be Class "A". Individual supervisory LEDs shall be provided to monitor the primary power, the charger, the batteries, and wiring, for "ground fault". The panel shall include a test switch to test all LEDs. In addition, the control panel shall have an on/off switch to de-energize the incoming A/C power. Interface completely with all elevators as required by ANSI and NFPA. Interface completely with the sprinkler systems in accordance with NFPA 72, NFPA 13 and NFPA Codes.

2.4.1 ANNUNCIATOR PANEL

Annunciator panel shall be part of the fire alarm control panel. An additional remote annunciator panel shall be provided that fully duplicates the annunciator located integral to the fire alarm control panel. A liquid crystal display type annunciator window shall be provided. Each annunciator shall include an amber trouble lamp (LED) and a red alarm lamp (LED). Each lamp shall provide specific identification. A warranty card shall be firmly attached in the control panel, providing general warranty information; such as contract number, project number, name and phone number of the Contractor, effective dates of warranty, etc. Near the annunciator panel a one-line drawing shall be provided; indicating the general room arrangement of the detector and alarm locations, zone configuration and wiring order is all devices. In mechanical rooms and similar shop area, these one-line drawings shall be installed in a picture frame with class cover. In other finished areas, such as hallways and offices, these drawings shall be installed in plastic protective covers and shall be located within the panel.

2.5 TRANSMITTERS

The main base station presently employs a Monaco Enterprise, Inc., Model D-500II Central Radio Transmitter/Receiver System, tuned for a VHF FM frequency of 139.675 MHZ. Provide a Monaco Model BSA-1 Omni-Directional Antenna for transmitting and receiving. Provide a 16 zone Monaco Enterprise, Inc. transmitter/receiver complete. The building transmitter/receiver shall be of the coded type that is fully compatible with the central system. The

transmitter shall be electrically supervised, designed to transmit coded fire alarm signals and distinctive code trouble signal over the tuned radio-waves to the central alarm location. Transmission of a coded trouble signal shall automatically result in a break in a fire detecting circuit or interior manual fire-alarm box circuit or from failure of main power supply for transmitters or alarm bell operation. Provisions shall be made also for a restoration signal upon restoration of the transmitter, interior circuits, and power supply to normal standby condition after a fire alarm or trouble signal. A fire-alarm signal consists of not less than three complete transmissions of a code number identifying the transmitter is acceptable as a trouble signal and one or more as a restoration signal. The transmitter shall come complete with a compatible omni-directional antenna, including mounting hardware and coaxial cable, necessary to provide an operational system. System shall be suitable for operating up to a range of 35 miles. The antenna system shall be grounded to a separate ground rod system, complete with lighting arrestor in rainproof enclosure with a minimum of a No. 6 ground conductor. The transmitter shall be housed in a lockable metal cabinet painted red inside and out. A stamped or engraved plate bearing the code number of the transmitter shall be securely attached to the front of the cabinet. The existing base central alarm is located in Building 375.

2.7 POWER SUPPLY

2.7.1 PRIMARY POWER SUPPLY

Primary power supply for the alarm system shall be low voltage rectified direct circuit (24 V). Rectifiers shall be of the solid state type. Point of connection shall be the line side of the main service switch, using approved lugs and a fused disconnect switch (painted red), installed within ten feet of the main service switch, and sized in accordance with NEC. The connection shall comply with applicable requirements of Standard No. 72 of the National Fire Protection Association. 120 volt power-supply wiring shall be in conduit or metallic tubing. Transformer, rectifier, resistor(s), and other required power-supply components shall be incorporated in the control unit, or a separate power-supply component shall be incorporated in the control unit, or a separate power-supply unit may be furnished and installed if approved for the application by the Contracting Officer.

2.7.2 STANDBY POWER SUPPLY

Standby power that will insure operation of all of the fire-alarm signaling devices within the building and activation of the transmitter in the event of power failure shall be provided by stoppage battery with a transfer switch. The transfer to battery shall be automatic upon failure of the primary power supply; indicated by a trouble signal at the control alarm location; and arranged so there will be no strain on the battery except on transfer and during a fire alarm. Restoration of primary power supply shall automatically disconnect the battery and reconnect the main supply. The batteries shall be housed in the control unit cabinet to prevent contact between cell terminals. Trickle charge shall be provided to maintain the emergency power supply at peak reserve power. The charger will automatically switch to a high rate charge if the battery voltage drops below full charge capacity.

2.7.3 BATTERIES

Back-up power shall consist of panel mounted, long-life, sealed, rechargeable gel cell batteries, of the power amperes-hours rating to operate the system and master box tripping circuits for a minimum of 24 hours under normal conditions, and to operate all audible signaling devices and transmission and control devices under alarm conditions for 15 minutes. Batteries shall be sized to allow for 20% growth in the alarm system. Calculations substantiating the above requirements shall be submitted by the Contractor to the Contracting Officer for approval before installation. Batteries shall be separated from the cabinet by a piece of non-conductive rubber material to provide additional corrosion protection.

2.8 TOOLS AND SPARE PARTS

The Contractor shall furnish any special tools necessary for the maintenance of the new equipment; one spare set of fuses for each control unit; one set of keys for each keyed device; one spare detector of each type and rating; one spare pull station, and one spare signaling device.

2.9 WIRING AND RACEWAY

AC operating power shall be obtained from the line side of the incoming building power source ahead of all building services. An independent properly fused safety switch, with provisions for locking the cover and operating handle in the "power on" position shall be provided for this connection. The switch box shall be painted red with white letters that say "FIRE ALARM PANEL SWITCH." Wiring shall be in accordance with the requirements of NFPA 70, 72, and 73. Wire for 120V circuits shall be No. 12 AWG minimum. Wiring shall be in concealed conduit where possible, electrical metallic tubing. Conduit sizing shall be in accordance with the National Electric Code. Concealed EMT shall be used in areas where lowered ceilings are installed and where new walls are being constructed. IMC shall be used out-of-doors or in wet locations. All exposed supporting hardware shall be painted to match the surface. Raceways shall be securely and rigidly fastened in a place to the ceiling supports at intervals not more than 10 feet. Raceways and supporting hardware shall be from the actual ceiling or roof - not suspended on false ceilings. Fastenings shall be by wood screws to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; and by machine screws, welded threaded studs, heat-treated of spring-steel-tension clamps on steel work. Low voltage DC wiring shall be (90 degrees C), stranded copper, No. 14 AWG installed in conduit. Wires shall be connected directly from the transmitter to the new building antenna. All alarm device wiring shall be Class "A". All wiring shall test free grounds or crosses between conductors before the control panel circuit boards are installed. Provide a complete separate return loop conduit and wire system for each signal line circuit.

2.10 CONDUCTOR IDENTIFICATION

All circuit conductors shall be identified within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coding of wires. Coding shall be by types of device and zone. A typed directory with plastic cover, showing color code used shall be permanently attached to the inside cover of each new control panel. The color coding shall also be indicated on the record drawings.

PART 3 SYSTEM OPERATION AND TESTING

3.1 SYSTEM OPERATION

The fire alarm system shall automatically initiate fire alarm signals wherever any manual or automatic fire detecting devices are placed into an alarm mode. Upon activation, the system shall indicate areas of annunciation and associated device activated and at the same instant deactivate HVAC fans, sound all signaling devices, and transmit a coded signal to the Central Fire Station, Building 375. Signal identification for both fire and line-trouble conditions shall be transmitted over the new radio wave antenna system. Reporting signals at central-alarm locations shall be made by annunciator identification, signal light or drops. The Contractor shall coordinate with the Base Fire Department to insure proper annunciation to existing alarm equipment in Building 375.

3.2 TESTS

After complete installation of the equipment, and after the Contractor has conducted a functional test to insure that all components are operational; the Contractor shall perform an operational test in the presence of the representative of the Contracting Officer, to demonstrate that the requirements of the specifications have been met. All detectors and pull stations shall be activated by the Contractor as directed. Any device or components that fail the tests shall be replaced and reconnected by the Contractor at no cost to the Government. The Contractor shall provide all necessary equipment for the test and shall provide at least a 7-day notice prior to testing. A representative of the manufacturer of the fire alarm system shall be present during the test. This operational test shall be performed prior to final acceptance.

3.3 ADDITIONAL REQUIREMENTS

The contractor shall provide the following additional services and equipment and software:

1. A computer floppy disk with the final program software complete for use by Langley AFB personnel.

2. Two days of training, day and time to be determined by LAFB personnel, complete with all required accessories to fully train LAFB personnel in the operation, programming and maintenance of the fire alarm system.

3. All required software including licensing, for LAFB to reprogram the fire alarm system as they require.

4. Additional required hardware components (including remote keyboards/computers) and for LAFB personnel to program the fire alarm system.

-- End of Section --

SECTION 16265

UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM, EACH SET
09/98

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 basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.110	(1998) Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 450	(1995) Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std 485	(1997) Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA PE 1	(1992) Uninterruptible Power Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

UPS System; G, AE.

Installation; G, AE.

Detail drawings consisting of a complete list of equipment and materials, manufacturer's descriptive and technical literature, battery sizing calculations per IEEE Std 485, installation instructions, single-line diagrams, ladder-type schematic diagrams, elevations, layout drawings, and details required to demonstrate that the system has been coordinated and will function properly as

a unit.

SD-03 Product Data

Performance Requirements; G, AE.

Pertinent performance data for the UPS system, using a copy of the data sheets supplied with this specification. Data sheets shall be certified by a responsible officer of the UPS manufacturer.

Spare Parts; G.

Spare parts data for each different item of material and equipment specified, not later than the date of beneficial occupancy. The data shall include a complete list of parts and supplies with current unit prices and source of supply and an itemized price breakdown of spare parts recommended for stocking. The recommended spare parts selected shall be those which, in the manufacturer's judgment, will be involved in the majority of maintenance difficulties encountered.

Field Training; G.

Lesson plans and training manuals for the training phases, including type of training to be provided and proposed dates, with a list of reference materials.

SD-06 Test Reports

Factory Testing; G, AE.

Field Supervision, Startup and Testing; G, AE.

A detailed description of proposed factory test and field test procedures, including proposed dates and steps outlining each test, how it is to be performed, what it accomplishes, and its duration, not later than 2 months prior to the date of each test.

Factory and field test reports in booklet form tabulating factory and field tests and measurements performed, upon completion and testing of the installed system. Factory and field test reports shall be signed by an official authorized to certify on behalf of the manufacturer of the UPS system that the system meets specified requirements. The reports shall be dated after the award of this contract, shall state the Contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

1.3 SYSTEM DESCRIPTION

The UPS system shall consist of UPS module, battery system, battery protective device, system cabinet (as required), bypass and transfer switching, maintenance bypass switch, microprocessor controls and monitoring and microprocessor diagnostics. Input ac power shall be connected to the normal source ac input of the UPS module. The battery shall be connected to the dc input of the UPS module through the battery protective device. The ac output of the UPS system shall be connected to the critical loads. The UPS system shall be a true online type system.

1.3.1 UPS Module and Battery System

UPS module shall contain required input isolation transformer, rectifier/charger unit, inverter unit and controls, battery protective device, and any other specified equipment/devices. Battery system shall contain the battery cells, racks, battery disconnect, battery monitor and cabinet, if required.

1.3.2 Cabinet, Bypass and Transfer Switching, Control and Monitoring

The UPS system shall include the system cabinet, static bypass transfer switch, system protective devices, monitoring and controls, means of isolating the system from the critical load, and remote monitoring interfaces.

1.3.2.1 Maintenance Bypass

Provide a maintenance bypass complete. Static switching bypass is not acceptable for the maintenance bypass. The maintenance bypass switching shall be interlocked to prevent paralleling circuits. Circuit breakers shall be rated for the circuit voltage connected to and no less than 50,000 amperes interrupting capacity.

1.3.3 Design Requirements

1.3.3.1 Parts and Materials

Parts and materials comprising the UPS system shall be new, of current manufacture, of a high grade and free of defects and imperfections, and shall not have been in prior service except as required during aging and factory testing.

1.3.3.2 Components

Active electronic devices shall be solid state. Semiconductor devices shall be sealed. Relays shall be dust-tight.

1.3.3.3 Semiconductor Fusing

Power semiconductors shall be fused to prevent cascaded or sequential semiconductor failures. Indicator lamp denoting blown fuse conditions shall be readily observable by the operator without removing panels or opening cabinet doors.

1.3.3.4 Interchangeability

The subassemblies in one UPS module shall be interchangeable with the corresponding modules within the same UPS, and from one UPS system to another of identical systems.

1.3.3.5 Control Power

Control power shall be derived from two sources, input and output, with automatic selective control. The control power circuit shall have suitable protection, appropriately marked and located in the immediate vicinity of the input protective device.

1.3.3.6 EMI/RFI Protection

The components and the system shall be designed to minimize the emission of electromagnetic waves that may cause interference with other equipment.

1.3.3.7 Wiring

Wiring practices, materials, and coding shall be in accordance with the requirements of NFPA 70 and other applicable standards. Wire runs shall be protected in a manner which separates power and control wiring. Control wiring shall be minimum No. 16 AWG extra-flexible stranded copper. Logic-circuit wiring may be smaller. Ribbon cables shall be minimum No. 22 AWG. Control wiring shall have permanently attached wire numbers.

1.3.3.8 Terminations

Terminals shall be supplied for making power and control connections. Terminal blocks shall be provided for field wiring terminals. Terminal blocks shall be heavy-duty, strap-screw type. Terminal blocks for field wiring shall be located in one place in each module and in the system cabinet. Control wiring shall be extended to the terminal block location. No more than two wires shall land on any terminal point. Where control wiring is attached to the same point as power wiring, a separate terminal shall be provided. If bus duct is used, bus stubs shall be provided where bus duct enters cabinets.

1.3.3.9 Internal Assembly

The subassemblies shall be mounted in pull-out and/or swing-out trays where feasible. Cable connections to the trays shall be sufficiently long to allow easy access to all components. Where not feasible to mount subassemblies in pull-out or swing-out trays, they shall be firmly mounted inside the enclosure. Test points or logic indicators shall be labeled and located on the front edge of the control logic cards, if used.

1.3.3.10 Cabinet Structure

UPS system shall be installed in cabinets of heavy-duty structure meeting the NEMA PE 1 standards for floor mounting. UPS module cabinet shall be structurally adequate for forklift handling or lifting. Removable lifting eyes shall be provided on top of each cabinet. UPS module cabinet shall have hinged and lockable doors on the front only, with assemblies and components accessible from the front only. Doors shall be key lockable. Operating controls shall be located outside the locked doors. Input, output, and battery cables shall be installed through the top or bottom of the cabinet.

1.3.3.11 Cabinet Finish

Equipment cabinet shall be cleaned, primed and painted in the manufacturer's standard colors, in accordance with accepted industry standards.

1.3.3.12 Mimic Bus

Provide a mimic bus of the power system on the front of the cabinet.If painted, mimic bus and other front-panel markings (such as those showing circuit breakers or switches and fuses) shall be painted with durable acrylic-based paint.

1.3.3.13 Live Parts (300 Volts and Above)

Live parts (300 volts and above) that are exposed when front access doors are open shall be adequately protected or covered to minimize the chance of accidental contact.

1.3.3.14 Drawout Assemblies

Drawout assemblies weighing 50 lbs or more shall be provided with a means of lifting, either an overhead device or a hoisting device.

1.3.3.15 Safety

UPS shall be equipped with instruction plates including warnings and cautions, suitably located, describing any special or important procedures to be followed in operating and servicing the equipment.

1.3.4 Performance Requirements

1.3.4.1 Normal Operation

The UPS module rectifier/charger shall convert the incoming ac input power to dc power for the inverter and for float charging the battery. The inverter shall supply ac power continuously. Inverter output shall be synchronized with the bypass ac power source, provided that the bypass ac power source is within the specified frequency range. The UPS system shall supply ac power to the critical loads.

1.3.4.2 Loss of ac Input Power

The battery shall supply dc power to the inverter so that there is no interruption of ac power to the critical load whenever the ac input power source deviates from the specified tolerances or fails completely. The battery shall continue to supply power to the inverter for the specified protection time. At the same time, an alarm shall sound to alert operating personnel, allowing startup of a secondary power source or orderly shutdown of the critical load.

1.3.4.3 Return of ac Input Power Source

The rectifier/charger shall start and assume the dc load from the battery when the ac input power source returns. The rectifier/charger shall then simultaneously supply the inverter with dc power and recharge the battery. This shall be an automatic function and shall cause no disturbance to the critical load.

1.3.4.4 Failure of ac Input Power to Return

Should the ac input power fail to return before the battery voltage reaches the discharge limit, the UPS system shall disconnect from the critical load to safeguard the battery.

1.3.4.5 Transfer to Bypass ac Power Source

When the static bypass switch senses an overload, two or more inverter shutdown signals, or degradation of the inverter output, the bypass switch shall automatically transfer the critical load from the inverter output to the bypass ac power source without an interruption of power only if the connected load exceeds the capacity of the remaining on-line modules. If the bypass ac power source is out of normal tolerance limits, the UPS and

the critical load shall shut down.

1.3.4.6 Retransfer to Inverter

The static bypass switch shall be capable of automatically retransferring the load back to the inverter output after the inverter output has returned to normal conditions. Retransfer shall not occur if the two sources are not synchronized.

1.3.4.7 UPS System Maintenance

Manual closure of the maintenance bypass switch shall transfer the critical load from the inverter output to the bypass ac power source without disturbing the critical load bus. UPS module shall be capable of manual return to normal operation after completion of maintenance.

1.3.4.8 Battery Maintenance

The battery protective device shall provide the means of disconnecting the battery from the rectifier/charger and inverter for maintenance. The UPS module shall continue to function and meet the performance criteria specified except for the battery function.

1.4 QUALITY ASSURANCE

1.4.1 Reliability

UPS shall have a minimum acceptable system Mean Time Between Failures (MTBF) of 60,000 hours, single module UPS operation and 2,250,000 hours for total single module UPS system output including bypass circuit. A failure is defined as any interruption to or degradation of the UPS output. Automatic switching to bypass due to a problem with the UPS system does not constitute a failure, provided that the critical load is not disturbed.

1.4.2 Maintainability

UPS shall have a maximum acceptable system Mean Time To Repair (MTTR) of 30 minutes. Repair time is defined as the clock time from the arrival of the service technician to the time when the UPS is restored to service either by repair or substitution of the failed component.

1.5 DELIVERY AND STORAGE

Equipment placed in storage shall be protected from humidity and temperature variations, dirt, dust, or other contaminants.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Environmental Conditions

The UPS and battery system shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics.

a. Operating altitude: Sea level to 4,000 feet. (Systems applied at higher altitudes shall be derated in accordance with the manufacturer's instructions).

b. Non-operating altitude: Sea level to 40,000 ft.

c. Operating ambient temperature range: 32 to 122 degrees F.

d. Non-operating and storage ambient temperature range: Minus 4 to plus 140 degrees F.

e. Operating relative humidity: 0 to 95 percent, without condensation.

1.6.2 Sound Pressure Levels

Sound pressure levels produced by the UPS, when operating under full rated load, at a distance of 5 feet in any direction from the perimeter of the unit, shall not exceed 65 dB as measured on the A scale of a standard sound level meter at slow response.

1.6.3 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.7 NAME PLATES

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.8 SPECIAL TOOLS

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

1.9 OPERATION AND MAINTENANCE MANUALS

Six complete copies of operation manuals for the UPS System outlining the step-by-step procedures required for system startup, operation and shutdown shall be provided. The instructions shall include the manufacturer's name, equipment model number, service manual, parts list, and brief description of equipment and its basic operational features. Six complete copies of maintenance manuals listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided. Corrective maintenance procedures shall identify the most probable failures and the appropriate repairs. Test measurement levels shall be referenced to specific test points on the installed equipment. Operation and maintenance manuals may be either combined or separate.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2 LOAD PROFILE

The UPS system shall be compatible with the load characteristics defined in the LOAD PROFILE TABLE below and load configuration shown. Compensation for UPS/load interaction problems resulting from nonlinear loads or transformer and motor inrush shall be provided.

LOAD PROFILE TABLE

Type of load: Electronic Data Processing Equipment.

Size of load: As Indicated.

Switching pattern: Unswitched.

Steady-state characteristics: As Indicated.

Special factors: The UPS System shall be capable of supplying rated output within specified limits with harmonic loads with a K Factor rating of K13.

2.3 UPS SYSTEM RATINGS

Unless stated otherwise, the parameters listed are under full output load at .9 power factor, with batteries fully charged and floating on the dc bus and with nominal input voltage. Provide for power factor correction to minimum of .9 power factor.

2.3.1 System Capacity

Provide KVA rating as indicated at .95 power factor.

2.3.2 Module Capacity

Provide KVA rating as indicated at .95 power factor.

2.3.3 Battery Capacity

Discharge time to end voltage: 15 minutes, at 77 degrees F. Battery shall be capable of delivering 125 percent of full rated UPS load at initial start-up.

2.3.4 Static Switch

Provide mperes symmetrical interrupting capacity same as the upstream circuit protective device (circuit breaker).

2.3.5 System Bus Bracing

Braced for amperes symmetrical interrupting capacity same as the upstream circuit protective device (circuit breaker) interrupting capacity.

2.3.6 ac Input

a. Voltage 480 volts line-to-line.

b. Number of phases: 3-phase, 3-wire, plus ground.

c. Voltage Range: Plus 10 percent, minus 15 percent, without affecting battery float voltage or output voltage.

d. Frequency: 60 Hz, plus or minus 5 percent.

e. Power walk-in: 20 percent to 100 percent over 15 to 24 seconds.

f. Total harmonic current distortion (THD) reflected into the primary line: 10 percent maximum.

g. Transformer sub-cycle inrush: 4 to 8 times full load rating.

2.3.7 ac Output

a. Voltage 480 volts line-to-line, 277 volts line-to-neutral.

b. Number of phases: 3-phase, 4-wire, plus ground.

c. Voltage regulation:

(1) Balanced load: Plus or minus 1.0 percent.

(2) 50 percent load imbalance, phase-to-phase: Plus or minus 2 percent.

(3) No-load voltage modulation: Plus or minus 1 percent.

(4) Voltage drift: Plus or minus 1 percent over any 30 day interval (or length of test) at stated ambient conditions.

d. Voltage adjustment: Plus or minus 5 percent manually.

e. Frequency: 60 Hz.

f. Frequency regulation: Plus or minus 0.1 percent.

g. Frequency drift: Plus or minus 0.1 percent over any 24 hour interval (or length of test) at stated ambient conditions when on internal oscillator.

h. Harmonic content (RMS voltage): 3 percent single harmonic, maximum; 5 percent total maximum with linear load. Voltage THD shall be less than 7 percent with up to 50 percent nonlinear load and a crest factor of less than 3 to 1.

i. Load power factor operating range: 1.0 to 0.8 lagging.

j. Phase displacement:

(1) Balanced load: Plus or minus 1 degree of bypass input.

(2) 50 percent load imbalance phase-to-phase: Plus or minus 3 degrees of bypass input.

k. Wave-form deviation factor: 5 percent at no load.

l. Overload capability (at full voltage) (excluding battery):

(1) 125 percent load for 10 minutes.

(2) 150 percent load for 30 seconds.

(3) 300 percent load for one cycle after which it shall be current

limited to 150 percent until fault is cleared or UPS goes to bypass.

m. Load sharing of parallel modules: Plus or minus 5 percent of average load per module.

2.3.8 Transient Response

2.3.8.1 Voltage Transients

a. 50 percent load step/0 percent to 50 percent load: Plus or minus 8 percent.

b. 50 percent load step/50 percent to 100 percent load: Plus or minus 8 percent.

c. Loss or return of ac input: Plus or minus 1 percent.

e. Automatic transfer of load from UPS to bypass: Plus or minus 4 percent.

f. Manual retransfer of load from bypass to UPS: Plus or minus 4 percent.

g. Response time: Recovery to 99 percent steady-state condition within 50 milliseconds after any of the above transients.

2.3.8.2 Frequency

a. Transients: Plus or minus 0.5 Hz maximum.

b. Slew Rate: 1.0 Hz maximum per second.

2.3.9 Efficiency

a. Minimum Single-Module Efficiency: 90 percent at full load kW.

b. Minimum System Efficiency: 89 percent at full system load kW.

2.4 UPS MODULE

2.4.1 General Description

UPS module shall consist of a rectifier/charger unit and a 3-phase inverter unit with their associated transformers, synchronizing equipment, protective devices and accessories as required for operation.

2.4.2 Rectifier/Charger Unit

Rectifier/charger unit shall be solid state and shall provide direct current to the dc bus.

2.4.2.1 Input Protective Device

Rectifier/charger unit shall be provided with an input protective device. The protective device shall be sized to accept simultaneously the full-rated load and the battery recharge current. The protective device shall be capable of shunt tripping and shall have amperes symmetrical

interrupting capacity as indicated. The protective device shall have provision for locking in the "off" position. A surge suppression device shall be installed at the UPS input to protect against lightning and switching surges.

