

APPENDIX F

PROPOSED SCHEMATIC NEW WORK FLOOR PLAN - BUILDING 44

Appendix F

Proposed Schematic New Work Floor Plan - Building 44

**Refer to separately bound drawings for Proposed Schematic Floor Plan
– Building 44**

APPENDIX G

SPECIFIC BASE-WIDE TECHNICAL SPECIFICATIONS

APPENDIX G - SPECIFIC BASE WIDE TECHNICAL SPECIFICATIONS**TABLE OF CONTENTS**

SECTION NUMBER	TITLE
DIVISION 01 - GENERAL REQUIREMENTS	
<u>01040</u>	<u>SITE REQUIREMENTS</u>
01560	ENVIRONMENTAL REQUIREMENTS
DIVISION 07 – THERMAL & MOISTURE PROTECTION	
07416	STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
DIVISIONS 16 - ELECTRICAL	
16195	IDENTIFICATION
16335	PAD-MOUNTED AIR SWITCHES
16361	PRIMARY UNIT SUBSTATION
16375	ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
16400	480 volt SECONDARY UNIT SUBSTATIONS
16415	ELECTRICAL WORK, INTERIOR
16500	COMMUNICATIONS SYSTEM
16671	LIGHTNING PROTECTION SYSTEM - ESE/EASE STYLE
16721A	ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 SPECIAL REQUIREMENTS:

A. Controlled Areas:

1. This project includes work in a Controlled Area. The Contracting Officer will assist in getting proper notation on personnel badges for applicable areas.
2. Use no radios, pagers, or walkie-talkies in these areas.
3. Allow 15 minutes wait at arrival for escorts.
4. The contractor is responsible for all controlled/restricted area badges issued for this project. Twenty-five dollars (\$25.00) per badge will be deducted from the final contract payment for badges lost or not returned, regardless of the reason for said loss/nonreturn. If a receipt is desired for badges turned in during the contract period, the contractor must furnish it for coordination.

B. Airfield Zone Requirements:

1. There are 4 areas within the Airfield Zone: AMC West area, AMC East area, Industrial area, and Flightline area. The project location is in the Industrial area. Each of these areas has various requirements for access and travel. To determine any possible release of requirements, contact the 78 OSS/OSAB, 926-2114. In lieu of specific information from 78 OSS/OSAB, assume that all of the requirements below apply.
2. Contractor employees requiring vehicle access to the controlled area of the Flightline shall display their company's name on both the right and left sides of the vehicle. Lettering shall be at least one and one half inches high and may be either permanently or magnetically affixed to the vehicle. The government will deny entry to contractor vehicles not displaying the company name.
3. Prior to driving on the Flightline, the contractor shall ensure that all personnel required to operate vehicles on the Flightline are trained and certified. The contractor is responsible for scheduling the training through 78 OSS/OSAB, 926-2114, with adequate lead-time so as not to interfere with the contract schedule. Upon completion of the training, an AF Form 483 (Certificate of Competency) will be issue by Airfield Manager's office, which certifies that the individual has been trained on Flightline driving. This certification must be in the possession of the vehicle operator when driving on the Flightline.
4. Contractors will provide an escort for all material suppliers or vendors transporting equipment or material to/from the Flightline job site. The certified escort can be a passenger or operate a lead vehicle no further than three vehicle lengths in front of the escorted vehicle. The contractor shall ensure that all subcontractors comply with all Flightline requirements. The contractor shall obtain approval from Base Operations for all haul routes or other travel requirements on the Flightline.
5. In addition to the validated AF Form 483, vehicle operators shall have valid state driver's licenses in their possession when driving on the Flightline. Vehicle operators shall adhere to

Flightline driving procedures contained in RAFB Instruction 13-204, Control And Operation Of Vehicle On Robins AFB Flightline.

6. The contractor is responsible for ensuring that all contractor personnel, subcontractors, and suppliers meet all Flightline requirements. The government may, at its discretion, remove any contractor, subcontractor, or supplier employee from and prohibit access to the Flightline for the duration of this contract for violations of Flightline procedures.

8. Under no circumstances shall contractor employees enter any Flightline building or area not covered by the contract or authorized for access to the contract area. .

9. Upon completion of the contract, AF Form 483 shall be turned in to the Contracting Officer before final payment will be made.

10. If a crane is required for construction on the airfield, the contractor must store the crane in such a manner as to not pose a hazard to flight operations. The contractor must contact, through the inspector, 78 OSS, 926-2114, to receive instructions on how to store the crane each night. In addition, any crane activity on the airfield will require a waiver from the 78 ABW Commander prior to starting work. Submit in writing a schedule for such work, the hours of operation, height of the crane, and location of the crane, to the contracting officer 45 days prior to the start of the work. The contracting officer will work with the Civil Engineering Community Planner, 63533 Ext 173 to obtain this permit.

11. Prior to the start of work each day, the contractor shall coordinate with Base Operations Chief of Airfield Management. The contractor will advise Base Operations of the current work schedule, location and duration of work, and the type of equipment at the site for the day. The contractor shall also coordinate with Base Operations before leaving the site for the day.

12. The contractor shall furnish a schedule to the Contracting Officer on the anticipated work schedule for each area in the contract.

13. The contractor shall obtain approval of Base Operations for the storage sites for all equipment and materials used on the contract.

14. The contractor shall provide continuous cleanup at the work site. All areas shall be kept so clean as to prevent the spread of materials that may be tracked into other aircraft areas or which may be windblown in such a way as to cause a hazard to aircraft traffic. Materials will not be allowed to accumulate in such a manner as to create an eyesore. The contractor shall be required to clean all haul routes as required to maintain aircraft safety and site order.

1.02 UTILITY OUTAGES: Request utility outages in writing to the Base Civil Engineer, with a copy to the Contracting Officer, a minimum of 21 days before the proposed outage. These will be scheduled at Government convenience and may be at times other than normal working hours. For example, the times may be on weekends or during the second and third shifts (including holidays, holiday weekends, and work curtailment days). These are at no additional cost to the Government.

1.03 SUBMITTALS:

- A. General: Provide the following submittals in accordance with instructions found in Section 01300, Submittals and Contractor Furnished Items.
- B. Material Submittals: None required under this section.
- C. Other Submittals: Provide the following submittals as required by the contract or as directed by the Contracting Officer.

<u>Para #</u>	<u>Description</u>	<u>Date Required</u>	<u>Inspector Checklist</u>
1.01.B.6	AF Form 483	Before final payment	_____
1.02	Utility Outage Requests	21 days prior to outage	_____
1.04	Safeguarding LAN Com Lines	21 days prior to work	_____
1.05.A	Airfield Zone Waiver	In hand prior to start of work	_____
3.01.E	Road/Parking Closure Request	21 days prior to work	_____
3.04.A	Govt Property Damage Notice	within 3 days of event	_____
3.05.C	Warning Tape	14 days after NTP	_____
3.05.D	Tracer Wire	14 days after NTP	_____
3.06	Bldg Number on Corners	14 days before pre-final	_____
3.07	Before - Site Photos	Before Construction	_____
3.07	After - Site Photos	Before Final Inspection	_____
3.09	Trailer Permit	14 days after NTP	_____
Atch 1	Fire Alarm Reports	At pre-final inspection	_____

1.04 SAFEGUARDING COMMUNICATION FACILITIES: For work that will interfere with Local Area Network (LAN) cable, aerial cable, house cable, underground cable, or other communication facilities, notify the Contracting Officer in writing 21 days before the scheduled construction. Do no work until receiving written approval.

1.05 AIRFIELD ZONE CONSTRUCTION WAIVER:

- A. UFC 3-260-01, Atch 2, Para. A2.2.6.4.7, requires a temporary waiver be obtained for obstructions by construction on the airfield. This applies to any construction, construction equipment storage, or hauling of materials or waste products that will take place within the boundaries of the Airfield Zone as shown on the Location map of Drawings. The Base Project Manager has advised the Base Community Planner to accomplish the necessary internal documents to obtain the temporary construction waiver for that area, and they are in process. Do not start any work in the Airfield Zone until the Technical Representative of the Contracting Officer (TRCO = CE Inspector) has provided the approved waiver to the Contractor.
- B. Contact 78 OSS, Base Operations, at the start of each working day to perform Airfield Zone work after the waiver has been provided.

PART 2 - PRODUCTS - OMITTED

PART 3 - EXECUTION

3.01 DIGGING/EXCAVATION REQUIREMENTS: The Drawings show underground utilities and structures as presently shown on the best available record drawings of the site, and these may have some inaccuracies. The information is provided for general bidding purposes only. Actual locations and quantities must be determined at the site while obtaining the form below.

- A. Digging/Excavation Permit (AF Form 103): Digging permits are obtained at 0800 Monday mornings, only, in Building 1555. The Contractor, along with the technical representative, shall meet with Civil Engineering utility personnel at this time to make all necessary arrangements for the excavation permit before any digging. The Contractor will be given instructions on how to prepare and properly complete an AF Form 103. This includes coordination before beginning any work involving digging/excavation and location of buried structures and utility lines. Before getting signatures, provide a drawing indicating the full extent of digging/excavation (width/depth/length of trench or hole). Civil Engineering utility personnel will meet with the Contractor at the site and locate their underground utility lines and buried structures that might be affected by any digging/excavation. Do not do any digging until all parties have approved the permit (three day maximum). The digging/excavation permit shall be effective only for the time period indicated by the final signature authority.
- B. Reoordination of the AF Form 103 with all organizations and the technical representative shall be required for any additional time required after expiration of the original time period. No digging/excavation shall be done after 1600 hours on weekdays or anytime on weekends unless prior approval is obtained.
- C. Location of Buried Structures and Utility Lines: Accurately locate and stake buried structures and utility lines indicated.
- D. Excavation, trenching, and backfilling: Excavate to the required depth by hand digging within three (3) feet either side of the buried structures or utility line. Do not use motorized equipment within these parameters. Only open those trenches for which material is ready for replacement. As soon as approved by the technical representative, backfill trenches as required by the drawings or specifications. As a minimum, replace topsoil and grass the disturbed area by seeding and watering.
- E. Damage: The contractor is responsible for any damage to underground structures and utility lines identified on the drawings and any identified and marked in the field as a result of obtaining the digging/excavation permit. If any underground utility is damaged, notify the technical representative immediately.
- F. Cutting of Roads, Streets, and Paved Parking Areas:
1. Mark, barricade, and illuminate construction work on or near roads or streets which may present a traffic hazard in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) 1995. Closures of streets, parking lots, and other traffic areas will not be permitted unless approved by the Contracting Officer after written request 21 days before the scheduled closure.
 2. Road cuts shall be backfilled immediately after completion of associated utility work. When the road is reopened, the cut shall be filled with temporary or permanent materials to a smooth condition, or metal plates or other approved methods shall be employed to prevent discomfort or damage to vehicular traffic. Road cuts shall be permanently closed within 5 working days unless approved otherwise by the Contracting Officer. Provide advance signage warning motorists of the condition in accordance with the MUTCD. Repair streets as shown on the drawings.

3.02 CRANES, BOOM-TRUCKS, ETC.: Any tall equipment, such as a crane or boom-truck, must be lowered when not in use, lowered at the end of each work day, or if used at night then the appropriate lighting at the peak element be attached.

3.03 STORAGE AREA: If approved by the Contracting Officer, the Contractor will be allowed limited space to put office and/or storage trailer for this contract. The location is identified in the RFP.

- A. Items stored for the project on Base are the responsibility of the Contractor. Replace all such items stolen, vandalized, damaged, or otherwise unusable at no additional cost to the Government.
- B. Site shall be kept clean and orderly.

3.04 REPAIR OF WORK AND MATERIAL: Carefully lay out cutting, channeling, chasing, or drilling of finish or structure or other surfaces for the installation of equipment or material to avoid damaging Government property or adjacent materials not involved in the project. If Contractor personnel or equipment inadvertently damage such items, then follow the procedures below. Failure to follow the notification procedures below shall be considered a serious violation of the contract.

- A. Notify the Contracting Officer by telephone immediately and confirm within 3 days with a typed letter if damage to Government property occurs. The Government reserves the right to require the Contractor to work overtime and purchase material for repair before the end of the workday at no additional cost to the Government.
- B. Repair damage to building or equipment to match existing as directed by the Contracting Officer with skilled workmen of the trades involved at no additional cost to the Government.
- C. Repair Fire Resistant Assemblies that have been violated before the end of the day. In the event the work is incomplete, provide fire-rated gypsum board to cover holes 2-inch and greater in any dimension.
- D. Reconnect Disconnected Equipment before the end of the day and insure that it is operating.
- E. Existing Equipment and Material to remain or to be relocated is the property of the Government. However, the Contractor is responsible for items to remain.
- F. Labels on equipment plates with information shall be properly protected before any operation that could damage or cover the label.
- G. Fire Alarm: If the contract involves work requiring existing fire alarm equipment either to remain or to be removed and reinstalled, the Contractor shall comply with the requirements of the inspection forms in the Appendix at the end of this section. One form is to notify the appropriate personnel that work is being accomplished on fire alarm systems. The other two forms are used to establish the conditions of the system components prior to and following the contractor's work.

3.05 IDENTIFYING UNDERGROUND LINES AND STRUCTURES:

- A. Regardless of statements in other Spec sections, provide tracer wires and warning tapes over buried underground utilities and structures. Follow these requirements if the other Spec sections are less detailed and stringent.

- B. These include all underground items such as utility lines, oil/water separators, fuel and water storage tanks, and utility pits and manholes with tops below grade.
- C. Provide a warning tape of standard industrial width and thickness with imprinted words identifying the type of utility line or structure below it. Place along the length (and width if not a utility line) of the protected item at one-foot depth below grade.
- D. For non-metallic lines and structures also provide a tracer wire placed just above it, so conventional locating equipment may be used to locate the line or structure. These items will be made of plastic, fiberglass, or similar non-metallic material. Design basis of the tracer wire is BMS Heavy Tracer Wire by Utilitronics, PO Box 480, Stoughton, MA 02072 - phone 1-800-245-8850. Use no less than #12 AWG copper solid wire, 5/64" HMWPE insulation, with white color.

3.06 BUILDING NUMBER: Place building numbers 59 and 62 on the facility at four locations as directed. Use metal plates furnished by the Government and installed as directed. These plates are approximately sixteen inches wide by eight inches high.

3.07 SITE PHOTOGRAPHS:

- A. General: Take "before" and "after" color photographs of the work site on a digital camera with a resolution for each picture of at least 60 KB compressed image. Provide for approval on a CD-RW disk at least 24 views chosen by the Technical Representative of the Contracting Officer (TRCO) before construction. Provide additional views as directed to show the full extent of the work. Provide for approval an identical set of "after" views.
- B. Underground Utilities: For projects where there is trenching for any underground utilities, even if just laterals from outside equipment into mech-elec rooms, take an additional set of as-built photos after construction for approval before final inspection. These must cover the entire length of the trenching with a view to showing nearby landmarks to enable a person to locate the line in the field in the future by using the photos after the disturbed soil is no longer visible.

3.08 SITE MAINTENANCE, CLEAN UP, AND RESTORATION

- A. Maintain the work site in a neat, orderly, and safe manner. Cut grass regularly to maintain site to base standards.
- B. Remove scrap, waste, and excess materials promptly. Provide signs, barricades, and lights as required to protect base personnel.
- C. Do not allow trash and debris to accumulate and become unsightly. Sweep up and collect in contractor-maintained disposal containers daily. Dispose of collected debris weekly as a minimum.
- D. Store materials on site in a neat and orderly manner.
- E. Restore the project site to its final condition as required by the contract as soon as possible.

- F. Do not open trenches or excavations until material is on-hand or scheduled to arrive within three days. Close excavations or ditches as soon as the work has been placed, inspected, and accepted by the government.
- G. For this project, install a chain link fence covered with vinyl fence fabric where shown on the project drawings.
1. The intent of this requirement is to screen the more objectionable portions of the construction operation from the base population so as to maintain the base appearance standards as much as possible during construction.
 2. The exact layout may be modified somewhat, at no additional cost to the government, with the approval of the contracting officer. The size of the gates shall be as required by the contractor for his operation.
 3. Details: The fence shall be a minimum of five feet tall unless indicated otherwise on the drawings. The fence screen shall be 100% polypropylene. The material shall weigh 5.1 oz/sy with a tensile strength using the grab method (ASTM D-1682) of 300 lbs (warp) and 110 lbs (fill). Burst strength shall be 320 psi using ASTM D-751 and tear strength using the trap method (ASTM D-4533) shall be 135 lbs (warp) and 50 lbs (fill). Air permeability shall be 150 cfm using ASTM D-737. The cable ties on grommets shall be a minimum of 7 1/2" x 3/16" cable tie, UV treated, black. The color shall be tan. The design basis is the 85% tan shade cloth manufactured by PAK Unlimited of Norcross GA, phone 770-475-9916. The shade cloth shall cover the size of fence specified without being folded at the bottom or ends of the fence. Install in accordance with the manufacturer's recommendations.

3.09 TRAILERS: All contractor trailers must be identified with a professionally lettered, neat sign giving the name and phone number of both the trailer rental company and the contractor. Trailers must be in good repair and give a presentable appearance. Trailers used as Field Offices shall be anchored with rods and cable or by steel straps to ground anchors. The anchor system shall be designed to withstand winds and must meet applicable state or local standards for anchoring mobile homes. A permit must be obtained from the Civil Engineer Group prior to locating any trailer on base.

<<<<< END OF SECTION >>>>>

Appendix follows:

Form 1 – Fill out and submit to get approval to work on a fire alarm system.

Form 2 – Fill out and submit to document existing conditions of a fire alarm system to be worked on.

Form 3 – Fill out and submit to document conditions of a fire alarm system after contractor work is completed.

Form 1

FIRE ALARM REQUEST FORM

TO: 78 CES/CC

No work is allowed on fire alarm systems until this form is coordinated through the 78th Civil Engineering Group's Industrial Electrical Shop at Bldg. 1556. PH: 926-7862, and approved by the 78 CES commander.

The Industrial Electric Shop will notify the Fire Dept. of alarm shutdown/inspection request. Requesters of all other action types should notify the Fire Dept. at 926-3487 before starting work and once completed.

Requester Information

Organization/Company

Phone:

Name:

Signature:

Type Service Required:

1. Shutdown_____

2. Inspection_____

3. Other_____

Shutdown Service Information:

Turn off

Reason

Turn on

Time:

Time:

Date:

Date:

Inspection Service Information:

Time:

System Type:

Date:

Contractor:

Bldg:

Contract Monitor:

Other Service Information:

Time:

Service (I.e., disable zone, bells, or transmitter)

Date:

Bldg:

Reason for Service:

78 CEG/CEF APPROVAL: _____

Date: _____

78 CES/CEOII APPROVAL: _____

Date: _____

78 CES/CEOUU APPROVAL: _____

Date: _____

78 CES/CC APPROVAL: _____

Date: _____

Form 2

FIRE ALARM SYSTEM INSPECTION
COMPONENTS EXISTING TO REMAIN OR TO BE REMOVED AND REINSTALLED

PART 1. Prior to construction start DONE (Contractor to Initial/Date)

A. Schedule testing of all fire alarm components not scheduled for demolition (at Government's convenience-minimum 72 hours notice required)

Person Notified (at CECC/CECM)

B. List all persons attending test:

- * Fire Alarm Shop CEOIE
- * Contractor Superintendent _____
- Construction Management (CECC/CECM)
- ** Sub-Contractor Foreman

* Required Personnel

** This shall be the person(s) directly overseeing any removal and re-installation of fire alarm equipment.

C. Inspection (CECC/CECM Inspector to check one of the following)
(All parties to initial below):

_____ All existing components in the project area have been tested and are working properly

_____ All components have been tested and the following are not working properly. (Specify equipment, quantity, and location; e.g., 2 smoke detectors in northwest quadrant of Room 102.):

Acknowledgments:

CEOIE CECC/CECM Contractor
 Sub-Contractor Others:

Form 3

FIRE ALARM SYSTEM INSPECTION
(COMPONENTS EXISTING TO REMAIN OR TO BE REMOVED AND REINSTALLED)

PART 2. At completion of work (before Prefinal inspection): DONE
(Contractor to
Initial/Date)

A. Schedule testing of all fire alarm components not scheduled for demolition (at Government's convenience-minimum 72 hours notice required)

Person Notified (at **CECC/CECM**)

B. List all persons attending test:

- * Fire Alarm Shop CEOIE
- * Contractor Superintendent _____
Construction Management **(CECC/CECM)**
- ** Sub-Contractor Foreman

* Fire Department (CEF)

* Required Personnel

**This shall be the person(s) directly overseeing any removal and re-installation of fire alarm equipment.

C. Inspection Results (to check by **CECC/CECM** Inspector all parties to initial below):

_____ Passed: All components have been tested and the system has been returned to its original condition.

NOTE: Minor failures referenced below are defined as only one or two components having been improperly reconnected or damaged and which can be readily repaired. Any damage to wiring, conduit or alarm panels, or more than one or two components, is a major failure on the part of the Contractor.

_____ Failed (Minor): All components have been tested and the system has not been returned to its original condition. The following items must be repaired, replaced, or reconnected as necessary to restore their operation, at no additional cost to the Government, and those items retested.

_____ Failed (Major): All components have been tested and the system has not been returned to its original condition. The following items must be repaired, replaced, or reconnected as necessary to restore their operation, at no additional cost the Government, and those items retested.

Acknowledgments:

CEOIE _____ CECC/CECM _____ Contractor _____
Sub-Contractor _____ Others:

NOTE: The contractor shall reimburse the Government for any failed (major) test at the current shop rate (between \$17.00 and \$30.00) per person hour, including one (1) hour per person travel and preparation time. This does not include the CECC/CECM Inspector. We estimate between 2 and 4 people will be required and the test will take 8 hours.

PART 1 - GENERAL

1.01 GENERAL:

- A. General Scope: This Section provides the requirements necessary to ensure that all construction projects are in environmental compliance. Major environmental program areas which may be affected include natural resources, air quality, underground storage tanks, asbestos, lead-based paint, PCBs, cultural resources, water quality, solid and hazardous wastes, and pollution prevention.
- B. Applicable Regulations and Publications: Comply with all applicable Federal, State of Georgia, any laws and regulations from other states where disposal might occur, and local laws and regulations concerning environmental compliance and pollution prevention.
- C. Ensure all products produced or generated under contract shall meet all stated performance objectives and shall not violate in any manner the environmental requirements of any applicable local, state, or federal entity including the Department of Defense. Applicable environmental requirements shall include but are not limited to a substance's toxicity, biodegradability, and volatile organic/inorganic compound content.
- D. Base Environmental Management personnel will conduct no-notice inspections to ensure compliance with all environmental requirements. Written notification of any findings from such an inspection will be forwarded to the Contracting Officer.
- E. Definitions:
1. CO - Contracting Officer
 2. EM - Environmental Management (WR-ALC/EM). This is the organization responsible for management of base environmental concerns. The EMQ division of EM handles most compliance issues. Their telephone number is (478) 926-1197, Ext 123.
 3. Dust - Minute solid particles caused to be suspended by natural forces or by mechanical processes such as, but not limited to, crushing, grinding, milling, drilling, demolishing, shoveling, conveying, covering, bagging, mixing, and sweeping.
 4. Open Burning - Any outdoor fire from which the products of combustion are emitted directly into the open air without passing through a stack, chimney or duct.
 5. Solid Waste - Defined in CFR 261.2. Examples include garbage, refuse, and other discarded solid material including non-hazardous wastes resulting from industrial, commercial, and agricultural operations.
 6. GA EPD - Georgia Environmental Protection Division of the Department of Natural Resources.

1.02 OMITTED

1.03 SUBMITTALS:

- A. General: Provide the following submittals in accordance with instructions found in Section 01300, Submittals and Contractor Furnished Items. The contractor may submit manufacturer's data in lieu of the required certificate of compliance if he desires. The Government requires manufacturer's data if an

“X” appears under the “Mfg. Data Required” column.

B. Material Submittals: Not required under this section.

C. Other Submittals: Provide the following submittals as required by the contract or as directed by the Contracting Officer.

*** Designer, edit list below to project requirements ***

Para #	Description	Date Required	Inspector Check Mark
1.04 A.1.a	Soil Erosion/Control Plan	14 days after NTP	_____
1.04 A.1.b	Boiler Air Permit Data	14 days after NTP	_____
1.04 A.1.c	Air Permit Data - Other	14 days after NTP	_____
1.04 A.1.d	Septic Tank Permits	prior to starting work	_____
1.04 A.2.a	SWPPP - Notice of Intent	prior to starting work	_____
1.04 A.2.a	SWPPP - Notice of Term.	as required	_____
1.04 A.2.b	GA EPD Demo Notice	prior to starting work	_____
1.04 A.2.c	UST Removal	14 days after NTP	_____
1.04 A.2.d	Solid Waste Disposal Plan	at pre-construction conf.	_____
1.04 A.2.d	Landfill receipts	within 1 day of dumping	_____
1.04 A.2.d	Solid Waste Handling Permit	within 3 days of receipt	_____
1.04 A.2.d	Disposal Certification Ltr.	prior to final payment	_____
1.04 A.2.e	Recycling letter	prior to final payment	_____
1.04 A.2.f	Asbestos removal info	as required	_____
(1.04 A.2.g	Lead Compliance/Training/ Sampling	prior to starting work	_____)
3.01 B.2.a.(1)	Waste Shipment Tracking	monthly	_____
3.01 B.2.b	Commencement Notice	prior to dumping	_____
3.01 B.2.b	Waste Mgmt Report	monthly	_____
3.01 B.2.c	Landfill License	prior to dumping	_____
3.01 C	Waste Mgmt Report	monthly	_____
3.02 A	Hazard Comm. Program	14 days after NTP	_____
3.02 B.2.b.	Submit DODAAC Form	14 days after NTP	_____
3.02 B.3.e.	DRMO Receipts	within 7 days	_____
3.02 B.3.i.	DRMO Bill	within 7 days	_____
3.02 B.4.e.	DRMO Receipts	within 7 days	_____
3.02 B.4.h.	DRMO Bill	within 7 days	_____
3.03 B	Tree tags	3 days after removal	_____
3.06	Use of Hazardous Chem	Prior to Work	_____
3.07 B	Pest Control License	prior to pest control	_____
3.12 B.2.	Notify of Find	Instance	_____
3.12 B.4	Notify EM of Digging	Beginning of Project	_____
3.12 B.4	Notify EM of Digging	Week Before Digging	_____
3.12 B.4	Notify EM of Digging	2 Hrs before restart Dig	_____

1.04 NOTIFICATIONS:

A. Provide to the Contracting Officer (CO) all data specified herein to insure compliance with applicable environmental requirements.

1. Permits: ***Designer - choose applicable permits***

a. Soil Erosion and Sedimentation Control Permit: (Not required.) (Since this project will disturb one acre or more of land surface, a soil erosion or sedimentation permit has been obtained. The requirements of the permit are included in the project. The contractor shall also comply with applicable State or Federal laws. The contractor shall provide as a submittal his plan for complying with the contract requirements in this area.)

b. Air Permit - Boilers: (Not required.) (In general, construction and operating permits must be obtained for boilers in excess of 10 MBtu/hr input capacity. The contractor shall submit required data to complete the permit application form within 14 days of NTP. Since an approved permit to construct is mandatory prior to start of construction, the contractor shall not order and the install the boiler(s) until the permit has been approved and Government approval of the contractor's submittal has been obtained. Contractor shall anticipate 90 days from the issuance of Notice to Proceed for this to occur.)

c. Air Permits - Other Emission Sources: (Not Required.) (For air emission sources that require permits (construction and operation) as defined in Georgia EPD Rules for Air Quality Control, Chapter 391-3-1, the Contractor shall submit data required on the permit application form. For this contract permits for the following items are required: (***) Manager: Provide list. (***) Since an approved permit to construct is mandatory prior to start of construction, the contractor shall not order and install the equipment until the permit has been approved and Government approval of the contractor's submittal has been obtained. Contractor shall anticipate 90 days from the issuance of Notice to Proceed for this to occur.

d. Septic Tanks: (Not Applicable.) (The Contractor shall obtain a permit from Houston County prior to starting work. In addition to the above the contractor shall notify EMQ (478) 926-9777 Ext 4 prior to starting work and submit the original copy of the permit to EMQ and a copy to the Contracting Officer.)

2. Other Submittals, Notifications, and Approvals: The following submittals, notifications, and approvals are required to maintain compliance:

a. Storm Water Pollution Prevention Plan (SWPPP): (Not Applicable.) (Since this project will disturb five acres or more, a SWPPP has been developed and the requirements included in the project. In conjunction with the SWPPP, the Contractor shall submit Notice of Intent (NOI) and Notice of Termination (NOT) forms to GA EPD for discharge of stormwater at a construction site. Provide copies of the EPD notifications to the CO.)

b. Building Demolition: (Not applicable.)

(1) Georgia Solid Waste Regulations require a 10 working day notification to GA EPD prior to the start of demolition activity, and this is a Contractor responsibility. This also applies to the renovation of a building, defined as the removal of a load-bearing wall.

(2) To start the process, coordinate with Sam Rucker in WR-ALC/EMQ at (478) 926-1197, Ext 109, for guidance and assistance.

(3) Submit copies of the notifications to the CO prior to starting work.

c. Underground Storage Tank (UST) Removal: (Not applicable.) (The contractor shall provide to the Contracting Officer information for EM to submit a notification to GA

EPD of project activities. At least 45 days shall be allowed after Notice to Proceed prior to start of the removal process for tanks.)

d. Solid Waste Disposal: When applicable, the Contractor shall provide a solid waste disposal plan which shall include a notarized letter from the contractor stating how all materials leaving Robins AFB shall be disposed of.

(1) The letter shall certify that the Contractor shall dispose of all materials in compliance with all Federal, State of Georgia, and local laws. A senior official of the company shall sign this letter. The plan shall address the disposal of each item addressed in Sections 3.01 and 3.02 as applicable. Non-hazardous solid waste shall be broken down into individual types, i.e., asphalt, concrete, wood, brick, etc.

(2) The plan shall address each landfill to be used. A copy of all landfill permits shall be provided unless the Houston County landfill is to be used. The plan shall designate the employee who shall be responsible for verifying that all materials removed from Robins AFB are disposed of in accordance with the above referenced laws. The employee shall be an employee of the contractor and shall have authority to act for the contractor. Provide five copies of the Disposal Plan to the CO prior to the Pre-construction Conference or 14 calendar days prior to the start of disposal operations if no pre-construction conference is held.

(3) Provide a copy of a Solid Waste Handling Permit, issued by GA EPD, which allows the Contractor to handle solid wastes. This is not required if the contractor is operating under the inert waste landfill permit-by-rule provision.

(4) Establish and maintain a waste disposal log. The log shall be updated daily. Each load of materials that leaves Robins AFB shall be accounted for in the log. The log shall list the load number, bill of sale number/date, or other record for recycling, as well as the name of the contractor person who verified that the material was disposed of properly, along with details as to how verification was accomplished.

(5) Keep on hand evidence of proper disposal of construction debris as well as providing this evidence to the Contracting Officer. Examples of evidence include dump tickets from a licensed sanitary landfill and copies of a current landfill permits from the State of Georgia (unless Houston County landfill is used.), manifest, bill of sale, or other record for recycling. This evidence shall be provided the workday after the load is carried off.

(6) After contract work is completed and prior to final payment, the Contractor shall submit a notarized letter of certification signed by a senior official of the company certifying that all materials removed from Robins AFB have been disposed of in accordance with all applicable Federal, State, and local laws. Attach a copy or duplicate of the Waste Shipment Tracking Document for each load transported to the Houston County Landfill. See paragraph 3.01.B.2.a.(1)

e. Recycling: Provide a letter indicating what materials shall be treated as recovered materials under GA EPD regulations and show how the criteria for recovered materials are met. See Section 3.0.1.B.2.d.

f. Asbestos Work/Removal: The Contractor shall provide 10 working day notifications to GA EPD prior to the start of any work involving asbestos. Copies of all notifications, EPD approval, and landfill disposal receipts must be provided to the CO.

*** Manager: select one of the three paragraphs below. ***

(g. Lead Based Paint ***Abatement projects only-not for our normal maintenance and repair projects*****: Provide submittals as specified in Section 02065 of the specifications.)

(g. Lead Based Paint for maintenance, repair, and minor construction projects. Provide written compliance program as required by OSHA standard, 29 CFR 1926.62. Provide certification that contractor personnel involved in removal and handling of lead based paint have received training in accordance with OSHA Lead Standards. Provide results of air sample testing needed to demonstrate worker safety.)

(g. Lead Based Paint: Not applicable.)

h. Hazardous Waste: See individual specification sections for requirements, if applicable.

PART 2 - PRODUCTS - OMITTED.

PART 3 - EXECUTION

3.01 DISPOSAL OF WASTE/EXCESS MATERIAL:

A. Excess Topsoil and suitable fill material shall be moved to a site on base. Contact the Horizontal Maintenance Shop at (478) 926-5820 Ext 201 for the current site locations and determination of whether the fill is suitable or not. Remove other soil from the base in a timely manner as directed by the contracting officer.

B. Non-hazardous Solid Waste or Excess Material, except topsoil and suitable fill material, shall be removed from the base daily. Dispose in a manner approved by the US Environmental Protection Agency and the Georgia Department of Natural Resources, Environmental Protection Division (EPD). Also comply with applicable local codes and requirements. Equipment/material to be removed from the project but not turned in to the Government is the property of the contractor.

1. Solid Waste Handling: All persons engaged in solid waste handling or operations of solid waste handling facilities or disposal sites shall have a solid waste-handling permit. The provision of Georgia EPD regulations concerning proper handling of solid wastes and applicable prohibitions (e.g., handling in such a manner as to create a nuisance and cause insect or rodent infestation) shall govern.
2. Disposal: Use one or more of the following methods to dispose of non-hazardous solid waste.
 - a. Sanitary Landfill: All solid waste may be disposed of in a sanitary landfill properly licensed by the State of Georgia. If a landfill other than the Houston County sanitary landfill is used, provide a copy of the landfill license. After 1 Jul 92, provide proof that any Georgia municipal solid waste disposal facility to which they propose to bring RAFB waste, except Houston County, is operated by someone who has obtained the certification required by the Georgia Solid Waste Management Act, O.C.G.A. 12-8-24.1.
 - (1) All non-hazardous wastes disposed of in the Houston County Landfill may require a Waste Shipment Tracking Document signed by the Contractor's hauler certifying that no hazardous waste was introduced into the waste while in his custody. (A copy of the form is attached at the end of this section.) If required, the contractor may be required to turn in a representative sample of building demolition material for the government to test and

the Government (Environmental Management) will filled out the top of the form. The contractor shall complete the bottom of the form. The contractor must provide this form with each load disposed of when required by Houston County. Attached is a copy of the completed Special Waste Acceptance Application (SWAA) (attached to end of this section) the government (will use)(was used during the design phase) to give the results of the government's testing..

Note to Designer: If we DO suspect the presence of lead based paint or asbestos (common concerns for demolition waste)--or other hazardous materials we still need to request permission for disposal via the SWAA process. DURING THE DESIGN have the lab analysis performed by a certified lab such as the base TI lab. Should you go through them, Glen McCall, 64930, is a POC and can provide instructions. If the lab analysis results is greater that .05 mg/L for lead the waste would have to be disposed of as hazardous waste--not a Subtitle D permitted facility such as the Houston County Landfill. The completed form (top & middle portion) along with a copy of the lab analysis should be forwarded to Linda Larsen in EM for obtaining approval. If we do NOT suspect the presence of lead paint, asbestos, or other hazardous materials, Houston County currently does not requiring a SWAA for materials disposed of in their C&D permitted disposal facility. If they do in the future, the contractor should take composite samples of the materials likely to be disposed of during the demolition of the project. Turn in through EM to the TI lab for testing and completion of the SWAA. Attach a copy of the lab analysis and turn in the SWAA to EM for them to sign. EM will fax the form to the County's landfill consultant for disposal approval/disapproval. Once it is approved, attach a copy to the specifications during advertisement. EM will also fill out the top part of the Waste Shipment Tracking Document at the same time. Include this form in the contract documents as well.

b. Inert Waste Landfill: Materials not likely to cause production of lechate of environmental concern may be disposed of in an inert waste landfill. Only earth and earth-like products, concrete, cured asphaltic concrete, rock, bricks, yard trimmings, and land clearing debris such as stumps, limbs, and leaves are acceptable for disposal in an inert waste landfill. This definition excludes industrial and demolition waste not specifically listed above. Provide a copy of the written notice of commencement of operation by the landfill as given to the Georgia EPD. Include the weights of material disposed of in this type of landfill in the monthly disposal and recycling report required in paragraph 3.01.C below.

c. Construction/Demolition Disposal Site: Only wood, metal, wallboard, paper, cardboard, as well as materials that can go in an inert waste landfill may be disposed of in this facility. Provide a copy of the landfill license.

d. Recycling: Recycling of materials is strongly encouraged. Materials destined for recycling must meet the definition of non-hazardous wastes under federal/state solid waste regulations. Materials defined as "recovered materials" by GA EPD regulations are excluded from regulation as solid wastes. Direct all inquiries to EMP, Pollution Prevention Division, (478) 926-1197, Ext 137.

e. All materials to be disposed of in other than a sanitary landfill must be kept segregated at the project site from those materials, which are allowed only in a sanitary landfill.

3. Solid Waste Disposal Outside of Georgia: Dispose of no solid waste outside the state of Georgia without prior written approval of the contracting officer. If the contractor desires this, he shall provide sufficient information as determined by the contracting officer to allow

verification of compliance with the law.

C. Reporting of Disposal and Recycling: Robins AFB is required to report on the amount (weight) of construction and demolition debris disposed of or recycled/reused during contracts on the base. The contractor will fill out monthly the attached Waste Management Report (at end of this section) showing the amounts of the various items disposed of or recycled/reused as a result of this contract. Weights of material disposed of in a sanitary or C&D landfill shall be based on the weight tickets required under 1.04.2.d (5) above. Material disposed of in other types of landfills, which do not have weight scales, may be estimated. The weight of materials recycled may be estimated. Use a good faith effort to obtain the most accurate estimate possible. The attached report shall be cumulative from the start of the project so that at the end of the project the final report shall reflect the total amount of material disposed of or recycled. A copy of the report will be turned in to the contract administrator monthly to be forwarded to:

WR ALC/EMPP

Attn: Solid Waste Program Manager
455 Byron St, Suite 465
Robins AFB GA 31098-1860

*** Manager: select one of the paragraphs below. If using the longer section, be sure to include all subparagraphs. ***

3.02 SPECIAL WASTES OR HAZARDOUS MATERIALS: Not applicable.

OR

3.02 SPECIAL WASTES OR HAZARDOUS MATERIALS:

A. Submit a written hazard communication program when hazardous materials or chemicals are to be used or demolished. This must include the following information:

1. A list of each work activity/process required to use/demolish hazardous materials, chemicals.
2. A list of hazardous materials/chemicals involved.
3. A Material Safety Data Sheet (MSDS) for each hazardous material/chemical involved.
4. Written procedures for disposing of hazardous waste generated.

B. Light Fixture Components

1. Included Items:

- a. HID and Fluorescent Lamps and Tubes: Those containing mercury must be recycled as hazardous waste. Excluded are low- and high-pressure sodium lamps.
- b. Fluorescent lighting ballasts and HID lighting capacitors whose labels do not specifically say that they do not contain PCB's must be destroyed as toxic waste. The items marked as non-PCB are handled as standard solid waste.
- c. Batteries used in emergency and exit lights that contain lead must be recycled as hazardous waste.

2. Advance Preparations: After the Preconstruction Conference, obtain a DODAAC account number to work directly with and pay DRMO for the disposals.

- a. To discuss DRMO prices during bidding, contact WR-ALC/EMPH at 926-1176. They have data on the latest disposal prices per pound.
 - b. After contract award, start with the EM POC in bldg 376, now MSgt Greg Mercer, WR-ALC/EMP, 926-1197, Ext 110, to discuss latest rules and obtain DODAAC form and container labels. Then have the Technical Representative of the Contracting Officer (CEG Inspector) submit DODAAC form to AFMC per instructions on the form. List Transportation Accounting Code (TAC) 3, Billing Address, and Point of Contact (POC) on DODAAC form prior to submitting.
 - c. Wait until the DODAAC account number is received to begin gathering these items, and then do the entire gathering at one time to avoid long-term storage issues.
3. Procedures for HID and Fluorescent Lamps/Tubes and Lead-Acid Batteries
- a. Gather the lamps/tubes and batteries into containers suitable for shipping per DOT guidelines. The lamps/tubes can be placed in the original boxes the new tubes came in or in boxes designed to prevent breakage.
 - b. Disposing of these items thru DRMO costs an average of \$0.50/ lb unbroken and \$6.00/lb broken, with an additional cost for containers.
 - c. Take care not to break any lamps/tubes. If any are broken, they must be treated as spilled hazardous materials per this Specification.
 - d. Place the provided labels on the boxes, properly filled out.
 - e. Deliver the boxes to bldg 359 for short-term storage, since this building is approved for such purposes. Payment for disposal will be made thru your DODAAC account.
 - f. The DRMO contractor will dispose of the items, normally by recycling the lamps, tubes and batteries. Their contractor will mail a signed copy of the manifest to EM and CE after they are transported to the disposal site.
 - g. Advise the Technical Representative of the Contracting Officer (CEG Inspector) if the containers are not delivered to DRMO within 30 days.
4. Procedures for Fluorescent lighting ballasts and HID lighting capacitors
- a. Gather the HID capacitors and fluorescent ballasts into separate containers during construction work. When through gathering them, pack them into suitably sized DOT-approved containers, per 49 CAR 173.202. Typical sizes are 1, 5, 10, 30, and 55 gallons.
 - b. Disposing of these items thru DRMO costs an average of \$0.35/ lb unbroken, with an additional cost for drums.
 - c. Take care not to break any lamps/tubes. If any are broken, they must be treated as spilled hazardous materials per this Specification.
 - d. Place the provided labels on the boxes, properly filled out.
 - e. Deliver the boxes to DRMO. Do not keep any of the full or partially full boxes at the construction site for more than 30 days. Provide DD form 1348 obtained from Bldg 359

prior to contacting DRMO.

f. Advise the Technical Representative of the Contracting Officer (CEG Inspector) if the containers are not picked up within 30 days.

g. After they are picked up deliver receipt copies to the Inspector within seven days.

h. The DRMO contractor will dispose of the items by incinerating the PCB units. Their contractor will mail a signed copy of the manifest to EM and CE after they are transported to the disposal site, and they will follow with a certificate of destruction in about one to two months.