2.4.2.2 Power Transformer

A dry-type, isolated-winding power transformer shall be used for the rectifier unit. The transformer's hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation material when operating at full load. The transformer insulation shall be Class H, 150 degrees C rise. Transformer connections shall be accessible from the front.

2.4.2.3 Power Walk-In

Rectifier/charger unit shall be protected by a power walk-in feature such that when ac power is returned to the ac input bus, the total initial power requirement will not exceed 20 percent of the rated full load current. This demand shall increase gradually to 100 percent of the rated full load current plus the battery charging current over the specified time interval.

2.4.2.4 Sizing

Rectifier/charger unit shall be sized for the following two simultaneous operating conditions:

a. Supplying the full rated load current to the inverter.

b. Recharging a fully-discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal ac power is restored, with the input protective device closed.

2.4.2.5 Battery Charging Current

a. Primary current limiting: Battery-charging current shall be voltage regulated and current limited. The battery-charging current limit shall be separately adjustable from 2 percent to 25 percent of the maximum discharge current. After the battery is recharged, the rectifier/charger unit shall maintain the battery at full float charge until the next operation under input power failure. Battery charger shall be capable of providing equalizing charge to the battery.

b. Second step current limiting: The rectifier/charger unit shall also have a second-step battery current limit. This second-step current limit shall sense actual battery current and reduce the input power demand for battery recharging to 50 percent (adjustable from 30 percent to 70 percent) of the normal rate without affecting the system's ability to supply full-rated power to the connected load. The second-step current-limit circuit shall be activated by a dry contact signal from the generator set controls and shall prevent normal rate battery recharging until utility power is restored.

2.4.2.6 Output Filter

Rectifier/charger unit shall have an output filter to minimize ripple

current supplied to the battery; the ripple current into the battery shall not exceed 3 percent RMS.

2.4.2.7 dc Voltage Adjustment

Rectifier/charger unit shall have manual means for adjusting dc voltage for battery equalization, to provide voltage within plus 10 percent of nominal float voltage.

2.4.2.8 Battery Isolation Protective Device

Module shall have a dc protective device to isolate the module from the battery system. The protective device size and interrupting rating shall be as required by system capacity and shall incorporate a shunt trip as required by circuit design. The protective device shall have provision for locking in the "off" position.

2.4.3 Inverter Unit

Inverter unit shall be a solid-state device capable of accepting power from the dc bus and providing ac power within specified limits.

2.4.3.1 Output Overload

The inverter shall be able to sustain an overload as specified across its output terminals. The inverter shall not shut off, but shall continue to operate within rated parameters, with inverse-time overload shutdown protection.

2.4.3.2 Synchronism

The inverter shall normally operate in phase-lock and synchronism with the bypass source. Should the bypass source frequency deviate beyond 60 Hz by more than 0.5 Hz, the internal frequency oscillators contained in the power module shall be used to derive the new frequency reference. Upon restoration of the bypass source within the required tolerance, the inverter shall resynchronize with that source at a slew rate not exceeding the specified rate. The oscillator shall be temperature compensated and shall be manually adjustable. The design of the oscillator and synchronizing circuits shall be such that failure of any associated component, connector pin, terminal lead wire or dc power source in either the open or shorted mode shall affect only one inverter leg. Such failure shall not cause transient disturbance of the critical load in excess of the stated limits.

2.4.3.3 Phase Balance

Electronic controls shall be incorporated to provide individual phase voltage compensation to obtain phase balance.

2.4.3.4 Modular Construction

Each control logic printed circuit board shall be electrically and physically packaged on an individual plug-in module with separate indication and adjustments.

2.4.3.5 Output Protective Device

The output protective device shall be capable of shunt tripping and shall

have interrupting capacity as specified. Protective device shall have provision for locking in the "off" position.

2.4.3.6 Output Transformer

The inverter output transformer shall be similar to the input transformer and shall be capable of handling up to K-13 nonlinear loads as described in IEEE C57.110.

2.4.4 External Protection

UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the ac input source and/or the bypass source. The UPS system shall sustain input surges without damage in accordance with IEEE C62.41. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.

2.4.5 Internal Protection

UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause that module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

2.5 STATIC BYPASS TRANSFER SWITCH

A static bypass transfer switch shall be provided as an integral part of the UPS and shall consist of a static switch and a bypass protective device or bypass switch. The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the bypass ac power source, without exceeding the transient limits specified herein, when a malfunction occurs in the UPS or when an external overload condition occurs. The power section of the static bypass transfer switch shall be provided as a plug-in type assembly to facilitate maintenance. The static bypass transfer switch shall be used to connect the bypass ac power source or the UPS inverter output to the critical load when required, and shall have the following features:

2.5.1 Uninterrupted Transfer

The static bypass transfer switch shall automatically cause the bypass ac power source to assume the critical load without interruption when the bypass control logic senses one of the following conditions and the UPS inverter output is synchronized to the bypass ac power source:

a. Inverter overload exceeds unit's rating.

b. Battery protection period is expired and bypass is available.

c. Inverter failure.

2.5.2 Interrupted Transfer

If an overload occurs and the UPS inverter output is not synchronized to the bypass ac power source, the UPS inverter output shall current-limit for 200 milliseconds minimum. The inverter shall then turn off and an interrupted transfer to the bypass ac power source shall be made. If the bypass ac power source is beyond the conditions stated below, an interrupted transfer shall be made upon detection of a fault condition:

a. Bypass voltage greater than plus or minus 10 percent from the UPS rated output voltage.

b. Bypass frequency greater than plus or minus 0.5 Hz from the UPS rated output frequency.

c. Phase differential of ac bypass voltage to UPS output voltage greater than plus or minus 3 degrees.

2.5.3 Manual Transfer

It shall be possible to make a manually-initiated static transfer from the system status and control panel by turning the UPS inverter off.

2.5.4 Automatic Uninterrupted Forward Transfer

The static bypass transfer switch shall automatically forward transfer, without interruption after the UPS inverter is turned "on", or after an instantaneous overload-induced reverse transfer has occurred and the load current has returned to less than the unit's 100 percent rating.

2.5.5 Forced Transfer

The control logic circuitry shall provide the means of making a forced or reverse transfer of the static bypass transfer switch on an interrupted basis. Minimum interruption shall be 200 milliseconds when the UPS inverter is not synchronized to the bypass ac power source.

2.5.6 Overload Ratings

The static bypass transfer switch shall withstand the following overload conditions:

a. 2000 percent of UPS output rating for two cycles.

b. 200 percent of UPS output rating for 5 minutes.

c. 125 percent of UPS output rating for 10 minutes.

2.5.7 Static Switch Disconnect

A static switch disconnect shall be incorporated to isolate the static bypass transfer switch assembly so it can be removed for servicing. The switch shall be equipped with auxiliary contacts and provision for padlocking in either the "on" or "off" position.

2.6 MAINTENANCE BYPASS SWITCH

2.6.1 General

A maintenance bypass switch shall be provided as an integral part of the UPS and located within the UPS module. The maintenance bypass switch shall provide the capability to continuously support the critical load from the bypass ac power source while the UPS is isolated for maintenance. The maintenance bypass switch shall be housed in an isolated compartment inside the UPS cabinet in such a way that service personnel will not be exposed to electrically live parts while maintaining the unit. Switch shall contain a maintenance bypass protective device and a module isolation protective device.

2.6.2 Load Transfer

The maintenance bypass switch shall provide the capability of transferring the critical load from the UPS static bypass transfer switch to maintenance bypass and then back to the UPS static bypass transfer switch with no interruption to the critical load.

2.6.3 Load Bank Protective Device

A load bank protective device shall be provided to allow the UPS system to be tested using a portable load bank. The load bank protective device shall be connected on the line side of the maintenance bypass switch isolation protective device.

2.7 MODULE CONTROL PANEL

The control panel shall employ the use of a touch screen interface which allows lock-out of all UPS control functions for security (the Emergency Power Off function shall not be locked-out). The UPS controls shall be the latest technology and microprocessor type with microprocessor diagnostics. The operator interface shall include, but not be limited to, the following:

a. UPS start-up procedure
b. UPS shutdown procedure
c. Emergency Power Off (EPO)
d. Audible alarm silence
e. System status levels

The UPS module shall be provided with a control/indicator panel. The panel shall be on the front of the UPS module. Controls, meters, alarms and indicators for operation of the UPS module shall be on this panel.

2.7.1 Module Meters

2.7.1.1 Monitored Functions

The following functions shall be monitored and displayed:

a. Input voltage, phase-to-phase (all three phases).

b. Input current, all three phases.

c. Input frequency.

d. Battery voltage.

e. Battery current (charge/discharge).

f. Output voltage, phase-to-phase and phase-to-neutral (all three phases).

g. Output current, all three phases.

h. Output frequency.

i. Output kilowatts.

j. Elapsed time meter to indicate hours of operation, 6 digits.

k. Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).

l. Output kilovars.

m. Output kilowatt hours, with 15-minute demand attachment.

2.7.1.2 Meter Construction

Meters shall have 1 percent accuracy and shall be digital type (minimum 4 significant digits).

2.7.2 Module Controls

Module shall have the following controls:

a. Lamp test/reset pushbutton.

b. Alarm test/reset pushbutton.

c. Module input protective device trip pushbutton, with guard.

d. Module output protective device trip pushbutton, with guard.

e. Battery protective device trip pushbutton, with guard.

f. Emergency off pushbutton, with guard.

g. dc voltage adjustment potentiometer, with locking guard.

h. Control power off switch.

i. UPS/bypass transfer selector switch.

j. Static bypass transfer switch enable/disable selector switch.

2.7.3 Module Alarm Indicators

Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.

a. Input ac power source failure.

b. Input protective device open.

c. Output protective device open.

d. Overload.

e. Overload shutdown.

f. dc overvoltage.

g. dc ground fault.

h. Low battery.

i. Battery discharged.

j. Battery protective device open.

k. Blower failure.

l. Input transformer overtemperature.

m. Inverter transformer overtemperature.

n. Equipment overtemperature.

o. Operating on internal oscillator.

p. Fuse blown.

q. Control power failure.

r. Charger off.

s. Inverter off.

t. Emergency off.

u. UPS on battery.

v. Critical load on static bypass.

w. Static bypass transfer switch disabled.

x. Inverter output overvoltage.

y. Inverter output undervoltage.

z. Inverter output overfrequency.

aa. Inverter output underfrequency.

bb. Bypass source overvoltage.

cc. Bypass source undervoltage.

dd. Bypass source overfrequency.

ee. Bypass source underfrequency.

ff. Bypass source to inverter out of synchronization.

2.7.4 Module Mimic Panel

UPS module shall have a mimic panel in the format of a module single-line diagram, with status indicators for input, output, battery protective devices, and battery disconnect switch. Each protective device shall have indicators for open (green) and closed (red), to give positive indication. The mimic panel shall provide indication of the following additional functions:

a. Charger on (functional).

b. UPS on-line (inverter furnishing load power).

c. UPS on-bypass (static switch operating).

d. System alarm (flashes for abnormalities, minor or major faults).

2.7.5 Module Emergency Off Button

Pressing the emergency off button shall cause the affected module to be disconnected from the system, via its input protective device, output protective device, and battery protective device. Activation of this button shall not affect the operation of the remainder of the system.

2.8 SELF-DIAGNOSTIC CIRCUITS

The control logic shall include status indicators for trouble-shooting the control circuits. These indicators shall be mounted on the circuit card edge or face such that they will be visible without repositioning the card, and shall be labeled with the function name.

2.8.1 Microprocessor Interface/Diagnostics

Provide microprocessor interface and diagnostics as follows and as specified herein.

2.8.1.1 Microprocessor Controlled Operator Guidance

The UPS' microprocessor logic shall, as standard equipment, provide menu-driven operator instructions detailing the operation of the UPS system. The instruction menu shall be accessible via a touch screen display located at the control panel. The microprocessor shall monitor each step, thus prompting itself to the next step of the instructions. The following instructions shall be available as a minimum:

a. Inverter stop.
b. Inverter start.
c. UPS shutdown.
d. UPS startup.
e. Transfer of load to static bypass.
f. Equalize charge to system battery.

2.8.1.2 Microprocessor Controlled Metering

All meters shall be digitally displayed having an accuracy of 1% or better. The following parameters shall be available for display:

a. Converter input voltage (all phases)

b. Converter input current (all phases)
c. Converter input frequency
d. Battery voltage
e. Battery charging/discharging current
f. Battery capacity remaining during power failure conditions
g. Battery load factor
h. Number of times of battery operation
i. Bypass input voltage (all phases including line-line and line-neutral)
j. Bypass input frequency
k. Output voltage (all phases including line-line and line-neutral)
l. Output current in RMS Amps, % Amps, and % Peak (all phases including line and neutral)
m. Load apparent power (kVA)
n. Load effective power (real kW)
o. Load power factor
p. Output frequency

2.8.1.3 Microprocessor Controlled Diagnostics

The UPS shall provide microprocessor controlled diagnostics capable of retaining fault alarms along with metering parameters in the event of a UPS failure. The microprocessor memory data shall be viewed via an LCD display located at the control panel. The following alarm/status information shall be provided as a minimum:
a. Load on Inverter
b. Inverter Operation
c. Inverter Start/Stop
d. Battery Operation
e. Battery Low Voltage
f. Output Overload
g. Overload Level Set
h. Remote Start/Stop Enabled
i. Remote Operation
j. Battery Depleted
k. Battery Temperature Abnormal
l. Converter Operation
m. CB1 (AC input Breaker) Tripped
n. CB2 (DC Breaker) Tripped
q. Converter Supplying DC Power
r. Converter Input Out of Range
s. Equalize Charge Activated
t. Inverter Stop Due to Overload Condition
u. Inverter Running Synchronously
v. Inverter Running Asynchronously
w. UPS on Static Bypass
x. Static Bypass Input Out of Range
y. UPS on Generator Power
z. Battery Liquid Level Low

2.9 REMOTE MONITORING PANEL

A remote monitoring panel shall be provided to monitor system status. The panel shall be designed for wall mounting near the critical load.

2.9.1 Indicators

Minimum display shall include the following indicators:

a. Load on UPS.

b. Load on battery.

c. Load on bypass.

d. Low battery.

e. Summary alarm.

f. New alarm (to alert the operator that a second summary alarm condition has occurred).

2.9.2 Audible Alarm

Any single indicator shall also turn on the audible alarm. An audible alarm test/reset button and lamp test/reset button shall be included. This reset button shall not affect nor reset the alarm on the module or on the system cabinet.

2.10 COMMUNICATIONS AND DATA ACQUISITION PORT

An RS 232C and RS 485 communications and data acquisition port shall be provided. This port shall allow the system parameters, status, alarm indication and control panel functions specified to be remotely monitored and controlled.

2.11 TEMPERATURE CONTROL

2.11.1 General

Cabinet and enclosure ventilation shall be adequate to ensure that components are operated within their ratings. Forced-air cooled rectifier, inverter, and control unit will be acceptable. The cooling fans shall continue operation if UPS input power is lost. Redundancy shall be provided so that failure of one fan or associated circuit breaker will not cause an overheat condition. Cooling air shall enter the lower front of the cabinets and exhaust at the top. Blower power failure shall be indicated as a visual and audible alarm on the control panel. Air inlets shall have filters that can be replaced without opening the cabinet doors.

2.11.2 Blower Power Source

Blower power source shall be internally derived from the input and output sides of UPS module, with automatic transfer arrangement.

2.11.3 Temperature Sensors

Temperature sensors shall be provided to monitor the air temperature. Separate sensors shall monitor the temperature of rectifier and inverter heat sinks. Separate sensors shall also monitor the transformer temperature. Critical equipment overtemperature indication shall start a timer that shall shut down the UPS system if the temperature does not return below the setpoint level in 15 minutes.

2.12 BATTERY SYSTEM

2.12.1 General

A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module. The battery shall be of heavy-duty, industrial design suitable for UPS service. The cells shall be provided with flame arrestor vents, intercell connectors and cables, cell-lifting straps, cell-numbering sets, and terminal grease. Intercell connectors shall be sized to maintain terminal voltage within voltage window limits when supplying full load under power failure conditions. Cell and connector hardware shall be stainless steel of a type capable of resisting corrosion from the electrolyte used.

2.12.2 Battery Ratings

a. Type: Lead Calcium, 20 year average life.

b. Specific gravity when fully charged: 1.215.

c. End voltage 1.67 volts per cell.

d. Float voltage: 2.17 to 2.26 volts per cell.

e. Equalizing voltage: 2.33 to 2.38 volts per cell.

2.12.3 Battery Construction

The battery shall be of the valve-regulated, sealed, non-gassing, recombinant type.

2.12.4 Battery Cabinet

The battery pack assembly shall be furnished in a battery cabinet matching the UPS cabinet. The battery cabinet shall be designed to allow for checking the torque on the connections in the battery system and to provide adequate access for annual housekeeping chores. External wiring interface shall be through the bottom or top of the assembly. A smoke and high temperature alarm shall annunciate detection of either smoke or high temperature within the battery cabinet.

2.12.5 Cell-Terminal Covers

Acid-resistant transparent cell-terminal covers not exceeding 6 feet in length and with vent holes drilled on top where needed shall be provided.

2.12.6 Battery Disconnect

Each battery pack assembly shall have a fused disconnect switch or circuit breaker provided in a NEMA 1 enclosure, finished with acid-resistant paint and located in line with the assembly. Switch/circuit breaker shall be complete with line side and load side bus bars for connection to battery cells. Switch shall be rated 480 V dc, amperes as required, 3-pole with interrupting rating as required by system capacity, and shall have an external operator that is lockable in the "off" position.

2.12.7 Seismic Requirements

The battery support system shall SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

2.12.8 Battery Monitor

A battery monitor shall be provided for each battery pack assembly. At a minimum, this device shall monitor the following parameters:

a. Total system voltage.

b. Ambient room temperature.

c. Total battery discharge cycles with a duration of greater than 30 seconds but less than 5 minutes .

The monitor shall also record the total accumulated discharge minutes and accumulated battery system discharge kW hours.

2.13 FACTORY TESTING

The UPS system shall be factory tested to meet the requirements specified using a test battery (not the battery to be supplied with the system). UPS module shall be factory load tested as an independent assembly with 3-phase ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Load shall be balanced at rated kVA and rated power factor. Factory tests for the UPS module shall be run under full load, and will be witnessed by the Government. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. As a minimum, the factory tests shall include the parameters described in paragraphs ac Input, ac Output, Transient Response and Efficiency. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings. The Government shall be notified in writing at least 2 weeks before testing. Factory-test time shall not be used for system debugging and/or checkout. Such work shall be done prior to notifying the Government that the system is ready for testing. Factory tests shall be performed during normal business hours. The system shall be interconnected and tested for an additional 8 hours to ensure proper wiring and performance.

2.13.1 Transient Tests

Transient tests shall be conducted using high-speed oscillograph type recorders to demonstrate the operation of the components to the satisfaction of the Government. These tests shall include 50 percent to 100 percent load changes, manual transfer, manual retransfer, low dc bus initiated transfer and low ac output bus transfer. A recording instrument equipped with an event marker shall be used.

2.13.2 Efficiency Tests

Testing for efficiency shall be performed at zero output up to 100 percent of stated kVA output in 25 percent steps, 0.8 power factor, with battery fully charged and floating on the dc bus, with nominal input voltage, and with modules connected to the system to represent actual operating conditions.

2.14 INSPECTION

Inspection before shipment is required. The manufacturer shall notify the Government at least 2 weeks before shipping date so that an inspection can be made.

PART 3 EXECUTION

3.1 INSTALLATION

The UPS system shall be set in place, wired and connected in accordance with the approved shop drawings and manufacturer's instructions. The UPS battery shall be shipped to the site dry. Provide weight spreading plates that will support the UPS system for transporting the UPS system over raised access flooring specified to the UPS system installation locations. The weight spreading plates shall be sufficient to support the UPS system and not deform or cause to fail, the raised access flooring system when the UPS system is transported over the raise access flooring.

3.2 Warranty

Provide a full warranty for the complete UPS system for no less than a two year period. The warranty provided shall be for "onsite" inclusive. The batteries shall be full warranted for a period no less than one year and fourteen years prorated.

3.3 Service and Manuals and Softwares

Provide the UPS with multiple, no less than three, service providers in the local area, within a 100 mile radius to the site, with choices and option by the Government who shall service the equipment. All service personnel providing onsite service shall be fully certified by the manufacturer to perform the required service. Provide three copies of complete service and repair manuals to the Government. Provide a minimum of one licensed copy of all software and programs associated with the UPS system and required to maintain or and repair the UPS equipment, to the Government.

3.4 FIELD SUPERVISION, STARTUP AND TESTING

The services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment and testing of the equipment. The representative shall check the wiring between equipment, start up the system, and field test the functions, interlocks and protective devices to ensure that the total system is functioning according to the intent of the design. The field tests shall be performed under the supervision of a factory-trained representative of the equipment manufacturer and witnessed by the Government. The Government shall be given 2 weeks written advance notice of the date and time when testing will be conducted.

3.4.1 Field Tests

As a minimum, the startup and field test procedures shall include the following:

a. Ensure that shipping members have been removed.

b. Check for damage (dents, scratches, frame misalignment, damage to panel devices, etc).

c. Ensure that interiors are free of foreign materials, tools and dirt.

d. Attach a phase rotation meter to the UPS input, output and bypass

buses, and observe proper phase sequences.

e. Torque test bus connections at shipping splits. Also torque test battery connections.

f. Check each electrical bus for proper phasing and identification.

g. Check and test selector switches and meters for proper operation.

h. Check doors for proper alignment and operation.

i. Check and test each protective device for proper mechanical and electrical operation.

j. Check protective device overcurrent trip settings.

k. Check and test indicating lights for proper operation and color.

l. Perform onsite field test procedures.

m. Demonstrate to the Government that the specified functions and interlocks have been implemented.

n. Provide IEEE Std 450 battery installation certification.

o. Check key interlock key numbers, if used, to ensure agreement with interlocking scheme.

3.4.2 Load Test

Should the Government witness the factory testing, including the load testing at the factory, then the Government may at its option, not require a field onsite load test. Should the Government option to not require this test, then the Government shall be due a credit for each test not performed. The installed system shall be load tested for a continuous 24 hour period by means of resistive load banks. The system shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. The equipment manufacturer shall provide resistive load banks of total kW load of equipment to facilitate startup under load conditions, and to conduct load tests described above. Instrument readings shall be recorded every half hour for the following:

a. Input voltage (all three phases, for each module).

b. Input current (all three phases, for each module).

c. Input frequency.

d. Battery voltage for each module.

e. Output voltage (all three phases, for each module).

f. Output current (all three phases, for each module).

g. Output kilowatts for each module.

h. Output frequency.

i. Output voltage (all three phases - system output).

j. Output current (all three phases - system output).

k. Output kilowatts (system output).

3.4.3 Full Load Burn In Test

Should the Government witness the factory testing, including the full load burn in testing at the factory, then the Government may at its option, not require a full load burn in field onsite test. Should the Government option to not require this test, then the Government shall be due a credit for each test not performed. The installed system shall undergo an additional full load burn-in period of 24 continuous hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. During the burn-in period, the following tests shall be performed:

a. With the UPS carrying maximum continuous design load and supplied from the normal source, switch 100 percent load .

b. With the UPS carrying maximum continuous design load and supplied from the emergency source, repeat the switching operations described in step a. Also, verify that the UPS module rectifier charger unit(s) go into the second-step current limit mode.

c. With the UPS carrying maximum continuous design load and operating on battery power, repeat the switching operations described in step a above.

d. Continue operation on battery power for 1 minute, then restore normal power.

The Contractor shall furnish a high-speed dual trace oscillograph to monitor ten or more cycles of the above tests at the ON and OFF transitions and two typical steady-state periods, one shortly after the load is energized (at 30 to 60 seconds) and one after operation has stabilized (at 8 to 10 minutes). Four copies of the traces shall be delivered to the Contracting Officer.

3.4.4 Battery Discharge Test

Should the Government witness the factory testing, including the battery testing at the factory, then the Government may at its option, not require a this test onsite, in part or in whole. Should the Government option to not require this test, in part or in whole, then the Government shall be due a credit for each test, in part or in whole, not performed. With the battery fully charged, the system shall undergo a complete battery discharge test to full depletion and a recharge to nominal conditions. Instrument readings shall be recorded every minute during discharge for the following:

a. Battery voltage for each module.

b. Battery current for each module.

c. Output voltage (all three phases) for each module.

d. Output current (all three phases) for each module.

e. Output kilowatts for each module.

f. Output voltage (all three phases - system output).

g. Output current (all three phases - system output).

h. Output kilowatts (system output).

i. Output frequency.

3.5 POSTING FRAMED DATA AND INSTRUCTIONS

Framed data and instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

3.6 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 12 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Field training shall cover the items contained in the operating and maintenance manuals. The 12 hours shall be divided into two sessions of 6 hours each. Each session shall be conducted on a different day. A factory training videotape shall be provided as part of the training materials.

UPS SYSTEM PERFORMANCE DATA SHEET SHEET 1 OF 6

	ITEM	SPECIFIED	SUBMITTED
	SYSTEM OPERATION	[SINGLE MODULE] [PARALLEL REDUNDANT] [PARALLEL NON REDUNDANT]	
	NUMBER OF SYSTEMS	[_____]	
GENERAL	NUMBER OF MODULES IN EACH SYSTEM	PRESENT [_____] FUTURE [_____]	
GENERAL	SYSTEM CAPACITY:		
GENERAL	PRESENT	[_____] kW/[_____] kVA	
GENERAL	FUTURE	[_____] kW/[_____] kVA	
	BATTERY	ONE PER MODULE	
	MTBF (SYSTEM)		
	MTTR		
	MODULE RATING	[_____] kW/[_____] kVA	
MODULE	DC VOLTAGE WINDOW	[_____] Vdc	
MODULE	INPUT/OUTPUT PROTECTIVE DEVICE INTERRUPT. RATING	[_____] A SYM.	
	MANUFACTURER	_____	
	TYPE	[LEAD-CALCIUM] [LEAD-ANTIMONY] [NICKEL-CADMIUM]	
BATTERY	DISCHARGE TIME TO END VOLTAGE AT FULL LOAD	[_____] MINUTES	
BATTERY	END VOLTAGE	[_____] V/CELL	
BATTERY	SPECIFIC GRAVITY	[_____]	
BATTERY	FLOAT VOLTAGE	[_____] V/CELL	
BATTERY	NUMBER OF CELLS	[_____] CELLS	

UPS SYSTEM PERFORMANCE DATA SHEET SHEET 2 OF 6

	ITEM	SPECIFIED	SUBMITTED
BATT	HYDROGEN GENERATION	_____	
	RECHARGE TIME TO 95% CAPACITY	10 X DISCHARGE	
SYS TEM	PROTECTIVE DEVICE	[AIR POWER, DRAW-OUT] [_____]	
	MANUFACTURER	_____	
	INTERRUPTING RATE	[_____] A SYM.	
	STATIC SWITCH	[_____] A	
AC INPUT	VOLTS, LINE/LINE	[_____] V	
	PHASES	[3-PHASE, 3-WIRE] [_____]	
	VOLTAGE RANGE	+ 10%, - 15%	
	FREQUENCY	[50] [60] Hz	
	FREQUENCY RANGE	+/- 5%	
	POWER WALK-IN 20% TO 100% LOAD	15 - 24 SECONDS	
	TOTAL HARMONIC DISTORTION REFLECTED-PRIMARY	[5% MAX (CURRENT)] [_____]	
	ORDER OF HARMONIC	_____	PERCENTAGE OF TOTAL
	2nd		
	3rd		
	4th		
	5th		
	6th		
	7th		
	8th		
	9th		
(FILL IN AS REQUIRED)			
	TRANSFORMER SUB-CYCLE INRUSH	[_____] x FULL LOAD	
	POWER FACTOR	[0.8] [0.9]	

UPS SYSTEM PERFORMANCE DATA SHEET SHEET 3 OF 6

	ITEM	SPECIFIED	SUBMITTED
	VOLTAGE, LINE-LINE	[_____] V	
	PHASES	3-PHASE, 4-WIRE	
	POWER FACTOR	0.8 LAGGING, 1.0	
	VOLTAGE REGULATION		
	BALANCED LOAD	+/- 1.0%	
	50% IMBALANCE BETWEEN PHASES	+/- 2.0%	
	NO-LOAD MODULATION	+/- 1.0%	
	DRIFT (30 DAYS)	+/- 1.0%	
	VOLTAGE ADJUST.	+/- 5.0% MANUALLY	
A C	FREQUENCY	60 Hz	
	REGULATION	+/- 0.1%	
O U T	DRIFT (24 HRS.)	+/- 0.1%	
P U T	HARMONIC CONTENT		
	TOTAL (50% NON-LINEAR LOAD	7.0% MAX.	
	TOTAL (LINEAR LOAD)	5.0% MAX.	
	SINGLE HARMONIC (LINEAR LOAD)	3.0% MAX.	
	PHASE DISPLACEMENT		
	BALANCED LOAD	+/- 1.0 DEG. OF BYPASS	
	50% IMBALANCE	+/- 3.0 DEG. OF BYPASS	
	WAVE FORM DEVIATION FACTOR (NO LOAD)	5.0%	
	OVERLOAD CAPACITY		
	125%	10 MINUTES	
	150%	30 SECONDS	
	300%	MOMENTARY	

UPS SYSTEM PERFORMANCE DATA SHEET SHEET 4 OF 6

	ITEM	SPECIFIED	SUBMITTED
	LOAD SHARING AMONG MODULES	+/- 5.0% OF AVERAGE LOAD	
	VOLT. TRANSIENT RESPONSE		
	50% STEP LOAD 0% to 50%	+/- 8.0%	
	50% STEP LOAD 50% to 100%	+/- 8.0%	
	LOSS OR RETURN OF INPUT	+/- 1.0%	
	LOSS OR RETURN OF A REDUNDANT MODULE		
	AUTOMATICALLY	+/- 8.0%	
	MANUALLY	+/- 8.0%	
AC OUTPUT	AUTO TRANSFER, AT FULL LOAD, FROM UPS TO BYPASS	+/- 4.0%	
AC OUTPUT	MANUAL TRANSFER, AT FULL LOAD, FROM BYPASS TO UPS	+/- 4.0%	
	RECOVERY TIME TO 99% STEADY-STATE COND.	50 MILLISECONDS	
	FREQUENCY TRANSIENT RESPONSE	+/- 0.5 Hz	
	SLEW RATE	1.0 Hz/SECOND	

UPS SYSTEM PERFORMANCE DATA SHEET SHEET 5 OF 6

	ITEM	SPECIFIED	SUBMITTED
AC OUTPUT	EFFICIENCY @ FULL LOAD MODULE	[_____]%	
	SYSTEM	[_____]%	
	SYSTEM NOISE GEN. LEVEL @ 6 FT. FROM EQUIPMENT	[_____] DBA	
	OPERATING AMBIENT TEMPERATURE	32 to [104] [122] DEG. F	
	STORAGE AMBIENT TEMPERATURE	-4 to +140 DEG. F.	
ENVIRONMENTAL	BATTERY ROOM AMBIENT TEMP.	77 DEG. F NOMINAL	
	RELATIVE HUMIDITY (NON-CONDENSING)	0 - 95%	
	BAROMETRIC PRESSURE (ALTITUDE)		
	OPERATING	0 - [_____] FT.	
	NON-OPERATING	0 - 40,000 FT.	
	HEAT REJECTION	_____	
	MODULE SYSTEM		
PHYSICAL DATA	MODULE	_____	
	SIZE WEIGHT		
	SYSTEM CABINET	_____	
	SIZE WEIGHT		

UPS SYSTEM PERFORMANCE DATA SHEET SHEET 6 OF 6

	ITEM		SPECIFIED	SUBMITTED
PHYSICAL	DATA			
	BATTERY		_____	
		SEISMIC PARAMETERS		
		RACKS SIZE		
		WEIGHT		
		CELLS SIZE		
		WEIGHT		
		DISCON- SIZE		
		NECT WEIGHT		

-- End of Section --

SECTION 16415

ELECTRICAL WORK, INTERIOR
06/02

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.16	(2000) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.1350	(1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C78.20	(1995) Electric Lamps - Characteristics of Incandescent Lamps A, G, PS, and Similar Shapes with E26 Medium Screw Bases
ANSI C78.21	(1995) Physical and Electrical Characteristics - Incandescent Lamps - PAR and R Shapes
ANSI C78.2A	(1991) 18 & 26- Watt, Compact Fluorescent Quad Tube Lamps **
ANSI C78.2B	(1992) 9 & 13-Watt, Compact Fluorescent

Quad Tube Lamps **

ANSI C82.1 (1997) Specifications for Fluorescent Lamp Ballasts \$18.00$\F\X Addenda D & E

ANSI C82.4 (1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1 (1995) Hard-Drawn Copper Wire

ASTM B 8 (1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM D 709 (2000) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13 (1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE C57.13 (1993) Instrument Transformers

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 242 (1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

IEEE Std 399 (1997) Recommended Practice for Industrial and Commercial Power Systems Analysis

IEEE Std 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \$31.00$\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA AB 1 (1993) Molded Case Circuit Breakers and Molded Case Switches

NEMA FU 1 (1986) Low Voltage Cartridge Fuses

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ICS 2 (1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC

NEMA ICS 3 (1993) Industrial Control and Systems Factory Built Assemblies

NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1998) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG 3	(1995) Power Switching Equipment
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1999) General Requirements for Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
NFPA 70	(2002) National Electrical Code

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

47 CFR 18	Industrial, Scientific, and Medical Equipment

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1004	(1994; Rev thru Nov 1999) Electric Motors
UL 1010	(1995; Rev thru Mar 1999) Receptical-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1022	(1998) Line Isolation Monitors

UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1995; Rev Jul 1998) Isolated Power Systems Equipment
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1449	(1996; Rev thru Dec 1999) Transient Voltage Surge Suppressors
UL 1564	(1993; R Sep 1998) Industrial Battery Chargers
UL 1569	(1999; Rev thru Jan 2000) Metal-Clad Cables
UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Nov 1999) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198L	(1995; Rev May 1995) D-C Fuses for Industrial Use
UL 20	(1995; Rev thru Oct 1998) General-Use Snap Switches
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 5	(1996) Surface Metal Raceways and Fittings
UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 506	(1994; R Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 512	(1993; Rev thru Mar 1999) Fuseholders
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 542	(1999) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 67	(1993; Rev thru Oct 1999) Panelboards
UL 674	(1994; Rev thru Oct 1998) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Mar 1999) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev thru May 1999) Cord Sets and Power-
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 844	(1995; Rev thru Mar 1999) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev thru Nov 1999) Motor Control Centers

UL 854	(1996; Rev Oct 1999) Service-Entrance Cables
UL 869A	(1998) Reference Standard for Service Equipment
UL 877	(1993; Rev thru Nov 1999) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 935	(1995; Rev thru Oct 1998) Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru May 1998) Ground-Fault Circuit-Interrupters
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL Elec Const Dir	(1999) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Hazardous Locations

Wiring in locations indicated shall conform to the NFPA 70 for Class I , Division 1 hazardous locations. Equipment shall be suitable for Group D

1.2.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers
Motor Control Centers	
Transformers	
Equipment Enclosures	
Switchgear	
Switchboards	
Motors	

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Interior Electrical Equipment; G, AE.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

a. Transformers.

b. Switchgear.

c. Battery system including calculations for the battery and charger.

d. Raised Access Flooring Boxes.

e. Grounding resistors.

f. Motors and rotating machinery.

h. Cable tray systems. Including complete floor plan layouts; indicating exact location of cable trays, fittings, risers, offsets, floor pedestals, in floor boxes, details and all other

devices in or on raised access flooring.

i. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

j. Sway bracing for suspended luminaires.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

SD-03 Product Data

Fault Current and Protective Device Coordination Study; G, AE.

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study, The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; G, AE.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient

detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; G, AE.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; G, AE.

Installation procedures for rotating equipment, transformers, switchgear and battery systems, Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

As-Built Drawings; G.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; G, AE.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; G, AE.

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; G, AE.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

SD-07 Certificates

Materials and Equipment; G, AE.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL

label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

1.5 SEISMIC REQUIREMENTS

Seismic details shall 16070A SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.1.2 Aluminum Conductors

Aluminum conductors shall not be used.

2.1.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.1.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter;

ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.1.5 Service Entrance Cables

Underground service entrance (USE) cables, UL 854.

2.1.6 Metal-Clad Cable (FOR UNDER RAISED ACCESS FLOOR BRANCH CIRCUITS ONLY)

UL 1569; NFPA 70, Type MC cable.

2.1.7 Cord Sets and Power-Supply Cords

UL 817.

2.2 CABLE TRAYS

Cable tray shall conform to NEMA VE 1, shall form a wireway system, and shall be of nominal 4 inch depth. Cable trays shall be constructed of aluminum . Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 24 inches or as required to fit around raised floor pedestals.

2.2.1 Ladder

Ladder-type cable trays shall be of nominal 18 inch width unless otherwise indicated. Rung spacing shall be on 6 inch maximum centers. Provide all required accessories, bends, t-offs, rises, runs, rise ups, turn down, 45's, 90's, ends, fittings, supports, ground connections, penetration firestopping, etc., for a complete installation.

2.3 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor voltage ratings shall be volts rms, operating voltage as required for the electrical characteristics installed on; 60 Hz; 3-phase; 4 wire with ground; transient suppression voltage (peak let-through voltage) of 492 volts on 277/489 volt system and 250 volts on 120/208 volt system volts. Fuses shall not be used as surge suppression. Type 1 TVSS where indicated shall comply with all ratings for Category C3 in accordance with IEEE C62.41. Type 2 TVSS where indicated shall comply with all ratings for Category B3 in accordance with IEEE C62.41. All TVSS devices shall comply with UL 1449. Each TVSS shall comply with the following:

1. Integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules with integral disconnect.

2. Protection modes shall be as follows:

a. Line to neutral.
b. Line to ground.
c. Neutral to ground.

3. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55dB at 100 kHz.

4. Accessories shall include the following:

a. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
b. Audible alarm activated on failure of any surge diversion module.
c. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

Provide the following respective ratings:

For Type 1 TVSS:

1. The minimum single-impulse current rating shall be as follows:

a. Line to Neutral: 300,000 A.
b. Line to Ground: 300,000 A.
c. Neutral to Ground: 300,000 A.

2. The repetitive surge current capacity / mode number of impulses shall be as follows:

a. Line to Neutral: 15,000 impulses.
b. Line to Ground: 15,000 impulses.
c. Neutral to Ground: 15,000 impulses.

For Type 2 TVSS:

1. The minimum single-impulse current rating shall be as follows:

a. Line to Neutral: 150,000 A.
b. Line to Ground: 150,000 A.
c. Neutral to Ground: 150,000 A.

2. The repetitive surge current capacity / mode number of impulses shall be as follows:

a. Line to Neutral: 12,000 impulses.
b. Line to Ground: 12,000 impulses.
c. Neutral to Ground: 12,000 impulses.

2.4 CHARGERS, BATTERY

UL 1564. Battery chargers shall be general purpose, continuous current output, with solid state rectifiers. Means shall be provided to regulate and to adjust the dc output voltage. Chargers shall have continuous current ratings of 10 to 15 percent higher than battery current outputs based upon an 8-hour discharge.

2.5 CIRCUIT BREAKERS

2.5.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489 and UL 877for circuit breakers and circuit breaker enclosures located in hazardous (classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, , or combination motor controllers. Provide circuit breakers 150 amperes and above for computer with shunt trip coil; 120 VAC.

2.5.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper and aluminum conductors in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.5.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.5.1.3 Cascade System Ratings

Circuit breakers used in series combinations are not acceptable.

2.5.1.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 225 amperes.

2.5.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices

are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

e. Short-time I square times t switch.

f. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

g. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but not greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap will not be permitted. n.

h. Adjustable ground-fault delay.

i. Ground-fault I square times t switch.

j. short-time and ground-fault trip indicators shall be provided.

2.5.3 Current-Limiting Circuit Breakers

Current-limiting circuit breakers shall be provided as shown. Current-limiting circuit breakers shall limit the let-through I square times t to a value less than the I square times t of one-half cycle of the symmetrical short-circuit current waveform. On fault currents below the threshold of limitation, breakers shall provide conventional overload and short-circuit protection. Integrally-fused circuit breakers shall not be used.

2.5.4 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.5.5 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.5.6 Low-Voltage Power

a. Construction:

Low-voltage power circuit breakers shall conform to IEEE C37.13, ANSI C37.16, and NEMA SG 3 and shall be three-pole, single-throw, stored energy, electrically operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact position indicator, charged/discharged stored energy indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of the primary disconnects when the circuit breaker is closed. Control voltage shall be 48 V dc or120 V dc or 120 VAC. The circuit breaker enclosure shall be suitable for its intended location. Provide coil coordinated operating circuit from a source (transformer, rectifier, etc) in the breaker.

b. Ratings:

Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with ANSI C37.16. Tripping features shall be as follows:

1. Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

2. Adjustable long-time delay.

3. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

4. Adjustable short-time delay.

5. Short-time I square times t switch.

6. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

7. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.

8. Adjustable ground-fault delay.

9. Ground-fault I square times t switch.

10. short-circuit and ground-fault trip indicators shall be provided.

2.5.7 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.6 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload

and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.6.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.6.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA O	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.7 CONDUIT AND TUBING

2.7.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.7.2 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.7.3 Intermediate Metal Conduit

UL 1242.

2.7.4 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.7.5 Rigid Metal Conduit

UL 6.

2.7.6 Rigid Plastic Conduit (Below slab only)

NEMA TC 2, UL 651 .

2.7.7 Surface Metal Electrical Raceways and Fittings

UL 5.

2.8 CONDUIT AND DEVICE BOXES AND FITTINGS

2.8.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.8.2 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.8.3 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.8.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.8.5 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.8.6 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.9 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.10 CONNECTORS, WIRE PRESSURE

2.10.1 For Use With Copper Conductors

UL 486A.

2.11 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.11.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.11.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.12 ENCLOSURES

NEMA ICS 6 or NEMA 250 or UL 698 for use in hazardous (classified) locations, unless otherwise specified.

2.12.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.12.2 Circuit Breaker Enclosures

UL 489.

2.12.3 Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations

UL 877.

2.13 LIGHTING FIXTURES, LAMPS, BALLASTS, EMERGENCY EQUIPMENT, CONTROLS AND ACCESSORIES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lighting equipment installed in classified hazardous locations shall conform to UL 844. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

2.13.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992.

a. Incandescent and tungsten halogen lamps shall be designed for 125 volt operation (except for low voltage lamps), shall be rated for minimum life of 2,000 hours, and shall have color temperature between 2,800 and 3,200 degrees Kelvin. Tungsten halogen lamps shall incorporate quartz capsule construction. Lamps shall comply with ANSI C78.20 and sections 238 and 270 of ANSI C78.21.

b. Fluorescent lamps shall be green-tipped and shall have color temperature 3,500 degrees Kelvin. They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer to provide for color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts	(4' lamp)	2800 lumens
T8/U,31-32 watts	(U-tube)	2600 lumens
T12/U,34 watts	(U-tube)	2700 lumens

(1) Linear fluorescent lamps, unless otherwise indicated, shall be 4 feet long 32 watt T8, 265 mA, with minimum CRI of 75. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on rapid start ballasts .

(2) Small compact fluorescent lamps shall be twin, double, or triple tube configuration as shown with bi-pin or four-pin snap-in base and shall have minimum CRI of 85. They shall deliver rated life when operated on ballasts as shown. 9 and 13 watt double tube lamps shall comply with ANSI C78.2B. 18 and 26 watt double tube lamps shall comply with ANSI C78.2A. Minimum starting temperature shall be 32 degrees F for twin tube lamps and for double and triple twin tube lamps without internal starter; and 15 degrees F for double and triple twin tube lamps with internal starter.

(3) Long compact fluorescent lamps shall be 18, 27, 39, 40, 50, or 55 watt bi-axial type as shown with four-pin snap-in base; shall have minimum CRI of 85; and shall have a minimum starting temperature of 50 degrees F. They shall deliver rated life when operated on rapid start ballasts .

c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -20 degrees F. Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355,ANSI C78.1375, and ANSI C78.1376.

2.13.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

a. Low voltage incandescent transformers shall be Class II UL listed 120/12 volt or 120/24 volt step-down transformers as required for the lamps shown. Transformers shall be high power factor type and shall be rated for continuous operation under the specified load. Transformers shall be encased or encased and potted, and mounted integrally within the lighting fixture unless otherwise shown.

b. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 77 degrees F above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be

mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 77 degrees F above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 120 or 277 volts at 60 Hz and maintain constant light output over a line voltage variation of ± 10%. Ballasts shall have an end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 50 degrees F or as shown. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum $10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid start linear & U-tubes	120 or 277 V	1	2.54
			2	1.44
			3	0.93
			4	0.73
34W T12	rapid start linear & U-tubes	120 or 277 V	1	2.64
			2	1.41
			3	0.93
59W T8	rapid start linear	120 or 277 V	2	0.80
60W T12	rapid start linear	120 or 277 V	2	0.80

(3) Magnetic fluorescent ballasts shall be energy-saving, automatic resetting type, approved for the application by the Certified Ballast Manufacturers and complying with ANSI C82.1 and UL 935. Minimum ballast starting temperature shall be 40 degrees F for normal service and 0 degrees F where cold temperature service

is required. Magnetic fluorescent ballasts shall have a ballast factor not less than shown in the following table:

MAGNETIC FLUORESCENT BALLAST FACTORS*

Design starting temperature above 40 degrees F with 60 Hz input frequency

LAMP TYPE	NUMBER OF LAMPS	NOMINAL OPERATIONAL INPUT VOLTAGE	TYPE OF STARTER & LAMP	MIN. BALLAST FACTOR
25W F25T8	1	120v	rapid start	.96
	1	277v		.96
	2	120v		.95
	2	277v		.94
32W F32T8	1	120v	rapid start	.96
	1	277v		.95
	2	120v		.85
	2	277v		.96
96W F96T8	1	120 or 277v	instant start	1.10
	2			.85

* For ballasts not specifically designed for use with dimming controls.

(4) Dimming fluorescent ballasts shall be electronic and shall comply with the applicable electronic ballast specifications shown above. Dimming ballasts shall be compatible with the specified dimming control equipment and shall operate the lamps shown in the range from full rated light output to 1 percent of full rated light output. Dimming ballasts shall provide smooth square law dimming such that perceived dimming action is proportionate to the motion of the dimming control. Single or two-lamp dimming ballasts shall be used. Multi-lamp dimming ballasts shall be designed to operate lamps of the same length and current rating.

(5) Dimming compact fluorescent ballasts shall be electronic and shall comply with the applicable compact fluorescent and dimming ballast specifications shown above. Ballasts shall operate the lamps shown in the range from full rated light output to 5 percent of full rated light output. Ballast power factor shall be <90% throughout dimming range. THD shall be <10% at maximum light output and <20% at minimum light output. Ballast shall ignite the lamps at any light output setting selected.

c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 77 degrees F above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of 0 degrees F.

(2) Magnetic high intensity discharge ballasts shall have a minimum starting temperature of -20 degrees F.

2.13.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum wall thickness of 0.125 inches. Plastic lenses shall be 100% virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type. Conoid recessed reflector cones shall be Alzak with clear specular low iridescent finish.

a. Incandescent fixtures shall comply with UL 1571. Incandescent fixture specular reflector cone trims shall be integral to the cone and shall be finished to match. Painted trim finishes shall be white with minimum reflectance of 88%. Low voltage incandescent fixtures shall have integral step-down transformers.

b. Fluorescent fixtures shall comply with UL 1570. Recessed ceiling fixtures shall comply with NEMA LE 4. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Fluorescent fixture lens frames on recessed and surface mounted troffers shall be one assembly with mitered corners. Parabolic louvers shall have a low iridescent finish and 45 degree cut-off. Louver intersection joints shall be hairline type and shall conceal mounting tabs or other assembly methods. Louvers shall be free from blemishes, lines or defects which distort the visual surface. Integral ballast and wireway compartments shall be easily accessible without the use of special tools. Housings shall be constructed to include grounding necessary to start the lamps. Open fixtures shall be equipped with a sleeve, wire guard, or other positive means to prevent lamps from falling. Medium bi-pin lampholders shall be twist-in type with positive locking position. Long compact fluorescent fixtures and fixtures utilizing U-bend lamps shall have clamps or secondary lampholders to support the free ends of the lamps.

c. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.

d. Emergency lighting fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes. Batteries shall be Nicad or equal with no required

maintenance, and shall have a minimum life expectancy of five years and warranty period of three years.

e. Exit Signs

Exit signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m^2 measured at normal (0 degree) and 45 degree viewing angles. Minimum luminance shall be greater than 8.6 cd/m^2 measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years.

2.13.4 Lampholders, Starters, and Starter Holders

UL 542

2.14 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.14.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.14.2 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.14.3 Fuses, Class R

UL 198E.

2.14.4 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.14.5 Fuses, D-C for Industrial Use

UL 198L.

2.14.6 Fuseholders

UL 512.

2.15 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.16 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations. In addition to the standards listed above, motors shall be provided with efficiencies as specified in the table "MINIMUM NOMINAL EFFICIENCIES" below.