C. Asbestos Containing Materials

1. Do not use any products containing asbestos.

MANAGER Use only one of the three choices of 2. below. ***Policy samples will be taken by the designer during design and routed through 78 CES/CEAV and WR-ALC/EMC for testing by the Base Chemical Lab to determine if the material contains asbestos or not. Items which must be sampled include floor tile and mastic, pipe insulation and insulation mastic. Others potential asbestos items include some sprayed on coatings, and roofing insulation. Funding of the testing will be by CEG for BA-04 projects and by users for tenant-funded projects. ***

(2. ASBESTOS: There is no known asbestos in the project area. However, if the contractor discovers any material he expects to be asbestos, he is to bring it to the Contracting Officer's attention immediately and stop all work in that area until directed to proceed.)

(2. ASBESTOS: Asbestos abatement work shall be performed in the areas shown as required by the specifications.)

(2. ASBESTOS: Asbestos is in the area of construction. It is located _____. There is no work to be done involving this asbestos. However, if any asbestos is accidentally damaged, notify Bioenvironmental Engineering, (478) 926-4914, and WR-ALC/EMQ, (478) 926-9777 Ext 4 immediately. After they inspect the damage, contractor shall repair it and remove debris in accordance with the following regulations, at no additional cost to the Government:

- a. 29 CFR 1910.1001 (1985)
- b. 40 CFR 61.20 Subpart B (1985)
- c. AFOSH Standard 161-4 (20 Jun 77)
- d. Georgia Air Quality Rules, Section 391-3-1-02(9)(b)1 (1986)

If the contractor discovers any other material he expects to be asbestos, he is to bring it to the Contracting Officer's attention immediately and stop all work in that area until directed to proceed)

*** Manager *** Use only one of the three choices below.

(D. Lead Paint: Not applicable.)

(D. Lead Paint (Major Abatement Requirements, (Housing?), Childcare ***Designer-not for our normal O&M projects***): All painted surfaces including painted surfaces covered by other materials such as wall paper in this project contain varying levels of lead. The contractor shall take precautions to protect

his workers and Government employees from exposure to lead dust hazards during construction and demolition in accordance with Specification Section 02065. The disposal of all debris containing lead paint shall be handled as a (non-hazardous)(hazardous) waste

***Policy: Composite samples will be taken by the designer during design and routed through 78 CES/CEAV and WR-ALC/EMC for TCLP testing by the Base Chemical Lab to determine if the debris will be a hazardous waste or not. Follow guidelines on sampling to insure the samples are representative of the weight of debris anticipated. Funding of the testing will be by CEG for BA-04 projects and by users for tenant-funded projects. ***

(D. Lead Paint (Maintenance, repair and minor construction projects): All painted surfaces including painted surfaces covered by other materials such as wall paper in this project contain varying levels of lead. The contractor shall take precautions to protect his workers and anyone near the construction from exposure to lead dust hazards during construction and demolition in accordance with 29CFR 1926.62, OSHA Lead in Construction Standard. The disposal of all debris containing lead paint is to be treated for collection and disposal purposes as a (non-) hazardous waste**make determination based on test results**). (For hazardous waste, the contractor shall provide DOT approved drums and collect the waste in the drums. The drums shall be sealed, properly labeled and turned in to the government for disposal.)

3.03 PROTECTION OF LAND RESOURCES:

A. General: Do not take any action which shall adversely affect the existing Water Quality Standards classification of any streams, rivers, lakes or reservoirs within or adjacent to the project site or which would otherwise contribute to pollution of these water resources. No fuel, oils, bituminous, calcium chloride, acids, construction waste or otherwise harmful materials shall be permitted to enter these water resources. Preserve the land resources in their present condition or restore to a condition that appears natural and does not detract from the appearance of the surrounding area. If restoration is to be accomplished, the Contractor must submit his restoration plan and receive base approval from EM on his proposed procedures.

B. Trees marked for removal on approved plans and drawings shall have existing identification tags removed (if present) and forwarded to the CO.

C. Prevention of Landscape Defacement:

1. Except in areas marked on the plans to be cleared, do not deface, injure, or destroy trees or shrubs, nor remove or cut them without authority from the CO. Trees designated to be saved shall be protected from either excavation or filling within the root zone closer than the normal drip line of the tree. No ropes, cables, or guys shall be fastened to or attached to any existing trees for anchorage unless specifically authorized by the CO. The Contractor shall in any event be responsible for any damage resulting from such use.

2. Where, in the opinion of the CO, trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or by his blasting, dumping, or other operations, the CO may direct the Contractor to adequately protect such trees by placing boards, planks, or poles around them. When directed by the CO, construct barriers to protect trees from earthwork operations. Rocks that are displaced into uncleared areas shall be removed. Monuments, markers and works of art shall be similarly protected before beginning operations near them.

D. Restoration of Landscape Damage:

1. Do not allow any trees or other debris to get into the storm drainage system.
2. Surface Drainage:
 - a. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall, if turbidity producing materials are present, be held in suitable sedimentation ponds or shall be graded to control erosion. Temporary erosion and sediment control measures such as berms, dikes, drains, or sedimentation basins, if required to meet the above standards, shall be provided and maintained until permanent drainage and erosion control facilities are completed and operating. The area of bare soil exposed by construction operations at any time shall be held to a minimum. Stream crossings by fording with equipment shall be limited to control turbidity. Fills and waste areas shall be constructed by select placement to eliminate adjacent streams.
 - b. Stabilization of permanent steep slopes shall be accomplished as soon as possible, using a 2-step procedure, if necessary, to establish vegetation. Apply mulch immediately after finished grading is completed, regardless of season, and delay seeding and fertilizing, if necessary, until the season most favorable for germination.

E. Spills: Prevent the spill of chemicals, fuels, oils, grease, bituminous materials, waste washings, herbicides, cement drainage or any other hazardous materials, including breaking fluorescent or HID lamps and tubes. Immediately report all spills to the Base Fire Department, 78 CEG/CEF, emergency number 911, giving name, telephone number, location of spill, and type and amount of material spilled. Notify the Contracting Officer of the spill immediately following initial reporting to the Fire Department. Take containment action against any hazardous spills, which threaten storm drains and other environmental areas. Ensure clean up of materials spilled as a result of contractor action, or lack thereof. The contractor is responsible for the clean up of material(s) spilled. No spill residue shall be transported off Robins AFB without specific approval from the Contracting Officer. Spills involving large quantities and/or requiring special protective clothing/breathing devices to facilitate clean up may require action by the Base Spill Response Team. Where the Spill Response Team is utilized, the contractor shall provide support, as appropriate, for containment and clean up of spills. If the spill exceeds reportable quantity limits, coordinate notification to the National Response Center with Base Environmental Management (EM) through the CO.

3.04 AIR QUALITY:

- A. Open burning operations are prohibited on base and shall not be used.
- B. Projects which will construct and put into operation equipment or processes involving regulated air emission sources will require both construction and operation permits. Examples are boilers with over 10Mbtu/hr input capacity and volatile organic compound (VOC) emissions from processes that use solvents. Provide data to CO for completion of permit applications as specified in paragraph 1.02. of this Section.
- C. Ozone depleting substances (ODS) are restricted from use. Comply with paragraph 3.07.C below.

3.05 DUST CONTROL: Maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work within or without the project boundaries free from dust which could cause a hazard or nuisance to others. Approved temporary methods of stabilization

consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods are permitted to control dust. To be approved, sprinkling must be repeated at such intervals as to keep all parts of the disturbed area damp at all times. If sprinkling is used, keep sufficient equipment on the job site at all times. Perform dust control as the work proceeds and whenever a dust nuisance or hazard occurs.

3.06 USING HAZARDOUS MATERIALS IN PERFORMING THE WORK:

- A. Written Notification: Comply with all applicable federal, state, and local requirements concerning use of hazardous materials. Provide written notification to the CO when hazardous materials/chemicals are to be used or demolished. This must include the following information:
1. A list of each work activity/process required to use/demolish hazardous materials/chemicals.
 2. A list of hazardous materials/chemicals used.
 3. A Material Safety Data Sheet (MSDS) for each hazardous material/chemical used.
 4. Written procedures for disposing of hazardous waste generated.
 5. The Contracting Officer will forward MSDS and the list of hazardous materials/chemicals to Hazardous Material Cell prior to work starting.
 6. For additional hazardous material brought on base during the performance of the contract, the contractor shall provide an updated list and MSDS to the Contracting Officer and the Contracting Officer will forward the list of hazardous material and MSDS to the Hazardous Material Cell.
- B. PCB's: Use no equipment or components containing polychlorinated biphenyls (PCB's). This includes ballasts and capacitors for fluorescent and HID lighting.
- C. Ozone Depleting Substances (ODS) Restriction: To comply with Government direction to reduce chlorofluorocarbons, provide only refrigerant 22 under this project, if applicable. Do not provide as an end product under this contract any Class I ODS or other controlled substances. If any portion of the specification or reference standard requires a Class I ODS to be provided, notify the contracting officer immediately. However, the contractor may use Class I ODS in his manufacturing process, at his option, to the extent permitted by public law. For the purposes of this policy the following are Class I ODS:
1. Halons: 1011, 1201, 1211, 1301, and 2402
 2. Chlorofluorocarbons (CFC): CFC-11, 12, 13, 111, 112, 113, 114, 115, 211, 212, 213, 214, 215, 216, 217
 3. Other controlled substances: carbon tetrachloride, methyl chloroform, and methyl bromide
- D. Asbestos: Do not use any products containing asbestos.

3.07 PESTICIDES (INSECTICIDES, FUNGICIDES, HERBICIDES, ETC.):

- A. Use only EPA approved pesticides, insecticides, fungicides, herbicides, etc.
- B. Submit proof of license for pest control operators and a list of all chemicals to be used. Use only a pest control operator licensed in the State of Georgia to apply these chemicals. Provide one copy of this submittal addressed to WR-ALC/EMX so that coordination of all pesticide usage can be coordinated with EM.
- C. Insure proper delivery, storage, handling, and disposal of all chemicals.

3.08 RADIOACTIVE MATERIALS:

A. Radioactive materials are not permitted on base without the prior approval of the CO in coordination with 78 AMDS/SGPB. Common items to be aware of include equipment for roof moisture testing, soil moisture/compaction testing, and radiographic testing of welds.

B. Dispose of radioactive waste in accordance with Technical Order 00-110N-2, Radioactive Waste Disposal. ***Insert more detailed specifications here, if applicable. Some building Exit signs may contain radioactive material.***

3.09 THREATENED AND ENDANGERED SPECIES:

A. The construction project is not anticipated to have any impact in this area since most plant and animal species of concern exist in wetlands. Any project activities believed to interface with threatened and endangered species shall be coordinated through the CO.

3.10 WETLANDS: Wetlands delineation has been completed on base and wetland boundaries are currently identified with markers. These areas shall not be disturbed and shall be protected. Comply with water and land protection paragraphs of this Section to prevent construction site sediments and runoff from entering wetlands.

3.11 UNDERGROUND STORAGE TANKS (UST's): (Not applicable.) (See specification Section *XXXXXX* for requirements regarding UST removal. The removal process must complete within a 90-day period to comply with GA EPD regulations.)

3.12 RECORDING AND PRESERVING HISTORICAL AND ARCHAEOLOGICAL FINDS:

A. Definitions:

1. Archaeological finds are defined as evidence of human occupation or use of an area prior to the year 1840. Evidence may consist of skeletons, stone, utensils, or evidence of habitations or structures.
2. Paleontological finds are defined as evidence of prehistoric plant or animal life, such as skeletons, bones, fossils, or casts and other indications such as pictographs.

B. Requirements:

1. Known area: Contractor will be digging in a known area of possible Paleontological finds. While the primary goal of the earth moving activities is the installation of the utilities, three important secondary goals can be met as well. First is the identification and avoidance of prehistoric burials. Second is the identification and salvaging of the contents of significant cultural features at the sites prior to their destruction. Third is the recovery of artifacts contained within the soil being excavated. Trenching will not be allowed in this project. Specific requirements apply to this project as follow:
 - a. The backhoe will be equipped with either a bucket lacking teeth (a flat, straight digging edge), or a bucket to which a section of grader blade has been temporarily added (i.e. spot welding) to the bucket teeth and an additional sheet of metal covering the teeth such that loosened dirt will not fall through during soil skimming. A backhoe bucket equipped with a straight cutting edge, or one that is modified as described above to have a straight cutting edge, will produce a smooth cut across the soil when skimmed. The

clean, smooth soil surface produced by straight cutting edge enhances the visibility of features, aiding the archeological monitoring and speeding the overall trenching process.

b. The backhoe excavation will proceed as follows: Once the backhoe is positioned and ready to begin excavation, the operator shall carefully skim about (2) inches (or less) of soil with each pass along the full reach of the backhoe arm. If necessary, the backhoe shall pause briefly after the pass to allow inspection of the freshly skimmed surface and for the recovery of any exposed artifacts. Occasionally, thinner skimming of the soil will be necessary such as during the initial exposure of the subplowzone portion of the soil. When that segment of trench is finally excavated to the required construction depth, the backhoe will move forward, positioned and readied to begin excavation, and then begin skimming the next segment of the trench. Assuming that no significant cultural resources are encountered that would halt excavation, some 200 to 300 feet of trench excavated to a depth of 4 feet can be excavated per day. The excavation of those areas for the installation of manholes or for equipment to push electrical conduit shall be excavated in a similar fashion.

2. Should finds be made during construction, immediately stop work in the vicinity of the find and notify the Contracting Officer.
3. The Contracting Officer may stop work in other areas if, in the Contracting Officer's opinion, the find is more extensive than may appear from uncovered materials.
4. Contractor shall call Larry Abbott (61197x145) at the beginning of the project, week before excavation starts and at least 2 hours before excavation resumes during the construction period.

C. Removal of Finds: All finds are the property of Robins Air Force Base. Do not remove or disturb finds without the Contracting Officer's written authorization.

---- END OF NARRATIVE SECTION ----

NOTE: Copies of the SWAA form, its tracking document, and monthly waste management report follow.

Houston County MSW Landfill
2018 Kings Chapel Road
Perry, Georgia 31069
Telephone: (478) 987-0089
Fax: (478) 987-0102

Profile No. _____
(Assigned by Houston County)

SPECIAL WASTE ACCEPTANCE APPLICATION (SWAA)

Generator Name: _____ Contact: _____
Address: _____
Telephone: _____ Fax: _____
Description of Waste: _____
Source / Location of Waste: _____
Waste Quantity: _____ Cubic Yards [] Tons []
Frequency of Disposal: Daily [] Weekly [] Monthly [] One Time [] Other []

LABORATORY DATA (Please attach a hard copy of laboratory test data)

Physical Properties: Physical State: _____ Solid ? Semisolid ? Liquid ? Color: _____
Halogenated Organics: mg/kg Flash Point: _____ ? F Odor: Yes ? No ?
Water Content: _____ % by Weight Paint Filter Test Passed ? Failed ?
Reactive: No ? Yes ? With H2S _____ mg/kg HCN _____ mg/kg Others _____ mg/kg
pH Value: _____ (S.U.) Infectious: Yes ? No : ?
Chemical Properties (TCLP): (Concentrations in mg/l)
Arsenic _____ m-Cresol _____ Hexachlorobenzene _____ Pyridine _____
Barium _____ p-Cresol _____ Hexachlorobutadiene _____ Selenium _____
Benzene _____ Total Cresol _____ Hexachloroethane _____ Silver _____
Cadmium _____ 2,4-D _____ Lead _____ Tetrachloroethene _____
Carbon Tetrachloride _____ 1,4 Dichlorobenzene _____ Lindane _____ Toxaphene _____
Chlordane _____ 1,2 Dichloroethane _____ Mercury _____ Trichloroethene _____
Chlorobenzene _____ 1,1 Dichloroethylene _____ Methoxychlor _____ 2,4,5 Trichlorophenol _____
Chloroform _____ 2,4 Dinitrotoluene _____ Methyl Ethyl Ketone _____ 2,4,6 Trichlorophenol _____
Chromium _____ Endrin _____ Nitrobenzene _____ 2,4,5TP (Silvex) _____
o-Cresol _____ Heptachlor (a hydroxide) _____ Pentachlorophenol _____ Vinyl Chloride _____
None of the above constituents exceed TCLP disposal limits _____
Others (List) _____
Other Information: Delivery method: Bulk ? Other _____
Regulatory Agency Approval Received: Yes ? No ? Permit Number _____
Material Safety Data Sheet Provided: Yes ? No ?

Generator's Certification Statement

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. To the best of my knowledge, the material described above is not classified as hazardous waste under current regulations, and I agree to notify Houston County MSW Landfill if such classification changes. The attached information provided is true and accurate to the best of my knowledge."

Signature of Authorizing Agent _____ Date _____
Name of Agent (Typed or Printed) _____ Title _____

Houston County MSW Landfill
2018 Kings Chapel Road
Perry, Georgia 31069
Telephone: (478) 987-0089

Profile No. _____
(Assigned to SWAA)

WASTE SHIPMENT TRACKING DOCUMENT

Generator Name: _____ Contact: _____
Address: _____
Telephone: _____ Fax: _____
Description of Waste: _____
Location of Waste: _____
Date Shipped: _____ Quantity Shipped: _____

Certification: I certify the waste described above is the waste represented by the Special Waste Acceptance Application (SWAA) of the same Profile Number and no regulated hazardous waste has been introduced into the waste.

Generator's Signature: _____ Date: _____

Transporter: _____ Contact: _____
Address: _____
Telephone: _____

Certification: I certify no regulated hazardous waste was introduced into the waste while in my custody:

Hauler's Signature: _____ Date: _____

Waste Management Report (Monthly)

I. Sanitary Landfill Waste

Quantity (tons)	Landfill Site	Tip fee/ton	*Total cost of disposal, including hauling, container rental/tip fees	*Total cost/ton

Contract Number: _____
 Contractor: _____
 Contractor POC: _____
 Phone #: _____
 Gov't Inspector: _____
 Project # Title: _____

II. Inert Landfill Disposal

Quantity (tons)	Landfill Site	*Total Cost of disposal	*Total cost/ton

Date: _____

III. Next Page

III. Alternatives to Landfilling (Recycling Strongly Encouraged)

Type of Material	Quantity (Weight) (pounds or tons)	Destination	*Cost to handle and transport	*Expected revenue & tip fee earnings	*Net cost	*Cost if landfilled	*Comparison cost (+) / savings (-)
Cardboard							
Dimensional wood							
Beverage containers							
Land debris							
Concrete							
CMU							
Asphalt							
Metals - all types							
Gypsum board							
Paint							
Carpet							
Insulation							
Glass							
Cast stone							
Wood materials							
Electric cable							
PVC piping							
Rubber flooring							
Raised flooring							
IV. Total net cost (+) or savings (-) from all alternatives to landfilling all project waste							

V. Means of keeping recyclables free of contamination

All similar materials will be grouped together based on the requirements of the recycling center. All dissimilar materials will be kept in separate containers/bins in order to avoid contamination.

*Optional

VI. Meetings to be held to address waste management

At regularly scheduled jobsite coordination/progress meetings and at job safety meetings, waste management requirements will be discussed to clarify any confusion with the craftpeople.

SECTION 07416

STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

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.

Regulatory, Reference Requirements and Standards; the most recent edition of each regulation, standard, code and requirement shall apply upon award of contract. "Where there is a conflict between the RFP and building codes, the most stringent shall apply. When codes are in conflict, the most stringent shall apply. This list is not intended to be a complete list. All work shall be designed and constructed to meet all state and federal codes, standards and laws."

ALUMINUM ASSOCIATION (AA)

AA-02 Aluminum Design Manual Specifications and Guidelines for Aluminum Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-04 Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI-01 Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463 Steel Sheet, Aluminum-Coated, by the Hot-Dip process

ASTM A 653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Gal annealed) by the Hot-Dip Process

ASTM A 792 Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM B 117 Operating Salt Spray (Fog) Testing Apparatus

ASTM C 518 Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus

ASTM C 991 Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings

ASTM C 1289 Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM D 522 Mandrel Bend Test of Attached Organic Coatings

ASTM D 523 Specular Gloss

ASTM D 714	Evaluating Degree of Blistering of Paints
ASTM D 968	Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	Measuring Adhesion by Tape Test
ASTM D 4214	Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
ASTM E 84	Surface Burning Characteristics of Building Materials
ASTM E 96	Water Vapor Transmission of Materials
ASTM E 1592	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)	
ASCE 7	Minimum Design Loads for Buildings and Other Structures

1.2 GENERAL REQUIREMENTS

The Contractor shall furnish a manufacturer's standard product which satisfies all requirements contained herein and has been verified by load testing and independent design analyses to meet the specified design requirements.

1.2.1 Manufacturer

The SSSMR system shall be the product of a manufacturer who has been in the practice of manufacturing SSSMR systems for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

1.2.2 Installer

The installer shall be certified by the SSSMR system manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be an independent installer.

1.3 DESIGN REQUIREMENTS

The design of the SSSMR system shall be provided by the Contractor as a complete system. Members and connections not indicated on the drawings shall be designed by the Contractor. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same manufacturer.

1.3.1 Design Criteria

Design criteria shall be in accordance with ASCE 7 unless otherwise specified.

1.3.2 Dead Loads

The dead load shall be the weight of the SSSMR system. Collateral loads such as sprinklers, mechanical and electrical systems, and ceilings shall not be attached to the panels.

1.3.3 Live Loads

1.3.3.1 Concentrated Loads

The panels and anchor clips shall be capable of supporting a 1335 N concentrated load. The concentrated load shall be applied at the panel midspan and will be resisted by a single standing seam metal roof panel assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

1.3.3.2 Uniform Loads

The panels and concealed anchor clips shall be capable of supporting a minimum uniform live load of 960 Pa (20 psf).

1.3.4 Roof Snow Loads

The design roof snow loads shall be as shown on the contract drawings.

1.3.5 Wind Loads

The design wind uplift pressure for the roof system shall be as shown on the contract drawings. The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly. The safety factor listed below shall be applied to the design force and compared against the ultimate capacity. Prying shall be considered when figuring fastener design loads.

- a. Single fastener in each connection.....3.0
- b. Two or more fasteners in each connection...2.25

1.3.6 Thermal Loads

Roof panels shall be free to move in response to the expansion and contraction forces resulting from a total temperature range of 110 degrees C (220 degrees F) during the life of the structure.

1.3.7 Framing Members Supporting the SSSMR System

Any additions/revisions to framing members supporting the SSSMR system to accommodate the manufacturer/fabricator's design shall be the Contractor's responsibility and shall be submitted for review and approval. New or revised framing members and their connections shall be designed in accordance with AISC-04. Maximum deflection under applied live load, snow, or wind load shall not exceed 1/180 of the span length.

1.3.8 Roof Panels Design

Steel panels shall be designed in accordance with AISI-01. Aluminum panels shall be designed in accordance with AA-02. The structural section properties used in the design of the panels shall be determined using the unloaded shape of the roof panels. The calculated panel deflection from concentrated loads shall not exceed 1/180 of the span length. The calculated panel deflection under applied live load, snow, or wind load shall not exceed 1/180 times the span length. Deflections shall be based on panels being continuous across three or more supports. Deflection shall be calculated and measured along the major ribs of the panels.

1.3.9 Accessories and Their Fasteners

Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces. There shall be a minimum of two fasteners per clip. Single fasteners with a minimum diameter of 9 mm (3/8 inch) will be allowed when the supporting structural members are prepunched or predrilled.

1.4 PERFORMANCE REQUIREMENTS

The SSSMR shall be tested for wind uplift resistance in accordance with ASTM E 1592; SSSMR systems previously tested and approved by the Corps of Engineers' STANDARD TEST METHOD FOR STRUCTURAL PERFORMANCE OF SSMRS BY UNIFORM STATIC AIR PRESSURE DIFFERENCE may be acceptable. Two tests shall be performed. Test 1 shall simulate the edge condition with one end having crosswise restraint and other end free of crosswise restraint. The maximum span length for the edge condition shall be 750 mm (30 inches). Test 2 shall simulate the interior condition with both ends free of crosswise restraint. The maximum span length for the interior condition shall be 1.5 m (5.0 feet). External reinforcement, such as clamps on the ribs, shall not be installed to improve uplift resistance. Bolts through seams shall not be installed.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Design Analysis; GA.

Design analysis signed by a Registered Professional Engineer employed by the SSSMR manufacturer. The design analysis shall include a list of the design loads, and complete calculations for the support system (when provided by the Contractor), roofing system and its components; valley designs,

gutter/downspout calculations, screw pullout test results, and shall indicate how expected thermal movements are accommodated.

SD-04 Drawings

Structural Standing Seam Metal Roof System; GA.

Metal roofing drawings and specifications and erection drawings; shop coating and finishing specifications; and other data as necessary to clearly describe design, materials, sizes, layouts, standing seam configuration, construction details, provisions for thermal movement, line of panel fixity, fastener sizes and spacings, sealants and erection procedures. Drawings shall reflect the intent of the architectural detailing using the manufacturer's proprietary products and fabricated items as required. The SSSMR system shop drawings shall be provided by the metal roofing manufacturer.

SD-08 Statements

Qualifications; FIO.

Qualifications of the manufacturer and installer.

SD-09 Reports

Test Report for Uplift Resistance of the SSSMR; GA.

The report shall include the following information:

- a. Details of the SSSMR system showing the roof panel cross-section with dimensions and thickness.
- b. Details of the anchor clip, dimensions, and thickness.
- c. Type of fasteners, size, and the number required for each connection.
- d. Purlins/subpurlins size and spacing used in the test.
- e. Description of the seaming operation including equipment used.
- f. Maximum allowable uplift pressures. These pressures are determined from the ultimate load divided by a factor of safety equal to 1.65.
- g. Any additional information required to identify the SSSMR system tested.
- h. Signature and seal of an independent registered engineer who witnessed the test.

SD-13 Certificates

Structural Standing Seam Metal Roof System; GA.

- a. Certification that the actual thickness of uncoated sheets used in SSSMRS components including roofing panels, subpurlins, and concealed anchor clips complies with specified requirements.
- b. Certification that materials used in the installation are mill certified.
- c. Previous certification of SSSMR system tested under the Corps of Engineers' Standard Test Method in lieu of ASTM E 1592 testing.
- d. Certification that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than three pieces has been tested and has met the quality standards specified for factory color finish.
- e. Certification of installer.
- f. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 20-year Warranty for Structural Standing Seam Metal Roof (SSSMR) System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material Warranty.

Insulation; FIO.

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

SD-14 Samples

Accessories; FIO.

One sample of each type of flashing, trim, closure, thermal spacer block, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels; GA.

One piece of each type to be used, 225 mm (9 inches) long, full width.

Factory Color Finish; FIO.

Three 75 by 125 mm (3 by 5 inches) samples of each type and color.

Fasteners; FIO.

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Insulation; FIO.

One piece, 300 by 300 mm (12 by 12 inches), of each type and thickness to be used, with a label indicating the rated permeance (if faced) and R-values. The flame spread, and smoke developed rating shall be shown on the label or provided in a letter of certification.

Gaskets and Insulating Compounds; GA.

Two samples of each type to be used and descriptive data.

Sealant; GA.

One sample, approximately 0.5 kg (1 pound), and descriptive data.

Concealed Anchor Clips; GA.

Two samples of each type used.

Subpurlins; GA.

One piece, 225 mm (9 inches) long.

EPDM Rubber Boots; GA.

One piece of each type.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage conditions shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The SSSMR system shall be warranted as outlined below. Any emergency temporary repairs conducted by the Government shall not negate the warranties.

1.7.1 Manufacturer's Weathertightness Warranty

The SSSMR system shall be warranted by the Manufacturer on a no penal sum basis for a period of twenty years against material and workmanship deficiencies; system deterioration caused by ordinary exposure to the elements and service design loads, water leaks, and wind uplift damage. The SSSMR system covered under this warranty shall include the entire roofing system including, but not limited to, the following: panel seams and joints, all accessories, components and trim; penetrations such as vents and curbs; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed to provide a weathertight roof system; and items specified in other sections of these specifications that become part of the structural standing seam metal roof system. All material and workmanship deficiencies, system deterioration caused by ordinary exposure to the elements and service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Manufacturer may supplement this warranty with written warranties from the installer, which shall be submitted along with Manufacturer's warranty; however, the Manufacturer shall be ultimately responsible for this warranty. The Manufacturer's written warranty shall be as outlined in attached example WARRANTY FOR STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM, and shall start upon final acceptance of the facility or the date the Government takes possession, whichever is earlier.

1.7.2 Manufacturer's Material Warranties.

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all SSSMR system components such as roof panels, anchor clips and fasteners, flashing, accessories, and trim, fabricated from coil material:

- a. A manufacturer's 20 year material warranty warranting that the aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.
- b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change color in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing with an air-drying version of the specified finish or replacing the defective coated material.

PART 2 PRODUCTS

2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 9 m (30 feet). When length of run exceeds 9 m (30 feet) and panel laps are provided, each sheet in the run shall extend over three or more supports. Sheets longer than 30 m (100 feet) may be furnished if approved by the Contracting Officer. Width of sheets shall provide not more than 600 mm (24 inches) of coverage in place. SSSMR system with roofing panels greater than 300 mm (12 inches) in width shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be not less than 38mm (2 inches).

2.1.1 Steel Panels

Steel panels shall be zinc-coated steel conforming to ASTM A 653; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463, Type 2, coating designation T2 65. Uncoated panels shall be 0.6 mm (0.0239 inch) thick minimum. Panels shall be within 95 percent of tested thickness.

2.2 CONCEALED ANCHOR CLIPS

Concealed anchor clips shall be the same as the tested roofing system. Clip bases shall have factory punched or drilled holes for attachment. Clips shall be made from multiple pieces with the allowance for the total thermal movement required to take place within the clip. Single piece clips may be acceptable when the manufacturer can substantiate that the system can accommodate the thermal cyclic movement under sustained live or snow loads.

2.3 ACCESSORIES

Flashing, trim, metal closure strips, caps and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the panels furnished. Die cast metal closures shall be installed with double bead tape sealant and fasteners that stitch the panel to a 2 mm (16 gage) preformed backer plate to ensure a positive compression of the tape sealant. The use of a continuous angle butted to the panel ends to form a closure will not be allowed.

2.4 FASTENERS

Fasteners for steel roof panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both tensile and shear ultimate strengths of not less than 3340 N (750 pounds) per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be sealed or have sealed washers on the exterior side of the roof to waterproof the fastener penetration. Washer material shall be compatible with the roofing; have a minimum diameter of 10 mm (3/8 inch) for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 3 mm (1/8 inch) thick. Exposed fasteners for factory color finished panels shall be factory finished to match the color of the panels.

2.4.1 Screws

Screws for attaching anchor devices shall be not less than No. 14. Actual screw pull out test results shall be performed for the actual material gage and yield strength of the structural purlins or subpurlins to which the clip is to be anchored/attached. Other screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

2.4.2 Bolts

Bolts shall be not less than 6 mm (1/4 inch) diameter, shouldered or plain shank as required, with locking washers and nuts.

2.4.3 Structural Blind Fasteners

Blind screw-type expandable fasteners shall be not less than 6 mm (1/4 inch) diameter. Blind (pop) rivets shall be not less than 7 mm (9/32 inch) minimum diameter.

2.5 SUBPURLINS

Cold formed supporting structural members/subpurlins shall have a minimum thickness of 1.5 mm (0.059 inches) and a minimum tensile yield strength of 345 MPa (50000 psi). Hot rolled structural members shall have a minimum thickness of 6 mm (0.25 inches) and a minimum tensile yield strength of 248 MPa (36000 psi). Subpurlins shall be galvanized or given one coat of shop paint.

2.6 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match in accordance with the Architectural Compatibility Guide for Robins Air Force Base. The exterior coating shall be a nominal 0.025 mm (2 mil) thickness consisting of a topcoat of not less than 0.018 mm (0.7 mil) dry film thickness and the paint manufacturer's recommended primer of not less than 0.005 mm (0.2mil) thickness. The interior color finish shall consist of a backer coat with a dry film thickness of 0.013 mm (0.5 mil). The exterior color finish shall meet the test requirements specified below.

2.6.1 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 3 mm diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

2.6.2 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition B for 1,000 total hours. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

2.6.3 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.6.4 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 13 mm (0.500 inch) diameter hemispherical head indenter, equal to 6.7 times the metal thickness in mm, expressed in Newton-meters, (1.5 times the metal thickness in mils), expressed in inch-pounds, with no loss of adhesion.

2.6.5 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.6.6 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 10 or less at an angle of 85 degrees when measured in accordance with ASTM D 523.

2.6.7 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.7 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 24 degrees C (75 degrees F) in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Insulation, including facings, shall have a flame spread not in excess of 75 and a smoke developed rating not in excess of 150 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

2.7.1 Polyisocyanurate Rigid Board Insulation for Use Above a Roof Deck

Polyisocyanurate insulation shall conform to ASTM C 1289, Type II, Class 1 (having a minimum recovered material content of 9 percent by weight of core material in the polyisocyanurate portion). For polyisocyanurate the maximum design R-value per 25 mm (1 inch) of insulation used shall be 1.27. Facings shall be non-asphaltic, glass fiber reinforced.

2.8 INSULATION RETAINERS

Insulation retainers shall be type, size, and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

2.9 SEALANT

Sealants shall be elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.10 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.11 VAPOR RETARDER

2.11.1 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to ASTM D 4397. A single ply of 0.25 mm (10 mil) polyethylene sheet; or, at the Contractor's option, a double ply of 0.15 mm (6 mil) polyethylene sheet shall be used. A fully compatible polyethylene tape which has equal or better water vapor control characteristics than the vapor retarder material shall be provided. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

2.11.2 Slip Sheet for Use With Vapor Retarder

Slip sheet for use with vapor retarder shall be a 0.24 kg per square meter (5 lb. per 100 square feet) rosin-sized, unsaturated building paper.

2.12 EPDM RUBBER BOOTS

Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from weather-resistant EPDM rubber. Rubber boot material shall be as recommended by the manufacturer. The boots shall have base rings made of aluminum or corrosion resisting steel that conform to the contours of the roof panel to form a weather-tight seal.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Molded closure strips shall be installed wherever roofing sheets terminate in open-end configurations, exclusive of flashings. The closure strip installation shall be weather-tight and sealed. Screws shall be installed with a clutching screw gun, to assure screws are not stripped. Field test shall be conducted on each gun prior to starting installation and periodically thereafter to assure it is adjusted properly to install particular type and size of screw as recommended by manufacturer's literature. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Field Forming of Panels

When roofing panels are formed from factory-color-finished steel coils at the project site, the same care and quality control measures that are taken in shop forming of roofing panels shall be observed. Rollformer shall be operated by the metal roofing manufacturer's representative. In cold weather conditions, preheating of the steel coils to be field formed shall be performed as necessary just prior to the rolling operations.

3.1.2 Subpurlins

Unless otherwise shown, subpurlins shall be anchored to the purlins or other structural framing members with bolts or screws. Attachment to the substrate (when provided) or to the panels is not permitted. The subpurlin spacing shall not exceed 750 mm (30 inches) on centers at the corner, edge and ridge zones, and 1500 mm (5 foot) maximum on centers for the remainder of the roof. Corner, edge, and ridge zones are as defined in ASCE 7.

3.1.3 Roof Panel Installation

Roof panels shall be installed with the standing seams in the direction of the roof slope. The side seam connections for installed panels shall be completed at the end of each day's work. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weather-tight installation. End laps of panels shall be provided in accordance with the manufacturer's instructions. Closures, flashings, EPDM rubber boots, and related accessories shall be installed according to the manufacturer's drawings. Fasteners shall not puncture roofing sheets except as provided for in the manufacturer's instructions for erection and installation. Expansion joints for the standing seam roof system shall be installed at locations indicated on the contract drawings and other locations indicated on the manufacturer's drawings.

3.1.4 Concealed Anchor Clips

Concealed anchor clips shall be fastened directly to the structural framing members. Attachment to the substrate (when provided) or to the panels is not permitted. The maximum distance, parallel to the seams, between clips shall be 750 mm (30 inches) on center at the corner, edge, and ridge zones, and 1500 mm (5 feet) maximum on centers for the remainder of the roof.

3.2 INSULATION INSTALLATION

Insulation shall be continuous over entire roof surface. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation with vapor retarder providing equivalent R-value and perm rating as remaining insulation. Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

3.2.1 Board Insulation with Blanket Insulation

Rigid board insulation shall be laid in close contact. Board shall be attached to the metal roof deck with bearing plates and fasteners, as recommended by the insulation manufacturer, so that the insulation joints are held tight against each other, and shall have a minimum of 1 fastener per 0.37 square meters (4 fasteners per square feet). Layout and joint pattern of insulation and fasteners shall be indicated on the shop drawings. If more than one layer of insulation is required, joints in the second layer shall be offset from joints in the first layer. A layer of blanket insulation shall be placed over the

rigid board insulation to be compressed against the underside of the metal roofing to reduce thermal bridging, dampen noise, and prevent roofing flutter. This layer of blanket insulation shall be compressed a minimum of 50 percent.

3.3 PROTECTION OF VAPOR RETARDER FROM ROOF DECK

A cloth industrial duct tape shall be applied over the seams of metal roof decks, at penetration edges, and at surface areas exhibiting sharp burrs or similar protrusions. For other types of roof decks, cloth industrial duct tape shall be applied over irregularities which could potentially puncture polyethylene membrane.

3.4 VAPOR RETARDER INSTALLATION

3.4.1 Polyethylene Vapor Retarder

The polyethylene vapor retarder membrane shall be installed over the entire surface. A fully compatible polyethylene tape shall be used to seal the edges of the sheets to provide a vapor tight membrane. Sheet edges shall be lapped not less than 150 mm (6 inches). Sufficient material shall be provided to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with polyethylene tape.

3.5 SLIP SHEET INSTALLATION

A slip sheet shall be laid over the blanket insulation facing to prevent the vinyl facing from adhering to the metal roofing.

3.6 CLEANING AND TOUCH-UP

Exposed SSSMR systems shall be cleaned at completion of installation. Debris that could cause discoloration and harm to the panels, flashings, closures and other accessories shall be removed. Grease and oil films, excess sealants, and handling marks shall be removed and the work shall be scrubbed clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Factory color finished surfaces shall be touched up with the manufacturer's recommended touch up paint.

MANUFACTURER'S TWENTY (20) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

PROJECT DESCRIPTION AND LOCATION (Include Bldg. No.): _____
CORPS OF ENGINEERS CONTRACT NUMBER: _____
SPECIFICATION SECTION NUMBER & DESCRIPTION:

07416 STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM

MANUFACTURER: _____
ADDRESS: _____
POINT OF CONTACT: _____
TELEPHONE NUMBER: _____
CONTRACTOR: _____
ADDRESS: _____
POINT OF CONTACT: _____
TELEPHONE NUMBER: _____
OWNER: _____
ADDRESS: _____
POINT OF CONTACT: _____
TELEPHONE NUMBER: _____
CONSTRUCTION AGENT: _____
ADDRESS: _____
POINT OF CONTACT: _____
TELEPHONE NUMBER: _____

THE SSSMR SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF TWENTY (20) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE. THE SSSMR SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE THE ENTIRE ROOFING SYSTEM, INCLUDING THE STANDING SEAM METAL ROOF PANELS, PANEL FINISHES, ROOFING SECUREMENT COMPONENTS, ALL ACCESSORIES, COMPONENTS, AND TRIM; INCLUDING PENETRATIONS SUCH VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE SSSMR SYSTEM. ALL LEAKS SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

(Company President) (Date)

(SEE REVERSE SIDE FOR SUPPLEMENTAL PROVISIONS AND EXCLUSIONS)

MANUFACTURER'S TWENTY (20) YEAR NO PENAL SUM WARRANTY
FOR
STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM
(continued)

THE MANUFACTURER MAY SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE INSTALLER OF THE SSSMR SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE MANUFACTURER'S WARRANTY. HOWEVER, THE MANUFACTURER WILL BE ULTIMATELY RESPONSIBLE FOR THE WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE SSSMR SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE FROM THE ROOF AND ALLOW PONDING WATER. MANUFACTURER'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE STRUCTURAL STANDING SEAM METAL ROOF (SSSMR) SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE MANUFACTURER AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES, UNLESS OTHERWISE APPROVED IN WRITING BY THE CONTRACTING OFFICER.

LEAKS SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE MANUFACTURER FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE SSSMR SYSTEM REPAIRED OR REPAIRED BY OTHERS AND CHARGE THE COST TO THE MANUFACTURER.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

PART 1 - GENERAL

1.01 GENERAL:

- A. Develop a rigorous marking plan.
- B. All items below included in the project, whether new or existing, shall be identified with the type identification indicated.
- C. For existing items, the existing identification may remain only if the existing identification matches perfectly this Specification in title, material, and color. If not, remove the old identification and install the new identification.

1.03 SUBMITTALS:

A. Material Submittals: Submit manufacturer’s data in lieu of the required certificate of compliance if you desire. If an “X” appears in the “Mfg. Data Required” column, then the Government requires Manufacturer’s data.