2.16.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.16.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motor efficiencies indicated in the tables apply to general-purpose, single-speed, polyphase induction motors. Applications which require definite purpose, special purpose, special frame, or special mounted polyphase induction motors are excluded from these efficiency requirements. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	80.0
1.12	86.5	86.5	85.5
1.49	87.5	86.5	86.5
2.24	89.5	89.5	86.5
3.73	89.5	89.5	89.5
5.60	91.7	91.0	89.5
7.46	91.7	91.7	90.2
11.2	92.4	93.0	91.0
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	93.6
44.8	95.0	95.0	94.1
56.9	95.0	95.0	94.5
74.6	95.0	95.4	94.5
93.3	95.4	95.4	95.0
112.0	95.8	95.8	95.4
149.0	95.4	95.8	95.4
187.0	95.4	96.2	95.8
224.0	95.4	95.0	95.4
261.0	94.5	95.4	95.0
298.0	94.1	95.8	95.0
336.0	94.5	95.4	95.4
373.0	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

kW	1200 RPM	1800 RPM	3600 RPM
0.746	82.5	85.5	78.5
1.12	87.5	86.5	85.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

1.49	88.5	86.5	86.5
2.24	89.5	89.5	88.5
3.73	89.5	89.5	89.5
5.60	91.7	91.7	91.0
7.46	91.7	91.7	91.7
11.2	92.4	92.4	91.7
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	94.1
44.8	94.5	95.0	94.1
56.9	95.0	95.4	94.5
74.6	95.4	95.4	95.0
93.3	95.4	95.4	95.4
112.0	95.8	95.8	95.4
149.0	95.8	96.2	95.8
187.0	95.6	96.2	95.9
224.0	95.4	96.1	95.8
261.0	94.5	96.2	94.8
298.0	94.5	95.8	94.5
336.0	94.5	94.5	94.5
373.0	94.5	94.5	94.5

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4
250	95.4	96.2	95.8
300	95.4	95.0	95.4
350	94.5	95.4	95.0
400	94.1	95.8	95.0
450	94.5	95.4	95.4
500	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

HP	1200 RPM	1800 RPM	3600 RPM

TOTALLY ENCLOSED FAN-COOLED MOTORS

1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8
250	95.6	96.2	95.9
300	95.4	96.1	95.8
350	94.5	96.2	94.8
400	94.5	95.8	94.5
450	94.5	94.5	94.5
500	94.5	94.5	94.5

2.17 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.17.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.17.2 Motor Starters

Combination starters shall be provided with circuit breakers, or the contractor may provide combination starters in lieu of separate starter and disconnectsfusible switches.

2.17.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 10 hp or larger unless VFDS are indicated.. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

2.17.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each

ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.17.4 Low-Voltage Motor Overload Relays

2.17.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds.Quick trip units shall be used on hermetically sealed, submersible pumps, and similar motors.

2.17.4.2 Construction

Manual reset type thermal relay shall be melting alloy or bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.17.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.17.5 Automatic Control Devices

2.17.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.17.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.17.5.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.18 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.19 RECEPTACLES

All receptacles that are connected to an uninterruptible power supply (UPS) shall have a yellow color body and face. All other receptacles shall be ivory color.

2.19.1 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

2.19.2 Ground Fault Interrupters

UL 943, Class A or B.

2.19.3 Hazardous (Classified) Locations

UL 1010.

2.19.4 NEMA Standard Receptacle Configurations

NEMA WD 6.

d. 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking: NEMA type 10-30R, locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R, locking: NEMA type L14-30R.

e. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

2.20 Service Entrance Equipment

UL 869A.

2.21 SPLICE, CONDUCTOR

UL 486C.

2.22 POWER-SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS AND SWITCHGEAR

2.23 SNAP SWITCHES

UL 20.

2.24 TAPES

2.24.1 Plastic Tape

UL 510.

2.24.2 Rubber Tape

UL 510.

2.25 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings, except as indicated. "T" connections may be used for transformers rated 15 kVA or below. Transformers supplying non-linear loads shall be UL listed as suitable for supplying such loads with a total K-factor not to exceed K-13 and have neutrals sized for 200 percent of rated current.

2.25.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 80 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 80 degrees C temperature rise shall be capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating.

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated . Transformers shall be provided in NEMA 1 enclosure. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.25.2 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
1-50	50
51-150	55

kVA Range	dB Sound Level
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

2.26 ISOLATED POWER SYSTEM EQUIPMENT

UL 1047, with monitor UL 1022.

2.27 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.28 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.28.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses

2.28.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the base electrical engineer for fault current availability at the site.

2.28.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provide, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.28.4 Fault Current Analysis

2.28.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.28.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.28.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.28.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situation where system coordination is not achievable due to device limitations (an analysis of any device curves which order overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.28.6 Study Report

a. The report shall include a narrative: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculations performed for the analyses, including computer analysis programs utilized. The name

of the software package, developer, and version number shall be provided.

2.29 Raised Access Floor Box

UL 514A Die cast aluminum body. The box lid shall be a hinged style and constructed of polycarbonate material. The box lid shall have a finish color of brown. The lid shall provide a minimum of three (3) removable cable guards for egress of power and communication workstation cables. The cable guards shall hold workstation cables in place with the lid either in the open or closed position. The trim flange shall be constructed of polycarbonate material and have a minimum overall dimension of 8 3/4" x 10 3/4". The hinged lid and trim flange shall be available for either carpet or tile floor applications. Coordinate the trim flange with the flooring in the location where the box is installed. The wiring chamber shall provide an upper and a lower compartment. The top compartment shall be divided into three (3) separate compartments to accommodate a combination of both power and communication wiring. These compartments shall be separated by use of integral; die cast aluminum built in dividers. The bottom compartment shall be available for either all power or all communication wiring. The total Box Volume capacity shall have a minimum of 300 cubic inches. Provide locking tabs. Activation and connectivity outlets and electrical outlets shall be as indicated on the drawings. The Raised Access Floor Box shall be as manufactured by Walker Model AF3 or approved equal.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 5 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers, or if sectional type rods are used. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 5 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms communications rooms , server farms and as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be

furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit rigid plastic conduit (below slab only) electrical metallic tubingintermediate metal conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit may be used below slab only. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07840A FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to

compensate for the building expansion and contraction and to provide for continuity of grounding.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Metallic conduits and tubing,and the support system to which they are

attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

3.2.1.9 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter. Minimum conduit size shall be 3/4 inch

3.2.2 Busway Systems

Busway systems shall be of the voltage, capacity, and phase characteristics

indicated. Vertical runs of busways within 6 feet of the floor shall have solid enclosures. Busways shall be supported at intervals not exceeding 5 feet, and shall be braced properly to prevent lateral movement. Busways penetrating walls or floors shall be provided with flanges to completely close wall or floor openings.

3.2.3 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 6 foot intervals and as indicated. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section 07840A FIRESTOPPING.

3.2.4 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.4.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.4.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.4.3 Cable Systems

Cable systems shall be installed where indicated.

3.2.4.4 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

c. Greater Than 600 Volt: Cable splices shall be made in accordance with the cable manufacturer's recommendations and Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.2.4.5 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall

be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 1 or as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks,

and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be satin finish corrosion resistant stainless steel. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of yellow for systems on UPS power and ivory for non-ups systems and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the

manufacturer's recommendations.

3.5.2.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.2.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use. Assemblies which utilize a self-sealing boot or gasket to maintain wet location rating shall be furnished with a compatible plug at each receptacle location and a sign notifying the user that only plugs intended for use with the sealing boot shall be connected during wet conditions.

3.5.3 Receptacles, 30-Ampere, 125/250-Volt

Receptacles, single, 30-ampere, 125/250-volt, shall be molded-plastic, three-pole, four-wire, grounding type, complete with appropriate mating cord-grip type attachment plug.

3.5.4 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the type indicated with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface

mounting unless otherwise indicated.

3.8 PANELBOARDS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

3.8.1 Loadcenters

Loadcenters are not acceptable.

3.8.2 Panelboards

Panelboards shall be circuit breaker equipped as indicated on the drawings.

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as specified.

3.9.1 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK5 CC shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.2 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK5 , current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9.3 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance

and terminated in accordance with the requirements of Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.11 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.12 MOTOR CONTROL

Each motor or group of motors requiring a single control shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.12.1 Reduced-Voltage Controllers

Reduced-voltage controllers shall be provided for polyphase motors 10 hp or larger except where VFD's are indicated. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starters or part winding increment starters having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

3.12.2 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.12.3 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.13 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.14 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye or wye-delta configuration as indicated except isolation transformers having a one-to-one turns ratio. "T" connections may be used for transformers rated at 15 kVA or below. Dry-type transformers shown located within 5 feet of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the building may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

3.15 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.15.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project

completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.15.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.15.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

3.15.2.2 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling, in conformance withUL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the ceiling panel structural supports.

3.15.2.3 Fixtures for Installation in Grid Type Ceilings

Fixtures for installation in grid type ceilings which are smaller than a full tile shall be centered in the tile. 1 by 4 foot fixtures shall be mounted along the grid rail as shown. Work above the ceiling shall be coordinated among the trades to provide the lighting layout shown. Fixtures mounted to the grid shall have trim exactly compatible with the grid. Contractor shall coordinate trims with ceiling trades prior to ordering fixtures. Metric fixtures shall be designed to fit the metric grid specified. Fixtures in continuous rows shall be coordinated between trades prior to ordering. Fixtures shall be mounted using independent supports capable of supporting the entire weight of the fixture. No fixture shall rest solely on the ceiling grid. Recessed fixtures installed in seismic areas should be installed utilizing specially designed seismic clips. Junction boxes shall be supported at four points.

3.15.2.4 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers or hand-straights so that they hang plumb. Pendants, rods, or chains 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at

120 degrees of separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 10 feet or as recommended by the manufacturer, whichever is less.

Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

3.15.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.15.4 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

3.16 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.17 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.17.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.17.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and terminated.

3.18 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable

circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.19 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTS AND COATINGS.

3.20 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.20.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.20.2 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 10 ohms.

3.20.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 72 hours before the site is ready for inspection.

3.20.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor

and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.20.4.1 Low Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

3.20.5 Motor Tests

a. Phase rotation test to ensure proper directions.

b. Operation and sequence of reduced voltage starters.

c. High potential test on each winding to ground.

d. Insulation resistance of each winding to ground.

e. Vibration test.

f. Dielectric absorption test on motor and starter.

3.20.6 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers .

a. Insulation resistance test phase-to-ground, each phase.

b. Turns ratio test.

3.20.7 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.20.7.1 Circuit Breakers, Low Voltage

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual and electrical operation of the breaker.

3.20.7.2 Circuit Breakers, Molded Case

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual operation of the breaker.

3.20.8 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.21 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.22 FIELD SERVICE

3.22.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 72 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations.

3.22.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.23 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16442

MAIN OUTDOOR WALKIN SWITCHGEAR
03/01

PART 1 GENERAL

This section applies to the outdoor main walkin switchgear incluidng the controls and auiliaries for paralleling and backup generators.

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	(1981; R 1992) Electrical Analog Indicating Instruments
ANSI C57.12.29	(1991) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware - AASHTO No.: M 232
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D 149	(1997; Rev. A) Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code (ANSI/IEEE)
IEEE C37.13	(1990) Low-Voltage AC Power Circuit Breakers Used in Enclosures (ANSI/IEEE)

IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear (ANSI/IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity (Revision of ANSI C57.12.28-88)
NEMA C12.1	(1995) Code for Electricity Metering
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LI 1	(1998) Industrial Laminating Thermosetting Products
NEMA ST 20	(1992) Dry-Type Transformers for General Applications

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; R 1999, Bul. 2000) Grounding and Bonding Equipment
UL 489	(1996; R 2000, Bul. 1999 and 2000) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 1558	(1999, Bul. 1999) Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

1.2 RELATED REQUIREMENTS

Section 16415, "ELECTRICAL WORK, INTERIOR," apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings; G, AE

Paralleling Control System; G, AE

SD-03 Product Data

Switchgear; G, AE

Paralleling Control System; G, AE

Paralleling Control System software and Programming; G, AE

SD-06 Test Reports

Switchgear design tests; G, AE

Switchgear production tests; G, AE

Acceptance checks and tests; G

Paralleling Operational Test; G, AE

SD-10 Operation and Maintenance Data

Switchgear Operation and Maintenance, Data Package 5; G, AE

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals;

Equipment Test Schedule; G, AE

Request for Settings; G

Paralleling Operational Performance; G, AE

1.4 QUALITY ASSURANCE

1.4.1 Switchgear Product Data

Each submittal shall include manufacturer's information for each component, device and accessory provided with the switchgear including:

a. Circuit breaker type, interrupting rating, and trip devices, including available settings

b. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device.

1.4.2 Switchgear Drawings

Drawings shall include, but are not limited to the following:

a. One-line diagram including breakers, current transformers, and meters

b. Outline drawings including front elevation, section views, footprint, and overall dimensions

c. Bus configuration including dimensions and ampere ratings of bus bars

d. Markings and NEMA nameplate data

e. Circuit breaker type, interrupting rating, and trip devices, including available settings

f. Three-line diagrams and elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

g. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device. These shall be used by the designer of record to provide breaker settings that will ensure protection and coordination are achieved.

h. Provisions for future extension.

1.5 MAINTENANCE

1.5.1 Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01781, "Operation and Maintenance Data."

1.5.2 Assembled Operation and Maintenance Manuals

Manuals shall be assembled and binded securely in durable, hard covered, water resistant binders. The manuals shall be assembled and indexed in the following order with a table of contents. The contents of the assembled operation and maintenance manuals shall be as follows:

a. Manufacturer's O&M information required by the paragraph entitled "SD-10, Operation and Maintenance Data".

b. Catalog data required by the paragraph entitled, "SD-03, Product Data".

c. Drawing required by the paragraph entitled, "SD-02, Shop Drawings".

d. Prices for spare parts and supply list.

e. Information on metering

f. Design test reports

g. Production test reports

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchgear and related accessories are specified in Section 16415, "ELECTRICAL WORK, INTERIOR,".

2.2 SWITCHGEAR

IEEE C37.20.1 and UL 1558.

2.2.1 Ratings

The voltage rating of the switchgear shall be 480Y/277 volts AC, 4-wire 3. The continuous current rating of the main bus shall be as indicated. The short-circuit current rating shall be rms symmetrical amperes as indicated. The switchgear shall be UL listed and labeled as service entrance equipment.

2.2.2 Construction

Switchgear shall consist of vertical sections bolted together to form a rigid assembly and shall be rear aligned. All circuit breakers shall be front accessible. Rear aligned switchboards shall have front accessible load connections. Compartmentalized switchgear shall have vertical insulating barriers between the front device section, the main bus section, and the cable compartment with full front to rear vertical insulating barriers between adjacent sections. Where indicated, "space for future" or "space" shall mean to include bus, device supports, and connections. Provide insulating barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness. Apply moisture resistant coating to all rough-cut edges of barriers. Switchboard shall be completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring.

2.2.2.1 Enclosure

The switchgear enclosure shall be a outdoor NEMA ICS 6 Type 3R walikin protected-aisle fabricated entirely of 11 gauge, minimum, galvanized steel or ASTM A 167 type 304 or 304L stainless steel. Enclosure shall be welded together with side end doors, and sloping roof downward toward rear. Side doors shall be provided with pad vault handles with a three point catch. Bases, frames and channels of enclosure shall be corrosion resistant and shall be fabricated of ASTM A 167 type 304 or 304L stainless steel. Base shall include any part of enclosure that is within 3 inches of concrete pad. Galvanized steel shall be ASTM A 123/A 123M, ASTM A 653/A 653M G90 coating, and ASTM A 153/A 153M, as applicable. Galvanize after fabrication where practicable. Paint enclosure "Langley Brown. Paint coating system shall comply with NEMA C57.12.28 for galvanized steel and ANSI C57.12.29 for stainless steel. Enclosure and switchgear shall be vented according to the manufacturer's standard practice.

2.2.2.2 Bus Bars

Bus bars shall be copper with silver-plated contact surfaces. Plating shall be a minimum of 0.0002 inch thick. Make bus connections and joints with hardened steel bolts. The through-bus shall be rated at the full ampacity of the main throughout the switchgear. Provide minimum one-quarter by 2 inch copper ground bus secured to each vertical section along the entire length of the switchgear. The neutral bus shall be rated 100 percent of the main bus continuous current rating. Phase bus bars shall be insulated with an epoxy finish coating powder providing a minimum breakdown voltage of 16,000 volts per ASTM D 149.

2.2.2.3 Main, Tie, Building Feeder and Generator Feeder Sections

Shall consist of an individually mounted drawout air power circuit breaker .

2.2.2.4 Distribution Sections

The distribution section(s) shall consist of molded-case circuit breakers.

2.2.2.5 Auxiliary Sections

Auxiliary sections shall consist of indicated instruments, metering equipment, control equipment, transformer, paralleling controls, and current transformer compartments.

2.2.2.6 Handles

Handles for individually mounted devices shall be of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

2.2.3 Protective Device

Provide protective devices as specified herein and asindicated.

2.2.3.1 Power Circuit Breaker (Main, Tie, Building Feeder and Generator Feeders)

IEEE C37.13. 120 Vac electrically operated drawout, unfused, low-voltage power circuit breaker with a short-circuit current rating of rms amperes symmetrical as indicated at rated volts. Breaker frame size shall be as indicated. Equip electrically operated breakers with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing the handle. Provide all required contactors and coils for electrically opening and closing the circuit breakers, both manually and automatically, and as required to interface with the paralleling controls. Provide LSIG electronic microprocessor protective device units.

2.2.3.2 Molded-Case Circuit Breaker

UL 489. UL listed and labeled, 100 percent rated, stationary, manually operated, low voltage molded-case circuit breaker, with a short-circuit current rating of rms symmetrical amperes as indicated at rated volts. Breaker frame size shall be as indicated. Series rated circuit breakers are unacceptable.

2.2.4 Drawout Breakers

Equip drawout breakers with disconnecting contacts, wheels, and interlocks for drawout application. The main, auxiliary, and control disconnecting contacts shall be silver-plated, multifinger, positive pressure, self-aligning type. Each drawout breaker shall be provided with four-position operation. Each position shall be clearly identified by an indicator on the circuit breaker front panel.

(1) Connected Position: Primary and secondary contacts are fully engaged. Breaker must be tripped before racking into or out of position.

(2) Test Position: Primary contacts are disconnected but secondary contacts remain fully engaged. Position shall allow complete test and operation of the breaker without energizing the primary circuit.

(3) Disconnected Position: Primary and secondary contacts are disconnected.

(4) Withdrawn (Removed) Position: Places breaker completely out of compartment, ready for removal. Removal of the breaker shall actuate assembly that isolates the primary stabs.

2.2.5 Electronic Trip Units

Equip breakers 600 amperes and above with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that will provide true rms sensing adjustable time-current circuit protection. The ampere rating of the current sensors shall be the same as the breaker frame rating. The trip unit ampere rating shall be as indicated. Ground fault protection shall be zero sequence sensing or residual type sensing. The electronic trip units shall have the following features.

a. Breakers shall have long delay pick-up and time settings, and LED indication of cause of circuit breaker trip.

b. Breakers shall have short delay pick-up and time settings and, instantaneous settings and ground fault settings.

d. Main and Building Feeder Breakers shall have a digital display for phase and ground current.

e. Main and Building Feeder Breakers shall have a digital display for watts, vars, VA, kWh, kvarh, and kVAh.

f. Main and Building Feeder Breakers shall have a digital display for phase voltage, and percent THD voltage and current.

2.2.6 Instruments

ANSI C39.1 for electrical indicating switchboard instruments, with 2 percent accuracy. Provide digital type metering. Provide current ransformers and voltage transfomrers as required.

2.2.7 Meter Fusing

Provide metering fusing as required. Size fuses as recommended by the meter manufacturer.

2.2.8 Heaters

Provide 120-volt heaters in each switchgear section. Heaters shall be of sufficient capacity to control moisture condensation in the section, shall be 250 watts minimum, and shall be controlled by a thermostat and humidistat located in the section. Thermostat shall be industrial type, high limit, to maintain sections within the range of 60 to 90 degrees F. Humidistat shall have a range of 30 to 60 percent relative humidity. Supply voltage for the heaters shall be obtained from a control power

transformer. If heater voltage is different than switchboard voltage, provide transformer rated to carry 125 percent of heater full load rating. Transformer shall have 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and shall conform to NEMA ST 20. Energize electric heaters in switchboard assemblies while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source. Provide temporary, reliable external power source if commercial power at rated voltage is not available on site.

2.2.9 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

2.2.10 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 Enclosure auxiliaries and distribution

Provide the following in the walkin enclosure: four 2 lamp fluorescent damp label light fixtures, light switch at each end of the walkin enclosure, four duplex convenience outlets, dry type transformer as indicated, panelboard as indicated, conduit wire and all required accessories for a complete installation.

2.4 NAMEPLATES

Provide as specified in division 16.

2.5 WARNING SIGNS

Provide as specified in division 16

2.6 SOURCE QUALITY CONTROL

2.6.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

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

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.6.2 Switchgear Design Tests

IEEE C37.20.1 and UL 1558.

2.6.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Short-circuit current test

b. Enclosure tests

c. Dielectric test

2.6.2.2 Additional design tests

In addition to normal design tests, perform the following tests on the actual equipment. Furnish reports which include results of design tests performed on the actual equipment.

a. Temperature rise tests

b. Continuous current

2.6.3 Switchgear Production Tests

IEEE C37.20.1 and UL 1558. Furnish reports which include results of

production tests performed on the actual equipment for this project. These tests include:

a. 60-hertz dielectric tests

b. Mechanical operation tests

c. Electrical operation and control wiring tests

d. Ground fault sensing equipment test

2.7 Paralleling Control System

Provide complete assembled paralleling equipment with digital electronic controls designed for fast, reliable operation and including the functions described herein. The paralleling equipment manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001. Provide all required current transformers, voltage transformers, transducers, software, touchscreens, and appurtenances for a complete operational system. Provide all required software for maintaining and servicing the paralleling system, fully licenses to the Government,

2.7.1 System Control Power

Control power for the paralleling system shall be derived from the generator set 24VDC starting batteries. A solid state, no break "best battery" selector system shall be provided so that control voltage is available as long as any battery bank in the system is available, and that all battery banks are isolated to prevent the failure of one battery from disabling the entire system. Generator set governing, voltage regulation, load sharing, synchronizing, protection, and control equipment shall be capable of proper operation with battery voltage levels down to 8VDC.

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2.7.1.2 Redundant Power

A redundant 24VDC control power supply shall be provided for the system master control, including batteries, rack, and charger.

2.7.1.3 Paralleling Breaker Control Power

Paralleling breaker control power shall be derived from the generator set for charging, opening, and closing the breakers.

2.7.2 Paralleling Controls

Provide a paralleling control panel for each generator set. The paralleling

control functions may be integrated with the generator set control functions (with duplicate functions eliminated). Each paralleling control panel shall contain the components and devices as described in this section.