Para #	Description	Mfg. Data Req'd	Certificate of Compliance	Except Taken	Inspector's Checklist
1.03 A	Samples	<u>X</u>	---	---	---
1.03 B	List	<u>X</u>	---	---	---

B. OTHER SUBMITTALS: Omitted.

1.04 SUBMITTAL REQUIREMENTS:

- A. SAMPLES: Contractor shall submit a sample of each different type of identification required for the project.
- B. LIST: Contractor shall submit a list of all required identification, the title, the type, and the location of each in the following typed format:

Item	Title	Type	Location
----	-----	-----	-----
1	Water Heater	Engraved Plastic	Sheet 3
2	Transformer T-1	Large Reflective Label	Sheet 4

1.04 TYPES OF IDENTIFICATION: Several basic types are specified below. Unless noted otherwise, use the means listed whenever the same words are used in the body of this Specification.

- A. ENGRAVED PLASTIC PLATE shall be stamped, engraved laminated plastic with white core covered by a black front and back. Lettering shall be etched through outer covering to display white

engraved lettering on a black background. Item shall be fastened to surfaces with No. 3 Phillips round-head self-tapping screws or pop rivets. A two-component epoxy adhesive that is manufacturer recommended for use on both plastic and metal may be used in lieu of screws or rivets. Lettering shall be a minimum of 3/16" high.

B. ENGRAVED BRASS PLATE shall be engraved brass with 1/8" minimum letters. Item shall be fastened to surfaces with No. 3 Phillips round-head self-tapping screws or pop rivets.

C. METAL FOIL LABEL shall be a metal foil label or plate with minimum 1/8" high letters. Where another means is the industry standard, make such a reference in the submittal for approval.

D. LARGE REFLECTIVE LABEL shall be 3-inch high sticky-back, reflective label. The item may be one label with necessary characters or a series of labels with each individual character on it.

E. SMALL REFLECTIVE LABEL shall be a 2-inch high sticky-back, reflective label. Each character shall be on its own independent label. Item shall be attached to equipment in series to form the "title" required.

F. COLORED TAPE shall be 1" wide stripe of tape of the color indicated.

G. DYMO LABEL shall be a label-maker type label with 1/8-inch high labels. Color shall be black. A piece of clear cellophane tape shall be applied over the label. The tape shall extend 1/8-inch beyond all edges of label.

H. COLORED PAINT shall be paint of the color indicated. Apply two coats of paint of specified color to object or equipment indicated. Do not apply second coat until the Government inspects the first. If the object or equipment does not have an existing painted surface, a primer coat shall be applied in addition to the two required coats.

I. COLORED INSULATION shall be electrical wire insulation of the type and color indicated. Color-coded tape shall be kept to a minimum and shall not be used except as specifically approved by the Contracting Officer.

PART 2 - PRODUCTS - OMITTED

PART 3 - EXECUTION

3.01 GENERAL: Contractor shall install the identification of the type required in the locations required even though not specifically indicated on the Drawings.

3.02 SERVICE ENTRANCE: Each panelboard, safety switch, switchboard, or other disconnecting means which serves as a service entrance shall be identified with engraved brass plate. The nameplate shall indicate the service number and area of building served. All other services in the building, the location of each, and the area served by each shall be identified.

A. One Service Example:

MAIN SERVICE, BLDG. ###

B. Two Service Example:

BLDG ###
 SERVICE 1 OF 2
 SERVES NORTH WING
 SERVICE 2
 LOCATED IN SOUTH WING
 SERVES SOUTH WING

3.03 SWITCHBOARDS AND PANELBOARDS shall be identified with engraved plastic plate.

A. LOCATION: The nameplate shall be centered on the lower portion of the cover plate inside the hinged cover. The identification shall indicate the panelboard title (ex. "MDP" or "LPCN#1") as indicated in Drawings.

B. FEED: In addition, the nameplate shall state the switchboard from which this switchboard is fed from (ex. "fed from MD1). If the switchboard is the service equipment, the identification in paragraph 3.02 shall be used in lieu of nameplate stating where the switchboard is fed from.

C. MAIN: Each panel with a main breaker shall be identified with an engraved plastic plate attached to cover plate adjacent to directories.

D. BRANCH CIRCUITS shall be identified with engraved plastic plate. The nameplate shall indicate the load served by the circuit.

3.04 TRANSFORMERS, including transformers in unit substations or load center, shall be identified with large reflective label. The title shall consist of three parts connected by dashes (ex. MDP-75-LA.)

Part One:	Title of panelboard fed from (Use "S" if the transformer is the service transformer.)
Part Two:	KVA rating of transformer.
Part Three:	Title of panel fed by transformer.

3.05 DISCONNECTING MEANS AND CONTROL DEVICES, including motor control centers, magnetic starters, control panels, safety switches, switchboards, manual motor starters, and other disconnecting means identified by the Contracting Officer, except panelboard branch circuits which utilize typed schedules, shall be identified with engraved plastic plate. The nameplate shall indicate the load served and shall be specific in title. The title shall not be "motor" but "Ex #1 fan motor."

3.06 WIRING CONSISTING OF 600 VOLT OR LESS CONDUCTORS other than control circuits shall be identified with the following identification:

A. COLORED INSULATION for different voltage systems shall be as follows:

0-120 volt, control wiring:	red or black
120/240 volt, single-phase:	red or black
120/208 volt, 3-phase:	red, black, or blue
277/480 volt, 3-phase:	yellow, brown, or orange

B. COLOR FOR GROUNDED CONDUCTORS shall be white. Where two or more circuits of the same or differing voltage systems are run in the same conduit, wireway, junction box, or other raceways, one neutral shall have white insulation. Each other system neutral required shall have insulation of white color with an identifiable unique stripe (not green) running along the entire length.

C. COLOR FOR GROUNDING CONDUCTORS shall be green except that bare wire may be used where specifically indicated on Drawings.

D. Terminations: Use metal foil label shall be used in each enclosure where a tap, splice, or termination is made and shall indicate the panelboard and circuit from which it is fed (i.e. LP-10.) Hand lettering or marking is not acceptable.

3.07 HID FIXTURES shall be identified with metal foil label. The label shall indicate the NEMA identification of the replacement lamps.

3.08 RECEPTACLES shall be identified with DYMO label. The title shall indicate the circuit (ex. LP-3) feeding the receptacle(s). The label shall be attached to the faceplate adjacent to receptacles. With double-faced outlets, such as on floor outlets, a label shall be placed on each side.

3.09 TELE-POWER POLES shall be identified with DYMO label. The title shall indicate the circuit(s) feeding the pole. Label shall be attached to the faceplate for the receptacles.

3.10 EMERGENCY CIRCUITS:

A. General: Those conduits indicated for emergency systems (connected ahead of mains and/or fed from generator) shall be identified with colored paint, red. All conduits, switches, disconnects, fittings, junction boxes, and other related items shall be completely painted. Adjacent surfaces such as other conduits, walls, ceilings, other boxes, etc. shall not be painted. Any paint accidentally applied to these items shall be removed at no additional cost to the Government.

B. Boundaries of Emergency Circuits shall be as identified on drawings and/or specified below. Boundary of circuits connected ahead of mains shall be from the point the conduit exits the enclosure in which tap is made to the last item fed by the circuit. Boundary of circuits connected to generators shall be from the generator to and including the double throw disconnect or other switching apparatus. Boundary of emergency light circuits shall be within the lighting unit itself (no paint) since the battery provides the emergency backup.

3.11 CONTROL CIRCUITS shall be identified with metal foil label. Identification shall be provided within each enclosure where a tap, splice, or termination is made. In addition, the wire shall be identified with colored insulation and shall be consistent with colors specified above. Control circuit terminals shall be properly identified as required. Hand lettering or marking is not acceptable.

3.12 KILOWATT OR ELECTRONIC METERS shall be identified with engraved brass plate located on lower right hand corner of meter base. The following information shall be included on the nameplate:

Description of service:	SERVICE WR. 2, BLDG 300
Serial No.	SERIAL WR: 63451W62
Multiplier	MULT WR: 40
CT ratio	CT: 3-200:5
PT ratio	PT: 2-277:120
Pulse ratio	PULSE: 5/2 KWH

3.13 FIRE ALARM:

A. Fire Alarm Zoning Devices shall be identified with engraved plastic plate. Lettering shall indicate zone.

B. Fire Alarm Transmitter shall be identified with engraved plastic plate. Lettering shall indicate base circuit number.

3.14 DUCT-BANK MARKERS shall be located at the ends of all duct banks except at manholes or handholes, at approximately every 200-feet along the duct run, and at each change in direction of the duct run. Markers shall be placed approximately 2-feet to the right of the duct bank when facing the longitudinal axis of the run and in the direction of the electrical load. Markers shall be made of class B concrete, 6-inch square or round section by 2-feet long. The top edges of the marker shall have a 1/2-inch chamfer all around. The letter "D" with two arrows shall be impressed or cast on top of the marker. One arrow shall be located below the letter and shall point toward the ducts. The second arrow shall be located adjacent to the letter and shall point in a direction parallel to the ducts. The letter and the arrow adjacent to it shall each be approximately 3-inches long. The arrow under the letter shall be approximately 2-inches long. The letter and the arrows shall be V shaped and shall have a width of stroke at least 1/4-inch at the top, and depth of 1/4-inch. The top of the duct markers shall be flush in paved areas and shall protrude not more than 2 inches above finished grade in unpaved areas. Where the duct bank changes direction, the arrow located adjacent to the letter shall be cast or impressed with an angle in the arrow approximately the same as the angular change of the duct bank.

3.15 EXPOSED LENGTHS OF CONDUIT containing high-voltage power conductors operating at more than 600 volts shall have two red bands spaced 8-inches apart painted near each coupling; the intervening space between the red bands shall be painted white, and on the white space the voltage shall be stenciled in black: volts.

3.16 MODULAR WIRING SYSTEM:

A. Sections of wireway system shall be identified with small reflective label. Each section shall be marked and shall indicate what "section" it is. Each section shall be a length of the wireway that a circuit or group of circuits feeds. The "section" will be as indicated on drawings (i.e., CSA.) The identification shall be placed on each side and bottom of wireway.

B. Division Point between each section of overhead power raceway shall be by means of colored tape. The tape shall be white in color and shall encircle the wireway. The tape shall be continuous except that it shall be cut to allow the opening of the lid or cover. The tape should be placed such that no receptacle or K/O is covered up.

C. "Tap-Off" Devices in overhead raceways shall be identified with small reflective label. The nameplates shall be placed on each side and bottom of the wireway. The nameplate shall not be attached to the "tap-off" device itself or the removal cover.

D. Wiring within the wireway shall be identified with metal foil label. The title shall indicate the panelboard and circuit fed from (ex. LPCN#2-23.) The label shall be placed at each "tap-off" device at a point close to the "tap-off" device as possible. If the circuit has a dedicated neutral and/or green grounding conductor, a piece of black plastic tape shall be wrapped around all conductors for the circuit. Place label 1" from the tape.

<<<<< END OF SECTION >>>>>

SECTION 16335

Dated 12/04/98

PAD-MOUNTED AIR SWITCHES

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS

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) PUBLICATIONS

ANSI C2	1996, National Electrical Safety Code
ANSI C57.12.28	1988, Switchgear and Transformer-Pad-Mounted Equipment-Enclosure Integrity

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A123	1989, (Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	1982, (R, 1987) Zinc Coating (Hot-Dip) on Iron and Steel Products
ASTM A525	1993, (Rev. A) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LI 1	1989, Industrial Laminated Thermosetting Products
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATION

NFPA 70	1996, National Electrical Code
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1.2 GENERAL REQUIREMENTS

General requirements include those specified in Section 16011, "General Requirements, Electrical," and as specified herein. Materials not normally furnished by the manufacturer with the equipment are specified in Section 16375, "Underground Electrical Work".

1.3 SUBMITTALS

1.3.1 Catalog Information

Pad-Mounted Air Switches

1.3.2 Shop Drawings

Pad-Mounted Air Switches

Shop drawings shall indicate, but not be limited to, the following:

- a. Overall dimensions, front view, and sectional views
- b. Bus arrangements including dimensions and ampere ratings of all bus bars
- c. Type and spacing of bus supports
- d. Maximum short circuit bracing
- e. Ratings and sizes of lugs
- f. Elementary diagrams and wiring diagrams having their terminals identified, and indicating the internal wiring for each item of equipment and the interconnection between the items

1.3.3 Spare Parts Data

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

1.3.4 Operating and Maintenance Manuals

Pad-Mounted Air Switches

1.3.5 Nameplate Schedule

Contractor shall prepare nameplate schedule for all devices and cable tags for approval.

1.3.6 Test Reports

Acceptance tests.

PART 2 - PRODUCTS

2.1 INSULATED PHASE BARRIERS

Barriers shall be provided in accordance with NEMA LI1, Type GPO-3, 0.25-inch minimum thickness.

2.2 UNDERCOATING

Pad-Mounted Switches which have bases that come in contact with concrete shall have the underside of their bases coated with coating conforming to ASTM A123, ASTM A153, ASTM A525 and ASTM D 1535, 4 mils thick as applicable.

2.3 NAMEPLATES

Provide laminated plastic nameplates for each switch. Laminated plastic: 1/8-inch thick Melamine plastic white with black center core. Surface: matte finish: corners: square. Accurately align lettering and engrave into the black core. Size of nameplates: One inch by 2 1/2 inches minimum; lettering: minimum 1/4 inch high normal block lettering. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

2.4 WARNING SIGNS

Provide warning signs for the enclosures of electrical switchgear having a nominal rating of 500 volts and above. Provide metal signs having the legend "DANGER HIGH VOLTAGE" in two lines of letters of nominal 3-inch height. Provide the number of signs required to be readable from each accessible side.

2.5 THREE PHASE PAD-MOUNTED SWITCH

Provide live front, three phase, four way, gang operated, pad-mounted air switch with viewing window. Provide enclosure of reinforced formed steel sheets no less than No. 611 US gauge in accordance with ANSI C57.12.28.

2.5.1 Switch Color

Manufacturer shall prepare the switch in accordance with ANSI C57.12.28 before the final coat is applied. The final coat shall be brown, Robins AFB #48. Air switch shall be painted at the manufacturers' plant. Field painting will not be allowed.

2.5.2 Load-Break Switch

2.5.1.1 Each of the four switches shall be gang operated and rated 14.4 kV, Nominal, 95 kV BIL, with a continuous rating of 600 Amps, load-breaking of 600 Amps, and make-and-latch rating of 14,000 Amps.

2.5.2 Interrupter switches shall be operated by means of an externally accessible 3/4-inch hex switch operating hub. The switch-operating hub shall be located within a recessed pocket, mounted on the side of the pad-mounted gear enclosure and shall accommodate a 3/4-inch deep-socket wrench or a 3/4-inch shallow-socket wrench with extension. The switch-operating hub

pocket shall include a padlockable access cover that shall incorporate a hood to protect the padlock shackle from tampering. Stops shall be provided on the switch-operating hub to prevent overtravel and thereby guard against damage to the interrupter switch quick-break mechanism. Labels to indicate switch position shall be provided in the switch operating hub pocket.

2.5.3 Each interrupter switch shall be provided with a folding switch operating handle. The switch-operating handle shall be secured to the inside of the switch-operating hub pocket by a brass chain. The folded handle shall be stored behind the closed switch-operating-hub access door.

2.5.4 Interrupter switches shall utilize a quick-make quick-break mechanism installed by the switch manufacturer. The quick-make quick-break mechanism shall be integrally mounted in the switch frame, and shall swiftly and positively open and close the interrupter switch independent of the switch-operating hub speed.

2.5.5 Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.

2.5.6 Accessories

2.5.6.1 Provide front barriers for each switch with window panel above barrier for visual check of switch position.

2.5.6.2 Provide ground stud and pad for each switch and bus compartment.

2.5.6.3 Provide 18-inch 12 gauge carbon steel base spacer for increased cable termination height.

2.5.6.4 Provide distribution class surge arresters for switches as called for on the contract drawings. The surge arresters shall be metal oxide type rated 9KV.

2.5.7 Provide controlled access and tamper resistant doors with penta-head latching bolt and mechanism. All hardware of mechanism shall be zinc plated steel, stainless steel, or nonferrous material to prevent corrosion. Mechanism shall prevent padlock insertion unless mechanism is fully latched closed. Enclosure shall be finished with power coat system which exceeds 1500 hr salt spray certification requirements. Folded and overlapping edges shall be folded and finished with an iron-oxide zinc-chromate anticorrosion primer.

2.5.8 Basis of Design for Pad Mounted Air Switches is S&C Model PMH-10.

2.6 CABLE TERMINATIONS

2.6.1 Air Switch Terminations

Two types are acceptable:

Type 1: 3M 5633K for #2 cable and 3M 5635K for #500 MCM cable.

Type 2: Raychem HVT-151-SJ for #2 cable and Raychem HVT-153-SJ for 500MCM. Complete kits shall be purchased from the manufacturer. The following installation equipment shall be used in the installation of the cable termination: cable preparation tools, Raychem P63 cable preparation kit, clean lint free cloths, nonconductive abrasive cloth (120 grit or finer), electricians tape, connectors and installation tools, and Raychem recommended torch. The torch shall include the Raychem FH-2629 for refillable cylinders and FH-2616A1 for disposable cylinder.

2.6.1.1 Install ground braid around spring clamp per manufacturers' installation instructions. Connect all three ground braids together in a copper #6 one hole lug with 1/2 inch stud, and connect with the neutral on the ground bus of the air switch. Neutral conductor and ground braids shall be connected to the same bolt on the ground bus. Air Switch terminations shall be installed in strict conformance with the manufacturers' installation instructions.

2.6.1.2 A sample air switch termination for each size cable being terminated shall be performed in front of the Government representative. This sample shall be done in the same manner as intended to be installed on the primary cables. The sample termination shall be performed on a five foot section of 15 KV cable. The sample may not be used on the primary cables being installed on this project. After witnessing the sample splice, the Government representative may reject any individual which does show adequate experience or does not demonstrate proper installation techniques. The terminations shall be installed in accordance with the detailed installation instructions as recommended by the manufacturer. The sample shall be performed prior to any terminating of 15 KV cables on this project.

2.6.2 Submit high voltage cable splicer/terminator's certification of competency and experience before splices or terminations are made in high voltage cables. Splicer's experience during the immediate past 3 years shall include performance in splicing and terminating cables of this type and classification being provided under this contract.

Any individual which performs medium voltage splices and terminations shall not be employed by the Electrical Contractor. The individual may be a subcontractor of the Electrical Contractor. The individual and company shall be a separate medium voltage company and in no way owned or operated by the Electrical Contractor. The company and the individual shall be regularly engaged in the splicing, termination, and maintenance of medium voltage lines. This shall include overhead and underground medium voltage distribution between 1000 volts and 100,000 volts.

Robins AFB Area Office has the right to refuse any individual or company based solely on inadequate qualifications, poor workmanship on past projects, and failed splices/terminations performed by the individual or company on past projects.

2.7 LOCKS

The Contractor shall furnish to the Contracting Officer 6 locks and one key

for each air switch installed. The locks shall be manufactured by Best Lock Corporation, lock number 21B720L-R with core number 8A59, short shank. The keys provided shall be blank and uncut also manufactured by Best Lock Corporation to match the locks.

PART 3 - EXECUTION

3.1 INSTALLATION

ANSI C2, NFPA 70, and to the requirements specified herein.

3.2 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount Pad-Mounted Air Switches on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6by 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 a least 8 inches beyond the equipment. Provide conduit turn ups and cable entrance space as required by the equipment to be mounted. Seal voids around conduit openings in slab with water and oil resistant caulking or sealant. Provide end bell on conduit at slab surface. Concrete work shall be as specified in Section 16375. USE CAST-IN-PLACE SWITCH PADS, PRE-CAST SWITCH PADS ARE NOT PERMITTED.

3.3 GROUNDING

Install 4 ground rods around the air switch, one at each corner. Connect the ground rods to a # 4/0 copper counterpoise around the switch. Extend a #4/0 copper pigtail up into each section of the switch through a sch 40 PVC sleeve. Connect the #4/0 pigtail to the switch enclosure grounding stud in each section. The #4/0 pigtail ground shall be connected directly to the air switch enclosure. The system neutral shall be connected directly to the switch enclosure with separate bolt and washers from the #4/0 pigtail ground. The above two copper conductors shall not be split-bolt together, but instead separately connected to the air switch ground pad in each section. All connections to the copper conductors shall be of the compression type only. Bolt sizes shall be 1/2 inch diameter and 2 1/2 inch length. Install lock washer and hex nut on bolt. The lock washer shall be on the side facing the front of the switch.

Install ground strap around tape shield on cable. Connect ground strap with brass bolt, nut and lock washer to a copper compression lug for each termination. Extend an insulated #12 stranded copper conductor to a bolt and hex nut on the ground pad of the air switch. Connect all three drain leads together on an copper eyebolt, sized 1/2 inch, and connect with the neutral on the ground bus of the air switch. Neutral and drain leads shall be connected to the same bolt on the ground bus.

3.4 SWITCH INSTALLATION

Pad-Mounted Air shall be installed in strict accordance with manufacturer's instructions.

The Contractor shall install conductors in the designated switch compartments as designated by the Government representative. Prior to installing any conductors, the Contractor shall request written direction from the Government representative on which circuits will be installed in each switch compartment. In general, all circuits between air switches (500 MCM) shall be installed on the road side, with "circuit in" on the road-side from the upstream switch from the substation, and "circuit out" on the road-side to the next air switch in-line. Pad mount transformers shall be installed on the back side opposite the road.

If the Contractor installs the conductors without the written direction, then new conductors shall be installed to the switches at the Contractors cost without any additional cost to the Government.

3.5 FIELD TESTS AND INSPECTIONS

3.5.1 Acceptance Checks, Settings, and Test: Perform in accordance with the manufacturer's recommendations and latest IEEE standards. Perform work in a careful and safe manner so as not to endanger personnel or equipment. All test shall be performed by an independent testing firm.

3.5.2 Acceptance Checks and Tests: Shall include but not be limited to the following:

- a. Compare actual connections with wiring diagrams. If differences are found, determine if error is in diagram or in actual wiring and correct if necessary.
- b. Inspect all devices, equipment, etc. for damage or maladjustment caused by shipment or installation.
- c. Assure that tightness of bolted bus joints are in accordance with manufacturer's recommendations (use calibrated torque wrench).
- d. Perform all mechanical operator and contact alignment test on breakers and operating mechanisms in accordance with manufacturer's recommendations. Make adjustments as necessary.
- e. Measure contact resistance. Make adjustments as necessary to stay within manufacturer's acceptable range.
- f. Make electrical continuity checks.
- g. Remove wedges, ties, and blocks installed by the manufacturer to prevent damage during shipment.
- h. Perform overpotential test on cable prior to connection of cables. Voltage shall be supplied in five equal steps and leakage current shall be measured at one minute intervals for a period of 10 minutes. Test voltage shall be 30kV DC.

-- End of Section --

SECTION 16361
4160 Volt
PRIMARY UNIT SUBSTATION

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.121 (1989; R 1995) Switchgear - Unit Substations

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A653/A653M (2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code (ANSI/IEEE)

IEEE C57.98 (1993; Correction 1998) Guide for Transformer Impulse Tests (ANSI/IEEE)

IEEE C62.11 (1999) Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV) (ANSI/IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C12.1 (1995) Code for Electricity Metering

NEMA LI 1 (1998) Industrial Laminating Thermosetting Products

NEMA ST 20 (1992) Dry-Type Transformers for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467 (1993; R 1999, Bul. 2000) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Request For Proposal Design-Build Documents

1.3 SUBMITTALS

A. GENERAL:

B. MATERIAL SUBMITTALS: Submit manufacturer's data in lieu of the required certificate of compliance if you desire. If an "X" appears in the Mfg. Data Required" column, then the Government requires Manufacturer's data.

None required in this section.

C. OTHER SUBMITTALS: Provide the following submittals:

Para #	Description	Mfg. Data Req'd	Certificate of Compliance	Test Rpts.	Date Req'd
SD-02	Manuf. Cat. Data				
a.	Airload inter. Switch	<u>X</u>	___	___	Proposal, Design
b.	Pri. Unit Substa.	<u>X</u>	___	___	Proposal, Design
c.	Med. Volt. Switch-gear	<u>X</u>	___	___	Proposal, Design
d.	Surge Arrestors	<u>X</u>	___	___	Proposal, Design
e.	Instruments	<u>X</u>	___	___	Proposal, Design
f.	Protective relays	<u>X</u>	___	___	Proposal, Design
g.	Time current-curves	<u>X</u>	___	___	Design
SD-04	Drawings				
a.	Substa. & Swtchgr.	<u>X</u>	___	___	Proposal, Design
SD-11	Fac. Test Reports				
a.	Transformer Test	___	___	<u>X</u>	Prior to Inst.
b.	Swtchgr. Des. Tst.	___	___	<u>X</u>	Prior to Inst.
c.	Swtchgr. Paint Tst.	___	___	<u>X</u>	Prior to Inst.
d.	Load Brk. Des. Tst.	___	___	<u>X</u>	Prior to Inst.
SD-19	O&M Manuals				
a.	Primary Unit Sub.	<u>X</u>	___	___	Prior Final
b.	Med. Volt Swtchgr.	<u>X</u>	___	___	Prior Final

1.3.1 SD-02 Manufacturer's Catalog Data

- a. Air load interrupter type switches
- b. Primary unit substations
- c. Medium-voltage switchgear
- d. Surge arresters
- e. Instruments

f. Protective relays, including manufacturer's instruction bulletins

g. Manufacturer's published time-current curves (on full size logarithmic paper) of fuses and overcurrent relays.

Each submittal shall include data on fuses, circuit breakers, switches, meters, instrument transformers, surge arresters, and associated accessories. Submittals for substations and switchgear shall show sectional views of cubicles.

1.3.2 SD-04 Drawings

a. Substations and switchgear

1.3.2.1 Substations and Switchgear

Furnish drawings that include, but are not limited to, the following:

a. Overall dimensions, weights, plan view, and front view

b. Ampere Ratings of bus bars

c. Maximum short-circuit bracing

d. Circuit breaker type and ratings, or switch type, continuous and load break rating

e. Ratings and sizes of lugs, impedance, and taps

f. Elementary diagrams and wiring diagrams with terminals identified and labeled to correspond to the designations on the equipment. Diagrams shall indicate prewired interconnections between items of equipment and the interconnection between the items

g. One-line diagram

h. Manufacturer's original published time-current curves, not reproduced copies, (on full size logarithmic paper) of fuses and overcurrent relays to ensure that protection and coordination are achieved

1.3.3 SD-11 Factory Test Reports

a. Transformer tests

b. Switchgear production and design tests

c. Switchgear paint qualification test

d. Load break switches production and design tests

1.3.4 Transformer Tests

ANSI/IEEE C57.12.90 as applicable. Submit certified copies of test data for the following tests.

a. Routine and other tests: Routine and other tests, as indicated below shall be made by the manufacturer on each transformer to ensure that the design performance is maintained in production.

- (1) Resistance measurements
- (2) Ratio
- (3) Polarity and phase relation
- (4) No-load losses and excitation current
- (5) Impedance voltage and load loss
- (6) Low frequency dielectric
- (7) Leak
- (8) Impulse tests

b. Design tests: Design test reports, as indicated below, will be accepted as proof of compliance with design tests requirements.

- (1) Temperature rise
- (2) Lightning Impulse dielectric
- (3) Audible sound level
- (4) Lifting and moving devices
- (5) Pressure

1.3.4.1 Switchgear Production and Design Tests

Furnish reports which include results of production and design tests performed according to ANSI/IEEE C37.20.2 or ANSI/IEEE C37.20.3 as applicable. Production tests shall be performed by the manufacturer on each switchgear assembly to ensure that design performance is maintained in production. Impulse withstand tests shall be performed on each switchgear assembly.

1.3.4.2 Switchgear Paint Qualification Test

Furnish reports showing that the paint qualification tests has been performed according to ANSI/IEEE C37.20.2, ANSI/IEEE C37.20.3, or ANSI C57.12.28 as applicable, to ensure the adequacy of finishes to inhibit the build-up of rust on ferrous metal materials used for enclosures.

1.3.4.3 Load Break Switches Production and Design Tests

Furnish reports which include results of production and design tests performed according to ANSI/IEEE C37.71 or ANSI/NEMA C37.72 as applicable. Production tests shall be performed by the manufacturer

on each load break switch to ensure that design performance is maintained in production.

1.3.5 Field Test Reports

- a. Field dielectric tests
- b. Ground resistance tests

1.3.5.1 Ground Resistance Tests

Upon completion and before final acceptance of the work, submit the measured ground resistance of each ground rod and grounding system, including the location of the rod and grounding system and soil conditions at the time the measurements were taken.

1.3.6 SD-19 Operation and Maintenance Manuals

- a. Primary unit substations, Data Package 4
- b. Medium-voltage switchgear, Data Package 4

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 PRIMARY UNIT SUBSTATIONS

ANSI C37.121, Single ended arrangement shall consist of one incoming section, one transformer section, one transition section, the number of auxiliary sections, bus-tie sections, and outgoing sections as needed.

ANSI C37.121, Double-ended arrangement shall consist of two incoming sections, two transformer sections, two transition sections, the number of auxiliary sections, bus-tie sections, and outgoing sections as needed.

Substation shall be designed for outdoor service. External doors shall have provisions for padlocking.

2.1.1 Incoming Sections

Each incoming section shall consist of a metal-enclosed switch section for connecting the incoming circuit through a load interrupter switch to the transformer. When required for proper connection and alignment, include a transition section with the incoming section. Connection between interrupter switch and transformer shall be insulated copper cable mounted on porcelain insulators spaced no more than 2 feet apart.

2.1.1.1 Conductor Termination

Conductor terminations shall be designed for terminating one single conductor cables per phase and shall be arranged for conduits entering

from below. Provide cable terminations of the type as specified in Section 16302, "Underground Transmission and Distribution".

2.1.1.2 Load Interrupter Switch as Main Protective Device

Load interrupter shall be dead-front metal-enclosed, fused with manual spring operator rated 15 kV, 95 kV BIL for service on a 12.47 kV system with a interrupting rating of 600 amperes and a fault close rating of not less than 40,000 amperes asymmetrical. The interrupter switch shall consist of automatic, visible blade disconnects in series with vacuum interrupters. A ground bus shall extend the width of the switch enclosure and shall be bolted directly thereto. Connect frame of unit to ground bus. Switch shall be three-pole, single-throw unit. Unit shall be designed for easy inspection and fuse replacement. Switch shall be operated by a manually charged spring operator mechanism which shall simultaneously disconnect or connect ungrounded conductors. The mechanism shall enable the switch to close against a fault equal to the momentary rating of the switch without affecting its continuous current carrying or load interrupting ability. Switch shall have provision for padlocking in the open and closed positions. Fuses shall be current limiting type rated as indicated and coordinated to the transformer provided.

2.1.2 Transition Sections

Provide transition sections for cable connections to the transformer primary and secondary. Support cable connections between high-voltage switch and transformer primary by insulators, and size and brace cable to withstand the specified available fault.

2.1.3 Liquid-Filled Unit Substation Transformer(s)

- a. ANSI C37.121 and ANSI/IEEE C57.12.00.
- b. kVA rating as indicated, forced-air-cooled, 3-phase.
- c. 12.47 kV, delta Primary.
- d. 4.16 kV, wye Secondary.
- e. Less-flammable liquid-insulation.
- f. 5.75 percent minimum impedance.
- g. 55/65 degrees C. Winding temperature rise over a 24-hour average 30 degrees C, 40 degrees C maximum, ambient.
- h. 4 externally operated 2 1/2 percent full capacity taps, 2 above and 2 below rated voltage.
- i. Low-voltage neutral bushings on units having wye-connected low-voltage windings.
- j. Bushings:

(1) High Voltage: (a) Located on transformer cover; (b) Removable without requiring access to interior of transformer tank (below 1200 amperes.)

(2) Low Voltage and Neutral: Located on the transformer cover.

k. Terminations:

(1) High Voltage: Within air-filled compartment.

(2) Low Voltage: Within air-filled transition section connected to switchgear.

1. Stainless steel diagrammatic nameplates.

2.1.3.1 Less-Flammable Liquid-Insulated Transformers

Less-flammable liquid-insulated transformer shall have an insulation system rated 55/65 degrees C rise to allow transformers to have a continuous overload capacity of 12 percent at rated voltage without exceeding 65 degrees C winding temperature rise above 40 degrees C maximum ambient.

2.1.3.2 Insulating Liquids

a. Less-flammable transformer liquids: NFPA 70 and FM P7825 for less-flammable liquids having a fire point not less than 300 degrees C tested in accordance with ASTM D 92 and a dielectric strength not less than 33 kV tested in accordance with ASTM D 877. Do not provide nonflammable transformer liquids including askarel and insulating liquids containing polychlorinated biphenyls (PCB's), tetrachloroethylene (perchloroethylene), chlorine compounds, and halogenated compounds.

2.1.4 Outdoor Equipment Power Center

a. Description: Total integrated weatherproof enclosure housing distribution and control equipment in a pre-engineered package.

b. Rating

Class - NEMA 3R

Wind Loading - 125 mph

Snow Loading - 40 lbs per sq. ft - roof panels

Floor Loading - 250 lbs. per sq. in

Insulation - R13 for use in walls and doors, R30 in roof

c. Construction:

1. Base: The base shall be constructed to welded I-beams, channels, and angle supports, sized and reinforced to accommodate loading requirements. Skid beams shall be incorporated into the base of the building if the width exceeds 8 feet. When welding is complete, the base shall be cleaned and primed

with zinc-chromate, followed by a layer of bituminous undercoating. The base exterior shall be finished with an epoxy coating.

2. Floor: The floor shall be constructed of 3/16" steel plate welded to the base framework. Floor material shall be tread plate finished with ASA #61 skid resistant epoxy.
3. Wall Panels: Wall panel material shall be galvanized steel formed in an interlocking design which is self-framing and capable of withstanding wind loads of 125 mph. Panel thickness shall be 18 gauge. Interior walls shall be flat steel.
4. Roof Panels: Roof panels shall be galvanized steel formed of 12 gauge in a standing rib design eliminating the possibility of water entry and capable of withstanding snow loads of 40 p.s.f.
5. Paint Finish: Painted with 3-5 mils of epoxy paint, providing a durable, corrosion-resistance finish. Exterior color shall match the exterior of the facility. See above. Interior color shall be ANSI #61 light gray. All paint shall be factory applied. Field painting will be unacceptable.
6. Insulation: See above.
7. Lighting: Fluorescent lighting shall be provided in sufficient quantity to maintain 30 foot candles of illumination at floor level. Lights shall be 48", 32W, T-8 lamps (2), with diffuser and electronic ballast. Interior lighting shall be controlled by a 3-way light switch at each door. Exterior lighting shall consist of 70 watt high pressure sodium fixtures, photo-cell controlled H-O-A switch.
8. Receptacles: Provide two 120 volt GFI receptacles.
9. Doors:
 - a. Provide two personnel doors (3 feet X 7 feet) located at opposite ends of the enclosure. Doors shall be double-walled, galvanized, constructed with cellular neoprene gaskets, complete with stainless steel panic bar hardware, door closures, and external drip shield. A wire meshed tempered safety glass in each door is required.
 - b. Equipment access doors shall be 12 gage minimum, equipped with stainless steel continuous hinge, stainless steel pad-lockable handle. 3-point latching system, full gasketing, external drip shield, hold-open device, "DANGER, HIGH VOLTAGE", sign and metal inner skin over insulation. Equipment

access doors shall be provided along the entire back side of the Outdoor Equipment Power Center.

c. Two double access doors shall be provided on the back side to facilitate future removal of the gear. Door opening shall be a minimum of 5 feet. Doors shall be constructed similar to the equipment access doors listed above. These doors shall not block the space dedicated for a future section.

d. Personnel doors shall be provided with "BEST Locks" construction cores. Contractor shall change out cores at the jobsite. Padlocks for each rear access door as manufactured by "BEST Locks" are to be provided by the contractor.

10. Lifting Lugs: Provide lifting lugs. These lugs shall be removable to eliminate a tripping hazard.
11. Floor Cutouts: Floor cutouts with 12 gage galvanized, gasketed and removable cover plates shall be provided for bottom cable exits.
12. Transformer Throat: Transformer throat shall be provided to close couple to the incoming feed from the transformer.
13. Wiring: Wiring of all utilities shall be copper conductors with THHN insulation routed in exposed EMT conduit (3/4" minimum size) with compression connectors. Two ground pads with lugs shall be provided at diagonally opposite corners of the enclosure.

d. Accessories

1. Louvers: Louvers shall be provided to allow adequate ventilation in the building. Louvers shall be aluminum. Louvers shall be fixed. Filters shall be supplied with each louver and shall be made of expanded aluminum, mesh, and washable.
2. Heating Units: A wall mounted heating unit shall be supplied to maintain the inside temperature at 56 degrees F. with an outside temperature of 30 degrees F. The heating unit shall be 120 volts, shall be installed at the factory, and wired to a panel located inside the structure. The heating unit shall be thermostatically controlled. The unit shall be installed and tested at the factory and may be removed from the wall for shipping. Installation of the wall-mounted heater in such cases will be the responsibility of the Contractor at the job site.
3. Ventilation Fans: A wall mounted ventilating unit with gravity louvers shall be turned on when the

inside temperature reaches 90 degrees F. The unit shall be 120 volts, installed at the factory, and wired to a panel located inside the structure. The unit shall be thermostatically controlled. Thermostats shall be industrial type to operate on temperature rise. The unit shall be installed and tested at the factory and may be removed from the wall for shipping. Re-install at the job site.

4. Air Conditioning Unit: A wall mounted air conditioner shall be provided to maintain the inside temperature at 80 degrees with an outside ambient temperature at 100 degrees. Wall mounted thermostat shall control the inside temperature. Electrical heat loads inside the Outdoor Equipment Power Center shall be included in the sizing of the air conditioner.
5. Emergency Lighting: Battery operated rechargeable emergency lighting 50W dual-lamp fixture shall be furnished to provide minimum lighting for a person to exit in the event of total power failure. Batteries shall be sealed nickel-cadmium with a fifteen year life expectancy.
6. Receptacles: Convenience receptacles shall be ground fault interrupting (GFI) 125V, 20 amp, 2 pole, 3-wire ground type. Duplex type receptacles shall be provided near each of the entrance doors.
7. Panelboard: Panelboard shall be provided and wired by the manufacturer. Panelboard shall be UL listed. All current carrying parts of the bus assembly shall be copper. Provide ground bus and isolated neutral bus. Bus assembly shall be enclosed in a steel cabinet with a hinged cover. Breakers shall be bolt-on type. Provide capacity for all electrical loads described herein plus 50% future capacity. Panel shall be fed from the switchboard with a step down transformer.
8. Metal Cabinet: Provide a 16"W x 20"H x 6" D UL listed NEMA type 12 enclosure with lever handles for storage of Operations and Maintenance manuals.

2.1.5 Metal - Clad Switchgear

The medium-voltage switchgear shall consist of removable circuit breakers, control relays, protective relays, and other components as identified on the data sheets or shown on the one-line diagram. The equipment shall be of draw-out, pad-mounted, free-standing, metal-clad, dead front construction. The type of components, number of poles, voltage, frequency, trip or current rating, and interrupting capacity shall be as specified on the data sheets and/or drawings. The equipment shall be completely factory-built, assembled, wired, and tested. All of the equipment and components shall be of new construction. Used or rebuilt equipment will not be acceptable. When

it is necessary to split the units for ease of shipment, adequate materials and instructions be provided for easy field assembly. The metalclad switchgear assemblies shall conform to applicable ANSI, IEEE, and NEMA standards.

2.1.5.1 Switchgear and Wiring

a. The switchgear shall contain the required number of dead front, free standing, vertical sections erected to form a complete assembly.

b. Enclosures shall be rigidly constructed to allow mounting pad level variations of +/- 0.125 inches over the entire length of the lineup. Under these conditions doors shall open and close smoothly and all mechanical interlocks shall function properly. Steel panels and doors shall be of 11 gage minimum thickness with appropriate forming to provide strength and rigidity. Enclosures requiring rear access must have either hinged rear doors or bolted panels with lift-off handles. A front hinged panel shall be provided for each unit and instrument panel.

c. The entire assembly shall be painted the same color as the new Hangar Facility in which the substation serves. This shall include the fused interrupter switch(s), transformer(s), transition section(s), and the switchgear enclosure. Exact color to be chosen by Contracting Officer during submittal review. After fabrication and prior to painting, all steel shall be thoroughly cleaned, given a rust-preventative treatment, and painted with a rust resistant priming coat. Painting shall be accomplished at the manufacturers' facility. Field painting will not be allowed.

d. The maximum number of primary interrupting devices per vertical section shall be two. Each breaker shall occupy approximately one-half of a full height vertical section. The full height vertical section shall be approximately 95 inches and the height of each vertical section shall be shown in the vendor's drawings.

e. All primary circuit components shall be completely enclosed by grounded metal barriers. This barrier shall be such that when the enclosure door is open and the breaker is in the connected position, no live primary circuit component will be exposed. Automatic shutters shall be provided so that when a breaker is removed, disconnected, or placed in the "TEST" position, no live primary circuit elements will be exposed. All other live parts shall be enclosed within grounded metal compartments. Padlocking provisions for the "OFF" position with the door open or closed shall be included.

f. When more than one section of switchgear is required, all subsequent sections shall be bussed together. In all cases, power, ground, and wiring facilities shall be arranged for the addition of future vertical sections.

g. The entire length of power bus (i.e. horizontal and vertical sections) shall be insulated for the rated voltage. All primary and secondary bus elements and buses shall be tin-plated copper. Material and instructions necessary for insulation of connections or terminations of main power bus shall be supplied with the equipment. In addition, bus bars shall be braced to withstand the short circuit MVA specified on the data sheets or shown on the plans.

h. Phase arrangement of busses and primary circuit connections shall be A, B, C left to right, top to bottom, front to rear as viewed from the front of the equipment. This orientation shall be shown on the Vendor's drawings.

i. All vertical sections shall be connected to a common copper ground bus continuous through the horizontal length of the switchgear assembly. The ground bus shall be arranged for future extension. All internal ground connections shall be made at the factory. The ground bus shall be provided with two (2) compression lugs at each end.

j. Each line-up shall be designed to accommodate the entry of cables as shown on the drawings. Compression lugs and required support shall be provided with the equipment for the termination of all power wiring. Space shall be provided for the use of purchaser's termination kits.