2.7.2.1 Operator Panel

Each paralleling control panel shall be provided with a panel to allow the operator to view the status and control operation of the specific generator set being paralleled. The operator panel shall be provided with the following features and capabilities.

a) 1% accuracy generator set AC output instruments; Ammeter, Voltmeter, Frequency Meter, Wattmeter, KW-hour meter, Power Factor Meter. Selector switches to allow viewing of voltage and amperes for each phase shall be provided. For 3-phase/4-wire systems the voltmeter shall indicate line to line and line to neutral conditions. Voltmeter and frequency meter shall be analog instruments. Switches and/or other provisions shall be included to allow reading of bus voltage and frequency from this metering set.

b) Synchroscope and "generator set synchronized" indication. Indication may be synchronizing lamps, LED indication, or other provisions, but must be located on the paralleling control panel, adjacent to the paralleling breaker control switches.

c) Running Time Meter, Start Counter

d) Generator Set Mode Selector Switch: Switch shall provide run, off, and automatic functions for control of the generator set. Run mode causes the generator set to immediately start and accelerate to rated speed and voltage, but paralleling breaker doe not automatically close. Off mode prevents generator set from starting, or immediately shuts down the generator set if it is running. Auto mode allows genset starting from a remote control system.

e) Breaker trip/close switch with breaker status indicating lamps. The switch shall be interlocked with the control system such that breaker closure is not possible unless the mode select switch is in the run position and the generator set is synchronized with the system bus.

f) Control Reset push button switch with indicating lamp. Lamp shall flash to indicate that generator set is locked out due to a fault condition.

g) Lamp test push button switch. Operation of this switch shall cause all lamps on the panel to be simultaneously tested.

h) The control panel shall be provided with a set of DC-powered lamps with a switch to allow viewing of all functions on the front panel when normal lighting systems are not available.

i) Emergency Stop switch. The emergency stop switch shall be a red, mushroom head switch which maintains it's position until manually reset.

j) Precision voltage and frequency adjust raise/lower switches. Switches shall allow the generator set frequency and voltage to be adjusted plus or minus 5% when the generator set is operating independently of the system bus. Voltage and frequency adjustment switches shall be located adjacent to the generator set and bus metering, breaker control switches, synchroscope and manual paralleling panel, for ease of use by the operator.

k) Alarm and status indicating panel to indicate the following conditions (alarm horn shall be located on master control) :

Alarm and status indicating panel

Function	Lamp Color	Alarm Horn	Shutdown Unit
Low DC Voltage	Amber	*	
High DC Voltage	Amber	*	
Weak Battery	Amber	*	
Fail to Sync	Amber	*	
Low Oil Pressure Alarm	Amber	*	

Alarm and status indicating panel			
Low Fuel - daytank	Amber	*	
High Engine Temp Alarm	Amber	*	
Ground Fault	Amber	*	
Overcurrent Alarm	Amber	*	
Breaker Failure	Red	*	*
Breaker Tripped	Red	*	*
Not in Auto	Red	*	*
High Engine Temp	Red	*	*
Low Oil Pressure	Red	*	*
Overcurrent	Red	*	*
Short Circuit	Red	*	*
Loss of Excitation	Red	*	*
Reverse Power	Red	*	*
Overcrank	Red	*	*
Overspeed	Red	*	*
Under Frequency	Red	*	
Under Voltage	Red	*	*
Over Voltage	Red	*	*
Phase Rotation	Red	*	*
Low Coolant Level	Red	*	*
Automatic	Green		
Generator Running	Green		
Breaker Open	Green		
Breaker Closed	Green		
Demand Mode Standby	Green		
Timing for Start	Green		
Timing for Shutdown	Green		

2.7.2.2 Internal Controls

The following internal control components or functions shall be provided for each generator set in the system.

a) Electronic isochronous kW load sharing control to operate the engine governors during synchronizing and to provide isochronous load sharing when paralleled. The control system shall allow sharing of real kW load between all generator sets in the system to within 1% of equal levels, without introduction of frequency droop into the system. The control system shall include all equipment required for kW load sharing with an infinite bus. The infinite bus governing controls shall allow the generator set to synchronize to an infinite bus, parallel, and ramp up to a preset load level on the generator set. Additional controls shall be provided to cause the generator set to ramp up to a kW load level signaled by the system master control PLC. The isochronous load sharing module and engine governor shall be a coordinated system of a single manufacturer.
b) Load demand governing controls shall be provided to cause the generator set to ramp down to zero load when signaled to shut down in a load demand mode. On a signal to re-start, the load demand governing controls shall cause the generator set to synchronize to the system bus, close, and ramp up to it's proportional share of the total bus load. The ramp rate of the generator set shall be operator-adjustable.
c) Electronic kVAR load sharing control to operate the alternator excitation system while the generator set is paralleled. The control system shall allow sharing of reactive load between all generator sets in the system to within 1% of equal levels, without introduction of voltage droop into the system. The control system shall include all equipment required for VAR load sharing with an infinite bus in either a constant VAR

or constant power factor mode for future application flexibility. (Mode and adjustments selectable by the operator)
d) Equipment shall be provided to monitor the generator set as it is starting, and verify that it has reached at least 90% of nominal voltage and frequency before closing to the bus. The equipment provided shall positively prevent out of phase paralleling if two or more engine generator sets reach operating conditions simultaneously by providing a lockout signal to disable breaker closure for generator set(s) in the system which have not been selected to be the first units to close to the bus. Controls to recognize the failure of the first breaker signaled to close, and allow system operation to proceed in spite of this failure shall also be provided (breaker failure alarm). Systems using dead bus relay schemes without a disable signal to positively prevent out of phase paralleling shall not be acceptable under this specification. System shall include an independent backup to automatically operate in the event that the primary system fails.
e) Synchronizer to electronically adjust the engine governor to match the voltage, frequency and phase angle of the bus. Synchronizer shall maintain the engine generator voltage within 1% of bus voltage and phase angle within 20 electrical degrees of the bus for 0.5 seconds before circuit breaker closing. Each unit shall have its own synchronizer; systems using a switching scheme to utilize a single system synchronizer will not be approved. Synchronizers and systems which utilize a motor driven pot for control of AC voltage during the synchronizing process will not be accepted. The system shall be provided with a fail to synchronize time delay that is adjustable from 10-120 seconds. Control logic for fail to synchronize function shall allow field adjustment of function for either alarm or shutdown of the generator set on failure condition.
f) Controls shall include a permissive relay function to assure that the generator set does not attempt to close out of phase with the bus, due to errant operation of the synchronizer.
g) Controls shall include a permissive (sync check) function, to be used with "generator synchronized" indicator during manual paralleling, to prevent accidental closure of the breaker with the generator set out of phase with the bus. Provisions to allow manual closure of the first generator set to a de-energized bus shall be included.
h) Control equipment shall contain a system of diagnostic LED's to assist in analyzing proper system function.
i) Controls shall include three phase sensing reverse power equipment, to prevent sustained reverse power flow into the generator set. When the reverse power condition exceeds 10% of the generator set kW for 3 seconds, the paralleling circuit breaker shall be tripped open and the generator shut down.
j) Controls shall be provided to verify generator set and bus phase rotation match prior to closing the paralleling breaker.
k) Electronic alternator overcurrent alarm and shutdown protection. This protection is required in addition to the overcurrent trip on the paralleling breaker, and shall sense current flow at the generator set output terminals. The overcurrent alarm shall be indicated when the load current on the generator set is more than 110% of rated current for more than 60 seconds. The overcurrent shutdown shall matched to the thermal damage curve of the generator set, and shall not have an instantaneous function.
l) Electronic alternator short circuit protection. This protection is in addition to the overcurrent trip on the paralleling breaker. The short circuit shall occur when the load current on the generator set is more than 175% of rated current and an aggregate time/current calculation indicates that the system is approaching the thermal damage point of the alternator. The equipment used shall not have an instantaneous function
m) Provide overcurrent and short circuit protection for the feeder

connecting the generator set to the paralleling switchgear. This protection may be integrated with alternator protection but must be positively coordinated to prevent tripping of the paralleling breaker prior to the operation of the alternator protective equipment.
n) Controls shall be provided to sense loss of excitation of the alternator while paralleled to the system bus.
o) Generator set start contacts rated 10 amps at 32 VDC. A redundant network-based starting system shall also be provided.
p) Cooldown time delay, adjustable: 0-600 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for shutdown.
q) Start time delay, adjustable: 0-300 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for start.
r) The control system shall monitor the paralleling breaker auxiliary contacts, and initiate a fault signal if the breaker fails to close within an adjustable time delay period after the control has signaled it to close (0.5-15 seconds). Breaker failure alarm shall cause the paralleling breaker to trip open, and lock out until manually reset.
s) Controls shall be provided to initiate an alarm condition when generator set is at 90% of rated frequency for more than 20 seconds.
t) Controls shall be provided to shut down generator set and initiate alarm when the generator set is at less than 85% of nominal voltage for more than 15 seconds, more than 110% of nominal voltage for more than 10 seconds, or more than 130% of nominal.
u) Provide all other components required, such as properly sized current transformers, transducers, terminal blocks, etc., for a complete operable system.

2.7.3 Master Control System

Provide a system master control to monitor and control the operation of the entire paralleling system, including the generator set controls. The master control panel shall contain the components and functions described in this section.

2.7.3.1 Solid State System Status Panel

Solid State System Status Panel. A system status panel shall be provided and shall include the following features and functions:

Solid State System Status Panel

" Alarm Silence Push-button Switch
" Alarm horn
" LED Indicating lamps to indicate the following conditions:

Function	Color	Alarm Horn
Generator Set #n On Line. (one for each genset in the system)	Green	
Load Demand Mode	Green	
Priority #n Load On (one for each load add level in the system)	Green	
Load Shed Level n (one for each load shed level in the system)	Red	*
System Test	Green	
Remote System Start	Amber	
Check Generator Set #n		

Solid State System Status Panel		
(one for each genset in the system)	Red	*
Controller Malfunction	Red	*
Check Station Battery	Red	*
Bus Overload	Red	*
System Not in Auto Mode	Red	*

2.7.3.2 Operator Interface Panel (OIP)

A full color high resolution OIP type operator interface panel (OIP) shall be provided which allows the operator to monitor and control the on site power system. The OIP shall have a minimum viewing area of 100 square inches. The components shown on the OIP shall all be designated as shown on the drawings. All data shall be configurable for display in either US standard or metric indications. The OIP shall include the following screens and/or functions:

a) Screens shall be configured in a typical WindowsTM format, with a pop-up menu in the lower left corner of the screen providing access to various screens. There shall not be a close program "button" in the upper right corner of any screen. (Closing the program shall be accomplished only through the menu structure.) There shall be a context sensitive help button on each screen.

b) One Line Diagram Screen. The one-line diagram screen shall display a system message (to advise the operator of needed or optional control operations), and shall also show the system status by a combination of animation, changing screen color, text messages, and pop-up indicators. Conditions visible on the screen shall include:

" Generator set(s), and bus configuration, with generator set, parallel breaker and bus energized/de-energized indication (red indicating energized, green indicating de-energized).

" Generator set designation. Control, data, and performance summary screens shall be accessible through hot keys (links) located on or adjacent to the genset icon.

" Generator set mode (run/off/auto)

" Generator set status (normal/warning/shutdown/load demand stop/% load). Pop-up screens shall provide access to detailed information and service manuals from the one-line diagram screen.

" Paralleling breaker status (open/closed/tripped)

" Bus condition (energized or de-energized)

" Access to other system control and monitoring functions through a menu button with pop-up option display

" Help "button" to allow access to information concerning the specific screen viewed, or concerning current system status.

c) System Control. The system control screen shall provide the operator with the ability to enable or disable load demand operation; initiate test (with or without load); control the shutdown sequence for the generator sets in the load demand mode; set the load demand time delays; set the load demand operation set points; and display and modify the automatic load add and shed sequence.

d) Genset Control. The genset control screen shall be a popup control screen to allow the operator to manually start and stop the genset, and manually open and close the genset paralleling breaker. It shall also display generator set status and percent load.

e) Genset Data Display. The genset data display shall provide the operator with information on the status and condition on the generator set. It shall include all data displayed at the local generator set control panel, and as a minimum shall include: engine rpm, oil pressure, coolant

temperature, DC voltage, engine hours, genset MW hours, number of starts, line to line and line to neutral voltage on all phases, bus line to line and line to neutral voltage on all phases, genset and bus frequency, load current, power factor, kVAR and kw, local control switch status, and genset status. It shall also provide display of all active faults in the local generator set control. The screen shall include a strip chart function that allows the operator to add any monitored data point to a scrolling screen to develop an active graphical display of conditions on that generator set.

f) Genset Status Summary. The genset status summary shall provide an analog and graphical display of critical generator set operating parameters. The screen shall include generator set state display (stopped, time delay start, idle speed state, rated volts/hz, synchronizing, load share, or load govern); analog AC metering for generator set, including 3-phase AC volts and current, frequency, kW, and power factor; and 3-phase AC bus voltage and frequency. The screen shall also include a strip chart function that allows the operator to add any function or value on to the strip chart to provide an active display of the condition of the system.

g) Load Control. The load control screen shall provide an analog display of system load as a percent of available capacity of the generator sets that are operating in parallel on the bus. The screen shall also provide an alphanumeric display of this data. It shall also display the name, status and priority of each load block (whether on or off), and the total load of that block. The screen shall allow the operator to manually add and shed loads in any sequence desired.

h) Trending. The Touchscreen shall be capable of providing real time trend charts for any monitored value in the system, with up to 8 monitored points at any time. Historical trend charts using a data log function in the control shall also be provided. Historical charts shall be configurable for functions displayed, and for the time frame displayed, and shall allow comparison of historical data from multiple time periods simultaneously.

i) Alarms. Any alarm on any generator set or in the system shall result in a pop-up screen display that describes the equipment where the fault has occurred, and the name of the fault. The screen shall allow the operator to attempt to reset the fault from the OIP. It shall also offer direct access to manuals.

j) Service Information. The service information pop-up screen shall include the name, address, and phone number for the local service point for the equipment.

k) Service Manuals. The OIP shall include the ability to display the entire content of all operating and service manuals for the entire system, including generator sets (engine, alternator and control system), paralleling controls, master controls, and transfer control equipment. This requirement is in addition to the hard copy manuals required elsewhere in this specification.

l) Transfer Controls. A transfer control screen shall be provided for each transfer breaker pair in the system. The transfer control screens shall provide status information on the condition of the normal service and generator service at each device (service available), which source is connected to the load, as well as transfer control status. Information to be provided shall include:

" Indication "lamps" for common alarm, not in auto, test/exercise mode, load shed, transfer inhibit, retransfer inhibit, fail to close, fail to disconnect

" AC data at the transfer pair, including line to line and line to neutral AC Volts for all phases of both sources, frequency of both sources, load current, power factor, kW, and kVA for the load.

" Test "pushbutton" and fault reset "pushbutton".

" The screen shall also display status of all active time delays and all active faults.

2.7.3.3 Internal Control Components

The following internal controls shall be provided within the master control section:

a) Programmable controller (PLC or PC) for interface with OIP, and to provide load demand, load pick up, and load shed functions. Documentation provided with the equipment shall include PLC program documentation.
b) Load pick up output contacts, rated 10 A at 600 VAC (3 contacts per level). Provide direct control for all feeder breakers in the system (14 total).
c) Load shed output contacts, rated 10 A at 600 VAC (3 contacts per level). Provide direct control for all feeder breakers in the system (14 total).
d) Digital Transducer(s), PT's, and CT's and other equipment required to provide bus condition information to the PLC.

2.7.3.4 Other Components

Provide all other components required, such as properly sized current transformers, transducers, terminal blocks, etc., for proper and reliable system operation.

2.7.4 PARALLELING OPERATION

2.7.4.1 Loss Of Normal Power

A. System is given signal to start by receipt of start signal from the power transfer control(s) (Master PC or PLC) or other remote device. On receipt of this signal, all generator sets automatically and independently start, accelerate to rated frequency and build up to rated voltage. The first start system monitors this process, and on finding a generator set at 90% of rated voltage and frequency, automatically disables all other units from closing to the bus, and closes the ready unit to the bus. At this time the utility main breakers are opened, non-essential loads are shed, and the generator main bus breakers connect generator sets to the system bus.
B. The priority (load add) controls prevent overloading of the system bus by providing control signals to delay operation of designated system loads until sufficient generating capacity is available on the bus, or until the priority override switch on the OIP is actuated.
C. After the first unit is closed to the bus, the control of the remaining units is switched to the synchronizer in each generator paralleling control, which causes the generator set to synchronize with the system bus, and then close to it at the proper time.
D. As each unit closes to the bus, the unit assumes it's proportional share of the total load on the bus, and the control system will automatically add loads to the generator bus by closing feeder breakers.

2.7.4.2 Failure Of A Unit To Start Or Synchronize:

A. If a unit fails to start, after the overcrank time delay (in the generator set control) has expired, the unit will be shut down, and an alarm will sound. The priority control will prevent the lowest priority loads from being added to the system without manual intervention. The priority override controls on the OIP may be used by an operator to

manually add low priority loads to the bus, if he determines that generator capacity is available to serve the loads. Bus overload monitoring shall protect the first priority loads in the event that the bus is inadvertently overloaded due to operator error.
B. If a unit fails to synchronize, after a preset time delay, an alarm will sound, but the unit will continue to attempt to synchronize until signalled to stop by manual operation of the control switches on the generator set.

2.7.4.3 Bus Overload

A. If a bus overload occurs for any reason, a load shed signal will be generated to initiate load shedding in the system.
B. If the bus does not return to proper frequency within a predetermined period of time (adjustable via the OIP), additional load shed signals will be generated until the generator set bus returns to normal frequency.
C. Loads that are shed due to overload shall require manual reset via the OIP.

2.7.4.4 Load Demand Mode

A. When the system running in the emergency mode with the "load demand" switch on the OIP in the "on" position , controls shall continuously monitor the total load on the bus. If the total load on the bus falls below preset limits for a period of 15 minutes, the controller will automatically shut down generator sets in an operator predetermined order, until the minimum number of generators required to operate the load remain on the bus. The purpose of this function is to allow the generator sets to operate closer to their rated capacity, thereby decreasing fuel consumption, and reducing wear on the system.
B. On sensing that the available bus capacity is being approached, the standby units will automatically be restarted (in the reverse order of which they were shut down) and paralleled with the bus to assume their proportional share of system load.

2.7.4.5 Return of Normal Power

A. When all of the system start signals are removed from the generator sets, the system will begin a retransfer process in either an open or closed transition mode, as selected by the operator.
B. If running in the closed transition mode, the system shall synchronize the generator bus to the first utility source, close the utility breaker, ramp down load on the generator breaker to a minimum value, then open the generator bus breaker. This process shall be repeated sequentially across each breaker transfer pair.
C. If running in the open transition mode, the system shall sequentially transfer back to the utility by opening each generator bus breaker, then closing it's associated utility breaker at an operator-programmed time period later. This process shall be repeated sequentially across each breaker transfer pair.
D. When all loads have been transferred back to the utility, the generator set paralleling breakers shall all open, and the generator sets shall operate at no load for a cooldown period. When the cooldown period has been completed, the generator sets shall shut down.
E. If a system start signal is received during the cooldown period, one generator set shall immediately close to the system bus and all other units shall synchronize to it, as described in "Loss of Normal Power" above.

F. Test With Load Mode:
1. The system shall allow the generator sets to be tested by transfer of the system loads to the generator sets. Systems loads shall transfer in either an open or closed transition mode, as determined by the setup of the control system for emergency standby operation.
2. Sequence of operation in this mode shall be similar to that described for a power failure condition.
3. When the system is operating in the closed transition mode, it shall always transfer between "good" sources without a power interruption to the load.
G. Generator Set Exercise (Test) Without Load Mode
1. The system shall allow testing of the generator sets at no load. In this operation mode the generator sets will start, build up to rated speed and voltage, synchronize and close to the generator bus, but system loads shall not automatically transfer to the generator system.

2.7.5 OTHER REQUIREMENTS

Factory Testing. The system manufacturer shall perform a complete operational test on the paralleling system (including generator sets, paralleling controls, and power switchgear) prior to shipping from the factory. A certified test report shall be provided, and permanently retained by the system manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 16375, "Electrical Distribution System, Underground". Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than No. 4/0 AWG not less than 30 inches below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 16375, "Electrical Distribution System, Underground.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchgear

IEEE C37.20.1.

3.3.2 Meters and Instrument Transformers

NEMA C12.1.

3.3.3 Galvanizing Repair

Repair damage to galvanized coatings using ASTM A 780, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Mount switchgear on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 inch No. 6 mesh placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. The top of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 03300, "Cast-In-Place Concrete".

3.5 FIELD QUALITY CONTROL

Contractor shall submit settings of breakers to the Contracting Officer for approval and at least 30 days in advance of their requirement.

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Switchgear

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical, electrical, and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Verify appropriate anchorage, required area clearances, and correct alignment.

(5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

(6) Verify that circuit breaker sizes and types correspond to approved shop drawings.

(7) Verify that current transformer ratios correspond to approved shop drawings.

(8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

(10) Clean switchgear.

(11) Inspect insulators for evidence of physical damage or contaminated surfaces.

(12) Verify correct barrier installation.

(13) Exercise all active components.

(14) Inspect all mechanical indicating devices for correct operation.

(15) Verify that vents are clear.

(16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

(17) Inspect control power transformers.

b. Electrical Tests

(1) Perform insulation-resistance tests on each bus section.

(2) Perform overpotential tests.

(3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.

(4) Perform control wiring performance test.

(5) Perform primary current injection tests on the entire current circuit in each section of assembly.

(6) Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.

(7) Verify operation of switchgear heaters.

3.5.1.2 Circuit Breakers - Low Voltage - Power

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Inspect anchorage, alignment, and grounding. Inspect arc chutes. Inspect moving and stationary contacts for condition, wear, and alignment.

(5) Verify that all maintenance devices are available for servicing and operating the breaker.

(6) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

(7) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.

(8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(9) Verify cell fit and element alignment.

(10) Verify racking mechanism.

b. Electrical Tests

(1) Perform contact-resistance tests on each breaker.

(2) Perform insulation-resistance tests.

(3) Adjust Breaker(s) for final settings in accordance with Government provided settings.

(4) Determine long-time minimum pickup current by primary current injection.

(5) Determine long-time delay by primary current injection.

(6) Determine short-time pickup and delay by primary current injection.

(7) Determine ground-fault pickup and delay by primary current injection.

(8) Determine instantaneous pickup value by primary current

injection.

(9) Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.

(10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.

(11) Verify operation of charging mechanism.

3.5.1.3 Circuit Breakers

Low Voltage Molded Case with Solid State Trips

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect circuit breaker for correct mounting.

(3) Operate circuit breaker to ensure smooth operation.

(4) Inspect case for cracks or other defects.

(5) Inspect all bolted electrical connections for high resistance using low resistance ohmmeter, verifying tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

(1) Perform contact-resistance tests.

(2) Perform insulation-resistance tests.

(3) Perform Breaker adjustments for final settings in accordance with Government provided settings.

(4) Perform long-time delay time-current characteristic tests

(5) Determine short-time pickup and delay by primary current injection.

(6) Determine ground-fault pickup and time delay by primary current injection.

(7) Determine instantaneous pickup current by primary injection.

(8) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.

3.5.1.4 Current Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance tests.

(3) Perform polarity tests.

(4) Perform ratio-verification tests.

3.5.1.5 Metering and Instrumentation

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

(4) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.6 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times for checks, settings, and tests.

-- End of Section --

1st COMM SQUADRON/LAFB

PREMISES DISTRIBUTION SYSTEM

04/01

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 basic designation only.

ELECTRONIC INDUSTRIES ASSOCIATION {EIA)

EIA ANSI/TIA/EIA-568-A	(1995) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-569-A	(1998) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607	{1994) Commercial building Grounding and Bonding Requirements for Telecommunications
EIA TSB 67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems
EIA TSB 75	(1996) Additional Horizontal Cabling Practices for Open Offices

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-8O-576	(1994) Communications Wire and Cable for Wiring of Premises

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables, as well as connecting hardware, and all required equipment and accessories for a complete structured cabling and pathway system, to transport telephone and data signals, including Local Area Network signals, between equipment items in a building. This will be a complete system, to include full telecommunication closet wire pathway support from entry into the telecommunication closet, as well as wire management system on equipment racks/cabinets. This will also include a complete grounding/bonding backbone system. The appendix A attached to the end of this section form a part of this section and this contract. The contractor shall provide equipment identified in the appendix A and as specified herein and indicated on the drawings.

1.3 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, non-condensing.

1.4 QUALIFICATIONS

1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by, and all equipment shall be furnished and installed by, a certified Telecommunications Contractor, hereinafter referred to as the Contractor, with the exception of furnishing and installing conduit, electrical boxes, and pull wires; this work shall be done by a licensed electrical contractor. The Contractor shall have the following qualifications in the Telecommunications Systems installation:

a. Contractor shall have a minimum of 5 years experience in the application, installation and testing of the specified systems and equipment to be installed.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premises distribution system cables and associated hardware.

c. All installers assigned to the installation of this system or any of its components shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and their components.

1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract shall be from manufacturers that have a minimum of 5 years experience in producing the types of systems and equipment specified.

1.5 SUBMITTALS

Government approval is required for submittals. The following shall be submitted to the Contracting Officer in accordance with Section 01330, SUBMITTAL PROCEDURES, except that seven (7) copies shall be submitted. One copy will be forwarded by the Contracting Officer to 1st CS/SCXI for review.

1.5.1 Spare Parts Lists;

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detailed drawings, not later than 60 days prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

1.5.2 Premises Distribution System Drawings;

Detail drawings, including a complete list of equipment and material. Drawings shall be furnished on 24" x 36" (Arch D Size) sheets using the standard Langley title block. The plot area shall be 22" x 34". Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details (to include complete wire management support systems in Telecommunications Closet/Room), elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearance for maintenance and operation. Provide registered communications distribution designer (RCDD) approved drawings complete with wiring diagrams and details required to prove that the distribution system shall properly support connectivity from the telecommunications equipment room to telecommunications work area outlets. Show the entrance facility and layout of cabling and pathway runs, cross connect points, MDF, BDF, IDF, grounding system, terminating block arrangements and type. Drawings shall depict final telecommunications cabling configuration, including location, color coding, gage, pair assignment, polarization, and terminating blocks layout at cross connect points and patch panels after telecommunications cable installation. Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, BDF's, IDF's, MDF's, and equipment rooms keyed to floor plans by room

number. Mount the laminated schematic near the MDF as directed by the Contracting Officer.

1.5.3 Record Keeping and Documentation;

1.5.3.1 Cables

Documentation on cables and termination hardware shall be provided in accordance with Section 3.6.2, CABLE TESTING, and with ANSI TIA/EIA-606, including record drawings for the installed wiring system infrastructure. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings. Two copies of as-built drawings, recording all installed cable, shall be provided in hard copy format per ANSI TIA/EIA-606 at least 7 days prior to acceptance testing. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility per ANSI TIA/EIA-606.