2.1.5.2 Incoming Line

a. The incoming line section shall include the provision for connecting the incoming cable to the medium voltage switchgear as shown on the drawings. Space shall be provided for the termination of the incoming cables and intermediate class surge arrestors.

b. The incoming line shall contain items shown on the drawings or items where mounting is more convenient or space saving.

2.1.5.3 Circuit Interrupting Devices

a. The power circuit breaker shall be of the drawout type and shall employ vacuum as the interrupter type. Power circuit breakers of either the stored energy or solenoid type shall be electrically and mechanically trip free. Each breaker shall be interchangeable with others of the same voltage, current, and interrupting ratings. Circuit breakers shall be interlocked to prevent withdrawal or insertion into the cubicle with the breaker in the closed position. Defeating mechanism to override this shall not be permitted. Each circuit breaker shall be capable of being moved from the connected to the disconnected position (or from the disconnected to the connected position) without the circuit breaker door being opened. Each circuit breaker mechanism shall also be positively and solidly grounded the complete length of this travel.

b. Drawout circuit breakers shall be provided with secondary disconnecting devices for auxiliary functions and control circuits.

c. Circuit breakers shall be equipped for 230VAC closing and capacitor tripping. Position indicators for main controls and for closing springs shall be provided. Operating handles shall be designed in such a manner that they allow up to three separate padlocks on a locking device. The locking device shall not interfere with the tripping mechanisms of the breaker under any circumstance.

d. All circuit breakers shall include as a minimum two normally open and two normally closed dry contacts for use by others. Contacts shall be wired out to terminal blocks.

e. The opening and closing springs of each circuit breaker shall be epoxy coated or otherwise protected from hydrogen embrittlement. In addition the other metal components of the circuit breakers shall be either stainless steel or plated to protect against corrosion or rust.

2.1.5.4 Relaying, Metering and Control

a. Protective relaying and metering shall be provided as shown on the drawings, contained in the specifications, or listed on the data sheets.

b. All relays shall be selected for proper operation in the designated atmosphere without further protection.

c. Instruments, meters, relays, and other control devices and their associated wiring shall be isolated by grounded metal barriers from the primary-circuit elements. The only exception is the short lengths of wire from instruments, etc., to transformers and other related equipment.

d. Relays and instruments may be mounted on the door of the enclosure section where the medium voltage circuit breaker is located.

e. The protective relays shall be draw-out, flush or semi-flush mounted, and installed to facilitate ease of maintenance, inspection, flag reset, and testing. Flags on protective relays shall be clearly visible, indicating operation of the relay has occurred. Minimum output contact rating shall be 5 amperes at 125 VDC.

f. Protective relays shall be digital solid-state.

g. Protective relays and meters shall have provisions for testing and calibrating using an external power supply without disconnecting the permanent wiring.

h. Digital Overcurrent Relay:

1. General: The digital overcurrent relay shall be three phase and ground time overcurrent and instantaneous protective device. The relay shall be microprocessor based, true RMS sensing. The relay shall be fully drawout and shall meet the applicable NEMA and ANSI standards. The relay drawout case shall be provided with a means to short the CT secondaries when the relay is withdrawn.

2. Protection: The relay shall have the following procedure elements:

- 3 - Phase time overcurrent (51)
- 3 - Phase instantaneous overcurrent (50)
- 1 - Ground time overcurrent (51G)
- 1 - Ground instantaneous overcurrent (50G)

The relay shall have the following curve shapes:

- Moderately inverse
- Normally inverse
- Very inverse
- Extremely inverse
- Definite time

The relay shall have 40 time dial settings for each of the above characteristic curves. The selection of a curve for phase time overcurrent and the selection of a curve for ground time overcurrent shall be independent of each other. The instantaneous phase and ground functions may be set to "OFF" to disable the function.

3. Indicators: The relay shall have eight target indicating lights to display the cause of tripping. There shall also be a phase and ground pickup light. This light shall be on when the associated protection element has picked up and is timing out. The relay shall have a load indicator on the front panel to indicate load current from 10-100% of the CT rating in steps of 10%. The relay shall be capable of displaying the last five causes of trip, starting with the most recent.

4. Diagnostics: The relay shall have a continuous self-test feature. There shall be an indicating light to show that the relay is operating properly. There shall also be an indicating light to indicate if a relay failure was detected and service is required.

5. Outputs: The relay shall have the following output contacts:

- Main trip (used for breaker trip)
- Auxiliary trip (used for ground or as an 86 lockout)
- Service required (used to indicate relay status)
- 8 - Dedicated programmable form "C" contacts (pickup only, trip only, or combination of both).

The main trip output contact shall have a high current carrying capability to interface directly with a breaker trip coil.

6. Communications: The relay shall have an RS485 hardware interface for connection to a remote computer or a SCADA network. The communications protocol shall be Modbus RTU. The relay shall be capable of communicating the following:

- Status
- Currents
- Settings
- Values at time of trip

7. Setup: The relay shall be provided with a computer disk. This disk shall contain a SETUP program. This program can be used to establish communications with the relay, read and save setpoints to a computer file, configure computer settings, and provide product information. The setup software shall be capable of monitoring relay current, output contacts, status indicators, and settings. The software shall also be capable of displaying the last five causes of trip along with the measured values of current.

8. Standards: The relay shall meet ANSI/IEEE C37.90.1 and ANSI/IEEE C37.90.

9. Manufacturers: The relay shall be Multilin SR735 or approved equal.

i. Multi-Function Electronic Meter:

1. The meter shall be a micro-processor based digital meter for measuring multiple electrical quantities. The meter shall be suitable for application on a three phase electrical power system. The meter shall be capable of displaying true RMS basic metering parameters and have a communications capability.

2. The meter shall have a 40-character vacuum fluorescent display with brightness control. Metered values, status, user programmed setpoints shall be displayed. The meter shall have flash memory storage of firmware for field updating via the communications port.

3. The meter shall have an alphanumeric keypad for entering setpoints and programming the meter. The keypad shall be rubber and shall be dust tight and slash proof. In addition an RS232 computer interface port, located on the meter front, shall be provided for downloading to the meter from a laptop computer and for accessing meter data. The meter shall also be provided with two RS485 ports which shall provide simultaneous access to the meter data using the MODBUS RTU protocol.

4. The meter shall measure and display the following true RMS values: Amperes (each phase and neutral), Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, Var, Watts, KWH, KVarH, KVAH, voltage/current unbalance.

Demand metering: W, Var, Amperes, VA. Each voltage and current shall be sampled 64 times per cycle for 0.2% accuracy.

5. The meter shall have user programmable setpoints for all measured quantities. These shall include overcurrent, undercurrent, neutral current, current unbalance, voltage unbalance, phase reversal, over/under frequency, and power factor. Tamper resistant settings shall be password protected to prevent unauthorized setpoint changes.

6. The meter shall accept standard 5 Ampere current transformer inputs and standard 120 Volt potential transformer input. Potential transformers shall not be required for system voltages up to 600 Volts AC. Control power shall be either AC or DC.

7. The meter shall have four (4) isolated 4-20 mA outputs programmable from measured parameters. The meter shall have four (4) logic inputs and three (3) output relays. The output relays shall be capable of being assigned to different setpoints.

8. The meter shall contain a data logger (trending) capability. This trending capability shall be for selected measured values and the trend data shall be capable of being plotted.

9. The meter shall contain a harmonic analysis capability. Voltage and current waveforms shall captured and displayed on a PC using the PQMPC program or the PMCS software.

10. The meter shall have alarms for the following conditions: overcurrent, undercurrent, neutral current, current unbalance, over/under voltage, phase sequence, over/under frequency, power factor, and switch input. The alarm messages shall be displayed in easy to understand English format.

11. The meter shall contain an event recorder. Alarms, setpoint triggers, input and output events shall be stored in a 40 event record and time/date stamped by the internal clock. The event record shall be available for printout via the PMCS software or the PQMPC program. Minimum and maximum values shall also be continuously updated and time stamped.

12. The meter shall be supplied with the PQMPC software for programming the meter and downloading setpoint values via the RS232 communications port. The software shall also

be capable of accessing metered values and performing harmonic analysis. The software shall be Windows based and capable of running on either a desktop or laptop PC. The meter shall also be supplied with a comprehensive instruction manual.

13. The meter shall meet the following standards:

- ANSI C37.90.1 Surge - Fast Transient and Oscillatory
- ANSI C37.90.2 Radiated EMI Withstand Capability
- IEC 801.2 Static Discharge Severity Class IV
- UL 1244

14. The meter shall be equal to the GE PQM.

j. Current transformers shall be window type, 5 ampere secondary, single ratio, and shall be of the insulation class required to provide the specified system BIL level. Potential and current transformers shall have a relaying and metering accuracy class to provide satisfactory performance for the burden to be applied. The primary circuits of all potential transformers shall include current limiting fuses. Current transformers shall be designed to mechanically and thermally withstand the imposed short circuit stress. The line side of each potential transformer shall be connected to its source by insulated bus, not cable.

k. Instrument switches shall be of the rotary cam type with engraved dial nameplates. Switch escutcheon plates shall be clearly marked to show operating positions. When interrupting devices or vertical sections are equipped with more than one operating control each requiring a manual operating handle, each handle shall be of a different physical size and shape to minimize the possibility of operating errors. Control handles shall be as follows:

1) Breaker control switches shall have pistol grip handles. They shall not be located adjacent to meter switches.

2) Selector type control switches shall have oval handles. Breaker control switches shall include indicating lights as follows:

- Red - breaker closed
- Amber - breaker tripped
- Green - breaker open

2.1.5.5 Control Power

a. The control power transformer shall be connected to each supply source and housed in an individual compartment. This transformer shall supply power to all space heaters and other components. CPT's up to 15 kva shall be in a rollout compartment. CPT's above 15kva shall be fixed mounted and the primary fuses shall be mounted in a rollout tray. A control power throwover scheme shall be provided when more

than one source is available to automatically select the live source should one fail.

b. Control power transformers shall be single phase, 3-wire 120/240 volt secondary with grounded neutral. The primary and secondary circuits of all control power transformers shall be fused. The primary shall be fused with current limiting fuses.

c. Circuit breaker control power for closing shall be 230VAC. Capacitor tripping shall be used for tripping the circuit breaker. Closing circuits shall be protected by individual fuses. The tripping circuits shall not be protected.

d. The line side of each control power transformer shall be connected to the source by insulated bus, not cable.

2.1.6 Heaters

Provide in each switchgear section. Heaters shall be rated 230 V, shall have sufficient capacity to control moisture condensation in the compartments, and shall be sized 250 watts minimum. Heaters shall be controlled by a thermostat and humidistat located inside each switchgear section. Thermostats shall be industrial type, high limit, to operate on temperature rise, with range of 60 to 90 degrees F. Humidistats shall have a range of 30 percent to 60 percent relative humidity. Provide transformer rated to carry 125 percent of heater full load rating. Transformers shall have 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and shall conform to NEMA ST 20. Provide fuses in each switchgear assembly to serve the heaters in that switchgear assembly. Energize electric heaters in switchgear assemblies while the equipment is stored or in place prior to being placed in service.

2.1.7 Insulated Barriers

Where insulated barriers are required by reference standards, provide barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness.

2.1.8 Corrosion Protection

Bases, frames, and channels of substation and switchgear which come in contact with concrete shall be corrosion resistant and shall be fabricated of hot-dip galvanized steel or stainless steel.

2.1.8.1 Galvanized Steel

ASTM A123, ASTM A653/A653M G90 coating, and ASTM A153, as applicable. Galvanize after fabrication where practicable.

2.1.8.2 Stainless Steel

ASTM A 167, Type 302 or 304

2.1.9 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.

2.1.10 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 multiple 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 fit the wire securely, and shall be keyed, or otherwise arranged, in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Wire markers for factory installed conductors shall indicate wire designations corresponding to the schematic drawings. Wire markers on field installed conductors shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached, as well as the terminal number to which the wire is directly attached (near end/far end marking).

2.1.11 Surge Arresters

Provide one surge arrester for each conductor on circuits where indicated. Surge arresters shall conform to IEEE C62.11 or ANSI/IEEE C62.11 for class indicated and shall be rated 9 kV.

2.2 SOURCE QUALITY CONTROL

Switchgear and substation shall be tested as integral assemblies at the switchgear and substation manufacturer's test facility. The Government reserves the right to witness the test. Notify the Government 30 days before scheduling test date. Once acceptance of test results is received, ship switchgear and substation.

2.2.1 Transformer Test Schedule

- a. Provide transformer test schedule for tests to be performed and submit required reports.
- b. Notify Contracting Officer 15 calendar days in advance of changes to scheduled dates and location for testing.

2.2.2 Routine and Other Transformer Tests

- a. Perform ANSI/IEEE C57.12.00 and ANSI/IEEE C57.12.90 tests on actual transformer prepared for this project.

b. Submit certified copies of test reports, by serial number, and receive approval before delivery of equipment to the project site.

c. Dielectric Tests:

(1) Applied voltage

(2) Impulse

(3) Induced voltage

2.2.3 Design Transformer Tests

ANSI/IEEE C57.12.80, Section 5.1.2 states that "design test are made only on representative apparatus of basically the same design." Submit design test reports with catalog data and drawings for each of the specified transformers.

a. Tests shall be certified and signed by a registered professional engineer.

b. ANSI/IEEE C57.12.00 and ANSI/IEEE C57.12.90 tests performed on a prototype transformer will be acceptable.

c. Temperature rise: "Basically the same design" for the temperature rise test means a primary unit-substation transformer with the same coil construction (strip, layer, or disk), the same kVA, the same cooling type (OA), the same insulation class, and the same insulating liquid as the transformer specified.

d. Lightning impulse: "Basically the same design" for the lightning impulse test means a primary unit-substation transformer with the same BIL, the same coil construction (strip, layer, or disk), and a tap changer (if specified).

(1) IEEE C57.98 and ANSI/IEEE C57.12.90.

(2) State test voltage levels.

(3) Provide oscillograms with test report.

e. Lifting and moving devices: "Basically the same design" for the lifting and moving devices test means a primary unit substation transformer in the same weight range as the transformer specified.

f. Pressure: "Basically the same design" for the pressure test means a primary unit substation transformer with the same kVA and the same insulating liquid as the transformer specified.

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 ANSI 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. Connect ground conductors to the upper end of the ground rods by exothermic welds. Provide compression connectors at equipment ends of ground conductors.

3.2.2 Substation and Switchgear Grounding

Provide bare copper cable as indicated, not less than 24 inches below grade connecting to the indicated ground rods. Substation transformer neutral connections shall not be smaller than No. 4/0 AWG. 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 mats by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 16302, "Underground Transmission and Distribution."

3.2.4 Ground Cable Crossing Expansion Joints in Structures and Pavements

Protect from damage by means of approved devices or methods of installation to allow the necessary slack in the cable across the joint to permit movement. Provide stranded or other approved flexible copper cable across such separations.

3.2.5 Grounding and Bonding Equipment

UL 467.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect substations, switches, switchgear, and miscellaneous devices furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Medium-Voltage Switchgear

ANSI/IEEE C37.20.2 and ANSI/IEEE C37.20.3 as applicable.

3.3.2 Meters and Instrument Transformers

NEMA C12.1.

3.3.3 Galvanizing Repair

ASTM A 780, using galvanizing repair 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 substation and switchgear on concrete slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Slab shall be of adequate size to project at least 12 inches beyond equipment, except that front of slab shall be large enough to serve as a platform to withdraw breakers. Provide conduit turnups and cable entrance space required by the equipment to be mounted and as indicated. 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

3.5.1 Performance of Acceptance Checks and Tests

Perform acceptance check and tests in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS as applicable to transformers, substations, switches, and switchgear, and referenced ANSI standards. Perform tests specific to switches, medium-voltage circuit breakers, relays, metering, and instrument transformers in accordance with NETA ATS. Perform tests to obtain information about the performance of breakers, meters, wiring, and instrument transformers together, as well as separately. The Government reserve the right to witness formal tests after receipt of written certification that preliminary tests have been completed and that system is ready for final test and inspection. Tests shall include those listed in NETA ATS for the specified equipment and the following:

- a. Compare actual connections with wiring diagrams. If differences are found, determine if error is in diagram or in actual wiring; correct if necessary.
- b. Inspect devices and equipment for damage or maladjustment caused by shipment or installation.
- c. Use calibrated torque wrench to ensure that tightness of bolted bus joints is in accordance with manufacturer's recommendations.

- d. Measure breaker contact resistance and perform minimum pickup voltage tests on trip and closing coils. Adjust as necessary to stay within manufacturer's acceptable range.
- e. Check electric continuity of control, current, and potential circuits in accordance with wiring diagrams.
- f. Perform insulation resistance test to 500 Vdc on field-installed control wiring, and current and potential circuits. Disconnect field-installed control wiring from equipment and from factory-installed wiring before testing. Minimum insulation resistance shall be 1,000,000 ohms.
- g. Verify type, ratio, and connections of instrument transformers. Confirm correct polarity of current transformers electrically.
- h. Remove short-circuiting links from current transformers after checking that secondary circuits are complete.
- i. Verify meter connections, ensure proper calibration, and ensure that correct multiplier has been provided on face of meter.
- j. Remove wedges, ties, and blocks installed by the manufacturer to prevent damage during shipment.
- k. Check medium-voltage circuit breakers in accordance with manufacturer's instructions.
- l. Perform testing and calibration of protective relays by a certified relay technician.
- m. Verify maximum resistance to ground of grounding systems.

CAUTION: Changes of connection, insertion, and removal of instruments, relays, and meters shall be performed in such a manner that the secondary circuits of energized current transformers are not opened immediately.

3.5.2 Field Dielectric Tests

Perform field dielectric tests on medium-voltage switchgear according to ANSI/IEEE C37.20.2 or ANSI/IEEE C37.20.3 as applicable.

3.5.3 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, notify the Contracting Officer 10 working days in advance of the dates and times for checks, settings, and tests.

Design Build Contractor may elect to provide the information below on the design drawings.

SWITCHGEAR DATA SHEET

MVA RATING: []

MAIN BUS RATING: [] AMPERES

VOLTAGE: 4,160, 3-PHASE 3-WIRE

BUS MATERIAL: COPPER

GROUND BUS: [] AMPERES

GROUND BUS MATERIAL: COPPER

SYSTEM GROUNDING METHOD:

A) SOLID

ENCLOSURE:

A) Insulated Walk-IN "Outdoor Equipment Power Center"

CONNECTION TO SUPPLY SOURCE:

MATERIAL: COPPER

ENTRANCE: Side Transition Sections

TRANSITION TO TRANSFORMER: 3-PHASE 3-WIRE

COPPER

FEEDER CABLES EXIT: BELOW

MAIN METERING EACH TRANSFORMER: Refer to specification for "MULTI-FUNCTION ELECTRONIC METER"

CIRCUIT BREAKER DATA SHEET

Design Build Contractor may elect to provide the information below on the design drawings.

CIRCUIT BREAKER DESIGNATION: MAIN

CIRCUIT BREAKER AMPERE RATING: [] Amps

CIRCUIT BREAKER VOLTAGE: 4160

CIRCUIT BREAKER MVA RATING: []

CIRCUIT BREAKER:

INTERRUPTING RATING: [] kV

MOMENTARY RATING: [] kV

CIRCUIT BREAKER CLOSE VOLTAGE: [] VAC

CIRCUIT BREAKER TRIP VOLTAGE: [] VAC

CIRCUIT BREAKER ACCESSORIES:

CAPACITOR TRIP

AUXILIARY CONTACTS

POSITION SWITCH

CT SETS: 1

CT RATIO[S]: []:5

RELAYS: Digital Overcurrent Relay, See specifications included within this section.

TIE CIRCUIT BREAKER DATA SHEET

Provide normally open tie breaker for double-ended design. Design Build Contractor may elect to provide the information below on the design drawings.

CIRCUIT BREAKER DESIGNATION: TIE

CIRCUIT BREAKER AMPERE RATING: Same as Main

CIRCUIT BREAKER VOLTAGE: 4160

CIRCUIT BREAKER MVA RATING: []

CIRCUIT BREAKER:

INTERRUPTING RATING: [] kV

MOMENTARY RATING: [] kV

CIRCUIT BREAKER CLOSE VOLTAGE: [] VAC

CIRCUIT BREAKER TRIP VOLTAGE: [] VAC

CIRCUIT BREAKER ACCESSORIES:

CAPACITOR TRIP

AUXILIARY CONTACTS

POSITION SWITCH

CT SETS: 1

CT RATIO[S]: [] :5

RELAYS: Digital Overcurrent Relay, See specifications included within this section.

FEEDER CIRCUIT BREAKER DATA SHEET

Provide information on feeder circuit breakers as needed.

CIRCUIT BREAKER DESIGNATION: []

CIRCUIT BREAKER AMPERE RATING: []

CIRCUIT BREAKER VOLTAGE: 4160

CIRCUIT BREAKER MVA RATING: []

CIRCUIT BREAKER: []
INTERRUPTING RATING: [] kV
MOMENTARY RATING: [] kV

CIRCUIT BREAKER CLOSE VOLTAGE: [] VAC

CIRCUIT BREAKER TRIP VOLTAGE: [] VAC

CIRCUIT BREAKER ACCESSORIES:

CAPACITOR TRIP
AUXILIARY CONTACTS
POSITION SWITCH

CT SETS: 1
CT RATIO[S]: [] :5

RELAYS: Digital Overcurrent Relay, See specifications included within this section.

Designer Notes:

1. This specification does not include specs on medium voltage starters. The Design Build Contractor will need to develop specifications for the medium voltage starters.
2. This specification is based on the secondary main protective device and feeder circuit breakers located within an outdoor walk-in enclosure adjacent to the unit substation transformer. Only circuit breakers shall be used on the secondary side of the unit substation transformer.
3. Unit substation may or may not have feeder circuit breakers located downstream of a main protective device in the outdoor walk-in enclosure. This will be determined based on the design selected by the Design Build Contractor.
4. Provide double-ended design for 1500 KVA or larger.

-- End Of Section --

SECTION 16375

Robins AFB/COE SPEC, Dated 12/04/98

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

INDEX

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 EXTRA MATERIALS
- 2.1 STANDARD PRODUCT
- 2.2 NAMEPLATES
- 2.3 CORROSION PROTECTION
- 2.4 CABLES
- 2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS
- 2.6 CONDUIT AND DUCTS
- 2.7 MANHOLES
- 2.8 HANDHOLES
- 2.9 TRANSFORMERS
- 2.10 OMITTED
- 2.11 OMITTED
- 2.12 GROUNDING AND BONDING
- 2.13 CONCRETE IN DUCTBANK
- 3.1 GENERAL INSTALLATION REQUIREMENTS
- 3.2 MEDIUM VOLTAGE CABLE INSTALLATION
- 3.3 CABLE MARKERS
- 3.4 OMITTED
- 3.5 DUCT LINES
- 3.6 INSTALLATION --- MANHOLES, HANDHOLES
- 3.7 OMITTED
- 3.8 OMITTED
- 3.9 OMITTED
- 3.10 GROUNDING
- 3.11 FIELD TESTING
- 3.12 PRE-ENERGIZATION OF SERVICE

PART 1 GENERAL

- 1.1 REFERENCES

Latest publications for the referenced material shall apply.

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions:

- a. Altitude 1000 feet.
- b. Ambient Temperature 120 degrees F.
- c. Frequency 60HZ.

1.3 SUBMITTALS

The following shall be submitted:

SD-01 Data

Manufacturer's Catalog Data; GA

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. Original copies obtained from the manufacturer shall be provided in 3 ring hard cover binders. Original copies shall be provided for major pieces of electrical equipment. Photocopies are acceptable for all others, such as conduit material, cable, etc.

Material, Equipment, and Fixture Lists; FIO

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

Installation Procedures; FIO

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-04 Drawings

Electrical Distribution System; GA.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

The following items shall be submitted as minimum:

- a. Medium-voltage cables and accessories including cable installation plan.
- b. Medium voltage cables and splices
- c. Exterior pole mounted light fixtures.
- d. Conduit and cables
- e. Nametags
- f. Padlocks

g. Manholes

SD-09 Reports

Factory Test; FIO.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests specified in applicable publications or in these specifications. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; FIO.

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Test Reports; FIO.

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

- a. A list of all equipment used, with calibration certifications.
- b. A copy of all measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The condition specified for the test.
- f. The test results, signed and dated.
- g. A description of all adjustments made.

SD-13 Certificates

Materials and Equipment; FIO.

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 under this section of the specifications 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.

Cable Splicer Qualifications; GA.

Any company or individual which performs medium voltage splices and terminations shall not be employed by the Electrical Contractor. The individual may be a subcontractor of the Electrical Contractor. The individual and company shall be a separate medium voltage company and in no way owned or operated by the Electrical Contractor. The company and the individual shall be regularly engaged in the splicing, termination, and maintenance of medium voltage lines. This shall include overhead and underground medium voltage distribution between 1000 volts and 100,000 volts.

Provide a certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least 5 recent years of experience in splicing and terminating the same or similar types of cables approved for installation.

In addition, any person recommended by the Contractor shall be required to perform sample splices and terminations, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. A sample air switch termination for each size cable, in-line splice and loadbreak elbow being terminated shall be performed in front of the Government representative. The samples shall be done in the same manner as

intended to be installed on the primary cables. Each sample shall be performed on a five foot section of 15 KV cable. The samples may not be used on the primary cables being installed on this project. After witnessing the sample splices, the Government representative may reject any individual which does show adequate experience or does not demonstrate proper installation techniques. All splices and terminations shall be installed in accordance with the detailed installation instructions as recommended by the manufacturer. The samples shall be performed prior to any terminating of 15 KV cables on this project.

Cable Installer Qualifications; GA.

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations.

A resume shall be provided showing the cable installers' experience in the last 5 years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-19 Operation and Maintenance Manuals

Electrical Distribution System; GA.

Six copies of Operation and Maintenance manuals which includes 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 test reports.

Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Manuals shall be submitted with Section 16415, but separate from other sections included within this specification. Manual shall consist only of original manufacturers' literature and catalogs. Copies will not be accepted.

Manuals shall include a complete set of electrical sheets reflecting as-built conditions.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Light poles shall be handled and stored in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the 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 5 years' prior to bid opening.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Air switch nameplates match existing at Robins AFB. As a minimum, nameplates shall be provided for transformers and air switch section.

2.2.2 Liquid-Filled Transformer Nameplates

Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the dielectric supplied is nonpolychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.4 CABLES

All medium voltage and low voltage cables shall be single copper conductor type. Multi-conductor cables are not acceptable.

2.4.1 Medium-Voltage Cables

Conductors shall be rated for a voltage of 15,000 volts, phase to phase. All cables shall be single copper conductors. Cables shall conform to the requirements of NEMA WC-7.

2.4.1.1 Conductor

Stranded annealed copper and extruded semi-conductive conductor shield

2.4.1.2 Insulation

100 percent insulation level, cross-link polyethylene (XLP) or EPR and a semiconducting layer with black polyvinylchloride jacket.

2.4.1.3 Shield:

Wire shielded cable

2.4.1.4 Neutrals

Neutral conductors installed with 15 KV conductors shall be a separate single 600 volt copper conductor and of the same insulation material, cross-linked polyethylene (XLP).

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70. Cables shall utilize THHN/THWN insulation.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Air Switch Terminations

Two types are acceptable:

Type 1: 3M 5633K for #2 cable and 3M 5635K for #500 MCM cable. For other sizes of cable, refer to appropriate manufacturers' literature.

Type 2: Raychem HVT-151-SJ for #2 cable and Raychem HVT-153-SJ for 500MCM. For other sizes of cable, refer to appropriate manufacturers' literature. Complete kits shall be purchased from the manufacturer. The following installation equipment shall be used in the installation of the cable termination: cable preparation tools, Raychem P63 cable preparation kit, clean lint free cloths, nonconductive abrasive cloth (120 grit or finer), electricians tape, connectors and installation tools, and Raychem recommended torch. The torch shall include the Raychem FH-2629 for refillable cylinders and FH-2616A1 for disposable cylinder. For other sizes of cable, refer to appropriate manufacturers' literature.

2.5.1.1 All lugs shall be copper compression terminal long barrel, UL Listed to 35 KV, closed-end barrel transition to protect the conductor from moisture, two hole, 1/2 inch bolt hole.

Install ground braid around spring clamp per manufacturers' installation instructions. Connect all three ground braids together in a copper #6 one hole lug with 1/2 inch stud, and connect with the neutral on the ground bus of the air switch. Neutral conductor and ground braids shall be connected to the same bolt on the ground bus. Air Switch terminations shall be installed in strict conformance with the latest manufacturers' installation instructions.

2.5.2 Medium-Voltage Separable Insulated Connectors

Pad-mount transformer terminations shall be 200 amp, 15 KV class three-phase rated (8.2/14.4 KV). Loadbreak elbow connectors shall meet the full requirements of ANSI/IEEE Standard 386 - Separable, Insulated, Connector Systems. Elbow connectors shall be fully shielded and separable connection for loadbreak operation. Elbows shall be made of molded high quality Peroxide Cured EPDM insulation and have a semiconducting shield. Elbow shall contain a coppertop friction welded compression connector, tin plated copper probe, and an ababiative arc follower tip. Termination shall contain a built-in stress relief to

control voltage gradients, and a test point for determination of circuit condition.

Grounding of elbows shall be in accordance with the instructions from the Government representative. Contractor shall request an on-site meeting prior to start of any work.

2.5.3 In-Line Splices

Two types are acceptable:

Type 1: 3M 5717 for #2 cable, and 3M 5719 for 500 MCM cable. Use latest version for installation instructions from the manufacturer. For other sizes of cable, refer to appropriate manufacturers' literature.

Type 2: Raychem HVS-1511S-J for #2 cable, Raychem HVS-1513S-J for 500 MCM. Complete kits shall be purchased from the manufacturer. The following installation equipment shall be used in the installation of the cable splice: cable preparation tools, Raychem P42 cable preparation kit, clean lint free cloths, nonconducting abrasive cloth (120 grit or finer), electricians tape, connectors and installation tools, and Raychem recommended torch. The torch shall include the Raychem FH-2609, FH-2629 for refillable propane cylinders and FH-2616A1 for disposable cylinder. In-line splice terminations shall be installed in strict conformance with the manufacturers' installation instructions.

Use latest version for installation instructions from the manufacturer. Use latest version for installation instructions from the manufacturer. For other sizes of cable, refer to appropriate manufacturers' literature.

2.6 CONDUIT AND DUCTS

All medium voltage lines shall be concrete encased. All secondary lines from the transformer to the service entrance shall be concrete-encased. All other lines installed below grade shall be direct buried schedule 40 or DB. Conduit installed in concrete encased ductbanks shall be schedule 40 or DB.

All elbows installed to transformer or an air switch shall be rigid steel conduit with long sweeping bends.

Pull wires shall be installed in each empty duct. Pull wire shall be nylon, Greenlee #430 or equal with a tensile strength of 210.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.2 Concrete Encased Ducts

Types Permitted: UL 651 Schedule 40 or Type DB.

2.6.2.3 Direct Burial

Ducts specified to be concrete encased elsewhere in this specification shall be concrete encased. Only ducts not specified elsewhere as concrete encased shall be direct burial.

Types Permitted: UL 651 Schedule 40 or Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), shall neither slump at a temperature of 150 degrees C (300 degrees F), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES ---

Manholes shall have the following dimensions: 8 ft X 8 ft X 7 ft high. Minimum cover opening shall be 32 inches. All manholes shall have sumps. Primary manholes shall have four 5-inch cast in terminators with end bells on each side of the manhole. Precast-concrete manholes shall have the required strength established by ASTM C 478. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. All frames and covers shall be rated for H20 wheel loading. Cast iron shall comply with ASTM A 48, Class 30B, minimum.

2.8 Handholes

Handholes shall be provided where shown or specified. A handhole may not be used in lieu of a manhole if a manhole is specified.

Handholes shall be 4 ft X 4 ft X 4 ft. All sides and bottom shall be concrete. Handhole covers shall have a minimum clear circular opening of 32 inches, and H20 wheel loading. All new handholes shall be

manufactured with two four inch cast in terminators. All connections to any existing handhole shall be core-drilled.

2.9 Transformers: Refer to Section 16361 for 4160 volt secondary and Section 16400 for 480 volt secondary.

2.10 Omitted

2.11 Omitted

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length. Sectional type rods may be used.

2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.13 CONCRETE IN DUCTBANK

Concrete shall be a minimum of 3000 psi at 28 days.

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and ANSI C2 as applicable.

3.1.2 Verification of Dimensions

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

3.2 Medium Voltage Cable Installation

All medium voltage cables shall be installed by a company with 5 years specialized experience in medium voltage work (1,000V to 100,000V). All submittals shall be prepared by the medium voltage installer. The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then prepare a checklist of significant requirements and perform pulling calculations to prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Marking of Medium Voltage Cables

Each circuit shall be identified by means of a laminated plastic, size 4 inches by 2 inches, with black background and white 1/4 inch high letters. Tags shall be attached around the three phases and neutral with two tie wraps, (one at each corner of the tag) at three evenly spaced locations in the manhole.

Tags shall be marked as designated by the Government.

3.2.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel manufacturers standard product in lengths recommended for the specific size and type of duct that is 1/4 inch less than inside diameter of duct, two wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of two times or until less than a volume of 131 cubic centimeters (8 cubic inches) of debris is expelled from the duct.

3.2.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.4 Cable Installation For Medium Voltage Cables

The Contractor shall provide a cable feeding truck and a cable pulling winch. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations.

The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 10 degrees C (50 degrees F) temperature for at least 24 hours before installation.

3.2.5 Cables in Manholes/ Handholes

Primary cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with ANSI C2.

All cables shall be routed and supported by the medium voltage installer. New racks shall be provided as needed to support new cables in existing manholes.

3.2.5 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices for medium-voltage cables shall be made in manholes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.6 Cable Splices and Terminations

All air switch, pad mount transformer, and cable splices shall be performed by the medium voltage installer. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS.

3.3 Cable Markers

0.127 mm (5-mil), brightly colored plastic tape not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of all electrical duct lines. Inscription shall read "Electrical".

3.4 Omitted

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Long sweeping schedule 40 manufactured 90-degree duct bends shall be used at air switch and pad mount transformer risers. In ducts, the minimum manufactured bend radius shall be 18 inches for ducts of less than 3-inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections

may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Each single duct requiring concrete encasement shall be completely encased in concrete with a minimum of 3 inches of concrete around each duct, except that only 2 inches of concrete are required between adjacent electric power or adjacent communication ducts, and 6 inches of concrete shall be provided between adjacent electric power and communication ducts. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Stepped concrete connected together without rebar will not be acceptable means to achieve the monolithic construction. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. Tops of concrete encasements shall be not less than 3 feet. Contractor shall coordinate exact depth requirements with other trades and existing utilities.

Separators shall be made of plastic placed not farther apart than 6 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete by tying the ducts to the ground at every 6 feet. Install metallic backed warning tape above all duct banks.

3.5.4 Nonencased Direct-Burial

Outside the building perimeter, the top of duct lines shall be 3 feet below finished grade. Conduits installed below the building slab shall be installed 1 (one) foot below the building capillary water barrier. All conduits shall be installed with a minimum of 3 inches of earth around individual ducts, or 2 inches between adjacent ducts. Between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise uneven materials, or materials which may damage the ducts, a 3-inch layer of sand shall

be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. The excavation shall be backfilled and compacted in to 6-inch layers. Install metallic backed warning tape above all duct banks.

3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4 turn twist to set the joint tightly.

3.5.6 Duct Line Markers

Duct line markers shall be a 5-mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core. This shall permit easy location of the duct line and be placed approximately 12 inches below finished grade levels of such lines.

3.6 Installation --- MANHOLES, HANDHOLES

The exact location shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location shall be approved by the Contracting Officer before installation is started. In unpaved areas, the top of covers shall be approximately 15 mm (1/2 inch) above the finished grade. Where existing grades are lower than the new finished grade, concrete bricks with mortar or manufactured concrete rings designed for the purpose shall be installed to elevate the cover to the new finished grade. A cast metal grille-type sump frame and cover shall be installed over the sump.

Racks shall be grounded by extending a #1/0 bare ground around the walls and connected to a ground rod.

Cables shall be securely supported from walls by metal cable racks and equipped with adjustable hooks and insulators. Two cable racks shall be installed in each manhole wall and not less than two spare hooks shall be installed on each cable rack. Porcelain insulators shall be installed on the cable racks with cables. Insulators will not be required on spare hooks.

Existing manholes and handholes shall be core-drilled for duct penetrations. Install endbells on duct connections to manholes and handholes.

All ducts shall be installed perpendicular to the walls.

3.6.1 Ground Rods

A ground rod shall be installed in the manholes and handholes. Precast concrete shall have the top of the ground rod above the bottom of the manhole with a watertight sleeve in the floor or wall.

3.7 OMITTED

3.8 OMITTED

3.9 OMITTED

3.10 GROUNDING

3.10.1 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in electrical-distribution-system manholes, handholes, or concrete pullboxes shall be connected to cable racks with a #4/0 bare copper conductor. Connect all cable shielding, and metallic sheath with a No. 6 tinned copper. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.11 FIELD TESTING

3.11.1 General

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 inspections 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 shall be signed and dated by the Contractor. All field testing shall be completed and test results submitted to the Corps of Engineers Robins Area Office prior to requesting for power to facility.

3.11.2 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.

3.11.3 Ground-Resistance Tests

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

3.11.5 Medium-Voltage Cable Test

After installation and terminations, all medium voltage cables shall be given a high potential test.

If new cables are in-line spliced to existing cables, then the new cables, splices and existing cables shall be given a high potential test together. Test shall be performed at a voltage as recommended for the existing cable.

Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing.

Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other

connections, the Contractor shall make necessary repairs and replace cables. Repaired or replaced cables shall be retested.

3.11.6 Low-Voltage Cable Test

Cables shall be tested for phase to phase, phase to ground connections, and correct phase sequence. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 1000 volts dc, applied for 1 minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or cable grounded. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1,000 length of cable in meters (feet)

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

3.12 Pre-Energization of Service

3.12.1 Padlocks

Padlocks for air switches and pad mount transformers shall be required to be provided to the Government prior to energization of the system. The padlocks specified in this specification shall be the type locks provided prior to initial energization.

3.12.2 Energization/ Inspection Schedule With The Government

The Contractor shall notify the Government in writing that the electrical system is ready for inspection. The Government shall be given three working days to inspect the installation. After the inspection with the Government, all deficiencies noted shall be corrected. After the Contractor notifies the Government that all deficiencies have been corrected, three working days shall be given to the Government to inspect correction of all prior noted deficiencies. The Contractor shall then give the Government written notice that the facility is ready for application of power. The Government shall then be given not less than three working days (Mon - Fri) for the application of power to the primary system and the main switchboard.

-- End of Section --

SECTION 16400
480 volt
SECONDARY UNIT SUBSTATIONS

12/28/01

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1999) National Electrical Safety Code
ANSI C12.1	(1995) Code for Electricity Metering
ANSI C37.121	(1989; R 1995) Switchgear - Unit Substations - Requirements
ANSI C57.12.13	(1982) Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(1997; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium- Nickel Steel Plate, Sheet, and Strip
ASTM A 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D 92	(1997) Flash and Fire Points by Cleveland Open Cup
ASTM D 877	(1987; R 1995) Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 1535	(1996) Specifying Color by the Munsell System

ASTM D 3455 (1995) Compatibility of Construction Material with Electrical Insulating Oil of Petroleum Origin

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825 (1996) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

ANSI/IEEE C37.20.3 (1987; R 1992) Metal-Enclosed Interrupter Switchgear

IEEE C57.12.00 (1993) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

ANSI/IEEE C57.12.01 (1989) Dry-Type Distribution and Power Transformers including Those with Solid Cast and/or Resin-Encapsulated Windings

ANSI/IEEE C57.12.80 (1978; R 1992) Terminology for Power and Distribution Transformers

ANSI/IEEE C57.12.90 (1993) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers

ANSI/IEEE C57.98 (1993) Guide for Transformer Impulse Tests

ANSI/IEEE C62.11 (1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (1995) Electrical Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LI 1 (1989) Industrial Laminated Thermosetting Products

NEMA PB 2 (1995) Deadfront Distribution Switchboards

NEMA PB 2.1 (1996) Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less

NEMA ST 20 (1992) Dry-Type Transformers for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 467 (1993; Bul. 1994, R 1996) Grounding and Bonding Equipment

UL 489 (1996; R 1997) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

UL 891 (1994) Dead Front Switchboards

1.2 OMITTED

1.3 DEFINITIONS

- a. In the text of this section, the words "load-interrupting switch" and "load-interrupter switch" are used interchangeably and have the same meaning.
- b. Year 2000 compliant - means computer controlled facility components that accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

1.4 SUBMITTALS

1.4.1 SD-02 Manufacturer's Catalog Data

- a. Secondary unit substation G

Submittal shall include manufacturer's information for each component, device and accessory provided with the equipment.

1.4.2 SD-04 Drawings

- a. Unit Substation Drawings G

1.4.2.1 Unit Substation Drawings

Drawings shall include, but are not limited to the following:

- a. An outline drawing, with front, top, and side views
- b. Ampere ratings of bus bars
- c. Maximum short-circuit bracing
- d. Nameplate data
- e. Circuit breaker type, interrupting rating, and trip devices, including available settings

- f. Elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items
- g. One-line diagram, including switch(es), circuit breakers, current transformers, meters and fuses
- h. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the fuse in the air interrupter switch, main secondary breaker, largest secondary feeder device; transformer thermal and magnetic damage information; and transformer inrush current information (magnetic inrush point) to enable the designer of record to verify fuse size and to provide breaker settings that will ensure that protection and coordination are achieved.