1.5.3.2 Termination Hardware

A record of all installed patch panels and outlets shall be provided in hard copy format per ANSI TIA/EIA-606. The hardware records shall include only the required data fields per ANSI TIA/EIA-606.

1.5.4 Manufacturer's Recommendations;

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

1.5.5 Test Plan;

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

1.5.6 Qualifications;

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein, which shall

include certification that all the installers are factory certified to install and test the provided products.

1.5.7 Test Reports;

Reports for all tests, performed in accordance with section 3.6.2 CABLE TESTING, shall be submitted in booklet form with witness signatures verifying execution of tests. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 7 days after completion of testing.

1.5.8 Certificates

1.5.8.1 Premises Distribution System;

Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-A, EIA ANSI/TIA/EIA-569-A, and EIA ANSI/TIA/EIA-606 standards.

1.5.8.2 Materials and Equipment;

Where materials and equipment are specified to conform, be constructed, or tested to meet specific requirements, certification that the items conform to such requirements must be provided. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specification.

1.6 DELIVERIES AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contamination.

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1 Cable Insulation

For each individual Category 5e cable, the insulation, material used on each pair shall be exactly the same in all physical, electrical, and chemical respects. The use of Teflon insulated plenum rated category 5e cable is required for both plenum and non-plenum environments. Plenum rated cable shall be type 4x0, where all four pairs are Teflon insulated. Type 3x1 and 2x2 are not acceptable.

2.2.2 Riser Cable

Riser cable shall meet the requirements of ICEA S-80-576 and ANSI/TIA/EIA-568-A for Category 3 unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMP per NFPA 70.

2.2.3 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-A for Category 5e horizontal cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be 4 pair. Cable shall be rated CMP per NFPA 70. All horizontal cables to be installed on any particular installation will be from the same manufacturer. Cable color will be the same throughout the particular facility. The only exception to this will be, if multiple communication closets are to be installed in a particular facility, these closet distribution cables may be separate colors to differentiate the difference of communication closet distribution. Colors for distribution cables shall be as indicated on the drawings.

2.2.4 Connecting Hardware

Connecting and cross-connecting hardware, as well as type 110 insulation displacement connection termination, shall be the same category as the cable it serves. Hardware shall be in accordance with EIA ANSI/TIA/EIA-568-A.

2.2.4.1 Telecommunications Outlets

Wall and floor outlet plates shall come equipped as indicated and be labeled according to the Langley AFB Standard Labeling Scheme, indicated on the drawings. Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-A. Modular jack pin/pair configuration shall be T568A per EIA ANSI/TIA/EIA-568-A. Termination shall be type 110 insulation displacement connection. Modular jacks shall be unkeyed. Faceplates shall be provided in the color specified. Wall outlet assemblies used in the premises distribution system shall consist of modular jacks assembled in a quadra-plex outlet assemblies in double gang covers as indicated on the drawings. The modular jacks shall conform to the requirements of EIA ANSI/TIA/EIA-568-A, Category 5e. In areas where floor mounted boxes are installed, outlets shall be provided for as indicated.

2.2.4.2 Patch Panels

Patch panels shall be rated category 5e, shall not be more than 48 port and shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows on 19 inch rack mounted panels. Jack pin/pair configuration shall be T568A per ANSI/TIA/EIA-568-A. Jacks shall be unkeyed. Panels shall be labeled in accordance with Langley AFB Standard Labeling Scheme.

2.2.4.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568A patch panel jack wiring per EIA ANSI/TIA/EIA-568-A. Patch cords shall be keyed (non-booted). Patch cords shall be factory assembled and in color indicated on drawings. Patch cords shall be category 5e rated, seven feet in length. Provide one patch cord for each port connection in each rack/cabinet plus 25 percent spare.

2.2.4.4 Terminal Blocks

Terminal blocks shall be rack and/or wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 IDC that meet the requirements of ANSI/TIA/EIA-568-A for category 5e. Blocks shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 AWG solid copper wire as a minimum, and shall be connected in pairs so that

horizontal cable and connected jumper wires are on separate connected terminals.

2.3 FIBER OPTIC CABLE SYSTEM

2.3.1 Backbone Cable

2.3.1.1 Multimode

Multimode fiber optic backbone cable shall be run from Main Distribution Frame (MDF)/ Telephone Entrance Facility (TEF) / Main Telecommunications Room to Intermediate Distribution Frame (IDF) or Telephone Closet (TC) for networking connectivity to government identified demarcation point. Fiber optic backbone cable will meet the requirements of EIA ANSI/TIA/EIA-568-A and ICEA S-83-596 for 12 strand, 62.5/125 micrometer multimode graded index optical fiber cable. Numerical aperture for each fiber shall be a minimum of 0.275. Cable construction shall be tight-buffered type. Individual fibers shall be color coded for identification. Cable shall be imprinted with fiber count and aggregate length at regular intervals. Cable shall be rated OFNP per NFPA 70.

2.3.2 Horizontal Distribution Cable

2.3.2.1 Multimode

Multimode fiber optic horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B and ICEA S-83-596 for 62.5/125 micrometer multimode graded index optical fiber cable. Numerical aperture for each fiber shall be a minimum of 0.275. Cable construction shall be tight buffered type, two strands, duplex. Individual fibers shall be color coded for identification. Cable shall be imprinted with fiber count, fiber type, and aggregate length at regular intervals of 3 feet. Cable shall be rated and marked OFNP per NFPA 70.

2.3.2 Connecting Hardware

2.3.2.1 Connectors

Connectors and couplers shall be ST and SC, as indicated, type for termination for connectivity in patch panels, with ceramic ferrule material with a maximum insertion loss of .5 db. Connectors shall meet performance requirements of EIA ANSI/TIA/EIA-568-A. Connectors shall be field installable. Connectors shall utilize adhesive for fiber attachment to ferrule. Connectors shall terminate fiber sizes as required for service.

2.3.3 Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-

connection. Patch panels shall be 19 inch rack mounted type panels. Patch panels shall provide strain relief for cables. Panels shall be labeled per Langley AFB Standard Labeling Scheme.

2.3.2.2 Patch cords

Patch cords shall be cable assemblies consisting of flexible optical fiber cable with connectors of the same type as used elsewhere in the system. Optical fiber shall be the same type as used elsewhere in the system. Patch cords shall be complete assemblies from manufacturer's standard product lines.). Patch cords shall be factory assembled and in color indicated on drawings. Patch cords shall be seven feet in length. Provide one patch cord for each port connection in each rack/cabinet plus 25 percent spare.

2.4 EQUIPMENT RACKS AND CABINETS

2.4.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be standard 19 inch aluminum relay racks. Uprights shall be 3 inches deep, 1-¼ inches wide, drilled and tapped 12-24 in a half inch pattern. Racks shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 7 feet in height and clear coated. AC outlets shall be provided, one quad outlet dedicated line assembly, per every two equipment racks provided.

2.4.2 Floor Mounted Cabinets

Equipment cabinets shall be floor mounted enclosures with side panels, acrylic plastic front doors, rear louvered metal doors, depth-adjustable front and rear mounting rails, and louvered top. Mount cabinet to floor. Ventilation fans shall be included. Vertical cable management devices shall be integral to the cabinet. Power strip outlets shall be provided within the cabinet as indicated. Cabinets shall be a nominal 23 inches wide. Interior equipment racks shall mount equipment 19 inches wide and shall be 72 inches high and 30 inches deep, unless otherwise indicated. Cabinet exteriors shall be painted blue.

2.4.3. Wall Mounted Open Frame

Wall mounted open frame equipment racks, where indicated, shall be aluminum relay racks to mount equipment 19 inches wide with standoff brackets for wall mounting. Uprights shall be drilled and tapped 12-24 in a 1/2 inch> pattern. Standoff brackets shall be of sufficient length for a 6 inch clearance between rack and wall. Wall mounted open frame racks shall be hinged. AC outlets shall be provided adjacent each set of wall frames.

2.4.4 Cable Management

Cable management shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on standard 19-inch equipment racks. Cable management shall consist of ring or bracket-like devices mounted on rack panels for front horizontal use or of a type that utilizes duct fingers with snap on covers. Cable management shall mount to racks by screws and/or nuts and lockwashers. Cable management shall be provided above, below and to both sides of each patch panel on the standard 19-inch equipment rack(s). Vertical cable management will be provided between and to the ends of equipment racks, and provide front and rear vertical cable management. Vertical Cable management shall be of a type that utilizes duct fingers with snap on covers. Cable management will be provided in the rear of the rack, utilizing duct fingers with snap on cover style, or stand off bars. Velcro ties shall be utilized for binding of horizontal distribution wires within the telecommunications room trays and wire management systems.

2.5 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards, 4 feet by 8 feet by ¾ inch and void free, grade A, shall be provided on no less than 2 walls, painted with gray fire resistant paint.

2.6 TELECOMMUNICATIONS OUTLET BOXES

2.6.1 Wall Type Boxes

Electrical boxes for telecommunication outlets shall be 4-11/16 inch square by 2-1/8 inches deep with minimum 3/8 inch deep single or two gang plaster ring. Boxes shall be flush mounted unless otherwise indicated or specified. Provide a minimum 1-inch conduit. All outlet boxes are to receive Quad jack installation.

2.6.2 Raised Access Floor Boxes

Boxes shall comply with UL 514A. Die cast aluminum body. The box lid shall be a hinged style and constructed of polycarbonate material. The box lid shall have a finish color of brown. The lid shall provide a minimum of three (3) removable cable guards for egress of power and communication workstation cables. The cable guards shall hold workstation cables in place with the lid either in the open or closed position. The trim flange shall be constructed of polycarbonate material and have a minimum overall dimension of 8 3/4" x 10 3/4". The hinged lid and trim flange shall be available for either carpet or tile floor applications. Coordinate the trim flange with the flooring in the location where the box is installed. The wiring chamber shall provide an upper and a lower compartment. The top compartment shall be divided into three (3) separate

compartments to accommodate a combination of both power and communication wiring. These compartments shall be separated by use of integral; die cast aluminum built in dividers. The bottom compartment shall be available for either all power or all communication wiring. The total Box Volume capacity shall have a minimum of 300 cubic inches. Provide locking tabs. Activation and connectivity outlets and electrical outlets shall be as indicated on the drawings. The Raised Access Floor Box shall be as manufactured by Walker Model AF3 or approved equal.

2.7 Building Protector Assemblies

Self-contained unit providing a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for 2000 pairs of outside cable. Building protector assembly shall have connector blocks for connection to interior cabling at full capacity.

2.7.1 Protector Modules

UL 497, RUS TECM 823, three-electrode gas tube or solid state type rated for the application. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.7.2 Connector Blocks

Insulation displacement Type 110 for Category 5e and higher systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system, from the facility’s government provided outside plant demarcation point, as shown on the project drawings, shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606 and Langley AFB Standard Labeling Scheme. Penetrations in fire-rated construction shall be fire stopped. Conduits, outlets and raceways shall be installed in accordance with EIA ANSI/TIA/EIA-569-A, Telecommunications Pathways and Spaces. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-A. Wiring and terminal blocks and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606. Cables shall not be installed in the same cable tray, utility compartment, or floor trench compartment with AC power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental

air, shall comply with NFPA 70 requirements for this type of installation. When overhead wire installation methods are utilized, cable tray will be installed, providing complete wire support within the telecommunications room, from room entrance to overhead rack area.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Cables shall be installed in conduit, cable trays in accordance with EIA ANSI/TIA/EIA-568-A. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas, if applicable.

3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer’s recommendations. Cable bend radius shall not be less that ten times the outside diameter of the cable during and after installation. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced. Maintenance loop or slack required for modification or re-termination of backbone cabling shall be provided no less than ten feet long, at both ends of termination.

3.1.3 Telecommunication Outlets

3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link, as per Langley AFB standard.

3.1.3.2 Cables

A maintenance loop or slack required for modification or re-termination of horizontal cabling shall be provided and shall be no less than ten feet at the distribution closet and no less than 12 inches at the outlet. Slack at the user termination shall not be placed in the outlet box, but shall be installed at the nearest practical point to the outlet box. For wall mounted outlet boxes, the slack shall be placed above the ceiling prior to entering the wall.

3.1.3.3 Pull Cords

Pull cords shall be installed in all conduits serving telecommunications outlets, which do not initially have fiber optic cable installed.

3.1.3.4 Outlet Location

Outlet locations, when placed on a fixed wall, shall be located 18" above finished floor (AFF) or at a height equal to the electrical outlets in the room, when applicable. When placing outlets in a raised floor setting, jacks shall be placed in recessed floor boxes as indicated and as specified, and that provide appropriate accessibility and protection of outlets.

3.1.4 Terminal Blocks

Terminal blocks shall be mounted on orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized. Rack mounted 110 IDC terminal blocks will be used at the Intermediate Distribution Frame (IDF) point (Patch Panel end) for copper backbone cable cross connects. Wall mounted 110 IDC terminal blocks will be utilized at the Main Distribution Frame (MDF) or Demarcation Point for outside plant copper cross connect capability.

3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be provided by the Contractor and mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 25 percent spares for future expansion. Cable management will be provided above, below, between, and to both sides of each panel, to include the front and rear.

3.1.6 Fiber Optic Patch Panels

Patch panels shall be provided by the Contractor and mounted in equipment racks/cabinets with sufficient ports to accommodate the installed cable plant, and number of ports, plus 25 percent spares. A slack loop of fiber shall be provided within each panel. Loop shall be 3 feet in length, or longer if recommended by the manufacturer. 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. ST and SC type connectors will be utilized for fiber termination, as indicated.

3.1.7 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable management shall be bolted or screwed to racks. Racks shall be

installed level, and ganged racks shall be bolted together (with cable management mounted in between racks). Ganged rack cabinets shall have adjacent side panels removed. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

3.1.8 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturers recommended fasteners.

3.2 TERMINATIONS

Cable and conductors shall sweep into termination areas. Cable and conductors shall not bend at right angles. Manufacturer’s minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel. The maximum pulling tensions for 4-pair 24 AWG horizontal UTP cables shall not exceed 25 lbf to avoid stretching the conductors during installation. Cable management precautions shall be observed to include the elimination of cable stress as caused by tension in suspended cable runs and tightly cinched cable bundles. To reduce untwisting of pairs, strip back only as much cable jacket as required to terminate on connecting hardware. In spaces with UTP terminations, cable bend radii shall not be less than four times the cable diameter for horizontal cable and shall not be less than ten times the cable diameter for multi-pair cable. Care shall be exercised to minimize twisting/kinking of cable during installation. The amount of untwisting in a pair as a result of termination to connecting hardware shall not exceed 0.5 inches for category 5 cables from IDC.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be un-terminated or contain un-terminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.2.2 Fiber Optic Cable

Each fiber shall be terminated to the Contractor supplied patch panel, using ST or SC type connectors, as indicated. No fiber will be left un-terminated.

3.3 BONDING AND GROUNDING

Bonding and grounding systems shall be installed and configured in the telecommunications entrance facility and in each telecommunications closet (utilizing grounding busbars with stand off insulators) in accordance with EIA ANSI/TIA/EIA-607. Equipment racks shall be separately grounded, or, only if a separate earth ground is not available, connected to the electrical safety ground. Bonding and grounding system shall be labeled per ANSI/TIA/EIA and Langley AFB Standard Labeling Scheme.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following spares and additional materials required for facility startup:

a. 100 of each type outlet.

b. 50 of each type cover plate.

c. One (1) patch cord per patch panel port (RJ45 or Sc or ST, as respectively connected to ports) installed, to support connectivity of all installed patch panel jacks/ports, plus 25 percent spares. Patch cords must be 7 feet in length.

d. 3 sets of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.5 ADMINISTRATION AND LABELING

3.5.1 Labeling

All labeling shall be done in accordance with Langley AFB Standard Labeling Scheme provided as a technical exhibit to this specification.

3.6 COMMUNICATION CABLING INSPECTION AND TESTING

3.6.1 Inspection

3.6.1.1 The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. These shall include in-progress inspections, which shall include visual inspections of equipment condition, wiring, splicing, cabling, mounting and placement of equipment, miscellaneous hardware, and adherence to safety procedures. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

3.6.1.2 The Contractor shall make available to the Contracting Officer or authorized representative all materials to be utilized in this project for pre-installation inspection. All items shall be verified for compliance with the requirements of the specifications, drawings, and other referenced material.

3.6.1.3 Communication system installation inspections will be made by the Contracting Officer or authorized representative through performance of pre-installation, in-progress and final inspections at intervals provided below. The Contractor shall notify the Contracting Officer or authorized representative and shall also notify 1st CS/SCXI, **telephone 764-7911,** when installation has reached the below installation phases:

a. (Weekly) consists of communication closet set-up, pathways, spaces, and cable support.

b. (35 Percent) consists of communication closet set-up, pathways, spaces, cable support, cable handling and pulling techniques, adherence to industry standards, and code compliance.

c. (50 Percent) consists of cable handling and pulling techniques, adherence to industry standards, and code compliance.

d. (75 Percent) consists of termination techniques, review of testing procedures and test plan, and documentation. No 100% inspection shall be conducted until the 75% inspection has been completed for all areas and 1st CS/SCXI has reviewed and approved testing documentation.

e. (100 Percent) Acceptance Inspection consists of documentation, final testing and test data, discrepancy review, operability testing, and final acceptance. The Contracting Officer or authorized representative and 1st CS/SCXI will conduct a final inspection that encompasses all phases of the installed project, including the Operating Tests specified in paragraph 3.9. This inspection shall be conducted to verify all phases of the contract have been completed according to the specifications and that proper installation practices have been followed. This inspection shall include a review of the “as-built” drawings provided to the Contracting Officer (USAF) by the Contractor upon completion of the installation.

3.6.1.4 The Contractor shall correct any area of noncompliance of requirements that are revealed by these inspections. Following correction, a re-examination of previous non-compliant items will be conducted at the discretion of the Contracting Officer (USAF).

3.6.1.5 The Contractor shall accompany the Contracting Officer (1st Comm Squadron) on all inspections specified herein and draft notes of all discrepancies found and all other pertinent information as deemed so by the Contracting Officer (1st Comm Squadron) The Contractor shall submit reports/inspection meeting minutes for each

of the inspections performed, to the Contracting Officer, within three days of each inspection.

3.6.2 Cable Testing

3.6.2.1 Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided. The Contractor shall record and provide all test data in hard copy format to the Contracting Officer prior to final inspection. All test results shall be provided. The Contractor shall perform the cable tests for all cables specified as follows:

3.6.2.2 The Contractor shall ensure that cables will meet ANSI/TIA/EIA-568-A Commercial Building Telecommunications Cabling Standard during post installation testing.

3.6.2.3 All installed cable shall be tested end to end, determining continuity, shorts, reversed pairs, split pairs and grounds.

3.6.2.4 End to end testing is defined from the equipment end through the cross connect to the terminal end.

3.6.2.5 After testing is completed, all circuits shall be restored to their pre-test state (i.e. reconnected, re-terminated, etc.)

3.6.2.6 All installed CAT 5e cable shall be tested for attenuation loss at 100 mega hertz and results reported in dB.

3.6.2.7. All installed CAT 5e cable shall be tested in both directions (TC to outlet, outlet to TC) for near end crosstalk (NEXT) at 100 mega hertz and results reported.

3.6.2.8 All "auto-test" results obtained from the cable tester shall be supplied in both hard copy and on disk to the Contracting Officer. All of the pairs in each installed copper backbone (CMR) cable shall be tested for continuity.

3.6.2.9 All circuit terminations shall be verified for color code consistency.

3.6.2.10 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identifications and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color-coding and termination of each pair shall be verified in the communication closet and at the outlet. Horizontal wiring shall be tested from and including the

termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These tests shall be completed and all errors corrected before any other tests are started. A disk copy output of the test results with the station ID assigned shall be provided to the Contracting Officer.

3.6.2.11 Category 5e Circuits

All category 5e circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TSB 67 Standard. Testing shall use the Basic Link Test procedure of EIA TSB 67. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

3.7 GROUNDING SYSTEM

All grounds and bonds shall be tested for continuity according to EIA ANSI/TIA/EIA-607 and test results reported in hard copy format. The ground shall be labeled or tagged in accordance with EIA/TIA 606.

3.8 FIBER OPTIC CABLES

3.8.1 All fiber optic test results shall be in compliance with ANSI/TIA/EIA-568-A, Commercial Building Telecommunications Cabling Standard. For all fiber optic cables, power meter test results shall be provided to the Contracting Officer in hard copy and correspond to a labeled fiber optic cable.

3.8.2 All multi-mode fiber optic cable tests shall be performed at the 850 nm and 1300 nm windows in both directions. All fiber optic cables shall be tested on the reels prior to installation.

3.8.3 All connectors shall be tested and the loss measured in dB; connectors shall have a loss limit that complies with ANSI/TIA/EIA-568-A, Commercial Telecommunications Cabling Standard.

3.8.4 All fiber optic links shall be tested with a power meter and the loss measured in dB/KM. A copy of the test results shall be provided by the Contractor to the Contracting Officer (USAF) for each fiber, tested in both directions at bandwidths specified in paragraph 2.3.1 above. All test results shall be documented.

3.9 OPERATING TEST

3.9.1 After installation is complete, in addition to any other required testing, the Contractor shall conduct an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be promptly corrected and the tests re-conducted.

3.9.2 Operational Testing shall include, but shall not be limited to, the following for the following circuit types:

a. Station Cable – Color code compliance, labeling, correct pin termination at outlet location, routing, workmanship, NEXT, and attenuation.

b. Backbone Cable (CMR) – Color code compliance, labeling, computer room and distribution closet jumpers, patch cords, grounding/bonding, workmanship, termination block layout and installation, and routing.

c. Fiber Optic Cable – Labeling, patch panel connections, loss measured in Db/km, workmanship, and routing.

3.10 ADDITIONAL TESTING

3.10.1 The Contracting Officer or his authorized representative may, at his discretion, perform tests in addition to those specified in this document, if there is any reason to question the condition of the material as furnished and installed.

SEE THE FOLLOWING APPENDIX A ATTACHED AT THE END OF THIS SECTION FOR ADDITIONAL REQUIREMENTS.

--End of Section --

SECTION 16751

CLOSED CIRCUIT TELEVISION SYSTEM (EACH SYSTEM)
08/00

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 basic designation only.

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

47 CFR 15	Radio Frequency Devices

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 170	(1957) Electrical Performance Standards - Monochrome Television Studio Facilities
EIA ANSI/EIA/TIA-232-F	(1997) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
EIA ANSI/EIA-310-D	(1992) Cabinets, Racks, Panels, and Associated Equipment
EIA ANSI/EIA-375-A-1976	(1974) Electrical Performance Standards for Direct View Monochrome Closed Circuit Television Monitors 525/60 Interlaced 2:1

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 142	(1991) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 SYSTEM DESCRIPTION

1.2.1 General

There are multiple closed circuit television system required for this project, that monitor specific areas, but are also interconnected and remotely monitored at the main security room (ECP) at the main entrance to the facility. The Contractor shall configure the system as described and shown. All television equipment shall conform to EIA 170 specifications. The system shall include all equipment,consoles, controls, monitors, switching, recording, connectors, adapters, terminators, etc., necessary to interconnect all equipment and for a complete installation. The Contractor shall also supply all cabling necessary to interconnect the closed circuit television (CCTV) equipment installed in the Security Center, and interconnect equipment installed at remote control/monitoring stations. If the CCTV system is installed for use with an Electronic Security System (ESS), or required to be interconnected to the ESS, the Contractor shall interface the CCTV system with the ESS.

1.2.2 System Overall Reliability Requirement

The system, including all components and appurtenances, shall be configured and installed to yield a mean time between failure (MTBF) of at least 10,000 hours, and shall be calculated based on the configuration specified in paragraph "System Overall Reliability Calculations."

1.2.3 Power Line Surge Protection

All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

1.2.4 Video and Sync Signal Transmission Line Surge Protection

All cable, except fiber optic cable, used for sync or video signal transmission shall include protective devices to safeguard the CCTV equipment against surges. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. The surge suppression device shall be capable of dissipating not less than 1500 watts for 1 millisecond, and the response time from zero volts to clamping shall not be greater than 5 nanoseconds. Fuses shall not be used for surge protection.

1.2.5 Control Line Surge Protection

All cables and conductors, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against surges and shall have surge protection installed at each end. Protection shall be furnished at the equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.2.6 Power Line Conditioners

A power line conditioner shall be furnished for the security console CCTV equipment. The power line conditioner used for the CCTV equipment shall be the same one as provided for Section 13720 ELECTRONIC SECURITY SYSTEM. The power line conditioner shall be of the ferroresonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The power line conditioner shall be sized for 125 percent of the actual connected kVA load. Characteristics of the power line conditioner shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus 1 percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

1.2.7 Video and Control Signal Data Transmission Media

The Contractor shall provide a video and data and control signal transmission system.