1.4.2.2 Transformer Drawings

Drawings shall include, but are not limited to the following:

- a. An outline drawing, with top, front and side views
- b. ANSI nameplate data

1.4.3 SD-08 Statements

- a. Year 2000 (Y2K) Compliance Warranty G

1.4.3.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component" provide a statement of Y2K compliance warranty for the specific equipment. The contractor warrants that each hardware, software, and firmware product delivered under this contract and listed below shall be able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations to the extent that other computer controlled components, used in combination with the computer controlled component being acquired, properly exchange data and time data with it. If the contract requires that specific listed products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be as defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract, provided that, notwithstanding any provision to the contrary, in such commercial warranty or warranties, the remedies available to the Government under this warranty shall include repair or replacement of any listed product whose non-compliance is discovered and made known to the contractor in writing within one year (365 days) after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

1.4.4 SD-11 Factory Test Reports

- a. Load Interrupter Switch design and production tests G
- b. Unit Substation Switchboard design and production tests G
- c. Unit substation transformer design tests (liquid-filled) G
- d. Unit substation transformer routine and other tests (liquid-filled)G
- e. Silicone compatibility tests G

1.4.5 SD-12 Field Test Reports

- a. Submit report of results of acceptance checks and tests specified by paragraph entitled "Field Quality Control" G
- b. Ground resistance test reports G

1.4.5.1 Ground Resistance Test Reports

Upon completion and before energizing electrical equipment, 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.

1.4.6 SD-18 Records

- a. Equipment test schedule G

1.4.7 SD-19 Operation and Maintenance Manuals

- a. Unit substations, Data Package 5 G
- b. Unit Substation Transformer (liquid-filled), Data Package 5 G

Submit Operation and Maintenance Manuals in accordance with Section 01730, "Operation and Maintenance Data."

1.4.7.1 Additions to Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the following on the actual secondary unit substations provided.

- a. An instruction manual with pertinent items and information highlighted
- b. An outline drawing, including front view and sectional views with items and devices identified
- c. Prices for spare parts and supply list
- d. Routine and field acceptance test reports
- e. Time-Current-Characteristic (TCC) curves of fuses and breakers
- f. Actual nameplate diagram

g. Date of purchase

1.4.8 SHORT CIRCUIT AND PROTECTIVE COORDINATION STUDY

Refer to Section 16415 for additional information.

A. General:

1. A short circuit and coordination study shall be performed by the same company. The company shall be regularly engaged in performing a system analysis.
2. Provide a combined short-circuit and time-current analysis of the facility for approval, including recommendations to correct problems discovered.
3. Resubmit report if settings are changed during approval procedures.
4. Make changes in equipment to account for problems encountered and verified by approval procedures at no additional cost to the Government.

B. Short-circuit Analysis:

1. Use the procedures listed in ANSI/IEEE Standard 242-1986, the "Buff Book".
2. Assume 400,000 KVA, X/R = 15 available short-circuit current at the primary terminals of the load interrupter switch.
3. Electronically compute currents available down to below the lowest standard AIC ratings of the equipment at each voltage.
4. Provide results on a single-line drawing of the system.

C. Coordination Analysis:

1. Use the short-circuit values obtained above. System short circuit shall be 400 MVA, X/R = 15, at the primary terminals of the load interrupter switch.
2. Start analysis from the nearest upstream device from the first device provided by the contract, such as a transformer primary fuse.
3. Extend analysis down to each circuit breaker and fuse.
4. Provide log-log plots of the devices showing recommended settings.
5. Verify that the primary fuse sizes shown on the drawings are adequate. If coordination analysis results in a change in the primary fuse sizes shown on the drawings, provide

the correctly sized fuses at no additional cost to the government.

2 PRODUCTS

2.1 Y2K COMPATIBILITY

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant(Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, utility monitoring and control systems and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers.

2.2 OMITTED

2.3 SECONDARY UNIT SUBSTATION

Secondary Unit substations shall comply with ANSI C37.121 regardless of the kVA rating specified. Entire substation assembly shall be designed for outdoor service with ventilation openings and gasketing provided to ensure a weatherproof assembly under rain, snow, sleet, and hurricane conditions. The walk-in enclosure for the switchboard section shall have full height lockable hinged doors, an enclosed walk-in aisle with lights, receptacles and other items as indicated.

The entire secondary unit substation shall be the product of a single manufacturer, namely the switchboard manufacturer. The switchboard manufacturer shall be solely responsible for the entire secondary unit substation.

2.3.2 Double-Ended Substation

Double-ended substation shall consist of two incoming sections, two primary transition sections, two transformer sections, two secondary transition sections, secondary distribution switchboards connected together through a normally open tie breaker for the outgoing section.

As a minimum, each switchboard shall consist of a main section and distribution feeder sections. Tie breaker shall be located in a dedicated distribution section in the center. Each switchboard and tie section shall be the same depth. Each main section shall have a meter display for incoming power and a main circuit breaker. Each main breaker and tie breaker shall be 100 percent rated with stationary insulated case circuit breakers. The secondary distribution sections shall contain stationary insulated case circuit breakers or thermal magnetic circuit breakers with solid state trip functions. Feeder breakers shall be divided equally between the distribution sections. Sections shall be minimum 40 inch wide. Both main sections, tie section, and distribution sections shall be the same depth.

Power source for the control switches and meters shall be connected to a preferred side of the available energized source. If the power source is sensed as not available on the preferred side, then control power shall

automatically be transferred to the side of the available energized source.

2.3.3 Exterior Color Of Secondary Unit Substation

The entire secondary unit substation shall have the following color:

Exterior side panels --- Robins Color #68 (Light Beige)

The final exterior paint shall be applied at the factory. Field painting shall not be acceptable.

2.3.4 Incoming Section

The incoming section shall consist of a metal-enclosed switch section for connecting the incoming circuit through a fused load interrupter switch to the transformer. If required for proper connection and alignment, include a transition section with the incoming section. Provide one surge arrester conforming to ANSI/IEEE C62.11 for each phase of each incoming circuit. Arresters shall be in the circuit ahead of any disconnecting devices and shall be rated 9 kV. Provide a holder attached to the door that will hold three spare fuses.

2.3.5 Conductor Termination

Provide 3M cable terminations of the modular outdoor molded rubber type.

2.3.6 Load Fused Interrupter Switch

ANSI/IEEE C37.20.3. Provide a three-pole, single-throw, deadfront, metal-enclosed, load interrupter switch with manual stored energy operator. Switch shall be fused, with fuses mounted on a single frame and designed for easy inspection and fuse replacement. The switch shall be operated by a manually charged spring stored energy mechanism which shall simultaneously disconnect or connect ungrounded conductors. The moveable blade of the switch shall be deenergized when in the open position. The mechanism shall enable the switch to close against a fault equal to the momentary rating of the switch without affecting its continuous current carrying or load interrupting ability. A ground bus shall extend the width of the switch enclosure and shall be bolted directly thereto. Connect frame of unit to ground bus. The door shall have an inspection window to allow full view of the position of the three switch blades through the closed door. Switch ratings shall be:

- a. 15 kV, 95 kV BIL for service on a 12.47 kV system with interrupting rating 600 amperes and a fault close rating of not less than 40,000 amperes asymmetrical.
- b. Switch shall have provision for padlocking in the open and closed positions.
- c. Fuses shall be current limiting type rated in accordance with the fuse manufacturer's recommendation. Provide three spare fuses. Fuse holder for spare fuses shall be mounted to the door beneath the viewing window.

2.3.7 Primary Transition Section

Provide transition section for cable connections to the transformer primary terminals. Support cable connections between high-voltage switch and transformer primary by porcelain insulators, and size and brace cable to withstand the specified available fault.

2.3.8 Secondary Unit Substation Transformer (Liquid-Filled) Section

ANSI C57.12.13. Less-flammable liquid-insulated, two winding, 60 hertz, 55/65 degrees C rise above a 30 degrees C average ambient, forced-air cooled type.

2.3.8.1 Transformer Ratings

- a. Transformer(s) KVA sizes shall be as specified on the drawings with a continuous 55/65 degree celsius rise forced air rating.
- b. Transformer voltage ratings: Delta-Wye, 12470 V - 480Y/277 V, 95 kV BIL.
- c. Transformer windings shall be copper.
- d. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Provide tap changer, with external, pad-lockable, manual type operating handle with locks, for changing tap setting when the transformer is de-energized.
- e. Minimum tested impedance shall not be less than 5.75 percent at 85 degrees C.
- f. Audible sound levels shall comply with the following:

<u>kVA</u>	<u>DECIBELS (MAX)</u>
1000	58

- g. Diagrammatic stainless steel or laser-etched anodized aluminum nameplate
- h. Transformer shall include ground pads, lifting lugs and provisions for jacking under base. The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. The transformer shall have an insulated low-voltage neutral bushing with lugs for ground cable, and with removable ground strap.
- i. Liquid-insulated type transformer shall have the following accessories:
 - (1) Liquid-level indicator
 - (2) Pressure-vacuum gage
 - (3) Liquid temperature indicator
 - (4) Drain and filter valves

- (5) Pressure relief device
- (6) Auxiliary cooling equipment and controls
- (7) Transformer shall be forced-air cooled. Forced-air cooling fans shall have automatic temperature control relay. Power for fans shall be provided from the control transformer in the new power center.

2.3.8.2 Insulating Liquid

- a. Less-flammable transformer liquids: NFPA 70 and FM P7825 for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D 92 and a dielectric strength not less than 33 kV tested per ASTM D 877. Do not provide nonflammable transformer liquids including askarel and insulating liquids containing polychlorinated biphenyls (PCB's) and tetrachloroethylene (perchloroethylene), chlorine compounds, and halogenated compounds. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

- (1) Silicone compatibility tests: When silicone is used as a less-flammable transformer liquid, compatibility of silicone with seals and gasketing materials in oil-immersed type tap changers shall be determined by compatibility tests conducted in accordance with ASTM D 3455. Test results shall show no evidence of shrinkage, swelling, or absorption caused by the liquid.

2.3.9 Secondary Transition Section

The secondary transition section shall have a hinged front panel, three-phase, four-wire insulated main bus and connections, a ground bus, necessary terminal blocks, wiring and control buses, control power transformer, and cable supports.

2.3.10 Outgoing Section

The outgoing section shall consist of insulated-case electronic trip circuit breakers and molded-case circuit breakers housed in enclosed switchboards. Trip functions shall include solid state trip elements in all circuit breakers in the walk-in enclosure. Key-interlock main secondary breaker with the primary switch to prevent operation of the primary switch with the main secondary breaker closed. Provide circuit breaker lifting device mounted on the top of the gear.

2.3.11 Distribution Sections

2.3.11.1 Switchboards

Switchboards

NEMA PB 2 and UL 891, deadfront, metal-enclosed, self-supported type. Main bus shall be as specified on the design drawings.

Switchboard shall be UL listed as service entrance equipment. Devices shall be front and rear accessible and shall be completely isolated between

sections by vertical steel barriers. Align sections of switchboard in rear. Switchboard shall be completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring. Switchboard shall consist of main, auxiliary and distribution sections.

Ampacity of bus shall have a 100 percent rating to carry the full KVA rating of the transformer based on a continuous 55/65 degree celsius rise forced air rating.

- a. Bus Bars: copper with silver-plated contact surfaces. Plating shall be a minimum of 0.0002 inch thick. Bus shall fully rated with no tapered connections. Make bus connections and joints with hardened steel bolts. A full-capacity bus shall connect sections together, with provisions for future expansion. Buses shall be completely insulated from the devices so that the only exposed energized parts will be at the point of connection to devices. Locate each bus horizontally in the rear of each section behind the components and vertically centered. Support and brace the buses for the short-circuit current specified. Provide and secure ground bus to each vertical switchboard section and extend ground bus the entire length of the structure. Size neutral bus for 100 percent of full load amperes.
- b. Main and Tie Circuit Breakers: Insulated-Case Breaker UL listed UL 891, 100 percent rated, true RMS sensing, drawout insulated-case circuit breaker, electrically operated with an interrupting rating of not less than the ratings shown on the drawings. Provide manual charging backup handle on the front of the breaker.

Ampacity of each main breaker frame and main trip plug shall have a 100 percent rating to carry the full KVA rating of the transformer based on a continuous 65 degree celsius rise forced air rating.

Equip main breakers with solid-state trip device with adjustable long time pickup with adjustable delay, adjustable short time pickup with adjustable delay, and adjustable ground fault pickup and adjustable delay tripping functions. Key interlock the main secondary breaker with the primary switch to prevent operation of the primary switch with the main secondary breaker closed.

Equip tie breakers with solid-state trip device with adjustable long time pickup with adjustable delay, adjustable short time pickup with adjustable delay, adjustable ground fault pickup with adjustable delay, and adjustable instantaneous. Trip plug and rating of the tie breaker shall be the same as the main circuit breakers. Key interlock both the main secondary breakers with the tie circuit breaker to prevent closing operation of both secondary mains and the tie at the same time.

Provide clear hinged cover for all key interlocks with instruction plate.

- a. Operating Mechanism: Provide breaker with true two-step, stored energy mechanism which allows closing in a maximum of five cycles.

- b. Each drawout breaker shall be provided with four-position operation, as follows:
 - 1. Connected Position: Primary and secondary contacts are fully engaged. The breaker must be tripped before it can be racked into or out of this position.
 - 2. Test Position: Primary contacts are disconnected but secondary contacts remain fully engaged. This 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 a shutter assembly which isolates the primary stabs.

- c. Distribution Section: Provide group mounted devices arranged to allow removal and interchanging from the front of the switchboard without disturbing adjacent devices. Where indicated, "space for future" or "space" shall mean to include bus, device supports, and connections. Enclosure depth of the distribution sections shall be the same as the main sections.
 - 1. Feeder Breakers: UL 489 Molded-case 80 percent rated, true RMS sensing type, of sizes and capacity indicated. Breakers shall have a minimum short-circuit-current rating equal to the short-circuit-current rating of the switchboard in which the breaker will be mounted. Series rated breakers are unacceptable. Equip feeder breakers with solid-state trip device with adjustable long time pickup with adjustable delay, adjustable short time pickup with adjustable delay, adjustable ground fault pickup with adjustable delay, and adjustable instantaneous.
 - 2. 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.

- d. All breakers in the new 480 volt service entrance switchboard shall have an integral LCD ammeter display permanently affixed on the front of the breaker.

2.3.12 Outdoor Equipment Power Center

- A. Description: Total integrated weatherproof enclosure housing distribution and control equipment in a pre-engineered package.
- B. Rating

Class - NEMA 3R
Wind Locating - 125 mph
Snow Loading - 40 lbs per sq. ft - roof panels
Floor Loading - 250 lbs. per sq. in
Insulation - R13 for use in walls and doors, R30 in roof

C. Construction:

1. Base: The base shall be constructed to welded I-beams, channels, and angle supports, sized and reinforced to accommodate loading requirements. Skid beams shall be incorporated into the base of the building if the width exceeds 8 feet. When welding is complete, the base shall be cleaned and primed with zinc-chromate, followed by a layer of bituminous undercoating. The base exterior shall be finished with an epoxy coating.
2. Floor: The floor shall be constructed of 3/16" steel plate welded to the base framework. Floor material shall be tread plate finished with ASA #61 skid resistant epoxy.
3. Wall Panels: Wall panel material shall be galvanized steel formed in an interlocking design which is self-framing and capable of withstanding wind loads of 125 mph. Panel thickness shall be 18 gauge. Interior walls shall be flat steel.
4. Roof Panels: Roof panels shall be galvanized steel formed of 12 gauge in a standing rib design eliminating the possibility of water entry and capable of withstanding snow loads of 40 p.s.f.
5. Paint Finish: Painted with 3-5 mils of epoxy paint, providing a durable, corrosion-resistance finish. Exterior color shall match the exterior of the facility. See above. Interior color shall be ANSI #61 light gray. All paint shall be factory applied. Field painting will be unacceptable.
6. Insulation: See above.
7. Lighting: Fluorescent lighting shall be provided in sufficient quantity to maintain 30 foot candles of illumination at floor level. Lights shall be 48", 32W, T-8 lamps (2), with diffuser and electronic ballast. Interior lighting shall be controlled by a 3-way light switch at each door. Exterior lighting shall consist of 70 watt high pressure sodium fixtures, photo-cell controlled H-O-A switch.
8. Receptacles: Provide two 120 volt GFI receptacles.
9. Doors:
 - a. Provide two personnel doors (3 feet X 7 feet) located at opposite ends of the enclosure. Doors shall be double-walled, galvanized, constructed with cellular neoprene gaskets, complete with stainless steel panic bar hardware, door closures, and external drip shield. A wire meshed tempered safety glass in each door is required.

- b. Equipment access doors shall be 12 gage minimum, equipped with stainless steel continuous hinge, stainless steel pad-lockable handle. 3-point latching system, full gasketing, external drip shield, hold-open device, "DANGER, HIGH VOLTAGE", sign and metal inner skin over insulation. Equipment access doors shall be provided along the entire back side of the Outdoor Equipment Power Center.
 - c. Two double access doors shall be provided on the back side to facilitate future removal of the gear. Door opening shall be a minimum of 5 feet. Doors shall be constructed similar to the equipment access doors listed above. These doors shall not block the space dedicated for a future section.
 - d. Personnel doors shall be provided with "BEST Locks" construction cores. Contractor shall change out cores at the jobsite. Padlocks for each rear access door as manufactured by "BEST Locks" are to be provided by the contractor.
- 10. Lifting Lugs: Provide lifting lugs. These lugs shall be removable to eliminate a tripping hazard.
 - 11. Floor Cutouts: Floor cutouts with 12 gage galvanized, gasketed and removable cover plates shall be provided for bottom cable exits.
 - 12. Transformer Throat: Transformer throat shall be provided to close couple to the incoming feed from the transformer.
 - 13. Wiring: Wiring of all utilities shall be copper conductors with THHN insulation routed in exposed EMT conduit (3/4" minimum size) with compression connectors. Two ground pads with lugs shall be provided at diagonally opposite corners of the enclosure.

D. Accessories

- 1. Louvers: Louvers shall be provided to allow adequate ventilation in the building. Louvers shall be aluminum. Louvers shall be fixed. Filters shall be supplied with each louver and shall be made of expanded aluminum, mesh, and washable.
- 2. Heating Units: A wall mounted heating unit shall be supplied to maintain the inside temperature at 56 degrees F. with an outside temperature of 30 degrees F. The heating unit shall be 120 volts, shall be installed at the factory, and wired to a panel located inside the structure. The heating unit shall be thermostatically controlled. The unit shall be installed and tested at the factory and may be removed from the wall for shipping. Installation of the wall-mounted heater in such cases will be the responsibility of the Contractor at the job site.
- 3. Ventilation Fans: A wall mounted ventilating unit with gravity louvers shall be turned on when the inside temperature reaches 90 degrees F. The unit shall be 120 volts, installed at the factory, and wired to a panel located inside the structure. The

unit shall be thermostatically controlled. Thermostats shall be industrial type to operate on temperature rise. The unit shall be installed and tested at the factory and may be removed from the wall for shipping. Re-install at the job site.

4. Air Conditioning Unit: A wall mounted air conditioner shall be provided to maintain the inside temperature at 80 degrees with an outside ambient temperature at 100 degrees. Wall mounted thermostat shall control the inside temperature. Electrical heat loads inside the Outdoor Equipment Power Center shall be included in the sizing of the air conditioner.
5. Emergency Lighting: Battery operated rechargeable emergency lighting 50W dual-lamp fixture shall be furnished to provide minimum lighting for a person to exit in the event of total power failure. Batteries shall be sealed nickel-cadmium with a fifteen year life expectancy.
6. Receptacles: Convenience receptacles shall be ground fault interrupting (GFI) 125V, 20 amp, 2 pole, 3-wire ground type. Duplex type receptacles shall be provided near each of the entrance doors.
7. Panelboard: Panelboard shall be provided and wired by the manufacturer. Panelboard shall be UL listed. All current carrying parts of the bus assembly shall be copper. Provide ground bus and isolated neutral bus. Bus assembly shall be enclosed in a steel cabinet with a hinged cover. Breakers shall be bolt-on type. Provide capacity for all electrical loads described herein plus 50% future capacity. Panel shall be fed from the switchboard with a step down transformer.
8. Metal Cabinet: Provide a 16"W x 20"H x 6" D UL listed NEMA type 12 enclosure with lever handles for storage of Operations and Maintenance manuals.
9. Provide a Transient Voltage Surge Suppressor (TVSS) ahead of each main circuit breaker inside the Outdoor Equipment Center. On double-ended substations, a separate TVSS is required on each side of the double ended switchboard. TVSS unit shall be a separate device from the main switchboard. In other words, the TVSS shall not be integral to the switchboard, but a separate electrical component.
 - a. Substitutes must meet the minimum standards listed here.
 - b. TVSS unit shall be UL 1449 listed and provide L-N, L-G and N-G for all 3 phases. The unit shall have UL 1449 suppression rating of 800 volts in all modes. The unit shall be rated for 480/277 volt, 3-phase, 4-wire grounded wire system. TVSS unit shall be UL 1283 listed as electronic interference filters and provide 34 dB insertion loss at 100KHZ, 51dB at 1 MHZ, 54dB at 10 MHZ and 48dB at 100MHZ. The unit shall have 250,000 amp single-pulse surge current capacity based on ANSI/IEEE C62.41 8 x 20 microsecond and current waveform.

- 1) The unit shall be mounted in a NEMA 1 enclosure.
- 2) The unit shall incorporate an integral test point allowing easy off-line diagnostic testing which verifies the operational integrity of the units suppression filter system.
- 3) The unit shall include an integral fused and safety interlocked disconnect switch located in the unit enclosure with an externally mounted manual operator. The switch shall disconnect all ungrounded circuit conductors from the distribution system. The switch shall be rated for 600 VAC. Provide 200,000 AIC rated fuses for each ungrounded circuit conductor. The unit shall be UL 1449 listed with the integral fused disconnect switch and the UL 1449 Suppression Rating for this configuration shall be provided.
- 4) A Diagnostic Test Set shall be provided which verifies the operational integrity of the unit's suppression system. The Diagnostic Test Set shall be self-contained and portable, and shall provide complete assurance of the unit's installation and capability without stressing the suppression system or posing detriment to continued operation.

2.3.13 Electronic Metering

- A. Provide Electronic Metering to accommodate the monitoring devices in the Outdoor Equipment Power Center.

1. Power Meters:

- a. The Power Meter shall include an LCD readout which will allow local display of the following electrical parameters for the incoming power. The power meter shall be equipped with a two-line LCD display, which will display metering information. A separate power meter will be required on each side of double-ended switchboards.

1. Current, per phase rms
2. Voltage, phase-to-phase & phase-to-neutral
3. Real power, per phase and 3-phase total
4. Reactive power, per phase and 3-phase total
5. Apparent power, per phase and 3-phase total
6. Power factor
7. Frequency
8. Peak demand current, per phase
9. THD, current and voltage, per phase

- b. Reset of the following electrical parameters shall also be allowed from the front of the Power Meter display:

1. Peak demand current

2. Peak demand power and peak demand apparent power
 3. Energy (MWH)
 4. Reactive energy (MVARH)
- c. All reset and setup functions shall be password protected to prevent unauthorized/accidental changes.
 - d. Power Meter shall be listed UL508, industrially rated for an operating temperature range of 0 degrees C to 60 degrees C and have an overcurrent withstand rating of 500 Amperes for one second. Power Meter shall be accurate to .25% of reading plus .05% of full scale for voltage and current metering, and 3% for all power and energy functions.

2.3.14 Additional Specification Requirements

2.3.14.1 Heaters

Provide 120-volt heaters in each switchboard section. Heaters shall be of sufficient capacity to control moisture condensation in the compartments, shall be 250 watts minimum, and shall be controlled by a thermostat and humidistat located in each section. Thermostat shall be industrial type, high limit, to maintain compartments within the range of 60 to 90 degrees F. Humidistat shall have a range of 30 to 60 percent relative humidity. If heater voltage is different than substation equipment 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 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.

2.3.14.2 Insulated Barriers

Where insulated barriers are required by reference standards, provide barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness.

2.3.14.3 Corrosion Protection

Bases, frames and channels of unit substation shall be corrosion resistant and shall be fabricated of stainless steel or galvanized steel. Base shall include any part of unit substation that is within 3 inches of concrete pad.

2.3.14.4 Stainless Steel

ASTM A 167, Type 304 or 304L.

2.3.14.5 Galvanized Steel

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.

2.3.14.6 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.

2.3.14.7 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.

2.3.14.8 NAMEPLATES

Provide nameplates for each breaker. Nameplates shall be furnished by the substation manufacturer.

2.3.14.9 WARNING SIGNS

Provide warning signs on each rear equipment door.

2.3.15 SOURCE QUALITY CONTROL

2.3.15.1 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.

2.3.15.2 Load Interrupter Switch Design and Production Tests

ANSI/IEEE C37.20.3. Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Design Tests

- (1) Dielectric:
 - a) Low-frequency withstand
 - b) Impulse withstand
- (2) Continuous current

- (3) Short-time current withstand (2 - second)
- (4) Momentary current (10 cycles)
- (5) Mechanical endurance
- (6) Insulator Supports
 - a) Flame-resistance
 - b) Tracking-resistance
- (7) Bus-bar insulation
 - a) Dielectric Strength
 - b) Flame-resistance
- (8) Paint qualification
- (9) Rain
- b. Production Tests
 - (1) Dielectric
 - (2) Mechanical operation

2.3.15.3 Unit Substation Switchboard Design and Production Tests

NEMA PB 2 and UL 891. Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

- a. Design Test
 - (1) Temperature rise tests
 - (2) Short-circuit current test
 - (3) Enclosure tests
 - (4) Dielectric test
- b. Production Test
 - (1) 60-hertz dielectric tests
 - (2) Mechanical operation tests
 - (3) Electrical operation and control wiring tests
 - (4) Ground fault sensing equipment test

2.3.15.4 Transformer Design Tests (Liquid-Filled)

In accordance with IEEE C57.12.00 and ANSI/IEEE C57.12.90. Additionally, ANSI/IEEE C57.12.80 section 5.1.2 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for the specified transformer(s). Design tests shall have been performed prior to the award of this contract.

- a. Tests shall be certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise test means a unit-substation transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (OA/FA) the same temperature rise rating, and the same insulating liquid as the transformer specified.
- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a unit-substation transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.
 - (1) ANSI/IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and ANSI/IEEE C57.98.
 - (2) State test voltage levels.
 - (3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.
- d. Lifting and moving devices: "Basically the same design" for the lifting and moving devices test means a transformer in the same weight range as the transformer specified.
- e. Pressure: "Basically the same design" for the pressure test means a unit-substation transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.3.15.5 Transformer Routine and Other Tests(Liquid-Filled)

In accordance with IEEE C57.12.00 and ANSI/IEEE C57.12.90. Routine and other tests shall be performed by the manufacturer on a prototype of the same size, design, and KVA as the actual transformer prepared for this project. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

- a. Cold resistance measurements (provide reference temperature)
- b. Phase relation
- c. Ratio

- d. Insulation power-factor by manufacturer's recommended test method.
- e. No-load losses (NLL) and excitation current
- f. Load losses (LL) and impedance voltage
- g. Dielectric

(1) Impulse: Per ANSI/IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and ANSI/IEEE C57.98. Test the primary winding only.

- a) State test voltage levels
- b) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test reports.

(2) Applied voltage

(3) Induced voltage

- h. Leak

3 EXECUTION

3.1 INSTALLATION

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

3.2 GROUNDING

NFPA 70 and ANSI 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 $\frac{3}{4}$ inch X 10 ft ground rods at 10 feet increments around the pad. Connect ground conductors to the upper end of the ground rods by exothermic weld. Provide compression connectors at equipment end of ground conductors.

3.2.2 Substation Grounding

Provide a ground counterpoise around the pad consisting of bare #4/0 copper cable not less than 24 inches below grade connecting to the indicated ground rods in para. 3.2.1. Extend in PVC conduit to the following grounding connection points: 1) Enclosure for the Load Interrupter Switch 2) Service Entrance Ground Electrode Connection Point in the Service Entrance Equipment.

For Double-ended switchboards, the grounding connections listed above from the equipment to the ground counterpoise shall be duplicated on each side.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld.

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 unit substations as indicated in the manufacturers' installation manual.

All conduits that enter the walk-in switchboard enclosure shall be installed from under the respective switchboard section. No conduit penetrations shall be allowed through the walls or the top. Feeder busducts may enter the sides of the walk-in enclosure near the top part of the ceiling. Penetration openings for the busduct shall be coordinated with the manufacturer of the walk-in enclosure.

3.3.1 Load-Interrupter Switch

ANSI/IEEE C37.20.3.

3.3.2 Switchboard

NEMA PB 2.1.

3.3.3 Meters and Instrument Transformers

ANSI C12.1.

3.3.4 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

Mount unit substation on a concrete slab.

The slab shall be at least 12 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 6 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 12 inches beyond the equipment on the sides and front and 3 feet on the back side.

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.

3.5 OMITTED

3.6 OMITTED

3.7 FIELD QUALITY CONTROL

3.7.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS. Acceptance checks and tests shall be performed together in the field, prior to energization, by the Electrical Contractor and the service engineer of the manufacturer. Both shall be present for entire testing listed below.

3.7.2 Interrupter Switch

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Confirm correct application of manufacturer's recommended lubricants.
- (4) Verify appropriate anchorage and required area clearances.
- (5) Verify appropriate equipment grounding.
- (6) Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
- (7) Verify that fuse sizes and types correspond to approved shop drawings.
- (8) Verify that each fuse holder has adequate mechanical support.
- (9) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic surveying is not required.
- (10) Test interlocking systems for correct operation and sequencing.
- (11) Verify correct phase barrier materials and installation.
- (12) Compare switch blade clearances with industry standards.
- (13) Inspect all indicating devices for correct operation

b. Electrical Tests

- (1) Perform insulation-resistance tests.
- (2) Perform over-potential tests.

- (3) Measure contact-resistance across each switch blade and fuse holder.
- (4) Measure fuse resistance.
- (5) Verify heater operation.

3.7.3 Transformers (Liquid-Filled)

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.
- (3) Verify tightness of accessible bolted electrical connection by calibrated torque-wrench method. Thermographic survey is not required.
- (4) Verify correct liquid level in transformer tank.
- (5) Perform specific inspections and mechanical tests as recommended by manufacturer.
- (6) Verify correct equipment grounding.

b. Electrical Tests

- (1) Perform insulation-resistance tests.
- (2) Perform over-potential tests.
- (3) Verify that the tap-changer is set at specified ratio.
- (2) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.7.4 Switchboard Assemblies

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) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.
- (9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
- (10) Verify clean switchboard.
- (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) Verify operation of heaters.

3.7.5 Circuit Breakers

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) Verify tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method. Thermographic survey is not required.

(6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

(1) Perform contact-resistance tests.

(2) Perform insulation-resistance tests.

(3) Adjust Breaker(s) for final settings in accordance with the system analysis.

(4) Perform test of solid trip units with a portable test kit.

(5) 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.

3.7.6 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) Verify tightness of accessible bolted electrical connections and by calibrated torque-wrench method. Thermographic survey is not required.

(6) Verify that all required grounding and shorting connections provide good contact.

3.7.7 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) Verify all instrument multipliers.

(2) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.7.8 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.

3.7.9 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.

3.8 Energization of Electrical System

No part of the electrical distribution system shall be energized prior to inspection from the Government.

3.8.1 Energization/ Inspection Schedule With The Government

The Contractor shall notify the Government in writing that the electrical system is ready for inspection. The Government shall be given three working days to inspect the installation. After the inspection with the Government, all deficiencies noted shall be corrected. After the Contractor notifies the Government that all deficiencies have been corrected, three working days shall be given to the Government to inspect correction of all prior noted deficiencies. The Contractor shall then give the Government written notice that the facility is ready for application of power. The Government shall then be given not less than three working days (Mon - Fri) for the application of power to the primary system and the main switchboard.

--End of Section--

ROBINS AFB/ COE SPEC

Dated 12/20/01

SECTION 16415

ELECTRICAL WORK, INTERIOR

INDEX

- 1.1 REFERENCES
- 1.2 GENERAL
- 1.3 SUBMITTALS
- 1.4 WORKMANSHIP
- 2.0 PART 2 --- MATERIALS AND EQUIPMENT
 - 2.1 CABLES AND WIRE
 - 2.2 OMITTED
 - 2.3 CIRCUIT BREAKERS
 - 2.4 SWITCHBOARDS
 - 2.5 PANELBOARDS
 - 2.6 MOTOR CONTROL CENTER
 - 2.7 METERING
 - 2.8 OMITTED
 - 2.9 DRY - TYPE TRANSFORMERS
 - 2.10 CORRECTION CAPACITORS
 - 2.16 CONDUIT AND TUBING
 - 2.22 DISCONNECT SWITCHES
 - 2.33 LIGHTING FIXTURES AND BALLASTS
 - 2.39 MOTORS
 - 2.40 RECEPTACLES
 - 2.41 SWITCHES
 - 2.42 WALL PLATES

Part 2 Execution

- 3.1 GROUNDING
- 3.2 WIRING METHODS
- 3.3 BOXES AND SUPPORTS
- 3.4 WALL PLATES
- 3.5 RECEPTACLES
- 3.6 WALL SWITCHES

- 3.7 OMITTED
- 3.8 SWITCHBOARDS
- 3.9 PANELBOARDS
- 3.10 MOTOR CONTROL CENTER
- 3.11 FUSES
- 3.12 OMITTED
- 3.13 MOTORS
- 3.14 MOTOR CONTROL
- 3.15 MOTOR DISCONNECT MEANS
- 3.16 TRANSFORMERS
- 3.17 LAMPS AND LIGHTING FIXTURES
- 3.20 EQUIPMENT CONNECTIONS
- 3.21 OMITTED
- 3.22 OMITTED
- 3.23 PAINTING AND FINISHING
- 3.24 REPAIR OF EXISTING WORK
- 3.25 FIELD TESTS
- 3.26 ONE LINE DIAGRAM
- 3.27 ENERGIZATION OF ELECTRICAL SYSTEM
- 3.28 TRAINING
- 3.29 SPARE PARTS AND STOCK
- 3.30 AS-BUILTS

PART 1 GENERAL

1.1 REFERENCES

Use latest publications for those referenced in the specification.

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 herein 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 located to avoid interference with mechanical or structural features; 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 is responsible for coordinating all wire sizes shown on the drawings with the electrical manufacturer.

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 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, all identification nameplates shall be made of laminated plastic in accordance with FS L-P-387 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

Panelboards

Minimum 1/8 inch
High Letters

Control Power Transformers

Starters
Safety Switches
Motor Control Centers
Transformers
Equipment Enclosures
Switchgear
Switchboards
Motors

Control Devices
Instrument Transformers

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 three sets of as-built drawings to the Contracting Officer.

1.2.7 Y2K Compliant

All equipment in this specification shall be Y2K compliant.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

1.3.1 Material For Submission; GA.

Submit all material in 3 ring hard cover binders.

Contractor shall submit drawings to scale on a CAD software which demonstrates the actual equipment layout meets NEC 110-26. Drawing shall demonstrate coordination with other trades in the same room with the equipment, such as structural steel or beams, sprinkler lines, HVAC duct, mechanical equipment, etc. This drawing shall be approved by the Government prior to any installation of conduit or material. Any installation without the approved CAD drawing shall be subject to demolition and reinstallation at the expense of the Contractor.

All material submitted for equipment shall be the manufacturers' original data sheets. No copies or faxes will be acknowledged. Conduit, conduit supports, switches, and receptacles will not

require original manufacturers' data. However, all other equipment shall be the original manufacturers' data.

All material for the light fixtures, circuit breakers, dry type transformers, panelboard schedules, panelboard manufacturers' data, switchboards, pad mount transformers, and motor control centers shall be submitted together. Operation and Maintenance Manuals for the items above shall be included in the submittal. Submit these items in a single 3 ring hard cover binder. All electrical equipment shall be separated by tabs. Within each tab shall include the submittal data for the equipment and the Operation and Maintenance Manuals and/or catalog for the equipment. Only manufacturers' original data and catalogs shall be provided for major pieces of equipment.

All other material shall be provided in a separate 3 ring hard cover binder. All material shall be submitted together in one single submission. Different material shall be separated by tabs with Operation and Maintenance Manuals.

Catalog data for all materials and equipment to be incorporated in this project shall be submitted. This drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required.

Complete wiring diagrams shall be provided for all electrical equipment. The wiring diagrams shall be computer generated and prepared by the electrical manufacturer. This shall include complete dimensions of the equipment, wiring schematics, diagrams of bus structure for switchboards/motor control centers, panelboard schedules, and lug sizes for all cable connections.

1.3.2 COORDINATED POWER SYSTEM PROTECTION

A fault-impedance diagram, a short-circuit analysis or study, and a power system coordination study shall be prepared to demonstrate that protective system after devices have been properly calibrated, adjusted, set and tested. These data, including complete descriptive and technical data of all protective devices, diagrams, and studies as required to ensure complete coordination, shall be prepared in conformance with industry practices, standards, or with other technical data approved by the Contracting Officer, and shall be submitted for approval of the Contracting Officer.

1) Determination of Facts

Short circuit available at the site shall be 400 MVA, X/R = 15. Primary system is 12470/7200 volt multi-grounded wye, 3 phase, 60 HZ. The Contractor shall coordinate with the Government for primary relay substation settings.

2) Fault-Impedance Diagram

The diagram shall be prepared to reflect the system impedance of power sources available to supply the building or facility, and the impedance of the new power system components for the facility.

3) Fault Locations and Short-Circuit Current Availability (SCCA)

The fault-impedance diagram shall, as a minimum, show fault locations for each voltage transformation and at each power distribution bus. The SCCA available at each fault location shall be shown in tabular form on the diagram for a bolted line-to-line fault and a line-to-ground fault.

4) System Coordination, recommended ratings and settings of protective devices, and design analysis shall be accomplished by a Registered Professional Engineer regularly engaged in the coordination of industrial and commercial power systems.

5) The Registered Professional Engineer shall provide an analysis of the system to the extent which includes a description of the logic used for recommended trip settings. This analysis shall be specific for this project and provided for each coordination plot in this study.

6) The study shall include Robins AFB relay curves. The Registered Professional Engineer shall make any recommendations for changes to existing settings in the event a coordination problem exists.

7) The Registered Professional Engineer shall coordinate with the manufacturer of the proposed equipment to be installed. Any changes to trip functions or equipment which may improve coordination, as a result of actual equipment installed, shall be made available to the Contracting Officer prior to performing the study.

8) Original manufacturers' literature shall be included on all circuit breakers and electrical equipment used in this project. Copies shall not be accepted. This shall include:

9) Operation, application, and maintenance catalogs on all circuit breakers, which shall contain the following: installation instructions, operational characteristics, such as trip unit adjustments, time current curves, let thru curves, circuit breaker accessories, handle locking devices and connectors, motor circuit protectors (MCP), and testing procedures. Provide a table for all MCP devices which shows recommended trip settings based on horsepower and motor full load amps.

10) Operation, application, and maintenance catalogs, on all electrical equipment shall be provided. This shall include all submittal items such as pad mount/ dry type transformers, panelboards, switchboard/panelboard equipment, panelboard schedules, circuit breakers, control wiring in switchboards and metering. Separate catalogs for each breaker type shall be provided. Separate catalogs shall be provided for the pad mount/ dry type transformers, switchboards,

panelboards, and metering. All items shall be separated by tabs in a 3 ring hard cover binder. Within each tab shall include the following: submittal data for the material, O & M manuals and/or catalogs.

11) All electrical equipment shall be submitted in this study. All Operation and Maintenance catalogs for this electrical equipment shall be included in this study. Separate submittals and O & M manuals for this same electrical equipment shall not be provided elsewhere except included in this study. Electrical equipment in this project shall not be approved or acknowledged without approval of the study by the Government.

12) The study shall show composite coordinate curves at each bus within the system. Composite coordination plots shall be on 8 1/2 inch by 17 inch paper. Composite coordination plots shown on 8 1/2 inch by 11 inch sheets will not be accepted. A coordination log-log plot shall be provided for each bus in the system.

13) Fault Calculations

Three phase fault and line to ground fault magnitudes shall be provided in the study. The fault calculations shall be performed and provided to the Government prior to proceeding with the Coordination Study. Any protective devices found not rated adequately shall be brought to the attention of the Government. The Government shall be given two weeks to review the fault calculations

Three phase fault and line to ground fault magnitudes at each bus within the system shall be shown on the amperage scale of the respective composite coordination drawing. Three phase fault and line to ground fault magnitudes shall be placed on the amperage scale with a distinct bus symbol for both types of fault.. The fault calculations shall be included with the Coordination Study in the final submission.

All data used in the fault calculations shall be provided with the calculations. This data shall include a copy of any tables for the source of resistance (R), reactance (X), and impedances (Z).

14) Coordination Analysis

a. A general description of a Coordination Analysis shall be provided in the study. This shall describe the desired method of protection and coordination of a power system. Describe method of calculation of short circuit currents, transformer protection, circuit breaker coordination, motor circuit protectors, primary Robins AFB Relays, and cable protection.

b. A specific coordination analysis shall be provided for this project. This shall include a description of the coordination of the protective devices in this project. Provide a written description which indicates which circuit breakers may trip in the event of a fault at each bus. Coordination analysis shall describe recommended breaker settings at each bus, coordination

between upstream and downstream devices for the protective devices at each bus, coordination of recommended ground fault settings, coordination of primary transformer fuse with Robins AFB relay substation relays and 480 volt main circuit breaker. Provide analysis of any curves which overlap. A detailed coordination analysis or commentary shall be provided as described above for each bus in the system.

The study shall be disapproved without the coordination analysis.

15) One line drawing of the entire system shall be shown. This shall show all cables and components within the system.

16) A one line drawing on each composite coordination plot shall be shown on the respective coordination sheets. This drawing is a reduced version of the system one-line. The drawing shall include only the circuit protective devices up to the respective bus, and any sub-breakers which may be plotted on the composite coordination plot.

17) The study shall be submitted in hard-cover 3 ring binders. Tabs shall be included to separate different sections. Original manufacturers' catalogs shall be permanently bound by separate subjects. Individual time current curves for each circuit breaker shall be the manufacturers' original transparent sheets (minimum size 10 1/2 x 15).

18) The Contractor shall submit five (5) complete sets of the study. All final five (5) approved sets shall be retained by the Government.

19) Equipment shall not be approved or acknowledged until final approval of the study. Ordering and/or procuring any equipment prior to approval of the study shall be at the Contractors' risk. All five (5) approved sets shall be provided to the Government prior to request for application of power.

1.3.3 Reports

Materials and Equipment; GA.

All material for use in this project shall have a label or listing of the Underwriters Laboratories, Inc.. 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 UL 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.] Materials and equipment shall 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 Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.3.4 Certificates

Telephone Installer and Company; GA.

Qualifications of the telephone installer in the field and the company.

1.3.4 Electrical Contractor Qualifications; GA

Evidence that the jobsite superintendant at the project during all installation contains an Electricians Master License, Unrestricted.

1.4 WORKMANSHIP

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

PART 2 PRODUCTS

2.0 MATERIALS AND EQUIPMENT

Materials and equipment 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.

2.1 Cables and Wires

All conductors shall be single, rated 600 volt copper type with THHN/THWN insulation. Cables and wires shall conform to UL 44 for rubber-insulated type; UL 83 for the thermoplastic-insulated type. Wiring for lights and receptacle circuits shall be stranded conductors. Light switches and receptacles shall be connected to the stranded wire by a vinyl insulated brazed fork terminal.

2.1.1 Grounding Cables

Grounding cables shall be insulated when in conduit with conductors and shall be bare when below grade installed in direct contact with earth. Insulated conductors shall have a green insulation in conduit and in the interior of electrical equipment.

2.2 Omitted

2.3 Circuit Breakers

Circuit breakers shall have voltage, current and interrupting ratings as indicated. Fully rated circuit breakers shall be provided to obtain the specified interrupting rating. Series rating of circuit breakers will not be acceptable. Circuit breakers, switchboards, meters, and panelboard enclosures shall be the same manufacturer.

All circuit Breakers shall be UL Listed.

2.39.4 Circuit Breakers in Service Entrance Rated Switchboards

Refer to Section 16400 for 600 volt system and Section 16361 for 4160 volt system.

2.39.5 Circuit Breakers in Downstream Switchboards and Panelboards, Non-Service Entrance Rated

2.39.5.1 For 600 amp frame and greater

Molded Case Type - Standard 80 Percent Rated
RMS Digital Solid State Trip with adjustable short time and instantaneous pickup

Circuit breaker shall be UL Listed in accordance with UL standard 489. The breaker shall contain a digital solid state, ambient insensitive trip unit. The microprocessor based trip unit shall accurately sense sinusoidal and nonsinusoidal current waveforms (fundamental through the 13th harmonic order on a 60 hertz base) by continuously sampling each phase throughout each cycle.

Circuit breaker frames shall employ high-strength, molded glass reinforced polyester cases and covers. All breakers shall have a "push to trip" button for checking the trip mechanism.

Breakers shall use a field-interchangeable fixed rating plugs to achieve the pickup setting.

2.3.2.2 For 400 amp frame size or less:

2.3.2.2.1 Standard Thermal Magnetic Molded-Case Circuit Breakers:
Breakers shall contain an adjustable magnetic trip on all frame sizes available.
All breakers shall be bolt-on type.

2.3.2.2.2 Ground Fault Circuit Interrupters:
UL 943. Breakers less than 20 amps equipped with ground fault interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.40 Switchboards

2.4.1 Switchboards shall meet the following requirements:

2.4.1.1 Switchboards shall meet Nema Standard PB 2 and UL 891.

Switchboard shall be totally enclosed, deadfront, free standing, front accessible. The switchboard shall be a Type 1 enclosure. The framework shall be UL guage steel and secured together to support all cover plates, bussing, and component devices during shipment and installation.

2.4.1.2 AIC rating shall be fully rated. Series rating to achieve short circuit rating is unacceptable.

2.4.1.3 Switchboard, bus interior construction, circuit breakers, and any metering shall be the same manufacturer as the circuit breakers. All circuit breakers for the switchboards and panelboards in this project shall be the same manufacturer.

2.4.1.4 Nameplates shall be provided by the manufacturer, 1/4 inch thick, black with white engraved marking to identify circuit.

2.4.1.5 All painted parts shall be pretreated and provided with a corrosion resistant, UL listed acrylic baked paint finish. The paint color shall be #49 medium light grey per ANSI standard Z55.1-1967.

2.4.1.6 The switchboard through bus shall be silver plated copper, nontapered bus. The through bus shall extend the full length of the switchboard and rated 100 percent. Bus shall be suitable for future extensions. The ground bus shall be sized per UL 891 and of the same material as the through bus. All switchboards shall contain a full neutral and ground bus.

2.4.1.7 Distribution sections shall have the same depth as the main service section.

2.5 Panelboards

2.5.1 Panelboards shall meet requirements listed below:

2.5.1.1 Deadfront construction, NEMA PB 1, Federal Specification W-P-115a. Panelboards, UL 67; UL 50 cabinets and boxes

2.5.1.2 All phase, neutral, and ground bus shall be copper. AIC rating shall be fully rated. Series rating of circuit breakers to achieve short circuit rating is unacceptable.

2.5.1.3 Directory shall be typed to reflect installed as-built conditions.

Directory shall indicate item and room number served, such as

“Receptacles, Room Number ; Lighting, Corridor Room Number ;etc .”

Install a laminated nameplate on the panel front to designate bus fed from, such
“ Fed From Main Switchboard “.

2.5.1.4 Breakers shall be located in the designated pole locations as shown on the contract drawings. Power panelboards shall be provided in lieu of lighting panelboards at no additional cost if needed to comply.

2.5.1.5 On any panelboard bus equal 800 amperes, construction shall be power distribution. Lighting panelboards will not be acceptable for 800 amperes. Boxes shall be minimum 9 1/2 inches deep.

2.5.1.6 Breakers shall be arranged in the panel interior as shown on the contract drawings. Power distribution panelboards shall be provided, if needed, to place the breakers in the designated locations regardless of bus ampacity specified. Manufacturer may not rearrange the breaker locations in order to utilize lighting panel-board construction.

2.6 Motor Control Center(s) (MCC)

2.6.1 General Electrical Characteristics:

480 volts, 3 phase, 3 or 4 wire with copper ground bus.

2.6.2 Storage

The motor control center shall be stored in a clean, dry, ventilated building free from temperature extremes. Storage trailers at the jobsite will be unacceptable.

2.6.3 MCC Finish

All steel parts (except plated parts used for ground connections) will be provided with UL Listed acrylic/alkyd baked enamel paint finish. All painted parts will undergo a multistage treatment process, followed by the finishing paint coat.

Pretreatment will include:

1. Hot alkaline cleaner to remove grease and oil
2. Iron phosphate treatment to improve adhesion and corrosion resistance.

The paint will be applied using an electro-deposition process to ensure a uniform paint coat with high adhesion.

The standard paint finish will be tested to UL 50 per ASTM B117 with no greater than 0.125 loss of paint from a scribed line.

Paint color will be #49 medium light grey per ANSI standard Z55.1-967(60-70 gloss) on all surfaces. Control station plates and escutcheon plates will be painted a contrasting grey. All unit interior saddles will be painted white for better visibility inside the unit.

2.6.4 Structures

Structures shall be totally enclosed, dead front, free standing assemblies. Structures shall be capable of being bolted together to form a single assembly.

The overall height of the MCC (excluding base channel) will not exceed 90 inches.

Structures will be NEMA 1A (gasketed general purpose).

Each section will have the necessary hardware and bussing for modular plug-on units to be added and moved around. All unused space will be covered by hinged blank covers and equipped to accept future units. Vertical bus openings will be covered by manual bus shutters.

2.6.5 Wireways

Structures shall contain a minimum 12 inch high wireway at the top of each section, and a minimum 6 inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of the motor control center.

A full depth vertical wireway will be provided in each motor control center section that accepts modular plug-on units. The vertical wireway will connect with the top and bottom horizontal wireway, and will be isolated from the unit interiors by a full height barrier. The vertical wireway will be 4 inch wide minimum, with a separate hinged door. There will be a minimum of 4,000 cubic inches of cabling space available. Access to the wireways will not require opening control unit doors.

2.6.6 Barriers

All power bussing and splice connections will be isolated from the unit compartments and the wireways. The horizontal bus will be mounted onto a glass-filled polyester support assembly that braces the bus against the forces generated during a short circuit.

The vertical bus will be housed in a molded glass-filled polyester support that provides bus isolation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 inches for unit stab on connections. Each opening will be provided with a manual shutter to close off the stab opening. These shutters will be attached to the structure so that, when the shutters are removed (to allow a stab connection) they are retained in the structure for ready access should a plug-on unit be removed from the MCC.

Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.

2.6.7 Bussing

All bussing and connectors shall be tin-plated or silver plated copper.

MCC main horizontal bus shall be untapered and extend the full length of the motor control center.

Bus ratings will be based on 65 degree C maximum temperature rise in a 40 degree C ambient. Provisions will be provided for splicing additional sections onto either end of the MCC.

A tin plated copper ground bus that runs the entire length of the MCC will be provided. The ground bus shall be 0.25 inch X 1.0 inch, and be rated for 300 amps.

A compression lug shall be provided for a # 4/0 to 250 MCM ground cable. For each loads, the ground bus will be provided with six 0.38 inch holes for each vertical section for lugs.

Each vertical section shall have a copper vertical ground bus connected to the horizontal ground bus. This vertical ground bus will be installed so the plug-on units engage the ground bus prior to engagement of the power stabs, and will disengage only after the power stabs are disconnected upon removal of the plug-on unit.

The power bus system will be braced for the calculated, available short circuit current.

2.6.8 Unit Construction

Units with circuit breaker disconnects through 250 A frame will connect to the vertical bus through a spring- reinforced stab-on connector. Units with larger disconnects will connect directly to the main horizontal bus with appropriately sized riser bus. Stabs on all plug-on units will be solidly bussed to the unit disconnect. Cabled stab assemblies are not permitted.

All plug-on units will use a lever to rack in and out the plug-on unit. The lever will work in conjunction with a hangar bracket to ensure positive stab alignment.

A cast metal handle operator must be provided on each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism will allow complete on/off control of the unit disconnect with clear indication of the disconnect's status. All circuit breaker operators will include a separate tripped position to clearly indicate a circuit breaker trip condition. It will be possible to reset a tripped circuit breaker without opening the control unit door.

A mechanical interlock will prevent an operator from opening the unit door when the disconnect is in the “on” position. Another mechanical interlock will prevent an operator from placing the disconnect in the “on” position while the unit door is open. It will be possible for authorized personnel to defeat these interlocks.

A non-defeatable interlock will be provided between the handle operator and the lever to prevent installing or removing a plug-on unit unless the disconnect is in the “off” position.

The plug-on unit will have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.

Provisions will be provided for locking all disconnects in the “off” position with up to three padlocks.

Operating handles shall be located on the left side of the vertical sections.

2.6.9 Components

All combination starters shall use a unit disconnect. All starters shall use NEMA/ EEMAC rated contactors. Starters will be provided with a 3 pole, external manual reset, overload relay for thermal overload units.

Control circuit transformers shall be provided in each unit. Secondary voltage shall be 120 volts. Protection shall include internal primary protection and one secondary fuse (in the non-grounded secondary conductor). The transformer will be sized to accommodate the contactor(s) and all connected control circuit loads. The transformer rating will be fully visible from the front when the unit door is opened.

When a unit control circuit transformer is not provided, the disconnect will include an electrical interlock for disconnection of externally powered control circuits.

Auxillary control circuit interlocks will be provided where indicated. Auxillary interlocks will be field convertible to normally open or normally closed operation.

~~Motor Circuit Protector (MCP) with separate adjustable overload shall be used for combination starter units. MCC units without a starter shall contain a thermal magnetic breaker. Thermal magnetic breakers with solid state overloads shall be used for combination starter units.~~

Each starter shall have a combination Off and Auto switch instead of HOA switch, red pilot lamp for “on” and a green pilot lamp for “off”.

2.6.10 Terminal Blocks

Type B wiring will be provided. Terminal blocks will be pull-apart type,

600 volt, and rated at 25 amperes. All current carrying parts will be tin-plated. Terminal blocks will be din rail mounted, with the stationary portion of the block secured to the unit bottom plate. The terminals used for field connections will face forward so they can be wired without removing the unit or any of its components.

2.6.11 Nameplates

Engraved phenolic nameplates will be provided for each MCC and unit compartment. Each nameplate will have a grey background, white lettering, and measure a minimum of 1.5 “ high x 6.25 “ wide.

2.7 Metering

2.7.1 Service Entrance Metering

Refer to Section 16400 for 480 volt substation and Section 16361 for 4160 volt substation.

2.8 OMITTED

2.9 Dry - Type Transformers

2.9.1 General Purpose Dry Type Transformers

2.9.1.1 Standards

Transformers shall be U.L. Listed under the requirements of Standard 506 and 1561. In addition, each transformer shall meet the requirements of NEMA ST-20, 1992, and applicable ANSI and IEEE standards.

2.9.1.2 Construction Specifications of General Purpose Dry Type Transformers

Only single- and three-phase transformers having two windings per phase will be approved.

Three-phase transformers shall be connected only in a delta-wye, [except isolation transformers having a one-to-one turns ratio].

The insulation on transformer windings shall be 150 degree celsius winding rise with 220 degree celsius temperature class. The insulation system shall be suitable for 40 degree celsius ambient as defined by ANSI and NEMA standards.

Transformers to be located within the building shall be provided in the manufacturer's standard, ventilated indoor enclosure.

Transformers shall contain six 2 1/2 percent universal taps, two above and four below rated primary.

2.9.1.3 Sound Levels of Dry Type Transformers

The average sound level in decibels (dB) of transformers shall not exceed the following dB level based on ANSI C89.2-1986.

kVA RANGE	dB SOUND LEVEL
1-9	40
10-50	45
51-150	50
151-300	55
301-500	60

2.9.2 K- Rated Non-Linear Dry Type Transformers

K factor transformers shall be rated in accordance with UL K factor test procedures.

Dry type K-rated transformers shall contain a K rating equal to 13.

Transformers located within an electrical closet shall have a temperature winding rise of 80 degree celsius. All others shall have a temperature winding rise of 150 degree celsius with a UL recognized 220 degree celsius insulation system. Transformer neutral shall be capable of operation at 200 percent of secondary phase current. Transformers shall contain a 480 volt delta primary and 120/208 volt wye secondary. Six 2 1/2 percent taps shall be provided, two above and four below rated primary volts. Transformers shall contain full width copper electrostatic shielding between the primary and secondary windings. Common mode noise attenuation shall average 120 db, and normal mode noise attenuation shall average 30 db.

Coils shall be of continuous wound construction. A vacuum impregnation insulation system using non-moisture absorbing varnish is required.

Transformers shall meet ANSI/NEMA ST-20 standards. Transformers shall be UL 1561 listed and meet test requirements listed in ANSI/IEEE C57.110-1986.

2.10 Correction Capacitors

2.10.1 Power Capacitors

Correction capacitors shall improve the power factor to .95 lagging.

When the motor is controlled by other than a full voltage non-reversing across the line starter, or the motor is subject to jogging by pushbutton station, locate the capacitor upstream from the controller.

Correction capacitors shall be sized as recommended by the manufacturer for the motor application. Capacitors shall have discharging resistors.

2.11 Omitted

2.12 Omitted

2.13 Omitted

2.14 Omitted

2.15 Omitted

2.16 Conduit and Tubing

See para. 3.2.1.1 for conduit types permitted

2.16.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)
UL 797. See para 3.2.2 for description of couplings permitted with EMT.

2.16.2 Flexible Conduit, Steel and Plastic

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

2.16.3 Intermediate Metal Conduit

UL 1242.

2.16.4 PVC Coated Rigid Steel Conduit --- NEMA RN 1.

2.16.5 Rigid Aluminum Conduit --- ANSI C80.5 and UL 6.

2.16.6 Rigid Metal Conduit --- UL 6.

2.16.7 Rigid Plastic --- UL 651A.

2.16.8 Surface Metal Electrical Raceways and Fittings --- UL 5.

2.16.9 Omitted

2.17 Omitted

2.17 Omitted

2.18 Omitted

2.19 Omitted

2.20 Boxes, Metallic Outlet --- NEMA OS 1 and UL 514A.

2.21 Omitted

2.22 Combination Starters and Disconnect Switches shall meet the following:

a) Heavy Duty Type

b) Enclosure shall be Nema type 1 indoors and Nema Type 3R outdoor.

c) Combination starters shall contain an integral starter, disconnect, and control transformer with fusing all built in the same enclosure and by the same manufacturer. Combination starter shall be UL Listed. Secondary voltage shall be 120 volts. Each starter shall have a HOA switch, red pilot lamp for "on" and a green pilot lamp for "off".

2.23 Boxes, Switch (Enclosed), Surface-Mounted --- UL 98.

2.24 Fittings for Conduit and Outlet Boxes --- UL 514B.

2.25 Omitted

2.26 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing ---- UL 514B.

2.27 Conduit Coatings Plastic Resin System --- FS L-C-530 or NEMA RN 1,
Type A-40.

2.28 Connectors, Wire Pressure

2.29 Copper Conductors --- UL 486A.

2.30 Electrical Grounding and Bonding Equipment --- UL 467.

2.30.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467, 3/4 inch
3/4 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.31 Enclosures

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

2.32 Cabinets and Boxes --- UL 50.

2.33 Fixtures, Lighting and Fixture Accessories/Components

Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.33.1 Fixture, Auxiliary or Emergency

UL 924.

2.33.2 Exit Signs

Exit signs shall be LED type, with a uniform illumination in non-explosion proof areas. . Exit signs which show visible LEDs will not be accepted. Housing shall be constructed of die cast aluminum. Finish shall be brushed aluminum. Panel letter color shall be red.

All emergency exit signs in the facility shall operate in the normal and emergency mode.

2.33.3 Incandescent Fixture

NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

2.33.4 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. 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.

Open type fluorescent fixtures with exposed lamps shall have a clear tube guard over the lamps.

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

b. Ballasts:

Electronic Ballast: All fluorescent fixtures shall have electronic rapid start ballasts.

Low Harmonic Distortion: less than 10 percent THD

Lamp Current Crest Factor: less than 1.7

Transient Protection: Meets IEEE 587A (ANSI C62.1)

EMI: MEET FCC Part 18C, Class A

UL Listed: Class P, Type 1

Power Factor: Greater Than .97

Input Frequency: 60 HZ

Starting Temperature: 50 degree minimum
Voltage Range: +/- 10 % of rated input
Sound Rating: Quieter than Class A

c. Fluorescent Lamps

Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps shall be T8, 32 watt, 3500K color temperature, 84 CRI, and medium bipin bases. Lamps shall have a 20,000 hour average rated life using electronic rapid start ballasts.

2.33.5 High-Intensity-Discharge, Pendant Mount Fixtures

a. Pendant hung fixtures for shall contain a die cast aluminum power hook. Power hook shall contain a receptacle hook/box and loop, cord and plug assembly. Safety chain shall be installed to the ballast.

b. Pendant hung fixtures shall contain a malleable iron swivel support.

2.33.6 Light fixtures mounted to building at balconies, walkways, entry sidewalks shall be metal halide, "Wall-Pak".

2.34 Omitted

2.35 Omitted

2.36 Omitted

2.37 Fuses and Fuseholders

2.37.1 Fuses, Low Voltage Cartridge Type --- NEMA FU 1.

2.37.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

UL 198C.

2.37.3 Fuses, Class K, High-Interrupting-Capacity Type --- UL 198D.

2.37.4 Fuses, Class H --- UL 198B.

2.37.5 Fuses, Class R --- UL 198E.

2.37.6 Fuses, Class T --- UL 198H.

2.37.8 Fuses for Supplementary Overcurrent Protection
UL 198G.

2.37.9 Fuses, D-C for Industrial Use --- UL 198L.

2.37.10 Fuseholders --- UL 512.

2.39 Motors, ac, Fractional and Integral Kilowatt (Horsepower)

Motors, ac, fractional and integral kilowatt, (horsepower,) 373.0 kW (500 hp) and smaller shall conform to NEMA MG 1 and UL 1004 for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous classified locations.

2.39.1 Kilowatt (Horsepower) Rating

The kilowatt (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.

2.39.2 Motor Efficiencies

Required motor efficiencies shall meet the recommended levels of the Department of Energy Federal Energy Management Program (FEMP).

2.39.3 Motor Controls

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845.

2.39.4 Motor Starters

Combination starters shall be provided with circuit breakers.

2.39.4.1 Reduced Voltage Starters

2.39.4.1.1 Solid State Reduced Voltage Starters

Starters shall provide a smooth, stepless acceleration through electronic control of the applied voltage. By controlling silicon controlled rectifiers (SCR's), the voltage shall be gradually ramped up to full voltage levels over an adjustable period of time providing a "soft start".

2.39.4.1.2 Autotransformer Starter

Starters shall provide reduced voltage to the motor terminals during starting through the use of a tapped, three phase autotransformer. Taps on the autotransformer shall allow for the selection at 50%, 65%, or 80 % of line voltage values.

2.39.4.1.3 Wye-Delta Starter

Wye-Delta starters shall be of the closed transition type.

2.40 Receptacles

2.40.1 Federal Specification/ Commercial Grade

Single and duplex receptacles shall be NEMA 5-20R, rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots.

Bodies shall be ivory. Receptacles shall be heavy duty with high grade brass alloy triple wipe contacts, indestructible nylon face, and rigid glass reinforced nylon back body. Receptacles shall be supported by mounting strap having plaster ears.

Receptacle shall be side- or back-wired with two screws per terminal.

The third grounding pole shall be connected to the metal mounting yoke.

2.40.2 Receptacles, 15-Ampere, 250-Volt -- NEMA 6-15R

Receptacles, 15-ampere, 250-volt, shall be duplex two-pole, three-wire, grounding type with bodies of ivory phenolic compound supported by mounting yoke having plaster ears. The third grounding pole shall be connected to the metal yoke. Each receptacle shall be provided with a mating cord-grip cap.

2.40.3 Receptacles, 20-Ampere, 250-Volt -- NEMA 6-20R

Receptacles, single, 20-ampere, 250-volt, shall be molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

2.40.4 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles required for the anticipated purpose. One matching plug shall be furnished with each receptacle. Locking of receptacles, indicated to be the locking type shall be accomplished by the rotation of the plug.

2.41 Wall Switches

2.41.1 AC Switches

Switches shall be rated 20-ampere, 277 volt for use on alternating current only. Switches shall be of the specification grade. Wall switches shall be of the totally enclosed tumbler type. The wall switch handle shall be ivory. Wiring terminals shall be of the screw type. Dimming switches shall be solid-state flush mounted, sized for the loads. All switches shall have a grounding screw.

2.42 Wall Plates

All device plates shall be Type 302, .035 inch thick, brushed finish, U.L Listed stainless steel.

2.43 Ground Fault Interrupters UL 943, Class A or B.

2.44 Service Equipment --- UL 869A.

2.45 Splice, Conductor ---- UL 486C.

2.46 Omitted

2.47 Omitted

2.48 Snap Switches --- UL 20.

2.49 Tapes

2.49.1 Plastic Tape --- UL 510.

2.49.2 Rubber Tape --- UL 510.

PART 3 EXECUTION

3.0 Electrical Contractor Qualifications

Electrical Contractor shall have on-site during all installation an Electrician with a Master Electricians License.

3.1 Grounding

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

3.1.1 Service Entrance Grounding

Resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a the system ground shall not exceed 25 ohms under normally dry conditions. On all service entrance equipment, a triangular ground shall be installed 100 feet from the facility which consists of three 3/4 inch ground rods spaced 20 ft apart with #4/0 connecting the rods, with a #4/0 wire extended to the service entrance ground bus. All below grade connections shall be exothermic. Extend one #4/0 from the service entrance ground bus to the steel structure and a #4/0 to the building lightning protection counterpoise. All metallic water piping shall be bonded to the service entrance ground bus. All connections to steel structure shall be exothermic type. In addition, on facilities with new construction, extend a #4/0 to the building rebar footing from the service entrance ground bus.

3.1.3 Grounding Conductors

A green ground wire shall be furnished regardless of the type of conduit or load. 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 boxes for receptacles, 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. All switches shall contain a ground screw for ground connections; in addition, switches shall be bonded to the box through a short bonding jumper. All equipment grounding conductors installed in conduit with phase conductors shall have the same insulation as the phase conductors. All equipment grounding conductors in the panelboards shall have insulation the entire length except at terminations.

3.2 WIRING METHODS

3.2.1 Conduit Types Permitted

Conduits installed exposed in the industrial areas shall be rigid steel ten feet above the floor.

In all other areas, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, rigid plastic conduit (schedule 40 in the earth only), electrical metallic tubing, or intermediate metal conduit. Flexible nonmetallic conduit or tubing will not be accepted as a raceway.

Short sections less than 4 ft of sealtite conduit shall be used for connections to motors or equipment which may need flexible connection.

Light fixtures shall have a 4" X 4", 1 1/2 inch depth junction box installed within 6 ft of the light fixture. Connect the light fixture to the junction box with metallic flexible conduit.

Manufacturers' approved flexible connections (3/8 inch or larger metallic flexible conduit less than 6 ft with internal separate ground conductor) shall be acceptable for light fixtures only.

Conduits in explosion proof locations shall be of a type approved for the location as specified in the National Electrical Code.

Circuits connected to 400 HZ system shall be installed in aluminum conduit above grade and PVC below grade.

3.2.2 Conduit Homerun Symbols

Conduit homeruns shall be installed as shown on the contract drawings. At each homerun symbol, a separate conduit shall be installed from the homerun symbol to the feeder panelboard. Contractor shall not mix or revise the homerun symbols from that shown on the contract drawings.

3.2.3 Conduits at Switchboards, Panelboards and Motor Control Centers

Switchboards:

Conduits shall enter only the section of the switchboard in which the feeder will terminate on a breaker. Any conduits and wiring found installed in the wrong section shall be removed and replaced at the Contractors' cost.

Panelboards:

If a panelboard is top fed, then the wiring shall enter the top of the panelboard enclosure. Likewise, on bottom fed panels, wiring shall enter only the bottom of the panel enclosure. Installing the conduit on the bottom and running the conductors in the side gutter space to reach top fed panels will be considered unacceptable workmanship. Likewise, installing conduit on the top of the panel enclosure and running the conductors through the side gutter space to reach bottom fed panels will be considered unacceptable workmanship. The Contractor shall coordinate with the manufacturer and plan the conduit runs appropriately.

Motor Control Centers (MCC)

Conduits shall enter the section of the MCC in which the wiring will terminate. It will be considered unacceptable to install wiring in a different section and run the wiring across the common top or bottom wireway.

3.2.4 Conductors shall not be spliced inside a switchboard or panelboard. Conductors shall not be spliced inside a MCC unit, within the top, bottom or vertical wireways. All wiring shall terminate on lugs or terminal strips within the unit.

3.2.5 Conduit and Tubing Systems

All fittings for electrical metallic conduit shall be of the steel compression type. Connectors for flexible metal conduit shall be malleable iron/ zinc plated and of the 2 screw clamp type with insulated throats conforming to UL 514B and NEMA FB-1. Minimum size of raceways shall be 1/2 inch. Electrical metallic tubing may be installed in concrete and grout in dry locations. Electrical metallic tubing installed in concrete or grout shall be provided with concrete tight fittings. EMT will not be installed in damp or wet locations. Insulating fittings shall be installed on the ends of all conduit, including all sizes of electrical metallic tubing. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped to maintain the fire rating of the rated wall. 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 shall be provided with expansion fittings to compensate for the building expansion and contraction and to provide for continuity of grounding. Covers to junction boxes shall be labeled with a permanent marker; labeling shall include panel designation and circuit number.

3.2.6 Below Slab-on-Grade or in the Ground

All electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit below the slab shall be installed in the earth and (1) one foot below the capillary water barrier. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Conversion to rigid steel or IMC shall be accomplished by a rigid steel elbow. 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.

3.2.7 Installing in Slabs Including Slabs on Grade

No conduits shall be installed within a horizontal run of a slab.

3.2.8 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.

3.2.9 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. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

3.2.10 Supports

Metallic conduits and tubing shall be securely and rigidly fastened in place 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, or ceiling trapeze. Conduit may not be used for a ceiling trapeze, only approved factory manufactured unistruct may be used to build conduit supports. C-clamps or beam clamps shall have strap or rod-type retainers. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging.

Each conduit support shall be extended to the building structural steel or bar joists. Attaching a unistruct to a box with over-hang on each side to support conduit will not be permitted. Conduit supported between threaded rods attached to the structure may not be used as a support for conduit raceways. Unistrut (and associated hardware such as channel nuts, spring nuts, conduit strut clamps, washers, threaded rods, and rod couplings) shall be used to support all conduit from the structure. Conduit pressure caddy clips which clamp onto structural steel may only be used for maximum 3/4 inch conduit size.

Supports shall be fastened to wood with wood screws; with bolts and metal expansion shields on gypsum, concrete or brick and concrete filled CMU cells; with toggle bolts on hollow masonry units; and with machine screws on steel work. Expansion metal anchors shall be permitted in lieu of toggle bolts on hollow masonry units for 3/4 inch conduit size or less only. Only toggle bolts shall be used on all equipment enclosures and boxes on hollow masonry units. Nail-type nylon anchors are not acceptable. Raceways or pipe straps shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws shall be used. Conduit shall not be supported using wire or nylon ties. Raceways shall be installed as a complete system and be independently supported from the structure.

Upper raceways shall not be the support of lower raceways. No conduit shall be supported from cable tray supports. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts, one locknut on each side. Insulating bushings shall be installed on all conduit, including all sizes of electrical metallic conduit. A pull wire shall be inserted in each empty raceway in which wiring is to be installed by others if the raceway is more than 15 meters 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 psi

tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire. Electrical metallic conduit shall be supported in the interior of stud walls within 3 feet of boxes and every 10 feet.

3.2.11 OMITTED

3.2.12 General Installation Of Conduits Concealed Verses Exposed

Rooms with finished walls shall have the conduits installed concealed in walls, ceilings, or below the slab; except surface mounting is acceptable in mechanical and electrical rooms.

3.2.13 Cables and Conductors

All conductors shall be single conductor, copper, and with Type THHN/THWN insulation. Wiring for lights and receptacle circuits shall be stranded conductors. Light switches and receptacles shall be connected to the stranded wire by a vinyl insulated brazed fork terminal.

Wire connectors of insulating material or solderless pressure connectors properly taped shall be utilized for all splices. Feeder conductors to panelboards shall not be spliced; all ends of conductors shall be installed at breaker terminations. Any conductors installed with the outer insulation damaged as a result of pulling conductors in electrical equipment shall be replaced with new material at the expense of the Contractor. Taping of damaged conductors will not be acceptable.

3.2.14 Sizes

Conductors shall be sized based on copper conductors only. 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 shall be no smaller than No. 10 AWG.

3.2.15 Power Conductor Identification

Phase conductors shall be identified by color coding. The color of the insulation on phases A, B, and C respectively (for three phase) or phases A and B respectively (for single phase) of different voltage systems shall be as follows:

120/208 volt, 3-phase: Black, red, and blue. White on neutral.

277/480 volt, 3-phase: Brown, orange, and yellow. Grey on neutral.

120/240 volt, single/phase: Black and red.

Conductor phase and voltage identification shall be made by color-coded insulation for all conductors No. 10 and smaller. For conductors No. 8 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 termination. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. In panelboards at branch circuits, install a label sticker with marking to identify branch circuit number. Install sticker to allow the circuit to be identified with the interior panel cover installed.

3.2.16 Control Conductor Identification

Control 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.

3.2.17 Switch Leg Identification

Switch leg identification for lighting circuits shall be the same color insulation as the phase conductor. Both conductors (to/from) the switch shall be the same color as the phase conductor.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways, 4-inch by 4-inch nominal size, shall be of the weatherproof type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces. In partitions of light steel construction, boxes shall be supported in walls with the studs installed between adjacent studs for back support. Another acceptable method to support boxes in walls is a pre-manufactured box mounting bracket, which shall provide support for boxes or plaster rings between studs. The pre-manufactured mounting bracket shall have the same height as the boxes, extend from stud to stud, and be of 16 gauge thickness.

The edges of plaster rings for electrical devices shall be not more than 1/4 inch back from the finished surfaces in gypsum and CMU finished walls. Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. Plaster ring extensions which decrease the box interior dimensions are not acceptable and shall not be used to extend the box to the finished surface. Boxes for mounting lighting fixtures shall be not less than 4 inches square except smaller boxes may be installed as required by fixture configuration, as approved. The bottom of boxes installed in masonry-block walls for concealed wiring shall be flush with the top or bottom of a block to minimize cutting of blocks. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Cast-metal boxes installed in wet locations and

boxes installed flush with the outside of exterior surfaces shall be gasketed. 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.

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 screws on steel work. Expansion metal anchors shall be permitted in lieu of toggle bolts on hollow masonry units for 3/4 inch conduit size or less only. Toggle bolts shall be used on all equipment enclosures and boxes on hollow masonry units. In open overhead spaces, cast-metal boxes threaded to raceways shall be separately supported where used for fixture support; sheet metal boxes having threadless connectors supported directly from the building structure by 1/4 inch "all-thread". 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. 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 Electrical Contractor shall have a representative present at the jobsite during the wall construction to ensure boxes are maintained flush with the finished surface.

3.3.1 Boxes for Use with Raceway Systems

3.3.1.1 Large size boxes shall be NEMA type 1 indoors and Nema 4X when located outdoors. Aluminum boxes shall be used with aluminum conduit. All junction boxes with devices shall have a plaster ring.

3.3.1.2 Sheetmetal junction boxes for all devices, except communication outlets, shall be not less than 4 inches square and 1 1/2 inch deep.

3.3.3 Pull Boxes

Pull boxes of not less than the minimum size required by NFPA 70 shall be constructed of [aluminum or] galvanized sheet steel. Boxes shall be furnished with screw-fastened covers. 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.

3.3.4 Clock Outlet

Clock outlet, for use in other than a wired clock system, shall consist of an outlet box, a plaster cover where required, and a single receptacle with clock-outlet plate. The receptacle shall be recessed sufficiently within the box to allow the complete insertion of a standard cap, flush with the plate. A suitable clip or support for hanging the clock shall be secured to the top of the plate. Material and finish of the plate shall be as specified in paragraph Wall Plates.

3.3.6 Omitted

3.4 Wall Plates

Wall Plates shall be specified in section under Materials.

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

Contractor is responsible to coordinate receptacle types as needed.

3.5.1 Single and Duplex

All conductors shall be installed with a pigtail connection to the receptacle. Pigtail connection shall be installed on the neutral, phase and ground. Pigtail connections shall be installed in the same outlet box as the receptacle.

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

Weatherproof receptacles shown shall be mounted in a box with a gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. The cap shall be provided with a spring-hinged flap and completely cover the plug when inserted.

3.6 Wall Switches

Not more than one switch shall be installed in a single-gang position.. Separate equipment ground conductor shall be connected to the switch grounding screw.

3.8 Switchboards

All manufacturers' bolts shall be re-torqued on the jobsite in the field. Coordinate with manufacturer on the required torque for all connections. Interior of all components shall be

cleaned thoroughly of all dirt prior to requesting for inspection. Switchboard(s) shall be clean prior to energization.

All switchboards shall be installed on 4 inch high concrete housekeeping pad.

Edges of pad shall have chamfer corners. Install laminated plastic nameplate next to each breaker to designate the feeder bus downstream, such as "Panel name" or "Panel through transformer XXX".

3.9 Panelboards

Door locks shall be keyed alike. Directories shall be typed to indicate loads served by each circuit, room number circuit feeds, such as "RECEPT- RM 102"

"LIGHTS- RM 103", etc. and mounted in a holder behind a clear protective covering. All manufacturers' bolts shall be re-torqued at the jobsite in the field. Coordinate with manufacturer on the required torque for all connections. Interior of all components shall be cleaned thoroughly of all dirt and debris prior to requesting for power.

3.10 Motor Control Centers (MCC)

All motor control centers shall be installed on 4 inch high concrete housekeeping pad. Edges of pad shall have chamfer corners. MCC(s) shall be installed a minimum of 6 inches from walls. A smooth, level surface shall be provided for installation.

3.11 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. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage.

3.11.1 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1, RK5 shall have tested interrupting capacity not less than 100,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.12 OMITTED

3.13 MOTORS

3.13.1 Each motor shall conform to the kW (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, application on 3 phase 480 volt systems shall have a nameplate of 460 volts. Unless otherwise specified, all 3 phase motors shall have a totally enclosed, fan cooled frame, 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 kilowatt (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.

3.13.2 Motor Lead Connections

For motors rated less than 1000 volts and less than 75 HP:

Motors leads shall be connected to feeder conductors by a compression lug connected to each conductor (motor lead and feeder conductor), bolt, flat washer and lock washer with hex nut on the other side. The entire splice connection shall be covered with three layers of 33 tape, rubber insulation, and 33 tape.

For motors rated less than 1000 volts and 75 HP and above

Motor lead splice kits shall be used. The splice kits shall be rated for 1000 volts, and contain lug covers (pigtail), mastic sealing strips, silicone grease lubricant, and locking pins (for motor leads #4 to 500 MCM).

Split bolts or kerney with insulated tape will not be accepted.

3.14 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 kilowatt (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.

3.15 MOTOR-DISCONNECT MEANS

All equipment which contains a motor shall have a wall-mounted disconnect next to the equipment. Disconnect switches shall be rated "heavy duty" and fused per manufacturers' recommendations.

Each motor shall be provided with a disconnect switch rated for the horsepower even though not indicated on the drawings. Circuit breaker will not be an acceptable means for a disconnect. 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.

***** **Notice to Designer** *****

Designer shall locate all dry type transformers on the floor. Dry type transformers are not to be suspended above the floor.

3.16 Transformers

Dry type transformers shall be installed on a 4 inch high concrete housekeeping pad with rubber isolation pads. Connect all conduits to the transformer enclosure with flexible conduit less than five feet; however, convert flexible conduit back to EMT prior to connection to a nearby panelboard or switchboard enclosure.

All conductor terminations shall be compression type only. Transformers shall be grounded in accordance with NFPA 70, Article 250.

3.17 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.17.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons. The lamps shall not be installed in the fixtures until four weeks prior to final acceptance of the facility.

3.17.1.1 Omitted

3.17.1.2 Omitted

3.17.2 Exit Signs

Exit signs shall be installed not higher than 9 feet to the center.

3.17.2 Fixtures

3.17.2.1 Accessories

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

3.17.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feet or longer excluding fixture, shall be braced to limit swinging. Bracing shall be three directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

3.17.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling. Recessed fixtures shall be attached to the ceiling grid with two hangar wires at opposite corners to the structural steel above. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels.

3.20 EQUIPMENT CONNECTIONS

All 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.

3.20.1 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment, and proper connections made thereto.

3.21 OMITTED

3.22 OMITTED

3.23 PAINTING AND FINISHING

All conduit and boxes on finished walls shall be painted the same color to match the wall surface. Galvanized electrical conduit and boxes shall first be given a primer washcoat to prepare the galvanized surface for painting. The surfaces shall then be painted in accordance with the finished schedules on the contract drawings or the paint specification.

3.24 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

3.25 FIELD TESTS

Field tests shall be performed at the jobsite in the presence of the Government.

3.25.1 Insulation Tests

All conductors and electrical equipment shall be given an insulation test. Each component in the power system shall be tested separately with no other apparatus or equipment connected. Provide all proposed test procedures with manufacturers' recommendations not later than 30 days prior to performing tests.

All test results shall be given to the Government not less than two weeks after performing tests. Tests results shall be submitted in 3 ring hard cover binders. Tests results shall be submitted prior to energizing power to any component.

Insulation resistance for each phase, neutral, and ground wire shall be shown. Any component which fails the test and/or indicate damaged insulation shall be removed, new material reinstalled and tested at the no additional cost to the Government.

3.25.2 Facility Ground Testing

The service entrance shall be given a resistance testing of that system's ground rods and submission of test results to the Contracting Officer. Test reports shall indicate the location of the rod and the resistance and the soil conditions at the time the test was performed.

3.25.3 Circuit Breaker Adjustable Settings and Testing

Manufacturers' Service Engineer shall adjust and test each new adjustable circuit protective device in the field. All solid state breakers shall be field tested with a portable test kit by the service engineer of the manufacturer. All adjustable settings shall be set by the service engineer of the manufacturer in accordance with the recommendations of the Protective Coordination Study. This shall be accomplished prior to request for initial energization.

At the completion of the test, portable test kit shall be turned over to the Government.

3.26 ONE-LINE DIAGRAM

A one-line diagram with main transformer, building disconnect means, and feeder breakers/switches to building panels located at the building disconnect shall be provided. Diagram shall be plastic laminated. The breaker/switch identification on the diagram shall match nameplate on the installed equipment. One line diagram shall include all data as stated in IEEE std. 141, chapter 2.3.28.

3.27 Energization of Electrical System

No part of the electrical distribution system shall be energized prior to inspection from the Government.