1.2.8 Environmental Conditions

1.2.8.1 Field Equipment

The cameras and all other field equipment shall be rated for continuous operation under ambient environmental conditions of 14 degrees to 120 degrees F using no auxiliary heating or cooling equipment. Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, wind loading, ice loading, and vibration conditions specified or encountered for the installed location.

1.2.8.2 Security Center Equipment

Security Center and remote control/monitoring station equipment shall, unless designated otherwise, be rated for continuous operation under ambient environmental conditions of 60 degrees F to 85 degrees F and a relative humidity of 20 to 80 percent.

1.2.9 Electrical Requirements

Electrically powered equipment shall operate on 240 volt 50 Hz AC source. Equipment shall be able to tolerate variations in the voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

1.2.10 Uninterruptible Power Supply

All electrical and electronic equipment in the console shall be powered from an UPS. The UPS shall be sized to provide at least 6 hours battery back-up in the event of primary failure. Batteries shall be sealed non-outgassing type.

1.3 DELIVERY OF TECHNICAL DATA AND COMPUTER SOFTWARE

All items of computer software and technical data (including technical data which relates to computer software), which are specifically identified in this specification shall be delivered strictly in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS, Section 01330 SUBMITTAL PROCEDURES, and in accordance with the Contract Data Requirements List (CDRL), DD Form 1423, which is attached to and thereby made a part of this contract. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. If the CCTV system is being installed in conjunction with an ESS, the CCTV Technical Data Packages shall be submitted as part of the Technical Data Packages for Section 13720 ELECTRONIC SECURITY SYSTEM.

1.3.1 Group I Technical Data Package

1.3.1.1 System Drawings

The data package shall include the following:

a. System block diagram.

b. CCTV system console installation, block diagrams, and wiring diagrams.

c. Security center CCTV equipment installation, interconnection with console equipment, block diagrams and wiring diagrams.

d. Remote control/monitoring station installation, interconnection to security center including block diagrams and wiring diagrams.

e. Camera wiring and installation drawings.

f. Pan/tilt mount wiring and installation drawings.

g. Interconnection with video signal transmission system, block diagrams and wiring diagrams.

h. Surge protection device installation.

i. Details of interconnection with ESS.

1.3.1.2 Manufacturers' Data

The data package shall include manufacturers' data for all materials and equipment and security center equipment provided under this specification.

1.3.1.3 System Description and Analyses

The data package shall include complete system descriptions, analyses and calculations used in sizing the equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance of this specification. The data package shall include the following:

a. Switcher matrix size.

b. Camera call-up response time.

c. System start up and shutdown operations.

d. Switcher programming instructions.

e. Switcher operating and maintenance instructions.

f. Manuals for CCTV equipment.

g. Data entry forms.

1.3.1.4 Software Data

The data package shall consist of descriptions of the operation and capability of system and application software as specified.

1.3.1.5 Overall System Reliability Calculations

The data package shall include all manufacturer's reliability data and calculations required to show compliance with the specified reliability. The calculations shall be based on all CCTV equipment associated with one camera circuit and the console CCTV equipment, excluding the data transmission media (DTM).

1.3.1.6 Certifications

All specified manufacturer's certifications shall be included with the data package.

1.3.1.7 Key Control Plan

The Contractor shall provide a key control plan as specified in Section 13720 ELECTRONIC SECURITY SYSTEM.

1.3.2 Group II Technical Data Package

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall submit a report to the Government documenting changes to the site, or conditions that affect performance of the system to be installed. For those changes or conditions which affect system installation or performance, provide (with the report) specification sheets, or written functional requirements to support the findings, and a cost estimate to correct the deficiency. The Contractor shall not correct any deficiency without written permission from the Government.

1.3.3 Group III Technical Data Package

The Contractor shall prepare test procedures and reports for the predelivery test. The Contractor shall deliver the predelivery test procedures to the Government for approval. After receipt by the Contractor of written approval of the predelivery test procedures, the Contractor may schedule the predelivery test. The final predelivery test report shall be delivered after completion of the predelivery test.

1.3.4 Group IV Technical Data Package

The Contractor shall prepare test procedures and reports for the performance verification test and the endurance test. The Contractor shall deliver the performance verification test and endurance test procedures to

the Government for approval. After receipt by the Contractor of written approval of the test procedures, the Contractor may schedule the tests. The contractor shall provide a report detailing the results of the field test and a video tape as specified in paragraph "Contractor's Field Testing." The final performance verification and endurance test report shall be delivered after completion of the tests.

1.3.4.1 Operation and Maintenance Manuals

A draft copy of the operation and maintenance manuals, as specified for the Group V technical data package, shall be delivered to the Government prior to beginning the performance verification test for use during site testing.

1.3.4.2 Training Documentation

Lesson plans and training manuals for the training phases, including type of training to be provided with a sample training report, and a list of reference material, shall be delivered for approval.

1.3.4.3 Data Entry

The Contractor shall enter all data needed to make the system operational. The Contractor shall deliver the data to the Government on data entry forms, utilizing data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession required for complete installation of the data base. The Contractor shall identify and request from the Government, any additional data needed to provide a complete and operational CCTV system. The completed forms shall be delivered to the Government for review and approval at least 90 days prior to the Contractor's scheduled need date.

1.3.4.4 Graphics

Where graphics are required and are to be delivered with the system, the Contractor shall create and install all graphics needed to make the system operational. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 8 by 10 inches in size, of each type of graphic to be used for the completed CCTV system. If the video switcher does not use a monitor for display of system information, the Contractor shall provide examples of the video annotation used for camera identification. The graphics examples shall be delivered to the Government for review and approval at least 90 days prior to the Contractor's scheduled need date.

1.3.5 Group V Technical Data Package

Final copies of each of the manufacturer's commercial manuals arranged as specified bound in hardback, loose-leaf binders, shall be delivered to the Government within 30 days after completing the endurance test. The draft copy used during site testing shall be updated prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. The number of copies of each manual to be delivered shall

be as specified on DD Form 1423.

1.3.5.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes.

1.3.5.2 Hardware Manual

A manual shall describe all equipment furnished, including:

a. General hardware description and specifications.

b. Installation and checkout procedures.

c. Equipment electrical schematics and layout drawings.

d. System schematics and wiring lists.

e. System setup procedures.

f. Manufacturer's repair parts list indicating sources of supply.

g. Interface definition.

1.3.5.3 Software Manual

The software manual shall describe the functions of all software, and shall include all other information necessary to enable proper loading, testing and operation, including:

a. Definitions of terms and functions.

b. Procedures for system boot-up.

c. Description of using the programs.

d. Description of required operational sequences.

e. Directory of all disk files.

f. Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer.

1.3.5.4 Operator's Manual

The operator's manual shall explain all procedures and instructions for operation of the system including:

a. Video switcher.

b. Video multiplexer.

c. Cameras and video recording equipment.

d. Use of the software.

e. Operator commands.

f. System start-up and shut-down procedures.

g. Recovery and restart procedures.

1.3.5.5 Maintenance Manual

The maintenance manual shall describe maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.3.5.6 As-Built Drawings

The Contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the CCTV system to be used for as-built drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the CCTV system and shall be delivered to the Government with the final endurance test report. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the final system drawings, a representative of the Government will review the final system work with the Contractor. If the final system work is not complete, the Contractor will be so advised and shall complete the work as required. Final drawings submitted with the endurance test report shall be finished drawings on mylar or vellum, and as AutoCAD or Microstation files on CD-ROM.

1.4 TESTING

1.4.1 General

The Contractor shall perform predelivery testing, site testing, and adjustment of the completed CCTV system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test, and in no case shall notice be given until after the Contractor has received written approval of the specific test procedures.

1.4.2 Test Procedures and Reports

Test procedures shall explain, in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

1.5 TRAINING

1.5.1 General

The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the CCTV system as specified. If the CCTV system is being installed in conjunction with an ESS, the CCTV training shall be concurrent and part of the ESS training. The training shall be oriented to the specific system being installed under this contract. Training manuals shall be delivered for each trainee with two additional

manuals delivered for archiving at the project site. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The Contractor is responsible for furnishing all audio-visual equipment and all other training materials and supplies. Where the Contractor presents portions of the course through the use of audio-visual material, copies of the audio-visual materials shall be delivered to the Government, either as a part of the printed training manuals or on the same media as that used during the training sessions. A training day is 8 hours of instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the facility. For guidance in planning the required instruction, the Contractor should assume the attendees will have a high school education or equivalent. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

1.5.2 Operator's Training

The course shall be taught at the project site for two consecutive training days during or after the Contractor's field testing. A maximum of 12 personnel will attend the course. No part of the training given during this course will be counted toward completion of the performance verification test. The course shall consist of classroom instruction, hands-on training, instruction on the specific hardware configuration of the installed system, and specific instructions for operating the installed system. The course shall demonstrate system start up, system operation, system shutdown, system recovery after a failure, the specific hardware configuration, and operation of the system and its software. The students should have no unanswered questions regarding operation of the installed CCTV system. The Contractor shall prepare and insert additional training material in the training manuals when the need for additional material becomes apparent during instruction. The Contractor shall prepare a written report after the completion of the course. The Contractor shall list in the report the times, dates, attendees and material covered at each training session. The Contractor shall describe the skill level of each student at the end of this course. The Contractor shall submit the report before the end of the performance verification test. The course shall include:

a. General CCTV hardware, installed system architecture and configuration.

b. Functional operation of the installed system and software.

c. Operator commands.

d. Alarm interfaces.

e. Alarm reporting.

f. Fault diagnostics and correction.

g. General system maintenance.

h. Replacement of failed components and integration of replacement components into the operating CCTV system.

1.6 MAINTENANCE AND SERVICE

1.6.1 General Requirements

The Contractor shall provide all services required and equipment necessary to maintain the entire CCTV system in an operational state as specified for a period of 1 year after completion of the endurance test, and shall provide all necessary material required for the work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other unscheduled work.

1.6.2 Description of Work

The adjustment and repair of the CCTV system includes all computer equipment, software updates, signal transmission equipment, and video equipment. Provide the manufacturer's required adjustments and all other work necessary.

1.6.3 Personnel

Service personnel shall be qualified to accomplish all work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

1.6.4 Schedule of Work

The Contractor shall perform two inspections at 6-month intervals or less. This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays. These inspections shall include:

a. Visual checks and operational tests of the CPU, switcher, peripheral equipment, interface panels, recording devices, monitors, video equipment electrical and mechanical controls, and a check of the picture quality from each camera.

b. Run system software and correct all diagnosed problems.

c. Resolve any previous outstanding problems.

1.6.5 Emergency Service

The Government will initiate service calls when the CCTV system is not functioning properly. Qualified personnel shall be available to provide service to the complete CCTV system. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within 24 hours after receiving a request for service. The CCTV system shall be restored to proper operating condition within 3 calendar days after receiving a request for service.

1.6.6 Operation

Performance of scheduled adjustments and repair shall verify operation of the CCTV system as demonstrated by the applicable portions of the performance verification test.

1.6.7 Records and Logs

The Contractor shall keep records and logs of each task, and shall organize cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices.

The log shall contain calibration, repair, and programming data. Complete logs shall be kept and shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the CCTV system.

1.6.8 Work Requests

The Contractor shall separately record each service call request, as received. The form shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within 5 days after work is completed.

1.6.9 System Modifications

The Contractor shall make any recommendations for system modification in writing to the Government. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to the systems shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.6.10 Software

The Contractor shall recommend all software updates to the Government for approval. Upon Government approval, updates shall be accomplished in a timely manner, fully coordinated with the CCTV system operators, operation in the system verified, and shall be incorporated into the operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the manufacturer's software.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

All system hardware and software components shall be produced by manufacturers regularly engaged in the production of CCTV equipment. Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Equipment located at the security center or a remote control/monitoring station shall be rack mounted as shown. Both Television and Computing devices shall comply with 47 CFR 15, Subpart B.

2.1.1 Soldering

All soldering shall be done in accordance with standard industry practices.

2.2 ENCLOSURES

The Contractor shall provide metallic enclosures as needed for equipment not housed in cabinets, consoles or supplied with a housing. The enclosures shall be as specified or shown.

2.2.1 Interior

Enclosures to house equipment in an interior environment shall meet the requirements of NEMA 250 Type 12.

2.2.2 Exposed-to-Weather

Enclosures to house equipment in an outdoor environment shall meet the requirements of NEMA 250 Type 4X.

2.2.3 Corrosion-Resistant

Enclosures to house equipment in a corrosive environment shall meet the requirements of NEMA 250 Type 4X.

2.2.4 Consoles

All system components except cameras shall be mounted in floor mounted consoles as indicated.

2.3 TAMPER PROVISIONS

Enclosures, cabinets, housings (other than environmental camera housings), boxes, raceways, conduits, and fittings of every description having hinged doors or removable covers, and which contain any part of the CCTV equipment or power supplies, shall be provided with cover operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. The enclosure and the tamper switch shall function together to not allow direct line of sight to any internal components and tampering with the switch or the circuits before the switch activates. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware concealed so that the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating; shall be spring-loaded and held in the closed position by the door cover; and shall be wired so that they break the circuit when the door or cover is disturbed. Tamper switches on the doors which must be opened to make routine maintenance adjustments to the system and to service the power supplies shall be push/pull-set, automatic reset type.

2.3.1 Enclosure Covers

Covers of pull and junction boxes provided to facilitate installation of the system need not be provided with tamper switches if they contain no splices or connections, but shall be protected by tack welding or brazing the covers in place. Zinc labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate that the box is part of the security system.

2.3.2 Conduit-Enclosure Connections

All conduit-enclosure connections shall be protected by tack welding or brazing the conduit to the enclosure. Tack welding or brazing shall be done in addition to standard conduit-enclosure connection methods as described in NFPA 70.

2.4 LOCKS AND KEY-LOCK OPERATED SWITCHES

2.4.1 Locks

Locks shall be provided on system enclosures for maintenance purposes shall be UL listed, round-key type, with three dual, one mushroom, and three plain pin tumblers. Keys shall be stamped "U.S. GOVT. DO NOT DUP." The locks shall be so arranged that the key can only be withdrawn when in the locked position. All maintenance locks shall be keyed alike and only two keys shall be furnished for all of these locks.

2.4.2 Key-Lock-Operated Switches

All key-lock-operated switches required to be installed on system components shall be UL listed, with three dual, one mushroom, and three plain pin tumblers, or conventional key type lock having a combination of five cylinder pin and five-point three position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." Key-lock-operated switches shall be two position, with the key removable in either position. All key-lock-operated switches shall be keyed differently and only two keys shall be furnished for each key-lock-operated-switch.

2.5 SYSTEM INTEGRATION

The CCTV system shall be interfaced to the ESS and shall provide automatic, alarm actuated call-up of the camera associated with the alarm zone. Equipment shall be supplied with all adapters, terminators, cables, main frames, card cages, power supplies, rack mounts, and appurtenances as needed.

2.6 SOLID STATE CAMERAS

2.6.1 High Resolution Color Camera

All electronic components and circuits shall be solid state. Signal-to-noise ratio shall not be less than 50 dB unweighted. The camera shall exhibit no geometric distortion. The lens mount shall be a C-mount, and the camera shall have a back focus adjustment. The camera shall operate from 14 to 131 degrees F without auxiliary heating or cooling, and with no change in picture quality or resolution. The camera shall operate on 50 Hz AC power, and shall be capable of operating at a voltage of 24 Volts. Provide with remote pan, tilt and zoom feature.

2.6.1.1 Solid State Image Array

The camera shall have a solid state imaging array, and the picture produced by the camera shall be free of blemishes as defined by EIA 330. The camera shall provide not less than 460 lines of horizontal resolution, and resolution shall not vary over the life of the camera. The imager shall have at least 768 horizontal x 494 vertical active picture elements.

2.6.1.2 Sensitivity

Camera shall provide full video output with the infrared cut-off filter installed, without camera automatic gain, and a scene reflectivity of 75 percent using an f/1.2 lens given a camera faceplate illumination at 3200K of 0.2 footcandle minimum.

2.6.1.3 Camera Synchronization

The camera shall have an input for external sync, and shall automatically switch over to internal sync if external sync is not present. The camera shall also have the capability of synchronization by line-locking to the AC power line frequency at the zero crossing point, and shall provide not less than plus or minus 90 degrees of vertical phase adjustment.

2.6.1.4 Connectors

Cameras with lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors and wiring as needed to operate the lens functions. Video signal output connector shall be a BNC. Cameras with integral fiber optic video transmitters shall have straight-tip bayonet type fiber optic video output connectors. A connector shall be provided for external sync input.

2.6.1.5 Automatic Circuits

The camera shall have circuitry for through the lens (TTL) white balancing, fixed white balancing, and automatic gain control.

2.6.2 Dome Cameras

2.6.2.1 Interior Dome Camera System

An interior dome camera system shall be provided with integral camera installed and integrated into the dome housing. The camera shall meet the requirements of Paragraph: High Resolution Color Camera as specified. The dome housing shall be nominally 6 inches and shall be furnished in a pendant mount or ceiling mount as shown. The lower dome shall be tinted acrylic and shall have a light attenuation factor of not more that 1 f-stop. The housing shall be equipped with integral pan/tilt complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt dome. The pan/tilt shall have heavy duty bearings and hardened steel gears. The pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360 degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second. There shall not be less than 64 preset positions, with positioning speeds of at least 360 degrees per second in the automatic mode, and not less than 120 degrees pre second in the manual positioning mode, with a positioning accuracy of plus or minus 1/2 degree. Each set of preset position data shall include auto focus, auto iris, pan, tilt, and zoom functions. The system shall be able to automatically scan between any two electronically-set limits, and shall be able to operate in the "tour" mode covering up to all presets in a user defined sequence. The dome system shall withstand temperature ranges from minus 22 to 122 degrees F over a humidity range of 0 to 90 percent, non-condensing.

2.6.2.2 Exterior Dome Camera System

An exterior dome camera system shall be provided with integral camera installed and integrated into the dome housing. The camera shall have a minimum horizontal resolution of 425 lines (color) or 500 lines (monochrome). The dome housing shall be nominally 6 inches and shall be furnished in a NEMA 4 pendant mount, pole mount, ceiling mount, surface

mount, or corner mount as shown. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be equipped with supplementary camera mounting blocks or supports as needed to position the specified camera and lens to maintain the proper optical centerline. All electrical and signal connections required for operation of the camera and lens shall be supplied. The housing shall protect the internal drives, positioners, and camera from the environment encountered for camera operation. The lower dome shall be tinted acrylic and shall have a light attenuation factor of not more that 1 f-stop. An integral heater, sized to maintain the lower dome above the dew point, shall be part of the camera system. The housing shall be equipped with integral pan/tilt complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt dome. The pan/tilt shall have heavy duty bearings and hardened steel gears. The pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360 degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second. There shall not be less than 99 preset positions, with positioning speeds of at least 360 degrees per second in the automatic mode, and not less than 120 degrees pre second in the manual positioning mode, with a positioning accuracy of plus or minus 1/2 degree. Each set of preset position data shall include auto focus, auto iris, pan, tilt, and zoom functions. The system shall be able to automatically scan between any two electronically-set limits, and shall be able to operate in the "tour" mode covering up to all presets in a user defined sequence. The dome system shall withstand temperature ranges from minus 40 to 122 degrees F over a humidity range of 0 to 90 percent, non-condensing. Provide with remote pan, tilit and zoom feature.

2.7 CAMERA LENSES

Camera lenses shall be all glass with coated optics. The lens mount shall be a C or CS mount, compatible with the cameras selected. The lens shall be supplied with the camera, and shall have a maximum f-stop opening of f/1.2 or the maximum available for the focal length specified. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lens focal lengths shall be as shown or specified in the manufacturer's lens selection tables. Provide with remote zoom feature.

2.8 CAMERA HOUSINGS AND MOUNTS

The camera and lens shall be enclosed in a tamper resistant housing as specified below. Any ancillary housing mounting hardware needed to install the housing at the camera location shall be provided as part of the housing. The camera and lens contained in a camera housing shall be installed on a camera support. Any ancillary mounting hardware needed to install the support and to install the camera on the support shall be provided as part of the support. The camera support shall be capable of supporting the equipment to be mounted on it including wind and ice loading normally encountered at the site.

2.8.1 Environmentally Sealed Camera Housing

The housing shall be designed to provide a condensation free environment for camera operation. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be purged of atmospheric air and pressurized with dry nitrogen, shall be equipped with a fill valve, overpressure valve, and shall have a humidity indicator visible from the exterior. Housing shall not have a leak rate greater than 2 pounds per square inch at sea level within a 90 day period. The housing shall be equipped with supplementary camera mounting blocks or supports as needed to position the specified camera and lens to maintain the proper optical centerline. All electrical and signal connections required for operation of the camera and lens shall be supplied. The housing shall provide the environment needed for camera operation, and shall keep the viewing window free of fog, snow, and ice. The housing shall be equipped with a sunshield, and both the housing and the sunshield shall be white. A mounting bracket which can be adjusted to center the weight of the housing and camera assembly shall be provided as part of the housing.

2.8.2 Interior Dome Housing

An interior dome housing shall be provided for each camera as shown. The dome housing shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mount as shown. The lower dome shall be black opaque acrylic and shall have a light attenuation factor of not more that 1 f-stop. The housing shall be equipped with integral pan/tilt/zoom complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt dome. The pan/tilt/zoom shall have heavy duty bearings and hardened steel gears. The pan/tilt/zoom shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360 degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second.

2.8.3 Exterior Dome Housing

An exterior dome housing shall be provided for each camera. The dome housing shall be a pendant mount, ceiling mount, surface mount, or corner mount as shown. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be purged of atmospheric air and pressurized with dry nitrogen, shall be equipped with a fill valve and overpressure valve, and shall have a pressure indicator visible from the exterior. The housing shall be equipped with supplementary camera mounting blocks or supports as needed to position the specified camera and lens to maintain the proper optical centerline. All electrical and signal connections required for operation of the camera and lens shall be supplied. The housing shall provide the environment needed for camera operation The lower dome shall be black opaque acrylic and shall have a light attenuation factor of not more that 1 f-stop. The housing shall be equipped with integral pan/tilt complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt dome. The pan/tilt shall have heavy duty bearings and hardened steel gears. The pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360

degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second.

2.8.4 Exterior Wall Mount

Where an exterior camera is wall mounted, the exterior camera wall mount shall be 16 inches long, and shall have an adjustable head for mounting the camera. The wall mount and head shall be constructed of aluminum, stainless steel, or steel with a corrosion-resistant finish. The head shall be adjustable for not less than plus and minus 90 degrees of pan, and not less than plus and minus 45 degrees of tilt. If the bracket is to be used in conjunction with a pan/tilt, the bracket shall be supplied without the adjustable mounting head, and shall have a bolt hole pattern to match the pan/tilt base.

2.8.5 Pan/Tilt Mount

The pan/tilt mount shall be capable of supporting the camera, lens and housing specified. If the pan/tilt is to be mounted outdoors, the pan/tilt shall be weatherproof, and sized to accommodate the camera, lens and housing weight plus maximum wind loading encountered at the installation site. The pan/tilt shall have heavy duty bearings, hardened steel gears, externally adjustable limit stops for pan and tilt, and mechanical, dynamic or friction brakes. Pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall not be less than 0 to 350 degrees, tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 6 degrees per second, and tilt speed shall not be less than 3 degrees per second. The pan/tilt shall be supplied complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt mount to fulfill the site design requirements.

2.9 VIDEO MONITOR

2.9.1 Color Video Monitor

All electronic components and circuits shall be solid state except for the picture tube. The monitor shall have a stabilized high voltage power supply, and regulated low voltage power supplies. The monitor shall have automatic frequency control (AFC) and horizontal resolution not less than 280 lines at the center of the picture tube. The video input shall allow switchable loop-through or 75 ohm termination. The monitor shall have circuitry for automatic degaussing. The monitor shall operate on 50 Hz AC power, and shall be capable of operating at a voltage of 105 to 130 Volts.

2.9.2 Picture Tube

The monitor shall have a picture tube dimension as indicated, measured diagonally.

2.9.3 Configuration

The monitor shall be configured in a console mount. The mount shall fit in a standard EIA 19 inch rack as described in EIA ANSI/EIA-310-D. Monitors shall not interfere with each other when console mounted or operated next to each other as described in EIA ANSI/EIA-375-A-1976.

2.9.4 Controls

Front panel controls shall be provided for power on/off, horizontal hold, vertical hold, contrast, and brightness. The monitor shall have switchable DC restoration.

2.9.5 Connectors for Video Monitor

Video signal input and output shall be by BNC connectors.