3.27.1 Energization/ Inspection Schedule With The Government

The Contractor shall notify the Government in writing that the electrical system is ready for inspection. The Government shall be given three working days to inspect the installation. After the inspection with the Government, all deficiencies noted shall be corrected. After the Contractor notifies the Government that all deficiencies have been corrected, three working days shall be given to the Government to inspect correction of all prior noted deficiencies. The Contractor

shall then give the Government written notice that the facility is ready for application of power. The Government shall then be given not less than three working days (Mon – Fri) for the application of power to the primary system and the main switchboard.

3.28 Training

Training shall consist of the following:

3.28.1 The Contractor shall conduct a training course for the operating staff. The training period shall consist of (8) eight hours classroom instruction on the operation and Maintenance Manuals and (8) eight hours hands-on field training. Training shall be provided after permanent power has been placed on the facility.

3.28.2 Training shall start after the system is functionally completed but prior to final acceptance tests. Training shall start not less than (30) days prior to receipt of approved Operating and Maintenance Manuals and Test Reports.

3.28.3 A separate classroom instruction and field training shall be given for each major piece of electrical equipment.

3.28.4 Training shall be given by a "Service Engineer" of the manufacturer.

3.28.5 Training shall be given for the following equipment under this contract:

Equipment below shall consist of a total of 4 hours of classroom instruction and 4 hours of hands-on field training. Training shall be conducted by the field service Engineer of the manufacturer.

- a) Switchboards
- b) Panelboards
- c) Motor Control Center
- d) Metering
- e) Circuit breakers
- f) Dry Type Transformers

3.28.6 Video Taping Operating and Maintenance Instructions

For all of the operating and maintenance instructions, the Contractor shall video tape these instructions as they are presented to the Government representatives. This shall include all classroom instruction and field training. The taping shall provide clear and understandable detailed instructions for all equipment. The tapes shall be prepared by an experienced video director/camera-person using good quality half-inch VHS color tape with correct sound equipment, lighting, and backdrop. Cordless microphone shall be provided for the person giving

the instruction. The sound and picture quality shall be high and subject to approval by the Contracting Officer. Background noise, such as construction activities at the jobsite which may impair sound quality, will not be permitted.

The tapes are intended as a follow-up training for other Government representatives at a later date. They must be suitable for this purpose. The Contractor shall be responsible for the contents of the instructions and shall verify that they are correct prior to taping. The video taping for the electrical equipment shall be done at the following locations:

Classroom Training	-----	Robins AFB Area Office
Field Training	-----	Project Site

Standard tapes provided by the manufacturer for the same equipment may subsidize the video tapes in this specification. However, standard tapes by the manufacturer may not replace the video taping at the Robins AFB Area Office and the project site. The tapes shall be for specific equipment identified by contents and contract name and number. The Contractor shall submit one copy of the tapes to the Government for review and approval. Unacceptable tapes are to be corrected by the Contractor as indicated by the Government at no additional cost to the Government.

3.29 Spare Parts and Stock

At the completion of the project, the Contractor shall provide the following spare parts:

- 1) At least one of each type of fixture for spare stock
- 2) At least 10 percent of each type of lamp for spare stock

-- End of Section --

ROBINS AFB/ COE SPEC
Dated 12/04/98

SECTION 16500

COMMUNICATIONS SYSTEM

INDEX

- 1.1 REFERENCES
- 1.2 GENERAL
- 1.3 SUBMITTALS
- 1.4 WORKMANSHIP
- 2.0 PART 2 --- MATERIALS AND EQUIPMENT
 - 2.1 MODULAR OUTLETS
 - 2.2 COMMUNICATION WIRING
 - 2.3 BACKBOARD TERMINATIONS
 - 2.4 TELEPHONE BACKBOARDS
 - 2.5 HUB RACK
 - 2.6 RISER TIE CABLE
 - 2.7 DEVICE PLATES
 - 2.8 RACEWAYS

Part 3 Execution

- 3.1 GROUNDING
- 3.2 WIRING METHODS
- 3.3 BOXES AND SUPPORTS
- 3.4 WALL PLATES
- 3.5 CABLES
- 3.6 OUTLETS
- 3.7 TERMINATION BLOCKS
- 3.8 LABELING METHOD
- 3.9 BACKBOARDS
- 3.10 BACKBOARD GROUNDING
- 3.11 HUB RACK
- 3.12 AUXILIARY DEVICES
- 3.13 QUALIFICATIONS OF INSTALLER
- 3.14 FIELD INSTALLER WAGES
- 3.15 TESTING

- 3.16 FINAL DOCUMENTATION (O & M MANUALS)
- 3.17 TRAINING
- 3.18 PAINTING AND FINISHING
- 3.19 REPAIR OF EXISTING WORK
- 3.20 AS-BUILTS

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-B (2001) Commercial Building Telecommunications Cabling Standard
- EIA ANSI/TIA/EIA-569-A (2001) Commercial Building Standard For Telecommunication 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/ Bonding Requirement Standard
- EIA TIA/EIA-TSB-67 (1995) Transmission Performance Specifications For Field Testing of Unshielded Twisted-Pair Cabling Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2002) National Electrical Code

1.2 GENERAL

The communications systems cables and connecting hardware shall meet the standards established by the American National Standards Institute (ANSI), the Electronic Industry Association (EIA) and the Telecommunications Industry (TIA) Standards.

1.2.1 Rules

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. Raceways 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.

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.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only.

1.3.1 Material For Submission; GA.

Submit all material in 3 ring hard cover binders.

Contractor shall submit drawings to scale on a CAD software which demonstrates the actual equipment layout. Drawing shall demonstrate coordination with other trades in the same room with the equipment, such as structural steel or beams, sprinkler lines, HVAC duct, mechanical equipment, etc. This drawing shall be approved by the Government prior to any installation of conduit or material. Any installation without the approved CAD drawing shall be subject to demolition and reinstallation at the expense of the Contractor.

All material submitted for equipment shall be the manufacturers' original data sheets. No copies or faxes will be acknowledged.

Catalog data for all materials and equipment to be incorporated in this project shall be submitted. This drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required.

Drawing shall show all backboard terminations, communications room layout of blocks/equipment/jacks/hub rack, etc. Provide layout of facility on CADD which shows facility with

rooms,doors, jack locations and labeling method. A file format compatible with an Microstation system shall be used. Provide grid map as described in Part 3, execution section of the specifications. Submittal shall include complete installation instructions for all wall jacks and terminations in the communication backboard(s). Installation instructions shall be obtained from the manufacturer.

1.3.3 Reports

Materials and Equipment; GA.

All material for use in this project shall have a label or listing of the EIA/TIA standard and Underwriters Laboratories, Inc..

1.3.4 Certificates

Telephone Installer and Company; GA.

Qualifications of the telephone installers in the field and the company.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as specified herein.

PART 2 PRODUCTS

2.0 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the respective publications and other requirements specified below.

2.1 Modular Outlet

Voice shall be single Category 5e, 8 pin RJ-45 modular connector, ivory color.
Data shall be duplex Category 5e, 8 pin RJ-45 modular connector. orange color.

Voice and data jacks shall be T568B wiring pattern.

2.2 Communication Wiring

2.2.1 Voice:

Category 5e, 4 pair (UTP) unshielded twisted pair, 24 AWG copper conductors.

2.2.2 Data:

Category 5e, 4 pair (UTP) unshielded twisted pair, 24 AWG copper conductors.

2.2.3 Fiber:

Multimode 62.5/125 um fiber optic cable. Cable shall consist of 6 fibers.

Numerical aperture for each fiber shall be a minimum of 0.275. Multimode fiber shall conform to the latest edition of EIA/TIA - 492AAAA for 62.5 micron core diameter/ 125 micron cladding diameter, Class 1A. Cable shall be rated OFNR per NFPA 70.

Multimode fibers shall also meet the following performance standards:

EIA 455-30B (FOTP-30), Frequency Domain Measurement For Multi-mode Optical Fiber Information Of Transmission Capacity

EIA 455-53A (FOTP-53), Attenuation by Substitution measurement for Multi-mode Graded Index Optical Fibers or Fiber Assemblies Used in long Length Communication Systems.

2.3 Communication Backboard Terminations

2.3.1 Voice: 6600 type punch down blocks rated for category 5 mounted on stand off block. Provide number required plus 50 percent spare. Two separate sets of 6600 blocks shall be provided in the main communication room and each telecommunication closet: one set for the voice station jacks and another set for the voice riser tie cable. Separation between the two sets of blocks shall be 24 inches.

2.3.2 Data: Terminations shall be modular jack panel. Jacks shall be T568B wiring pattern. The modular jack panel shall have on the front an 8 pin RJ-45 connector. The rear of the modular panel shall contain 110 connecting blocks mounted on a printed wiring board. The 110 connecting blocks shall be made continuous to the 8 pin modular jack on the front of the panel through printed wiring board interconnections. The panel shall be 19 inches wide.

Modular jacks shall be mounted on a hub rack.

The modular jack panels shall meet or exceed the electrical requirements for category 5e cable. Provide number required plus 50 percent spare.

2.3.3 Multimode Fiber Optic Patch Panel:

Connectors shall be ST type with ceramic ferrule material with a maximum insertion loss of .5 db. Connectors shall be field installable. Connectors shall utilize adhesive for fiber attachment to ferrule.

2.4 Telephone Backboards

Install 3/4 inch plywood on the walls. Metal color-coded backboards shall be installed over the 3/4 inch plywood for the voice cable terminations. Color coding shall be as follows: green for voice riser tie cables, blue for station voice cables from outlets. Data cable terminations shall be mounted on a hub rack.

2.5 Hub Rack

A hub rack shall be installed in the main communication room and each tele-communication closet that contains category 5 modular backboard terminations. Hub rack shall contain the following features:

- Constructed of 14 and 12 gauge steel;
- Eight inch deep, welded "U" member and triangular bracket hold uprights to 12 gauge base;
- Panel mounting rails tapped 10-32 on EIA universal spacing;
- Chassis type base, 20 3/8 inch X 28 inch, drilled for RC-7754 casters;
- Rack bolted together in "add- a rack" fashion;
- Finish-Metallic Grey;
- Size shall be 7 inches X 19 inches, height 80 3/8 inch, width 20 3/8 inch , weight 80 LBS.

Hub equipment to be installed within the rack will be provided by others, but the hub rack shall be provided and installed by the Contractor.

2.6 Riser Tie Cable

Tie cable shall contain three 100 pairs. Cable shall be rated MPR/CMR . Cable shall be 24 AWG and rated Category 3. Insulation shall be flame retardant, semi-rigid PVC. The riser tie cable shall be used to connect voice wiring between each telecommunication closet and the main communication room. The main communication room shall be considered the point at which the communication conduits enter the building from the outside. Tie/riser cable shall be installed in separate conduit entire length from the telecommunication closet to the main communication room.

2.7 Device Plates

All device plates on finished walls shall be Type 302, .035 inch thick, brushed finish, U.L Listed stainless steel.

2.8 Raceways

All communication wiring shall be installed in a raceway system. Each outlet shall have separate wiring back to the communication backboard.

Refer to Part 3, "Execution", for description of types of conduit permitted at certain locations.

2.8.1 Intermediate Metal Conduit

UL 1242.

2.8.2 Rigid Metal Conduit --- UL 6.

2.8.3 Rigid Plastic --- UL 651A.

2.8.4 Electrical Metallic Conduit

UL 797. See para 3.2.2 for description of couplings permitted with EMT

PART 3 EXECUTION

3.0 Electrical Contractor Qualifications

Electrical Contractor shall have on-site during all installation an Electrician with a 16 hour course on category 5e wiring and terminations. Provide copy of course certificate to the Government.

3.1 Grounding

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

3.1.1 Ground Bus In Each Communication Room

Install a 1 1/2 wide x four feet long copper bus in each communication room. Install the ground bus on insulators. Connect the ground bus to the service entrance ground bus with #1/0 insulated copper. Use compression connectors on both sides.

3.2 WIRING METHODS

3.2.1 Communication Raceways

Extend a separate 3/4 inch conduit from each outlet to the nearest communication room.

Conduits shall be of the following types: threaded rigid metallic conduit , rigid plastic conduit (schedule 40 in the earth only, electrical metallic tubing (inside facility only), or threaded intermediate metal conduit. Flexible nonmetallic conduit or tubing will not be accepted as a raceway, except as six feet or less connection to modular office systems furniture. Conduit in hazardous areas shall be threaded rigid or intermediate metallic conduit only.

3.2.2 Conduit and Tubing Systems

All fittings for electrical metallic conduit shall be of the steel compression type. Connectors for flexible metal conduit shall be malleable iron/ zinc plated and of the 2 screw clamp type with insulated throats conforming to UL 514B and NEMA FB-1. Minimum size of raceways shall be 1/2 inch. Electrical metallic tubing may be installed in concrete and grout in dry locations. Electrical metallic tubing installed in concrete or grout shall be provided with concrete tight fittings. EMT will not be installed in damp or wet locations. Insulating fittings shall be installed on the ends of all conduit, including all sizes of electrical metallic tubing. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped to maintain the fire rating of the rated wall. 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 shall be provided with expansion fittings to compensate for the building expansion and contraction and to provide for continuity of grounding. Covers to junction boxes shall be labeled with a permanent marker; labeling shall include panel designation and circuit number.

3.2.3 Below Slab-on-Grade or in the Ground

All electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit below the slab shall be installed in the earth and (1) one foot below the capillary water barrier. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Conversion to rigid steel or IMC shall be accomplished by a rigid steel elbow. Metallic conduits installed below slab-on-grade, passing vertically through the slab shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay.

3.2.4 Installing in Slabs Including Slabs on Grade

No conduits shall be installed within a horizontal run of a slab.

3.2.5 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.

3.2.6 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. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

3.2.7 Supports

Metallic conduits and tubing shall be securely and rigidly fastened in place 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, or ceiling trapeze. Conduit may not be used for a ceiling trapeze, only approved factory manufactured unistrut may be used to build conduit supports. C-clamps or beam clamps shall have strap or rod-type retainers. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging.

Supports shall be fastened to wood with wood screws; with bolts and metal expansion shields on gypsum, concrete or brick and concrete filled CMU cells; with toggle bolts on hollow masonry units; and with machine screws on steel work. Expansion metal anchors shall be permitted in lieu of toggle bolts on hollow masonry units for 3/4 inch conduit size or less only. Only toggle bolts shall be used on all equipment enclosures and boxes on hollow masonry units. Nail-type nylon anchors are not acceptable. Raceways or pipe straps shall not be welded to steel structures.

Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws shall be used. Conduit shall not be supported using wire or nylon ties. Conduit supported between threaded rods attached to the structure may not be used as a support for conduit raceways. Unistrut (and associated hardware such as channel nuts, spring nuts, conduit strut clamps, washers, threaded rods, and rod couplings) shall be used to support all conduit from the structure. Conduit pressure caddy clips which clamp onto structural steel may only be used for maximum 3/4 inch conduit size. Raceways shall be installed as a complete system and be independently supported from the structure. Upper raceways shall not be the support of lower raceways. No conduit shall be supported from cable tray supports. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts, one locknut on each side. Insulating bushings shall be installed on all conduit, including all sizes of electrical metallic conduit. A pull wire shall be inserted in each empty raceway in which wiring is to be

installed by others if the raceway is more than 15 meters 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 psi tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire. Electrical metallic conduit shall be supported in the interior of stud walls within 3 feet of boxes and every 10 feet.

3.2.8 Junction Boxes For Tie Cables

Tie cable shall be installed with junction boxes if the run exceeds 75 feet, 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.

3.2.9 General Installation Of Conduits Concealed Verses Exposed

Rooms with finished walls, either sheetrock or concrete masonry units, shall have the raceways installed concealed in walls, ceilings, or below the slab; except surface mounting is acceptable in mechanical and electrical rooms. Explosion proof areas shall have the conduits installed on the surface of the walls.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be of the weatherproof type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces. In partitions of light steel construction, boxes shall be supported in walls with the studs installed between adjacent studs for back support. Another acceptable method to support boxes in walls is a pre-manufactured box mounting bracket, which shall provide support for boxes or plaster rings between studs. This bracket shall be 16 guage, of the same height as the box or boxes being mounted, and extend from stud to stud. The edges of plaster rings for electrical devices shall be not more than 1/4 inch back from the finished surfaces in gypsum and CMU finished walls. Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. Plaster ring extensions which decrease the box interior dimensions are not acceptable and shall not be used to extend the box to the finished surface. Boxes for mounting lighting fixtures shall be not less than 4 inches square except smaller boxes may be installed as required by fixture configuration, as approved. The bottom of boxes installed in masonry-block walls for concealed wiring shall be flush with the top or bottom of a block to minimize cutting of blocks. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. 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.

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 screws on steel work. Expansion metal anchors shall be permitted in lieu of toggle bolts on hollow masonry units for 3/4 inch conduit size or less only. Toggle bolts shall be used on all equipment enclosures and boxes on hollow masonry units. In open overhead spaces, cast-metal boxes threaded to raceways shall be separately supported where used for fixture support; sheet metal boxes having threadless connectors supported directly from the building structure by 1/4 inch "all-thread". 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. 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 Electrical Contractor shall have a representative present at the jobsite during the wall construction to ensure boxes are maintained flush with the finished surface.

3.3.1 Boxes for Use with Raceway Systems

3.3.1.1 Communication Junction Boxes

Boxes for voice and data outlets shall be 4-11/16 inch square and 2-1/8 inch deep.

3.3.3 Pull Boxes

Common pull boxes shall not be used with communication raceways.

3.4 Wall Plates

Wall Plates shall be specified in section under Part 2, Materials.

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 Cables

3.5.1 Cables For Voice and Data Station Jacks: A separate four-pair cable shall be installed from each jack to the backboard termination. Splicing of individual cables shall not be permitted.

3.5.2 Voice Riser Cable: Install separate riser tie cables from each telecommunication room to the main communication room.

3.5.3 Fiber Data Cable: Install fiber optic cable in 27 mm innerduct plus one 27 mm innerduct with pull cord from each telecommunication room to the main communication room.

3.5.4 Voice Cross-connect Wiring:

Four pair jumper cables shall be installed from each 4 pair on the riser blocks to the four pair on the station cables.

3.6 Outlets

Each outlet in the room and at the backboard shall be numbered for easy identification of type and location. The contractor shall coordinate with the Government for the desired labeling scheme. The telephone outlet shall consist of an outlet box, modular outlet and device cover.

3.7 Termination Blocks

3.7.1 Modular jacks shall be T568B wiring pattern.

3.7.2 The installer shall submit to the Government the proposed layout of the connecting blocks prior to installation. Layout shall be drawn on a computer CADD system.

3.7.3 At the backboard, terminate the voice cables on 6600 blocks rated for category 5e. Each cable at the jack and the backboard termination shall be labeled as designated by the Government. Install a label sticker on the cables from a label machine designed for this purpose. Punch down 6600 type connecting blocks rated for category 5e shall be provided to terminate all voice and riser tie cables. Terminate riser tie cable on separate blocks from the station blocks

3.7.4 Modular RJ-45 jack panel rated for category 5e shall be used to terminate all category 5 data cables.

3.7.5. Terminate fiber on each end with multimode fiber optic patch panel with ST connectors.

3.8 Labeling Method For Cabling, Voice Blocks, and Data Modular Crossconnect Blocks

1) The Contractor shall provide a CAD drawing which shows all outlets in the facility. The CAD drawing shall be provided in the submittal stage prior to any installation. The drawing shall be drawn to scale with outlet locations, walls, doors, system furniture identification numbers (if project includes) and room numbers. Sheet size shall be 36 inches by 24 inches. Drawing shall identify each outlet location with a distinct number.

2) A grid map shall be provided in the submittal stage with the CAD drawing listed above.

3) Facilities with more than one telecommunication closet shall have the closet ID letter in front of the outlet ID number. For example, Closet A, jacks shall be labeled jack A-1
 Outlets shall be grouped together by telecommunication closets. Each comm closet shall be given an alphabet symbol, such as A,B,C,D etc. Duplex outlets shall label the jacks with letters A and B, such as A-1A and A-1B, which indicates outlet location A-1 with jacks A and B. Outlets shall be terminated on the blocks in a numerical sequence, from lowest to highest. Labels shall be provided on the front of the blocks, cable at each end, and on the front of each jack in the room location.

The grid shall be on 8 1/2 by 11 inch size paper which includes the following information:
 Below is an example to indicate the labeling format and the grid:

<u>Outlet</u>	<u>Room</u>	<u>Voice or Data</u>	<u>Length</u>	<u>Closet ID</u>	<u>System furniture ID (If applicable)</u>
A-1	100	Voice		A	
A-1A	100	Data		A	
A-1B	100	Data		A	
A-2	100	Voice		A	
A-2A	100	Data		A	
A-2B	100	Data		A	
.....					
.....					
.....					
B-1	200	Voice		B	
B-1A	200	Data		B	
B-1B	200	Data		B	
B-2	201	Voice		B	
B-2A	201	Data		B	
B-2B	201	Data		B	

4) At completion of the project , the CAD drawing shall reflect As-Built conditions. Grid shall be placed in each communication room and telecommunication closet. The grid shall contain the actual length based on test results from a cable testing instrument.

3.9 Backboards

Telephone backboards shall be installed at each communication room. The backboards shall be 3/4 inch plywood having a two-coat paint finish.

Provide D rings along the sides for running conductors up the plywood backboard.

3.10 Ground Bus At Each Backboard

3.10.1 Install copper ground busses in the communication rooms as follows:

Main communications room:

2 feet length, 4 inch high, 1/4 inch thick.

Telecommunications closets:

1 feet length, 4 inch high, 1/4 inch thick.

Install on two standoff brackets with two insulators. For gypsum board, copper ground bar shall be supported to the wall with a wood backing behind the gypsum board. For filled CMU, install copper bar to the wall with metal expansion anchors. For hollow masonry units, install copper bus to the wall with toggle bolts.

3.10.2 Grounding Conductors Between Copper Ground Busses:

3.10.2.1 Main Communications Room:

At the main communications room, connect one insulated #500 MCM copper conductor to the copper ground bus from the service entrance ground bus.

3.10.2.2 Telecommunications Closets:

At each telecommunications closet, connect one insulated #4/0 Awg copper conductor to each ground bus from the ground bus in the main communication room. There shall be a separate #4/0 copper conductor from the main communications room to each telecommunications closet. No sharing or looping between closets to the main communications room will be allowed.

3.10.2.3 All connections to the copper ground busses shall be compression type lugs. Install ground conductor in IMC conduit above grade and PVC below a slab.

3.11 Hub Rack

Install hub rack within 12 inches of category 5e modular terminations in each communication closet or communication room. Bolt hub rack to floor with metal expansion shields. Hub equipment to be installed within the rack will be provided by others, but the rack shall be provided by the Contractor.

Install cable tray from the backboard to the hub rack.

3.12 Auxiliary Devices

All auxiliary devices such as tie bars, cable rings, etc. which are not shown but are required for a high grade installation shall be provided.

3.13 Qualifications of Installer

The system shall be installed by an experienced installer regularly engaged in the installation of a category 5e wiring system. Installer in the field shall have a minimum of 2 years experience or satisfactory classroom training on category 5 installation. The Contracting Officer may reject any proposed installer who can not show evidence of such qualifications. Sufficient qualifications of any installer in the field shall be provided. No installer will be permitted on the jobsite unless evidence of qualifications has been provided to the Government. These qualifications will be required for any individual which installs any category 5 wiring on the jobsite. This shall include pulling wire, terminating wire, and testing.

3.14 Field Installer Wages

Any installer in the field shall be provided with the wages and fringe benefits in accordance with the Davis Bacon Act. Any installer in the field shall be classified as an "Electrician". Refer to the Davis Bacon Act wage rates included within the special provisions of this contract. The installer shall be any individual which installs and/or pulls communication wire, terminates modular jacks, test and troubleshoot wiring.

3.15 Communication Testing

3.15.1 Unshielded Twisted Pair Tests

All cable pairs shall be tested for proper identification 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 communications closet and at the outlet.

3.15.2 Category 5e Circuits:

All category 5 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TIA/EIA-TSB-67 standard, including the additional tests and test set accuracy requirements of EIA ANSI/TIA/EIA-568-B.2.1. Testing shall use the Basic Link Test procedure of EIA TIA/EIA-TSB-67. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

Telephone installer shall test each data wiring to the backboard connecting block for transmission characteristics of the category 5e wiring. Test shall be provided with a communication cable testing instrument designed for testing category 5e wiring. This test shall be in addition to a continuity test. Test results shall be provided for each jack installed in this project. Provide hardcopy of all test results in 3 ring binders with O & M manuals. Test all voice wiring for continuity and correct wiring pattern.

All terminations shall be complete prior to any testing.

3.15.3 Fiber

3.15.2.1 The Contractor shall inspect and document that any multi-mode fibers installed meets the EIA455-30B and EIA455-53A performance standards.

3.15.2.2 Tests shall be performed from both ends of each fiber. Connectors shall be visually inspected for scratches, pits, or chips and shall be reterminated if any of these conditions exist. Each circuit leg and complete circuit shall be tested for insertion loss at 850 and 1300 nm using a light source similar to that used for the intended communications equipment. High resolution optical time domain reflectometer (OTDR) tests shall be performed from one end of each fiber. Scale of the OTDR trace shall be such that the entire circuit appears over a minimum of 80 percent of the X-axis.

3.16 Final Documentaion (O & M Manuals)

At completion of the project, provide the following in a 3 ring hardcover binder:

- 1) CADD drawing which shows the location of all outlets. Each jack location shall show the label placed on the cable and the termination block.
- 2) Grid Map updated which reflects as-builts, include actual lengths from pentascanner and furniture ID (if applicable).
- 3) Tests results from each jack using a pentascanner.

3.17 Training

Training shall consist of the following:

The Contractor shall conduct a training course for the operating staff. The training period shall consist of (3) three hours classroom instruction on the operation and Maintenance Manuals and (3) three hours hands-on field training. O & M Manuals shall be accepted by the Govt prior to scheduling the training. Training shall be provided after installation and testing is complete.

A separate classroom instruction and field training shall be given for each major piece of electrical equipment.

Training shall be given by a "Telephone Installer".

3.18 PAINTING AND FINISHING

All conduit and boxes on finished walls shall be painted the same color to match the wall surface. Galvanized electrical conduit and boxes shall first be given a primer washcoat to

prepare the galvanized surface for painting. The surfaces shall then be painted in accordance with the finished schedules on the contract drawings or the paint specification.

3.19 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

3.20 As-Builts

The Contractor shall maintain a complete set of communication as-built drawings on electronic file. The file format shall be Microstation or Autocad. The CADD drawing shall show the location of all outlets. Each jack location shall show the label placed on the cable and the termination block. All backboard locations, terminations and labeling method shall be shown on the drawings. Drawing shall show layout of facility and drawn to scale. The drawing shall show doors with door numbers, and rooms with room numbers, etc.

-- End of Section --

Designer Notes:

1. Maximum allowable length of communication runs is 300 feet. If the runs exceed 300 feet, then the designer shall provide a main communication room on the first floor and telecommunication closets throughout the facility. Separate communication rooms shall be provided on each floor. Additional communication rooms shall be provided on each floor if the runs exceed 300 feet.
2. Separate voice riser tie cables and data fiber shall be installed between each telecommunication closet and the main communication room.
3. The main communication room and each telecommunication closet will need to be in separate rooms in the facility. No other equipment, (such as dry type transformers, switchboards, HVAC air handlers, panelboards, etc.,) may be installed in this room. These areas will require a room with a lockable door and air conditioned space. The electrical designer shall coordinate the space needed with the architects or the facility planners.
4. Designer shall show the location of all communication outlets on the drawings.

5. At each outlet location, 1 voice jack and two data jacks shall be installed in the same junction box. The dual outlet symbol (1 voice jack and 2 data jacks) shall be the method used within the facility at all locations.
6. Designer to size the riser tie cable size between each telecommunication closet and the main communication room. However, minimum size allowed will be three 100 pairs. Show on the drawings the size of tie cable between each closet and the main communication room.
7. Voice and data wiring shall be installed in a complete and continuous raceway system. A separate 3/4 inch conduit shall be installed for each outlet to the nearest communication room.

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. Provide a complete lightning protection system installation and related work as specified, including all labor, material, equipment, and services required for the buildings indicated. The Early Streamer Emission (ESE) system provided shall be of the EASE (Electronically Activated Streamer Emission) type. (Robins AFB has permission from HQ AFCESA to use these systems in lieu of the older Franklin, or Faraday Cage, systems.)
- B. The following items of work are specifically included in, but not limited to, the generality implied by these specifications:
 - 1. EASE lightning protection air terminal.
 - 2. Complete mast, base, and supports.
 - 3. Down conductors.
 - 4. Grounding terminations.
 - 5. Transient voltage surge suppression on electrical and telephone-voice/LAN/data incoming lines.
 - 6. Mounting Pole and Concrete Base (if required)
- C. Soil Resistivity: The median value runs in the range of 25,000 ohm-cm for soil near buildings at Robins AFB.

1.02 MANUFACTURER’S REQUIREMENTS: Provide any completed forms requested by the EASE manufacturer for certification, verification, archiving, and system documentation.

1.03 SUBMITTALS:

A. General: Provide the following submittals in accordance with instructions found in Section 01300, Submittals and Contractor Furnished Items. The contractor may submit manufacturer’s data in lieu of the required certificate of compliance as desired. The Government requires manufacturer’s data if an “X” appears under the “Mftr Data Required” column.

B. Material Submittals:

Para #	Description	Mftr Data Req’d	Certificate of Compliance	Exceptions Taken	Inspector Check Mark
1.04 A	Shop Drawings (including Concrete Pole)	X	_____	_____	_____
1.04 B	Product Data Sheets	X	_____	_____	_____
1.04 C	Installer Certification	X	_____	_____	_____
1.04 D	Installation Instructions	X	_____	_____	_____

16671 - EARLY STREAMER EMISSION (ESE) LIGHTNING PROTECTION SYSTEM
UHHZ 0000000

C. Other Submittals: Provide the following submittals as required by the contract or as directed by the Contracting Officer.

<u>Para #</u>	<u>Description</u>	<u>Date Required</u>	<u>Inspector Check Mark</u>
2.10	EASE Tester and Instruction	Before Final	_____
3.04 A	Field Inspection	One week after	_____
3.04 B	Grounds Inspection	Before Prefinal	_____
3.04 C	Surge Protection Certification	Before Prefinal	_____
3.04 D	Surge Suppression	Before Prefinal	_____
3.04 E	Insurance Certificate	Before Final	_____
3.04 F	5-Year Warranty	Before Final	_____

1.04 SUBMITTALS REQUIRED FOR APPROVAL

A. Submit four (4) sets of shop drawings showing location of EASE air terminal, conductors, bonding connections, mounting poles and locations, pole base details, and grounding equipments.

1. Shop drawings shall include sizes for mounting poles, conductors, ground electrodes, and connection/termination details.
2. Design for a soil resistivity of 25,000 Ohm-cm if actual field test values are not provided.
3. All shop drawings shall include a verifiable phone number and address of the EASE manufacturer or supplier.

B. Submit detailed product data sheets showing application, dimensions, and material of each component utilized in the lightning protection system installation.

C. Submit proof of installer's approval or certification by the EASE system manufacturer.

D. Submit manufacturer's installation instructions under other provisions.

PART 2 – PRODUCTS

2.01 NAMES AND PHONE NUMBERS OF ACCEPTABLE SUPPLIERS (BY ORDER OF PREFERENCE)

- A. AZ Lightning Protection Corp. - Canton, GA Phone: 770-345-4435
- B. National Lightning Protection Corp. Phone: 800-628-2816
- C. Triple C. Phone: 405-235-5456

2.02 SUBSTITUTIONS: Provide the following information if a different supplier is proposed.

- A. A sample of all parts to be used in the lightning protection system shall be submitted for evaluation. Samples will not be returned.
- B. Certified test data showing the EASE air terminals' t and L advantages.
- C. Calculations showing the air terminals protection zones using the current t and L of the air terminal based upon the test data.
- D. Effective Projected Area (EPA) calculations for proposed mast to be utilized as specified in section 2.3 part B of this specification.
- E. Submit copy of manufacturer's EASE system warranty.
- F. Submit copy of minimum five-year warranty and copy of lightning protection insurance certificate for minimum of \$10,000,000 per occurrence coverage.
- G. Submit a list of twenty (20) verifiable installations utilizing the EASE terminal with names, addresses, and phone numbers of the completed installations. At least one of the installations shall be in place over five years.

2.03 EASE AIR TERMINAL

- A. Complete EASE air terminal assembly
 - 1. Stainless Steel ¾" diameter air terminal.
 - 2. Sensing mechanism.
 - 3. Early streamer initiator.
 - 4. Triggering mechanism.
 - 5. Sealed stainless steel housing.
 - 6. Threaded base for connection to mast.
- B. Plate indicating name and phone number of the EASE air terminal manufacturer.
- C. Minimum of five (5) years full replacement warranty.
- D. Air terminal shall be made in USA.

2.04 CONDUCTORS

- A. Copper conductors shall be 28 strands of 14-gauge copper wire in a rope lay configuration with a net weight of 380 lbs. Per 1,000 ft. minimum. Copper strip of equivalent capacity may be substituted.
- B. The structural steel may be utilized as the main down conductor.
 - 1. Structural steel shall be electrically continuous or made so.

16671 - EARLY STREAMER EMISSION (ESE) LIGHTNING PROTECTION SYSTEM
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2. Every other column shall be grounded or at intervals not exceeding an average of 60 feet on center.
- C. All conductors shall be securely fastened to the structure at every 36" on center utilizing fasteners with corrosion resistance equal to that of the conductor.
- D. All metal objects of induction situated within 15' 0" of a lightning protection conductor or bonded metal body shall be interconnected to the lightning protection system.
 1. Grounded metal bodies shall be interconnected to the lightning protection system via a main size 10 conductor.
 2. Underground metal bodies shall be interconnected to the lightning protection system via a secondary conductor no smaller than # 6 AWG copper.
- E. No copper materials shall be installed upon a dissimilar metal. Tin coated copper and bronze equipment shall be installed where these conditions exist.
- F. Tin or lead coated copper and bronze equipment shall be utilized where corrosive atmospheres are present.
- G. Lightning protection conductors shall maintain a downward or horizontal path to ground avoiding "U and "V" pockets with the following exception:
 1. A conductor may rise no more than 3" for every 12" of run.
- H. No bend of conductor shall form a final included angle of less than 90 degrees nor shall have a radius of less than 8 inches. Exceptions are thru roof, thru wall, and "T" connections.
- I. Each EASE air terminal shall be provided with two (2) paths to ground from the base plate of the mast, with the exception of an elevated mast that may have a single conductor run for a maximum of 16 feet (4.8 meters) before two (2) down conductors are implemented.

2.05 LIGHTNING PROTECTION MAST

- A. Aluminum or galvanized steel masts
 1. Height as required by application.
 2. Threaded connection for acceptance of EASE air terminal.
 3. Bonding plate for cable connection.
 4. Mast shall be structured as required by wind and safety factors inherent to the geographic location of the installation.
- B. Anchor base and direct burial masts shall provide the following Effective Projected Area (EPA) data based on AASHTO code.
 1. Wind velocity based upon safety factors inherent to the geographic location.

2. Moment of inertia.
3. Section modulus.
4. Allowable stress at base.
5. Bending allowable stress.
6. Shear allowable stress
7. Longitudinal moment.
8. Longitudinal shear.
9. Transverse moment.
10. Transverse shear.
11. Torsion moment.
12. Combined moment.
13. Combined shear.
14. Axial load.
15. Maximum overturn moment.
16. Combined stress ratio.

C. As indicated on lightning protection drawings.

D. Certified or accepted by the EASE system manufacturer.

2.06 GROUNDING SYSTEM

A. The ground system shall have no more than 10 ohms of resistance.

B. Ground terminations.

1. Ground rods: ¾" x 10' copper-clad (3 per down lead).
2. Ground plates: 20 gauge copper 2 sq. ft in area (3 per down lead) encased in *San-Earth*® conductive concrete.
3. Electrolytic ground electrodes (1 per down lead) may be used in lieu of or in combination with ground rods, and plates to achieve the 10-ohm resistance requirement.
4. Ground loop: 4/0 19 strand copper encased in *San-Earth*® conductive concrete.

C. All ground connections shall be accomplished via Burndy Hyground compression fittings as first preference. The only alternate allowed is via exothermic welding

16671 - EARLY STREAMER EMISSION (ESE) LIGHTNING PROTECTION SYSTEM
UHHZ 0000000

- D. Connections to ground rods, ground plates, electrolytic ground electrodes, or ground loop conductors shall be made at a point not less than 24 inches away from foundation walls and 18 inches below grade.
- E. Ground terminations shall be spaced as evenly as possible around the building perimeter.
- F. All grounded systems shall be bonded together via main size conductor to achieve equal potential of all grounded systems. All such connections shall be accomplished via Burndy Hyground compression fittings as first preference. The only alternate allowed is exothermic welding.

2.07 CONNECTORS, FASTENERS, AND HARDWARE

- A. Provide all connectors, fittings, fasteners, clamps, guards, lugs, exothermic connections, etc. as required to install all parts of the lightning protection system. All material should be listed where applicable. All equipment shall be fabricated from copper and/or bronze material for the use intended.
- B. All connections between dissimilar metals shall be executed with tinned copper or tinned bronze equipment.

2.08 SURGE SUPPRESSION - This is mandatory when lightning protection is installed on a facility. Comply with requirements outlined in the transient voltage surge suppression specification section.

2.09 MOUNTING POLE AND CONCRETE BASE: In some cases, a mounting pole for the EASE equipment will be required to be placed beside a facility instead of on top of its roof. Provide per manufacturer's recommendations the complete pole system, including pole concrete base adequate for 90 mph winds; pole of adequate material, height, and strength; and all associated equipment.

2.10 EASE TESTER: Provide a tester unit for the EASE system as manufactured by or recommended by the EASE manufacturer. Provide basic operating instructions on the use of this device to 78 CEG Shop personnel before Final Inspection.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that all surfaces are ready to receive work.
- B. Verify and compare dimensions and measurements shown on shop drawings with field conditions
- C. Verify that all systems that may influence the lightning protection system design are included or referenced on the shop drawings.

3.02 INSTALLATION – GENERAL

- A. Install EASE lightning protection system in accordance with manufacturer's instructions.
- B. Installation shall be accomplished in a neat and orderly manner by an installer approved or certified by the EASE system manufacturer.
- C. All work inside the building shall be concealed.

- D. All wall, roof, and other penetrations shall be sealed as required and performed by the appropriate trade.
- E. All structural applications shall be coordinated with the project structural engineer and all other applicable trades.
- F. Protect elements under other sections from damage or disfiguration during work under this section.
- G. All adhesive lightning protection components shall be installed with an adhesive approved by the roof manufacturer.
- H. All work installed in accessible areas shall be properly guarded and protected from damage.
- I. All material shall be installed in a manner to protect against electrolytic couple in the presence of moisture.

3.03 PERSONNEL GROUND LEVEL PROTECTION

- A. Provide personnel protection over the ground surface under which the EASE electrical grounding is installed, since there can be high voltage gradients in the soil if a person inadvertently stood on the surface during a lightning strike.
- B. This shall be accomplished as shown on the Drawings or by providing a sign on the pole or nearby wall alerting personnel not to stand in that area during potential lightning activity.

3.04 FIELD QUALITY CONTROL

- A. Field inspections will be held and documented. Provide two copies of each type of documentation to the contracting officer.
 - 1. Field inspection of down conductors prior to being covered by interior, exterior, or other installations.
 - 2. For inspection of lightning protection system grounds prior to burial.
- B. Obtain services of National Recognized Testing Laboratory (NRTL) to provide the inspection and certification of the lightning protection system to manufacturer's recommendations.
- C. Certification that surge protection with a minimum of 160 ka per phase surge capacity is installed on each of the main electrical services. The EASE manufacturer's insurance underwriter shall approve the electrical TVSS installations. Make any changes required by the underwriter at no additional cost to the Government.
- D. Certification that approved surge suppression is installed on electrical, telephone, data, and CATV lead wires.
- E. Provide a lightning protection insurance certificate from the supplier of the lightning protection equipment to the owner covering both property damage and personal injury due to lightning. The certificate shall cover the facility to a minimum of \$10,000,000 per occurrence throughout the life of the EASE installation. The 78 CEG Shop personnel in applicable Shops performing the periodic testing of lightning protection systems at Robins AFB shall be considered to be the same as manufacturer's certified inspectors when using the manufacturer's testing units.

16671 - EARLY STREAMER EMISSION (ESE) LIGHTNING PROTECTION SYSTEM
UHHZ 0000000

- F. Provide a minimum 5-year warranty for the EASE unit(s) against defects in workmanship and materials.
- G. Provide an insurance certificate covering damage to each building and personal injury caused by a direct lightning strike. The certificate shall cover each building or facility to a minimum of \$10,000,000 per occurrence with an infinite life as long as the EASE system is properly maintained and maintenance records are retained and filed per the next paragraph.
- H. The 78 CEG applicable Shops will have at least one person certified by the EASE manufacturer to inspect, test, and complete the annual written inspection report on the EASE system(s). Completed written inspection reports will be sent yearly to the EASE manufacturer to fulfill insurance requirements.

<<<<< END OF SECTION >>>>>

SECTION 16721A

ADDRESSABLE FIRE ALARM SYSTEM

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 72 (1999) Installation, Maintenance and Use of Protective Signaling Systems

NFPA 90A (1996) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 38 (1994; Rev Nov 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 228 (1997) Door Closers-Holders, with or without Integral Smoke Detectors

UL 268 (1996 Rev thru Jun 1998) Smoke Detectors for Fire Protective Signaling Systems

UL 268A (1998) Smoke Detectors for Duct Applications

UL 464 (1996; Rev May 1997) Audible Signal Appliances

UL 521 (1993; Rev Oct 1994) Heat Detectors for Fire Protective Signaling Systems

UL 797 (1993; Rev thru Mar 1997) Electrical Metallic Tubing

UL 864 (1996) Control Units for Fire-Protective Signaling Systems

UL 1242 (1996; Rev Mar 1998) Intermediate Metal Conduit

UL 1971

(1995; Rev thru May 1997) Signaling Devices for
the Hearing Impaired

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be items that have been in satisfactory use for at least 3 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours.