2.10 VIDEO SWITCHER

The switcher shall conform to EIA 170 specifications, and shall be a vertical interval switcher. Electronic components, subassemblies, and circuits of the switcher shall be solid state. The switcher shall be microprocessor based and software programmable. The switcher shall be a modular system that shall allow for expansion or modification of inputs, outputs, alarm interfaces, and secondary control stations by addition of the appropriate modules. Switcher components shall operate on 240 volts 50 Hz AC power. The switcher central processor unit shall be capable of being interfaced to a master security computer for integrated operation and control. The video switcher central processing unit (CPU) shall have the capability of accepting time from a master clock supplied in ASCII format through an EIA ANSI/EIA/TIA-232-F input. All components, modules, cables, power supplies, software, and other items needed for a complete and operable CCTV switching system shall be provided. Switcher equipment shall be rack mounted unless otherwise specified. Rack mount hardware shall be supplied to mount the switcher components in a standard 19 inch rack as described in EIA ANSI/EIA-310-D.

2.10.1 Switcher Software

The switcher shall be software programmable, and the software shall be supplied as part of the switcher. The software shall be installed in the switcher CPU, and shall be configured as required by the site design. Changes or alterations of features under software control shall be accomplished through software programming without changes in hardware or system configuration. The switcher shall retain the current program for at least 6 hours in the event of power loss, and shall not require reprogramming in order to restart the system.

2.10.2 Switcher Matrix

The switcher shall be a programmable crosspoint switcher capable of switching any video input to any video output. The switcher to be installed at the site shall be configured to switch all cameras to two or more monitors, and shall have an expansion capability of not less than 10 percent.

2.10.3 Switcher Modular Expansion

The switcher shall be expandable in minimum increments as specified below.

2.10.3.1 Input Module

Hardware expansion modules shall be provided to expand the switcher matrix configuration in increments of at least 8 camera inputs.

2.10.3.2 Output Module

Hardware expansion modules shall be provided to expand the switcher matrix configuration in increments of at least 4 video outputs.

2.10.4 Alarm Interface

An alarm interface shall be furnished with the switcher. The interface shall be compatible with the ESS alarm annunciation system. The alarm interface shall monitor alarm closures for processing by the switcher CPU. Alarm inputs to the alarm interface shall be relay contact or through an EIA ANSI/EIA/TIA-232-F interface. The alarm interface shall be modular and shall allow for system expansion. The alarm interface to be installed at the site shall be configured to handle 10 alarm points, and shall have an expansion capability of not less than 10percent. An output shall be provided to actuate a video recorder.

2.10.5 Switcher Response Time and Alarm Processing

The switcher response time shall not be greater than 200 milliseconds from the time the alarm is sensed at the switcher alarm interface, until the picture is displayed on the monitor. The switcher shall continue to process subsequent alarms and shall put them in a queue. The operator shall be able to view the alarms in queue by operating an alarm release function which switches the subsequent alarms to the monitor in the order of occurrence.

2.10.6 Control Keyboards

Control and programming keyboards shall be supplied for the video switcher at the security center, and control keyboards shall be supplied for any control/monitoring stations as shown. The control keyboard shall provide the interface between the operator and the CCTV system, and shall relay commands from the operator to the switcher CPU. The keyboard shall provide control of the video switcher functions needed for operation and programming of the video switcher. Controls shall include, but not be limited to: programming the switcher, switcher control, lens function control, pan/tilt/zoom (PTZ) control, control of environmental housing accessories, and annotation programming. If the switcher CPU requires an additional text keyboard for system management functions, the keyboard shall be supplied as part of the video switcher.

2.10.7 Accessory Control Equipment

The video switcher shall be equipped with signal distribution units, preposition cards, expansion units, cables, software or any other equipment needed to ensure that the CCTV system is complete and fully operational.

2.10.8 Connectors for Video Switcher

Video signal input and output shall be by BNC connectors.

2.10.9 Video Annotation

Video annotation equipment shall be provided for the video switcher. The annotation shall be alphanumeric and programmable for each video source. Annotation to be generated shall include, but not be limited to: individual video source identification number, time (hour, minute, second) in a 24 hour format, date (month, day, year), and a unique, user-defined title with

at least 8 characters. The annotation shall be inserted onto the source video so that both shall appear on a monitor or recording. The lines of annotation shall be movable for horizontal and vertical placement on the video picture. The annotation shall be automatically adjusted for date. Programmed annotation information shall be retained in memory for at least 4 hours in the event of power loss.

2.11 VIDEO MULTIPLEXER

The video multiplexer shall be a multi-channel record and playback system with the capability of monochrome and color real time multi-screen viewing. Electronic components, sub assemblies, and circuits of the multiplexer shall be solid state. The multiplexer, using time division multiplexing, shall permit up to 16 camera inputs to be recorded simultaneously on a single video cassette recorder (VCR)and digital recording. All 16 camera inputs shall be capable of being viewed on a video monitor either live or recorded. The multiplexer shall allow for viewing of either live video or input from the VCR (Simplex Operation) The multiplexer shall allow for simultaneous viewing, recording playback, and multiplexing (Duplex Operation). The inputs shall be capable of simultaneous viewing on the monitor or full screen individually and in other multi-screen modes such as 2x2, 3x3, 4x4 or other configurations. The viewing format shall also permit 2x dynamic zoom capability, full screen. The multiplexer shall be compatible with EIA/NTSC video cameras and standard or super VHS VCRs. External camera synchronization shall not be required for proper operation of the video multiplexer. Control of all functions of the multiplexer shall be provided either by a full function keyboard or by pushbutton selection with on-screen menu driven set-up. The multiplexer shall retain the current program for at east 6 hours in the event of power loss.

2.12 Digital Recorder

The digital recorder shall provide live viewing, and playback of recorded video for periods of up to a minimum of one week. Perform all viewing, playback, and video storage functions simultaneously. recorders shall be capable of rack-mounting or standard desktop mounting. The digital controls shall be completely compatible with the CCTV controller and CCTV equipment. The recorder shall be configured to record video continuously, only during alarm events, or only while activity is present. Recorder shall permit simple search and retrieval of video data, for viewing and downloading to store on an exterior media such as compact disc or magnetic tape. User-defined parameters shall allow searches based on the time and date the video was captured, whether alarm or motion events occurred, and which camera captured the video. Provide full video storage management, hardware control, alarm configuration, and export of video and individual frames. Digital controls and software shall be capable of viewing live video or recorded video over standard network or modem connections and to fast view the archived video prior to editing and downloading original quality movie files. Recorder shall capture, digitize, compress, and store full-motion video from up to eight video inputs onto internal hard drives. Provide all required fully licensed software for maintenance, programming and servicing, to the Government.

2.12.1 Frame Rates, Compression, and Video Format

Recorder shall capture video at a minimum of 12 fields per second NTSC (10 PAL) when multiple cameras are connected. The rate of image capture and the size of individual images shall be capable of being controlled.

2.12.2 Disk storage

Recorder shall store video in segments on its internal hard drive. Provide a minimum of 40 GB hard drive. The system shall be capable for the user to configure newly captured video to automatically begin replacing the oldest video stored on the disk when the disk's capacity is reached.

2.12.3 Recording Options

System shall be capable of recording in four modes: Optional motion mode (records activity only); Alarm mode (records alarm events only); Both mode (records activity and alarm events only); and normal mode (records continually).

2.12.4 Video Information

System shall record information about the time, date, and source of all video for easy search and retrieval. The status of all alarm inputs is recorded with each stored image.

2.12.5 Live Video Display

Live video shall be viewed in 2x2 and 3x3 modes during recording.

2.12.6 Video review, search, interface and retrieval

System shall be capable of searches based on a time frame, one or more video sources, and types of events (motion, alarm, normal etc.). Search results shall be listed with the following information: source camera; time and date captured; whether motion or alarm events occurred; number of frames in the segment; and location. Results shall be displayed as a database and can be reviewed as oldest first and by all or specific cameras. Search results shall be played back with full VCR type control (play, fast forward, rewind, pause, step forward, and so on). Individual images shall be capable of being exported to other disks in standard Windows image file formats.

2.12.7 Administrator and other applications

Provide full control of video viewing, alarm configuration, scheduling, search and playback, hardware setup, and user administration. The main viewing and/or screen shall include indicators for the current date and time, the recording status of each camera input, disk usage, and the amount of recording time available at the current hardware settings. The user interface shall control the contrast, brightness, sharpness, hue, and saturation of video. Live and view modes can be programmed separately. Provide scheduling of all cameras to record in the same mode for 24 hours a day. Images shall be captured at sizes from 7KB to 40KB.

2.13 VIDEO CASSETTE RECORDER (VCR) (Backup to Digital Recorder)

VCR shall conform to EIA 170 standards. The VCR shall be specifically designed as a time lapse recorder for use in security systems. The VCR shall operate on 240 volts 50 Hz AC power. Resolution of the VCR in normal play mode shall not be less than 350 horizontal lines in monochrome, 300 horizontal lines in color. Signal-to-noise ratio shall not be less than 40 dB. The VCR shall have a condensation or dew circuit. The VCR shall have a built-in time and date generator that can be turned on or off, and shall

impose the time and date on the video during recording. A 24 hour battery back-up shall be provided to protect time/date and programmed information. The VCR shall have an audible warning alarm that shall annunciate the end of tape, excessive condensation, tape transport malfunction, or tape jam.

2.13.1 Tape and Tape Transport

The video tape used in the recorder shall be contained in a cassette mechanism, and shall not require the operator to thread the tape through the tape transport mechanism. The tape shall load through the front of the recorder.

2.13.2 Recording and Playback

The VCR shall be capable of recording for 168 hours or more on a single cassette tape with at least 6 user selectable time-lapse record speeds. The VCR shall have a contact closure alarm signal input which shall automatically switch the recorder into standard play, record mode when an alarm is initiated. The recorder shall reach stabilized record speed in 1 second or less. The VCR shall put a cue mark on the tape at the beginning of an alarm event recording. The alarm event record time shall be selectable for up to 3 minutes of automatic recording as a minimum. A record-lock feature shall be provided which shall protect the VCR against tampering with the tape transport controls and power control once recording has started. Playback functions shall include: alarm search, fast forward search, fast rewind search, rewind/fast forward, play, slow motion or step field/frame, and pause/still.

2.13.3 Connectors for VCR

Video signal input and output shall be by BNC connectors. The recorder shall provide connectors for alarm trigger signal input and output.

2.14 VIDEO SIGNAL EQUIPMENT

The following video signal equipment shall conform to EIA 170. Electrically powered equipment shall operate on 240 Volts 50 Hz AC power. All video signal inputs and outputs shall be by BNC connectors.

2.14.1 Ground Loop Corrector

The ground loop corrector shall eliminate the measured ground loop interference (common mode voltage) in wireline or coaxial video transmission lines. The ground loop corrector shall pass the full transmitted video bandwidth with no signal attenuation or loss. Clamping ground loop correctors shall be capable of rejecting at least an 8 volt peak-to-peak 50 Hz common mode signal. Ground isolation transformers shall be capable of rejecting at least a 10 volt peak-to-peak 50 Hz common mode signal. Ground isolation amplifiers shall be capable of rejecting at least a 30 volt peak-to-peak 50 Hz common mode signal. Differential ground loop correctors shall be capable of rejecting at least a 100 volt peak-to-peak 50 Hz common mode signal.

2.14.2 Video Loss/Presence Detector

The video loss/presence detector shall monitor video transmission lines for presence of the video signal. The detector shall annunciate an alarm when the video signal drops below a pre-set threshold level. A threshold level adjustment shall be provided for each video channel, and the threshold

level shall be continuously adjustable through a lockable front panel control. A front panel reset control shall be provided for each video channel, which shall reset the detector after an alarm. The video loss alarm shall be annunciated through a front panel LED and a contact closure as a minimum. Video input shall be loop-through, and the video shall be unaffected when the detector is turned off. The detector shall not attenuate or reduce the level of the video signal passing through it.

2.14.3 Video Equalizing Amplifier

The video equalizing amplifier shall be designed to correct loss in video signal level and high frequency attenuation caused by long distance video signal transmission over wireline DTM. The amplifier shall have independent signal gain and equalization controls. The amplifier shall be capable of equalizing at least 3000 feet of RG-11/U coaxial cable conforming to paragraph CCTV Equipment Video Signal Wiring. The amplifier shall provide a minimum of plus or minus 6 dB of video gain and 12 dB of high frequency compensation. At least one video output shall be provided for each video input. Bandwidth shall be 10 MHz or greater, and frequency response to 8 MHz shall be plus or minus 1 dB or less. Hum and noise shall be 50 dB below 1 volt peak-to-peak or better. Video inputs shall be 75 ohm unbalanced, terminating, differential grounded. Video outputs shall be 75 ohm, differential, source terminated, 1 volt peak-to-peak. Output isolation shall be 40 dB or greater at 5 MHz.

2.14.4 Video Distribution Amplifier

The video distribution amplifier shall be designed to distribute a single, 75 ohm, unbalanced video input signal to a minimum of 4, 75 ohm, source terminated video outputs. The distribution amplifier shall have not less than plus or minus 3 dB of gain adjustment for the video output. Output isolation shall be 40 dB or greater at 5 MHz. Bandwidth shall be 10 MHz or greater, and frequency response to 8 MHz shall be plus or minus 0.5 dB or less. Hum and noise shall be 55 dB below 1 volt peak-to-peak or better.

2.14.5 Master Video Sync Generator

The master video sync generator shall generate horizontal drive, vertical drive, blanking, and sync signals as a minimum, with at least one 75 ohm output provided for each signal. The master oscillator crystal shall be pre-aged, and temperature stabilized, ovenized or temperature compensated. The sync generator shall have a composite video input and shall lock to the incoming video signal. If no video is present at the video input, the sync generator shall switch to internal crystal control. Not less than 2.5 microseconds advance and 2.5 microseconds delay of horizontal phase shall be provided. Vertical blanking width adjustment shall be provided. Vertical blanking width adjustment shall have a minimum selection range of 19, 20, and 21 lines.

2.14.6 Video Sync Distribution Amplifier

The sync distribution amplifier shall be a regenerative amplifier designed to distribute a sync signal input to not less than 6, 75 ohm outputs. Output level shall remain constant and shall not be affected by input level variations. Output isolation shall be greater than 35 dB at 5 MHz. A high impedance loop through shall be provided in addition to the 6 outputs. The distribution amplifier shall have continuously variable delay range of at least 250 nanoseconds to 2.2 microseconds. The delay shall be adjustable through a front panel control.

2.15 ACCESSORIES

Standard 19 inch electronic rack consoles conforming to EIA ANSI/EIA-310-D shall be provided for each CCTV system at the local security location indicated and remote control/monitoring site (main entrance control point room).

2.16 WIRE AND CABLE

The Contractor shall provide all wire and cable not indicated as Government Furnished Equipment. All wire and cable components shall be able to withstand the environment the wire or cable is installed in for a minimum of 20 years.

2.16.1 CCTV Equipment Video Signal Wiring

The coaxial cable shall have a characteristic impedance of 75 ohms plus or minus 3 ohms. RG 59/U coaxial signal cable shall have shielding which provides a minimum of 95 percent coverage, a solid copper center conductor of not less than 23 AWG, polyethylene insulation, and a black non-contaminating polyvinylchloride (PVC) jacket. RG 6/U coaxial cable shall have shielding which provides a minimum of 95 percent coverage, with center conductor of 18 AWG or larger polyethylene insulation, and a black non-contaminating polyvinylchloride (PVC) jacket.

2.16.2 Low Voltage Control Wiring

Twisted pair low voltage control wiring to be provided. Plenum or riser cables shall be IEEE C2 CL2P certified.

2.16.3 Digital Data Interconnection Wiring

Interconnecting cables carrying digital data between equipment located at the security center or at a secondary control/monitoring site shall be not less than 20 AWG and shall be stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100 percent coverage. Cables with a single overall shield shall have a tinned copper shield drain wire. Plenum or riser cables shall be IEEE C2 CL2P certified.

2.17 PREDELIVERY TESTING

2.17.1 General

The Contractor shall assemble the test CCTV system as specified, and perform tests to demonstrate that the performance of the system complies with the contract requirements in accordance with the approved predelivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced during predelivery testing, including results of each test procedure, shall be delivered to the Government at the conclusion of predelivery testing prior to Government approval of the test. The test report shall be arranged so that all commands, stimuli, and responses are correlated to allow logical interpretation.

2.17.2 Test Setup

The Contractor shall provide the equipment needed for the test setup and shall configure it to provide alarm actuated camera call-up and alarm recording as required to emulate the installed system. The test setup shall consist of at least 4 complete camera circuits. The alarm signal input to the CCTV test setup shall be by the same method that is used in the installed system. The video switcher shall be capable of switching any camera to any monitor and any combination of cameras to any combination of monitors. The minimum test setup shall include:

a. Four video cameras and lenses, including dome cameras if required for the installed system.

b. Three video monitors.

c. Video recorder if it is required for the installed system.

d. Video switcher including video input modules, video output modules, and control and applications software.

e. Video multiplexer, if required for the installed system.

f. Alarm input panel if required for the installed system.

g. Pan/tilt mount and pan/tilt controller if the installed system includes cameras on pan/tilt mounts.

h. Any ancillary equipment associated with a camera circuit such as equalizing amplifiers, video loss/presence detectors, terminators, ground loop correctors, surge protectors or other in-line video devices.

i. Cabling for all components.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system. Raceways shall be furnished and installed as specified in Section 16415 ELECTRICAL WORK, INTERIOR. DTM shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. All other electrical work shall be as specified in the above sections including grounding to preclude ground loops, noise, and surges from adversely affecting system operation.

3.1.1 Current Site Conditions

The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Government.

3.1.2 Enclosure Penetrations

All enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.1.3 Cold Galvanizing

All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.4 Interconnection of Console Video Equipment

The Contractor shall connect signal paths between video equipment with RG-6/U coaxial cable. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.

3.1.5 Cameras

The Contractor shall install the cameras with the proper focal length lens as indicated for each zone; connect power and signal lines to the camera; set cameras with fixed iris lenses to the proper f-stop to give full video level; aim camera to give field of view as needed to cover the alarm zone; aim fixed mount cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun; focus the lens to give a sharp picture over the entire field of view; and synchronize all cameras so the picture does not roll on the monitor when cameras are selected. Dome cameras shall have all preset positions defined and installed.

3.1.6 Monitors

The Contractor shall install the monitors as shown and specified; connect all signal inputs and outputs as shown and specified; terminate video input signals as required; and connect the monitor to AC power.

3.1.7 Switcher

The Contractor shall install the switcher as shown and according to manufacturer's instructions; connect all subassemblies as specified by the manufacturer and as shown; connect video signal inputs and outputs as shown and specified; terminate video inputs as required; connect alarm signal inputs and outputs as shown and specified; connect control signal inputs and outputs for ancillary equipment or secondary control/monitoring sites as specified by the manufacturer and as shown; connect the switcher CPU and switcher subassemblies to AC power; load all software as specified and required for an operational CCTV system configured for the site requirements, including data bases, operational parameters, and system, command, and application programs; provide the original and 2 backup copies for all accepted software upon successful completion of the endurance test; and program the video annotation for each camera.

3.1.8 Video Recording Equipment

The Contractor shall install the video recording equipment as shown and as specified by the manufacturer; connect video signal inputs and outputs as shown and specified; connect alarm signal inputs and outputs as shown and specified; and connect video recording equipment to AC power.

3.1.9 Video Signal Equipment

The Contractor shall install the video signal equipment as specified by the manufacturer and as shown; connect video or signal inputs and outputs as shown and specified; terminate video inputs as required; connect alarm signal inputs and outputs as required; connect control signal inputs and outputs as required; and connect electrically powered equipment to AC power.

3.1.10 Camera Housings and Mounts

The Contractor shall install the camera housings and mounts as specified by the manufacturer and as shown, provide mounting hardware sized appropriately to secure each camera, housing and mount with maximum wind and ice loading encountered at the site; connect signal lines and AC power to mount interfaces; and connect wiring harness to camera.

3.2 SYSTEM STARTUP

The Contractor shall not apply power to the CCTV system until the following items have been completed:

a. CCTV system equipment items and DTM have been set up in accordance with manufacturer's instructions.

b. A visual inspection of the CCTV system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

c. System wiring has been tested and verified as correctly connected as indicated.

d. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.

e. Power supplies to be connected to the CCTV system have been verified as the correct voltage, phasing, and frequency as indicated.

f. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

The following requirements supplement the contractor quality control requirements specified elsewhere in the contract. The contractor shall provide the services of technical representatives who are thoroughly familiar with all components and installation procedures of the installed IDS; and are approved by the Contracting Officer. These representatives will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These representatives

shall also be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives shall participate in the testing and validation of the system and shall provide certification that their respective system portions meet its contractual requirements.

3.4 SITE TESTING

3.4.1 General

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing. The Government will witness all performance verification and endurance testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test.

3.4.2 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure. In addition, the Contractor shall make a master video tape recording showing typical day and night views of each camera in the system and shall deliver the tape with the report. Note any objects in the field of view that might produce highlights that could cause camera blinding. Note any objects in the field of view or anomalies in the terrain which may cause blind spots. Note if a camera cannot be aimed to cover the zone and exclude the rising or setting sun from the picture. Note night assessment capabilities and whether lights or vehicle headlights cause blooming or picture degradation. If any of the above conditions or other conditions exist that cause picture degradation or interfere with the camera field of view, the Contractor shall inform the Contracting Officer. The tape shall be recorded using the video recorder installed as part of the CCTV system. If a recorder is not part of the CCTV system, the Contractor shall provide the tape in Video Home System (VHS) format. The Contractor shall provide the Government with the original tape as part of the documentation of the system and shall submit a letter certifying that the CCTV system is ready for performance verification testing. The field testing shall as a minimum include:

a. Verification that the video transmission system and any signal or control cabling have been installed, tested, and approved as specified.

b. When the system includes remote control/monitoring stations or remote switch panels, verification that the remote devices are functional, communicate with the security center, and perform all functions as specified.

c. Verification that the switcher is fully functional and that the switcher software has been programmed as needed for the site

configuration.

d. Verification that switcher software is functioning correctly. All software functions shall be exercised.

e. Verification that video multiplexers are functioning correctly.

f. Operation of all electrical and mechanical switcher controls and verification that the control performs the designed function.

g. Verification that all video sources and video outputs provide a full bandwidth signal that complies with EIA 170 at all video inputs.

h. Verification that all video signals are terminated properly.

i. Verification that all cameras are aimed and focused properly. The Contractor shall conduct a walk test of the area covered by each camera to verify the field of view.

j. Verification that cameras facing the direction of rising or setting sun are aimed sufficiently below the horizon so that the camera does not view the sun directly.

k. If vehicles are used in proximity of the assessment areas, verification of night assessment capabilities and determination if headlights cause blooming or picture degradation.

l. Verification that all cameras are synchronized and that the picture does not roll when cameras are switched.

m. Verification that the alarm interface to the IDS is functional and that automatic camera call-up is functional with appropriate video annotation for all designated ESS alarm points and cameras.

n. When pan/tilt mounts are used in the system, verification that the limit stops have been set correctly. Verification of all controls for pan/tilt or zoom mechanisms are operative and that the controls perform the desired function. If preposition controls are used, verification that all home positions have been set correctly, and have been tested for auto home function and correct home position.

o. When dome camera mounts are used in the system, verify that all preset positions are correct and that the dome also operates correctly in a manual control mode.

The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

3.4.3 Performance Verification Test

The Contractor shall demonstrate that the completed CCTV system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until receipt by the Contractor of written permission from the

Government, based on the Contractor's written report. This shall include certification of successful completion of Contractor Field Testing as specified in paragraph "Contractor's Field Testing," and upon successful completion of training as specified. If the CCTV system is being installed in conjunction with an ESS, the CCTV performance verification test shall be run simultaneously with the ESS performance verification test. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to commencing the endurance test.

3.4.4 Endurance Test

a. The Contractor shall demonstrate the specified requirements of the completed system. The endurance test shall be conducted in phases as specified. The endurance test shall not be started until the Government notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. If the CCTV system is being installed in conjunction with an ESS, the CCTV performance verification test shall be run simultaneously with the ESS performance verification test. The Contractor shall provide one operator to operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing, in addition to any government personnel that may be made available. The Government may terminate testing at any time the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test the Contractor shall verify the operation of each camera. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

b. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing. If the system experiences no failures during Phase I testing, the Contractor may proceed directly to Phase III testing after receipt by the Contractor of written permission from the Government.

c. Phase II (Assessment): After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected

by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, or may require that Phase I be repeated. If the retest is completed without any failures, the Contractor may proceed directly to Phase III testing after receipt by the Contractor of written permission from the Government.

d. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

e. Phase IV (Assessment): After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, and may require that Phase III be repeated. The Contractor shall not commence any required retesting until after receipt of written notification by Government. After the conclusion of any retesting which the Government may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

f. Exclusions: The Contractor will not be held responsible for failures resulting from the following:

(1) An outage of the main power supply in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished.

(2) Failure of a Government furnished DTM circuit, provided that the failure was not due to Contractor furnished equipment, installation, or software.

(3) Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.

-- End of Section --