1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.2.3 Keys and Locks

Locks shall be keyed alike.

1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.2.5 Verification of Dimensions

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

1.2.6 Compliance

The fire detection and internal alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

All equipment shall be Y2K compliant.

1.2.7 Qualifications

1.2.7.1 Technician

National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

1.2.7.2 Installer

The installing Contractor shall provide the following:

A NICET level 3 or level 4 Fire Alarm Technician shall supervise the installation of the fire alarm system. "Supervise" means provide technical on-site assistance and guidance of NFPA codes, ensuring system is being installed in a manner to meet the Style NFPA wiring specified, ensuring the system is being installed in accordance with manufacturers' requirements, etc. NICET

Level 3 technician shall be on-site for the following: 1) prior to any installation (at preparatory meeting) 2) final check-out of the system wiring and terminations

An electrician or NICET Level 1 fire alarm technician shall install conduit for the fire alarm system. All conduit shall be installed in accordance with the approved fire alarm shop drawings.

1.4 SYSTEM DESIGN

1.4.1 Operation

Alarm initiating devices shall be connected to signal line circuits (SLC), Style 6 in accordance with NFPA 72. Notification appliances circuits (NAC) shall be connected to Style Z in accordance with NFPA 72.

The fire alarm and detection system shall be a complete, supervised, intelligent addressable fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the fire alarm control panel is reset and restored to normal.

All textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 volts dc. Addressable system shall be microprocessor based with the following features:

- a. Sufficient memory to perform required functions;
- b. Individual identity of each initiating device;
- c. Capability of each addressable device being individually disabled or enabled from the panel;
- d. Each SLC loop shall be sized to provide at least 40 percent addressable expansion without hardware modifications to the panel.

1.4.2 Operational Features

The system shall have the following operating features:

- a. Liquid crystal display
- b. Individual address, location and condition of each initiating device shall have the capability of being displayed on the LCD display. Control circuits (such as fan shutdown) shall have the capability of being individually controlled.
- c. Electrical supervision of alarm signal line circuits and notification appliance circuits.
- d. Electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm module (card, PC board) within the control panel, and transmitter circuit integrity.
- e. System trouble lamp and buzzer shall activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble

buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

f. A supervisory trouble lamp and buzzer shall activate from supervisory devices not in the normal state, examples include the following:
Any supervisory device intended to monitor the sprinkler system, such as an OS & Y valve on sprinkler system, low air switch, etc.
System trouble shall not activate upon a supervisory trouble.

g. Transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but shall provide a trouble signal when disconnected and a restoration signal when reconnected.

h. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the alarm devices will be activated.

i. Electrical supervision of circuits used for supervisory signal services. Supervision shall detect any open, short, or ground.

j. Zones for alarm SLC shall be arranged as indicated on the contract drawings. Manufacturer may rearrange the signal line circuit layout subject to approval in the submittal process.

k. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. Provide a separate addressable relay at each air handler.

l. Support a 1,000 event history buffer stored in non-volatile memory capable of maintaining all data in the event of a power loss.

m. Alarm Verification: Each of the intelligent addressable detectors in the system may be independently selected and enabled for alarm verification. Each FACP shall keep a count of the number of times each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of alarm and trouble signal over the radio fire reporting system.

b. Visual indications of the alarmed devices on the fire alarm control panel LCD readout.

c. Continuous sounding of alarm notification appliances throughout the building.

d. Deactivation of all air handling units and all fans over 5000 CFM.

e. Elevator Control

Provide the following controls for each elevator. Refer to the drawings for type of initiating devices to be provided on each elevator.

1. Whenever a heat detector is activated in the top of the elevator machine room or in the top of the elevator shaft, an alarm signal shall be sent to the FACP. The FACP shall then send a signal to a time delay relay (set at 1 second) to shunt trip the breaker feeding the elevator.

2. Note: Provide the following control module at all elevators with battery lowering devices. One dedicated addressable control module with a set of NC/NO (normally closed/normally open) set of contacts shall be located in the elevator equipment room. This control module shall be used to signal the elevator controller when the FACP shunt trips the elevator circuit breaker. The elevator controller shall then disable the battery lowering device. The normally closed contacts in the control module shall be wired in series with the normally closed contacts in the manual disconnect. If either closed contacts should open, either from the shunt trip activated or the manual disconnect turned off, then the battery lowering device shall be disabled.

3. Two dedicated addressable control modules with normally open/normally closed set of contacts shall be installed in each elevator equipment room. One of these control modules shall be used to signal the elevator to travel to the lowest floor upon smoke detector activation in the top of the elevator shaft or elevator lobby other than the first floor; the other control module shall be used to signal the elevator to travel to the top floor upon smoke detector activation in the first floor lobby, smoke detector in the elevator pit or smoke detector in the elevator equipment room.

4. Provide one set of NC/NO (normally closed /normally open) auxiliary contacts on the manual disconnect for the power in the elevator machine room. Whenever the manual disconnect is turned off, the battery lowering device shall be disabled. These contacts are available as an attachment to the manual disconnect. Note: Provide auxiliary contacts at all elevators with battery lowering devices.

5. Provide a dedicated 120 volt circuit from a 120/208 volt panelboard to shunt trip the breaker.

6. All interface connections to the elevator controller shall be provided through a relay. Label all relays on the outside junction box cover.

1.4.4 Primary Power

Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.5 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only.

1.5.1 Data

Battery; GA.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Spare Parts; FIO

Spare parts data for each different item of material and equipment specified, not later than 1 month prior to the date of beneficial occupancy. Data shall

include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

1.5.2 Drawings

Fire Alarm Reporting System; GA.

Detail drawings shall be prepared and signed by a NICET Level 4 fire alarm Technician.

A. Detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

All drawings shall be shown on a computer generated CADD system.

On a separate sheet of white full size drawing (minimum sheet size - 36 inches by 24 inches), show the following external panel wiring:

- 1) Layout of the entire facility drawn to scale which shows all device locations;
- 2) Fire alarm panel mounting and location which demonstrates proper clearance and coordination with other trades;
- 3) All conduit and wiring runs external to the fire alarm panel. Conduit runs shall be drawn parallel and perpendicular to the facility at the same locations to be installed;
- 4) Detail drawings shall show all connections between the FACP and all devices, appliances, supervised devices, and any equipment controlled by the FACP;
- 5) All addresses for devices. Show the address next to the device location. If more than one signal line circuit, show the SLC loop number with the address.
- 6) The drawing shall be specific for this particular project. Standard drawings obtained from a manufacturer shall not be accepted.

B. On a separate sheet(s) of white full size drawing (minimum sheet size - 36 inches by 24 inches), show the following:

--- Each device with all field terminal wiring for installation. This shall include all power wiring, SLC circuit, indicating circuits, connections from other trades (such as supervision of auxiliary contacts in duct smoke detectors with HVAC DDC panel) etc. All wiring diagrams shall be shown on this sheet. Wiring schematics referenced to manufacturers' diagrams packaged with the device will not be acceptable.

--- Complete wiring schematic showing shutdown of AHU, CRU units, and fans. This shall show all terminal connections to the relays at the FACP and terminal connections to the Hand-OFF-Auto circuit inside the starter. Include complete wiring schematic of the starter circuit for each mechanical equipment device provided. (Starter circuit may be copy from mechanical or controls contractor, but include in submittal).

Complete wiring schematic diagram which shows elevator controls from the FACP. This shall include the following:

- a) Panel terminal connections

- b) Smoke detector Recall --- Wiring to addressable control modules in the elevator machine room. Show location of control modules and terminal wiring schematics with contacts. Provide cutsheet of all devices.
- c) Heat detector --- Wiring connection diagram for time delay relay to shunt trip elevator breaker upstream. Show all connections to time delay relay, 120 volt panel, and FACP interface wiring.
- d) Battery backup disable --- all wiring between control module CM1 and manual disconnect auxiliary contacts. For description of CM1, see paragraph titled "Elevator Control".

C. On a separate sheet of white full size drawing (minimum sheet size - 36 inches by 24 inches), show the following internal panel wiring:

1) Layout of all circuit boards, modules, all terminations from circuits on screw terminals, and internal wiring, such as power supplies, batteries and transmitter connections. Drawing needs to be clear where the circuits shown on the external panel wiring terminates on the internal wiring drawing. All modules shall be clearly marked to reflect screw terminal number and conductor to terminate from the external wiring diagram.

2) This drawing shall be specific for this particular project.

D. Provide hardcopy of program in 3 ring inch binder and electronic copy of program on 3 1/2 inch floppy.

E. Only original manufactures' literature shall be included in submittal. Photo-copies will not be acknowledged. Submittals shall be provided in 3 ring hard cover binders.

1.5.3 Instructions

Fire Alarm Reporting System; GA.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Instructions shall be approved prior to training. All information included in paragraph titled "Drawings" shall be included in the O & M Manuals reflecting as-built conditions. Only original manufacturers' literature shall be included in the O & M Manuals. Manuals shall be provided in 3 ring hard cover binders. The manuals in Section

16721A shall be in separate binders from other O & M Manuals in this contract.

1.5.4 Training; GA

Submit schedule with list of topics for the entire training period.

1.5.5 Statements

Test Procedures; GA.

Detailed test procedures for the fire detection and alarm system 30 days prior to performing system tests. Test procedures shall be specific for this project and system installed.

1.5.6 Reports

Testing; GA.

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document all readings, test results and indicate the final position of controls.

1.5.7 Certificates

Equipment; GA.

Certified copies of current approvals or listings issued by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

1.5.8 Qualifications

- 1) Qualifications of the Installer
- 2) Manufacturers Services In The Field

1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

PART 2 - PRODUCTS

2.1 CONTROL PANEL

Control panel shall comply with all the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing all components and equipment required to provide the specified operating and supervisory functions of the system.

The panel shall have a liquid crystal display, separate supervisory and system trouble acknowledge keypads, separate supervisory and system trouble LED annunciation, programmable custom label for each unique initiating device, control keypad for four programmable controls on the front of the panel.

The panel shall have separate supervisory and system trouble. Supervisory trouble shall be used to indicate when a device is not located in the normal position, and as a result may impede the fire protection system within the facility. Supervisory troubles include examples such as tamper switches on OS&Y valves, tamper switches on PIV valves, low air switch on preaction systems, monitoring of abnormal conditions on fire pump controllers, etc. System trouble shall be considered a problem with the wiring (open conductor) or module failed, etc.

Nameplates for fuses shall also include ampere rating. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). LCD screen, meters and lamps shall be plainly visible when the cabinet door is closed.

Signals shall be provided to indicate any device by alarm, supervisory or trouble condition on the system. Each SLC and NAC circuit shall be supervised so that a signal on one circuit does not prevent the receipt of signals from other circuits. Loss of power, including any or all batteries, shall not

require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate all units. All shall be painted red.

Fire alarm control panel shall provide alarm verification, by device, with tally, smoke detector pre-alarm indication at control panel, 80 character display on panel, printer interface, CRT display interface, non-fire alarm module reporting, automatic NFPA 72 detector test, programmable trouble reminder, upload/download system database to PC computer, one-man walk test, and smoke detector maintenance alert.

Panel shall have UDACT communications.

2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be the sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be sized per NFPA requirements. Battery cabinet shall be a separate compartment within the control panel or a separate cabinet.

2.3 POWER SUPPLY AND BATTERY CHARGER

Battery charger shall be switching power supply design for high efficiency, precise monitoring and control of output power. Charging rate shall be as recommended by the manufacturer. Charger shall be located in control panel or battery cabinet.

2.5 INITIATING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, and UL 521. All devices shall be addressable type. Devices shall have screw terminals for making connections. No solder connections will be allowed. Devices shall be connected into signal line circuits.

Devices in hazardous locations shall conform to the applicable area per NEC, article 500. Intrinsically safe devices will not be allowed.

2.5.1 MANUAL FIRE ALARM STATIONS

Stations shall conform to the applicable requirements of UL 38. Stations shall be installed on semiflush-mounted outlet boxes in administrative areas. Stations shall be the double action type only. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a

key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Boxes shall be sized as recommended by the manufacturer. Manual stations shall have a surface trim over the flush and surface mounted boxes. Surface-mounted boxes shall be painted the same color as the fire alarm manual stations.

2.5.2 Smoke Detectors

Detectors shall be photoelectric type. Detectors shall be UL Listed to Standard 268. Detectors shall be the plug-in type in which the detector base contains terminals for making all wiring connections. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.5.2.1 Analog Addressable Smoke Detectors

Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a prealarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value.

An alternate alarm sensitivity level shall be provided for each detector, which can be set to any of the five (5) sensitivity settings manually or automatically using a time of day event. In addition to the five alternate sensitivity levels the detector shall provide an alternate prealarm sensitivity setting, which shall be settable in 5% increments of the detector's alternate alarm sensitivity value.

The detector shall be able to differentiate between a long drift above the prealarm threshold and fast rise above the threshold.

The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal that 75% to 99% compensation has been used. The detector shall provide a dirty fault signal that 100% or greater compensation has been used.

The system shall allow for the changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector type has been installed or change in the application program profile has been made.

2.5.3 Duct Detectors

Duct detectors shall be provided and installed under this section of the specifications. The duct detector shall be UL Listed and the same manufacturer as the fire alarm control panel. Detectors shall be photoelectric type and operate on the light-scattering, photodiode principle. To minimize nuisance alarms, detectors shall have an insect screen and be designed to ignore invisible airborne particles or smoke densities that are below the factory-set alarm point. No radioactive materials shall be used. Removal of the detector head shall interrupt the supervisory circuit and activate a trouble signal at the control panel.

2.5.4 HEAT DETECTORS

Heat detectors shall be UL Listed to Standard 521. Detectors shall be intelligent addressable devices rated at 135 degree fixed temperature with rate of rise of 15 degrees per minute. Detectors shall have an alarm initiating LED and self restoring operation.

Detectors in elevators shafts and elevator equipment rooms shall be 190 degree fixed temp with rate of rise.

2.5.6 Addressable Device Modules (ADM)

2.5.6.1 ADM - Monitor Type

Monitor type shall be used to provide a unique address for status monitoring and supervision of nonaddressable devices to the signal line circuit. A separate ADM shall be used on each tamper switch, pressure switch, water-flow paddle switch, and explosion proof manual stations, etc. Monitor type shall be Style D on the secondary side of the ADM.

2.5.6.2 ADM - Control Type

Control type shall be used to provide addressable control functions. The control type shall be used for shutdown of air handling units, computer room units, and exhaust fans. ADM shall have two normally open and two normally closed contacts rated 2 Amps @ 120 V or 28 V DC. ADM control type shall also be used to power and release electromagnetic door hold-open devices.

2.5.6.3 Isolation Module

Provide addressable fault isolator circuit modules as specified in the project requirements document. The module shall be capable of isolating and removing a fault from a Class A data circuit while allowing the remaining data loop to continue operating. The isolator module shall continuously check the faulted side of the loop to determine if the short still exist. When the fault is cleared, the module shall automatically restore the entire data loop to its normal condition. Wiring for the isolator modules shall have Style 6 input wiring and Style 6 output wiring on the secondary side.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. All devices shall have a separate screw terminal for each conductor. All devices shall be painted red. Strobes shall provide synchronized flash outputs.

2.6.5 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances may be used in lieu of separate audible and visual devices. All units shall be factory assembled.

2.6.7 Strobes

Devices shall be UL Listed and compatible to ADA requirements. Visual appliances shall be rated for use at 28 VDC powered Xenon Flashtube. Color shall be red with White "Fire" lettering. Devices shall be wall mounted. Flash rate shall be 1 HZ.

2.7 System Printer

The FACP shall have a printer for monitoring all activities within the panel. The printer shall be integral with the panel or a separate component from the fire alarm control panel.

The system shall provide an EIA-232 printer/PC interface (variable baud rate) on the main circuit board. The event and status printer shall be a UL 864 listed, 9-pin, impact, dot matrix printer with a minimum print speed of 232 characters per second and shall be automatic type listing code, time, date, location, category, condition, and user defined message for each event printed. The printer shall be capable of serial or parallel communications protocol. The communications speed for RS-232 communications protocol shall be adjustable from 300 to 9600 Baud.

2.8 Omitted

2.9 Conduit

Conduit and fittings shall comply with latest UL standards.

2.10 Conductors

Conductors for 120V ac power shall be No. 12 AWG minimum. Conductors for low voltage dc circuits shall be No. 14 AWG stranded minimum. Conductors for addressable signal line circuits shall be shielded and stranded No. 18. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70.

2.11 Spare Parts

Two spare fuses of each type, five spare lamps and LED's of each type shall be furnished. Two of each type of detector shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

2.12 Radio Transmitter and Antenna

Radio transmitter, antenna, surge suppressor, coax, and mounting brackets shall be provided and installed under this contract. Radio transmitter shall have a frequency of 165.1375 MHZ and shall be compatible with the base-wide MONACO D-700 system. Backup battery shall be capable of standby for 60 hours. Radio transmitter shall have 16 zones. Antenna shall be omni-directional type. Installation of antenna and grounding shall be as recommended by the manufacturer.

Radio transmitter shall be a separate and stand-alone system. Any combination FACP and radio transmitter, included with the same enclosure, shall not be approved.

2.13 Remote Annunciator

The remote annunciator shall have a LCD display and controls as needed for local control under key operation.

2.14 DACT Communications

The fire alarm system shall provide off premise communications capability using a digital alarm communications transmitter (DACT) for sending system events to multiple central monitoring station (CMS) receivers. The system shall provide the CMS(s) with point identification of system events using Contact ID protocols.

2.15 Omitted

2.16 Omitted

PART 3 - EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated branch-circuit connection for supplying power to each building fire alarm system shall be provided.

3.1.2 Wiring

Wiring for systems shall be installed in 3/4 inch minimum diameter conduit. Conduit shall be electrical metallic conduit above grade, PVC schedule 40 below grade only, threaded intermediate metallic conduit above grade and outside. Maximum length of flexible conduit shall not exceed 6 feet.

Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. Wiring installed in hazardous areas shall meet requirements of NEC, Article 500.

All conductors shall be installed from device to device with no splices in-between devices. Terminal strips installed between devices in junction boxes will not be accepted. Connections and splices shall be made only at the FACP terminals or at the device terminals. The use of wire nut type connectors are prohibited in the system.

A two-loop conduit system shall be provided so that if any one conduit and all conductors contained in that conduit are severed all SLC, NAC on that circuit shall remain functional. Junction boxes shall not be shared in the two-loop conduit system, in other words, all supply and return wiring shall be installed in separate junction boxes, as well as separate conduit. Each signal line circuit shall be installed in a separate conduit loop from the panel. Junction boxes shall not be shared between devices. Only one signal line circuit shall be installed in any junction box.

All devices shall be connected to normally open contacts. The FACP shall be programmed to recognize a device as either supervisory trouble or alarm. A wire break shall be considered as system trouble.

Notification devices shall not be connected into the signal line circuit(s) through field addressable modules. All power for the notification circuits shall be derived from the FACP power supply, or next to the FACP (within the same room) from power extender panels. Style Z wiring shall be extended from the FACP or the extender panels, located next to the FACP, to the notification devices and back. Signal line circuits (SLC) with addressable modules shall not be used with notification devices, or any part of the circuit.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. All manually operable controls shall be between 36 inches to 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be installed in accordance with NFPA 72E. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be

located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

3.1.5 Notification Appliances

Notification appliances shall be mounted at 80 inches above the finished floor.

3.1.6 Annunciator Equipment

Annunciator equipment provided shall be mounted where indicated.

3.2 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.3 GROUNDING

Grounding shall be provided from an equipment grounding conductor supplied from the panel which supplies power to the FACP.

3.4 TESTING

All preliminary and acceptance testing listed below shall be performed by the fire alarm installing company. The Contractor shall notify the Contracting Officer by writing 14 days before the acceptance tests are to be conducted. The Contractor shall provide written notice of all deficiencies found in the preliminary testing have been corrected prior to written notice of acceptance test to be scheduled. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The fire alarm system manufacturers' representative shall be present to supervise all tests. The Contractor shall furnish all instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including random testing of installed initiating and notification appliances. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional.

3.4.2 Final Acceptance Test

Acceptance tests shall not be performed until two weeks after written notice of all deficiencies completed in the preliminary testing. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The test shall include the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of all wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

3.5 TRAINING

Training course shall be provided for the operations and maintenance staff. The training period shall consist of 1 training day (8 hours). Training shall be conducted after the system is functionally completed, preliminary testing is complete and all deficiencies from the preliminary testing is corrected. Training shall be conducted prior to final acceptance tests and on a separate calendar date from the final acceptance tests. The Contractor shall notify the Government of the training time in writing not less than 14 days prior to the scheduled training.

The instructions shall cover all of the items contained in the operating and maintenance instructions in the Corps of Engineers Office. The training shall continue at the jobsite to discuss the panel interior, operation, and wiring diagrams. All training shall be conducted by the fire alarm manufacturers' service representative.

The training for the fire alarm detection system shall be as follows:

<u>Training</u>	<u>Length</u>	<u>Location</u>
Classroom Training (4 hours)	-----	Robins AFB Area Office
Field Training (4 hours)	-----	Project Site

3.6 DEVICE LABELING

All devices shall be given an adhesive label which designates the individual device address. Lettering shall be 1/2 in by 1/2 in. Label shall be visible on the front of the device.

3.7 CONDUIT LABELING

Conduit shall be labeled every 10 ft with a 3 inch wide red tape band. Junction box covers shall be painted red.

3.8 AS BUILTS

The Contractor shall maintain a complete set of fire alarm as-built drawings on electronic file. The file format shall be compatible with the .dgn microstation system. The CADD drawing shall include the shop drawings included in the O & M Manuals, and any changes to the fire alarm construction drawings.

Drawing shall show layout of facility and drawn to scale. The drawing shall show doors with door numbers, and rooms with room numbers, etc.

3.9 Software

All software, programming, and data used in each FACP shall be given to the Government at the completed installation and testing of the respective panel. This shall be provided in electronic format on discs and hardcopy on printed sheets included in the O&M Manuals. All parameters used in the programming shall be included. Complete programming manuals shall be included in the O& M Manuals.

-- End of Section --

APPENDIX H

PROCESS MATERIAL SAFETY DATA SHEETS

Paint Application Narrative

The following information shall be used when calculating the required paint hangar airflow, allowable percentage of recirculated air (if applicable) and corresponding paint hangar chemical concentrations. There are four processes that require analysis:

1. Alodine
2. Epoxy Primer
3. Polyurethane Topcoat
4. APC Topcoat

This facility is planned to paint 30 aircraft per year as part of the depot maintenance cycle. Workers in the space utilize personal protective equipment (PPE) consisting of respirators and breathing air suits. Paint will be applied with electrostatic air guns as required in Section 01014 of this RFP.

The following information has been provided by the users and is applicable for the C-5 aircraft.

1. Alodine (Alumibond 1200)

MSDS No.: Not Given

Usage: 3028 L (800 gal) avg. / 3785 L (1000 gal) max.

Time Used: 2 hrs

Task Time: 8 hrs

Overspray: N/A. 90% rinsed away.

2. Epoxy Primer

MSDS No.: 193316 Resin
193317 Catalyst

Mixture: 3:1 Resin to Catalyst

Usage: 416 L (110 gal) avg. / 454 L (120 gal) max.

Time Used: 3 hrs

Task Time: 8 hrs

Overspray: 30%

3. Polyurethane Topcoat

MSDS No.: 193491 or 12344 Resin
10009 Catalyst

Mixture: 3:1 Resin to Catalyst

Usage: 454 L (120 gal) avg. / 511 L (135 gal) max.

Time Used: 4 hrs

Task Time: 8 hrs

Overspray: 30%

4. APC Topcoat

MSDS No.: 193702 Resin
MSDS No.: 139703 Catalyst

Mixture: 3:1 Resin to Catalyst

Usage: 757 L (200 gal) avg. / 851 L (225 gal) max.

Time Used: 7 hrs

Task Time: 8 hrs

Overspray: 10%

Refer to the MSDS sheets located in this appendix for specific information on each product.

MATERIAL SAFETY DATA SHEET

ACI Chemicals, Inc.

140 Industrial St
Phone (972) 227-2241

Lancaster, Texas 75134
Fax (972) 227-7943

ALUMIBOND 1200

Section 1: Chemical Product Identification

Product Name: ALUMIBOND 1200
Emergency Phone (Chemtran): 1-800-424-9300

Formula: Proprietary Mixture
Date: September 9, 1994

Section 2: Composition Information on Ingredients

ACI Chemicals' hazard evaluation has identified the following chemical ingredients as hazardous under OSHA's Hazard Communication Rule, 29 CFR 1910.1200.

Ingredients:	CAS #:	Approximate %:	OSHA PEL:	ACGIH TLV:
Chromic Acid	1333-82-0	50 - 60	1 mg/m ³	0.05 mg/m ³
Potassium Ferricyanide	13746-66-2	10 - 20		Not established
Sodium Fluoride	7681-49-4	< 10	2.5 mg/m ³	2.5 mg/m ³
Potassium Fluozirconate	16923-95-8	< 10	2.5 mg/m ³	2.5 mg/m ³

Section 3: Hazards Identification

Emergency Overview: Product is a reddish powder mixture with a slight odor. ALUMIBOND 1200 is an oxidizer and may react with easily oxidizable or combustible materials. It is also corrosive and can cause severe burns to eyes, skin, respiratory tract and mucous membranes.

Potential Health Effects:

Eye: Contact can cause severe burns.

Skin: Contact can cause severe burns, external ulcers and ulceration of broken skin, "Chrome sores" and slow healing scars.

Ingestion: Can cause burns, severe gastric pain, internal bleeding and tissue damage to the digestive tract. Swallowing even a small quantity can be fatal.

Inhalation: Inhalation of dust or mist can cause acute poisoning damage to mucous membranes, perforation of nasal septum, nose bleeds and irritation of the respiratory system.

Chronic Effects: Hexavalent chromium compounds as a group have been listed as there being sufficient evidence for carcinogenicity to humans and animals.

Signs and Symptoms: Redness, irritation, sneezing, burning

Carcinogenicity: NTP: Listed

IARC Monographs: Listed

OSHA Regulated: Listed

Section 4: First Aid Measures

Eyes: Hold eyelids apart and flush eyes with plenty of water for at least 15 minutes. Seek immediate medical attention.

Skin: Immediately flush skin with plenty of water. Remove contaminated clothing. Wash clothing separately before reuse. Get medical attention immediately.

Ingestion: If swallowed DO NOT induce vomiting. Get immediate medical attention. Never give anything by mouth to an unconscious person.

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult give oxygen. Get immediate medical attention.

Note to Physician: Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

Section 5: Fire Fighting Measures

Flash Point: None

Method:

Flammable Limits: Non flammable

LEL:

UEL:

Extinguishing Media: Use extinguishing media suitable for surrounding fire.

Unusual Fire and Explosion Hazards: This product may act as an oxidizing agent to initiate or sustain a fire involving organic matter or other easily oxidizable material. Reaction with strong acids may liberate toxic hydrogen cyanide gas which forms an explosive mixture with air.

Fire - Fighting Equipment: As in any fire, wear self contained breathing apparatus, pressure-demand, MSHA/NIOSH (approved or equivalent) and full gear.

Section 6: Accidental Release Measures

Spill Control and Recovery: Clean up workers must use protective clothing and equipment to prevent body contact.

Solid Product - When product is spilled in dry condition, it should be promptly shoveled up for recovery or disposal. Delay in clean up will allow for absorption of moisture from the atmosphere and will increase the difficulties of clean up. Control the disposal of solid waste.

Liquid Form - The preferred clean-up procedure is to dam up the spill, then cover with sand or inert porous material. Place in container for disposal. Avoid flushing chemical into public sewer or water systems. For large spills pick up spill with vacuum equipment (acid resistant) for disposal, or flush to holding area with water, prior to neutralization. Notify local health and pollution control officials if flushed spillage unavoidably enters public sewers or other water systems. US regulations require reporting of spill of this material that could reach any surface waters. Spills containing 10 lbs. or more of Chromic Acid or 1000 lbs. or more of Zirconium Potassium Fluoride must be reported to the US Coast Guard National Response Center is (800) 424-8802.

Section 7: Handling and Storage

Handling: Wash thoroughly after handling. Wash hands with soap and water before eating, drinking, smoking or using toilet facilities. Use with adequate ventilation. Follow all MSDS/label precautions even after container is emptied because it may retain product residues. Avoid breathing dust or mist. Avoid contact with eyes, skin and clothing.

Storage: Store in tightly closed container in a cool dry place. Do not store near strong acids or combustible materials. Keep out of the reach of children.

Section 8: Exposure Controls, Personal Protection

Engineering Controls:

Eye Protection: Chemical safety glasses or chemical splash goggles. Have emergency eye bath available where eye contact can occur.

Skin Protection: Gloves coated with rubber, PVC, or other plastic, along with rubber apron and sufficient clothing to minimize skin contact. Have emergency safety shower available where skin contact can occur.

Respiratory Protection: A respiratory program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

Exposure Guidelines: Provide ventilation adequate to maintain airborne concentrations below OSHA limits of 1mg/m³. Local exhaust ventilation preferred where dilutions or reactions cause misting.

Section 9: Physical and Chemical Properties

Specific Gravity: Not applicable

pH (1% Solution): 1.81

Solubility in Water: Complete

Vapor Pressure: Negligible

Vapor Density: Not available

Appearance: Reddish powder mixture

Odor: Slight odor

Boiling Point: No data available

Evaporation Rate: No data available

Melting Rate: No data available

Section 10: Stability and Reactivity Data

Stability: Stable

Conditions to Avoid: None known

Incompatibility with Other Materials: This product contains a strong oxidizing agent even in solution. Avoid contact with organic materials, oils, greases, any oxidizable materials, acids, copper nitrate, ammonia, sodium nitrate, chromium trioxide.

Hazardous Decomposition or Byproducts: During melting operations and at elevated temperatures, various fluoride compounds will be liberated including, but not limited to, hydrogen fluoride and potassium fluoride, also various cyanide compounds including hydrogen cyanide.

Hazardous Polymerization: Will not occur.

Section 11: Toxicological Information

Toxicological data is for Chromic Acid:

Oral LD50 = 52 mg/kg (rat - both sexes)

Dermal LD50 = 57 mg/kg (rabbit - both sexes)

Inhalation LC50 = 217 mg/m³ (rat - both sexes)

Cancer Hazard data for Chromic Acid:

There is laboratory evidence that aqueous sodium dichromate administered directly into the lung, at the highest tolerated dose, over the lifetime of rats, causes a significantly increased incidence of lung cancer. It is expected that if chromic acid was tested in the same manner as aqueous sodium dichromate it would give a similar response. Other laboratory animal tests indicate that Chromic Acid is carcinogenic to laboratory test animals.

Section 12: Ecological Information

No data available

Section 13: Disposal Considerations

It is the responsibility of the user to dispose of the chemicals, chemical baths, their containers and materials used in spill clean up in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, as well as any other relevant federal, state or local laws and regulations regarding disposal.

Section 14: Transport Information

DOT Shipping Description: Oxidizing solid, corrosive, n.o.s. (containing Chromic Acid, Sodium Fluoride), 5.1, UN3085, PG II

Section 15: Regulatory Information

The following Federal Regulations apply to this product:

OSHA's Hazard Communication Rule, 29 CFR 1910.1200:

Based on ACI Chemicals' hazard evaluation, the following ingredient in this product is hazardous and the reason is shown below.

Chromic Acid - oxidizer

Sodium Fluoride - irritant

Potassium Ferricyanide - toxic

Potassium Fluozirconate - poison

CERCLA, 40 CFR 117.3:

This product contains the following ingredients specified in the List of Reportable Quantities of Hazardous Substances.

Chromic Acid - 10 lbs.

Zirconium Potassium Fluoride - 1000 lbs.

Section 15: Regulatory Information Cont.**SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III)****Section 302, Extremely Hazardous Substances (40 CFR 355):**

This product does not contain ingredients listed in Appendix A and B as an Extremely Hazardous Substance.

Sections 311, Hazard and Physical Properties (40 CFR 370):

ACI Chemicals' evaluation has determined this product should be reported under the following categories:

- | | |
|-----------------------------------|------------------------|
| X Immediate Health Hazard (Acute) | Pure Chemical |
| X Delayed Health Hazard (Chronic) | X Mixture of Chemicals |
| Fire Hazard | X Solid Chemical State |
| Sudden Release of Pressure Hazard | Liquid Chemical State |
| X Reactive Hazard | Gaseous Chemical State |

Section 313 - Toxic Chemical Release Inventory (40 CFR 372) (Form R):

This product contains the following chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right to Know:

Chromium Compounds

Cyanide Compounds

Toxic Substances Control Act (TSCA) (40 CFR 710):

All components of this product are listed or are excluded from listing on the 8(b) Inventory List.

Section 16: Other Information**Hazard Rating System:****NFPA:**

- 3 Health
- 0 Flammability
- 2 Reactivity
- Ox Special Hazard

Prepared By: Diane Patterson

HMIS:

- 3 Health
- 0 Flammability
- 2 Reactivity
- F Personal Protection

All information, recommendations and suggestions appearing in this bulletin concerning the use of our products are based upon tests and data believed to be reliable; however, it is the user's responsibility to determine the suitability for his own use of the products described herein. Since the actual use by others is beyond our control, no guarantee, expressed or implied, is made by ACI Chemicals, Inc. as to the effects if such use or the results to be obtained, nor does ACI Chemicals, Inc. assume any liability arising out of use, by others, of the products referred to herein. Nor is the information herein to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist because of applicable laws or government regulations.

SECTION I - Material Identity

Item Name.....EPOXY - PART 1 OF 2 PARTS
 Part Number/Trade Name.....MTL-PRF-23377G (MIL-F-23377G)TY I,CL C;02Y040
 National Stock Number.....8010014166557
 CAGE Code.....33461
 Part Number Indicator.....A
 MSDS Number.....193316
 HAZ Code.....C

SECTION II - Manufacturer's Information

Manufacturer Name.....DEFT, INC.
 Street.....17451 VON KARMAN AVE.
 City.....IRVINE
 State.....CA
 Country.....US
 Zip Code.....92714
 Emergency Phone.....800-424-9300 CHEMTREC
 Information Phone.....949-474-0400

MSDS Preparer's Information

MSDS Preparer Name.....NORM GAUL
 Street.....17451 VON KARMAN AVE.
 City.....IRVINE
 State.....CA
 Zip Code.....92614
 Date MSDS Prepared/Revised.....30NOV99
 Active Indicator.....Y

Alternate Vendors

SECTION III - Physical/Chemical Characteristics

Specification Number.....MIL-P-23377G
 Specification Type/Grade/Class.....TY I
 Appearance/Odor.....YELLOW LIQUID WITH SOLVENT ODOR
 Boiling Point.....213-396F
 Vapor Pressure.....SEE INGRED
 Vapor Density.....>AIR
 Specific Gravity.....1.34814
 Evaporation Rate.....1.66 X N-BUTYL ACETATE
 Solubility in Water.....INSOLUBLE
 Percent Volatile by Volume.....44.8
 Percent Volatile by Weight.....27.6
 Volatile Pounds per Gallon.....3.1031
 Chemical PH.....N/A
 Unit of Issue.....KT
 Container Type Code.....F
 Container Pressure Code.....4
 Temperature Code.....8
 Product State Code.....L

SECTION IV - Fire And Explosion Hazard Data

Flash Point.....= 46F
 Flash Point Method.....TCC
 Lower Explosive Limit.....90

Upper Explosive Limit.....10.50
 Extinguishing Media.....FOAM, ALCOHOL FOAM, CO2, DRY CHEMICAL, WATER FOG.
 Special Fire Fighting Procedures.....FULL FIREFIGHTING EQUIP W/SCBA & FULL PROT
 CLOTHING SHOULD BE WORN BY FIREFIGHTERS. WAT MAY
 BE USED TO COOL CLSD CNTRS TO PREVENT
 PRES. BU/UP, AUTO IGNIT, EXPLOSION
 Unusual Fire/Explosion Hazards.....KEEP CNTRS TIGHTLY CLSD. ISOLATE FROM
 HEAT, SPARKS, ELECTRICAL EQUIP & OPEN FLAME. CLSD
 CNTRS MAY EXPLODE WHEN EXPOSED TO EXTREME
 HEAT. *SUPP. DATA

SECTION V - Reactivity Data

Stability.....YES
 Stability Conditions to Avoid.....HIGH TEMPERATURES, SPARKS, OPEN FLAMES. AVOID
 UNCONTROLLED REACTIONS WITH AMINES.
 Materials to Avoid.....STRONG OXIDIZING AGENTS & STRONG LEWIS OR MINERAL
 ACIDS.
 Hazardous Decomposition Products.....BY HIGH HEAT/TEMPERATURE: CO, CO2, OXIDES OF
 NITROGEN. ALDEHYDES & ACIDS MAY BE FORMED DURING
 COMBUSTION.
 Hazardous Polymerization.....NO
 Polymerization Conditions to Avoid.....N/A
 LD50 - LD50 Mixture.....N/A

SECTION VI - Health Hazard Data

Route of Entry: Skin.....YES
 Route of Entry: Ingestion.....NO
 Route of Entry: Inhalation.....YES
 Health Hazards - Acute & Chronic.....VAPORS ARE IRRIT TO EYES, NOSE, THROAT. INHAL MAY
 CAUSE HDACHES, DIFF BREATHING & LOSS OF
 CONSCIOUSNESS. CHRONIC: PROL CONTACT WILL CAUSE
 DRYING & CRACKING OF SKIN, DUE TO DEFAT
 ACTION. SKIN SENSITIZATION, ASTHMA OR OTHER
 ALLERGIC RESPONSES MAY DEVELOP.
 Carcinogenicity: NTP.....NO
 Carcinogenicity: IARC.....NO
 Carcinogenicity: OSHA.....NO
 Explanation of Carcinogenicity.....N/A
 Symptoms of Overexposure.....INHAL: IRRIT OF RESP TRACT & ACUTE NERV. SYS
 DEPRESSION
 W/HDACHE, DIZZ, STAG. GAIT, CONFUSION, UNCONS, OR
 COMA. SKIN: MAY CAUSE
 IRRIT, SWELLING, REDNESS, RASH. EYES: IRRIT & MAY
 CAUSE TEARING, REDNESS, SWELLING W/STING
 SENSATION. SKIN ABSORP: PROL/REPEATED CONTACT CAN
 CAUSE MOD IRRIT, DRYING, DEF OF SKIN WHICH MAY
 CAUSE SKIN TO CRACK. **SUP
 Medical Cond. Aggravated by Exposure...ASTHMA & ANY OTHER RESP. DISORDERS. SKIN
 ALLERGIES, ECZEMA, AND DERMATITIS.
 Emergency/First Aid Procedures.....INHAL: MOVE TO FRESH AIR. RESTORE
 BREATHING. ASTHMATAIC TYPE SYMPTOMS MAY DEVELOP &
 BE IMMED OR DELAYED BY SEV. HRS. SEEK MED
 ATTN. SKIN: REMOVE & WASH CONTAM. CLOTHING BEFORE
 REUSE. WASH AREAS THORO W/SOAP & WATER. EYES: FLUSH
 W/CLEAN LUKEWARM WATER (LOW PRES) FOR 15 MIN., OCCAS
 LIFTING LIDS. SEEK MED ATTN. INGEST: DO NOT INDUCE
 VOMITING. DO NOT GIVE ANYTHING TO
 UNCONS. PERSON. GET MED ATTN.

SECTION VII - Precautions For Safe Handling And Use

Steps if Material Released/Spilled.....EVACUATE ALL NON-ESSENTIAL PERSONNEL.REMOVE ALL SOURCES OF IGNIT(FLAME, SPARKS, HOT SURFACES).VENTILATE AREA.CONTAIN & REMOVE W/INERT ABSORBENT & NON-SPARKING TOOLS.

Waste Disposal Method.....MUST BE DISPOSED OF IAW FEDERAL, STATE & LOCAL REGUL.EMPTY CNTRS MUST BE HANDLED W/CARE, DUE TO PRODUCT RESIDUE & FLAM.VAPOR.DO NOT INCINERATE CLOSED CNTRS.

Handling & Storage Precautions.....STORE IN BLDGS DESIGNED TO COMPLY W/OSHA 1910.106.AVOID STORING NEAR HIGH TEMPS, FIRE, OPEN FLAMES, SPARK SOURCES.STORE TIGHT CLSD CNTRS.STORE WELL VENT.

Other Precautions.....KEEP CNTRS TIGHT & UPRIGHT TO PREVM.LEAK.AVOID PROL INHAL OF VAPORS/MISTS.MAY CAUSE ALLERG.REACTION.AVOID SKIN/EYE CONTACT.DO NOT TAKE INTERNALLY.DO NOT HANDLE UNTIL MFCR SAFETY PRECAUT HAVE BEEN READ & UNDERSTOOD.

SECTION VIII - Control Measures

Respiratory Protection.....AIR PURIFYING OR FRESH AIR SUPPLIED IS NECESSARY.OBSERVE OSHA REGUL FOR RESP.USE.

Ventilation.....EXHAUST VENT SUFF.TO KEEP AIRBORNE CONC OF SOLV VAPORS OR MISTS BELOW THEIR TLV'S MUST BE UTILIZED.REMOVE IGNIT.SOURCES

Protective Gloves.....NEOPRENE, RUBBER, POLYETHYLENE

Eye Protection.....S/EYEWEAR, SPLASHGRDS, SIDESHLDs, CHEM.GOG

Other Protective Equipment.....LONG SLEEVE & LONG LEG CLOTHING IS RECOM.REMOVE & WASH CONTA .CLOTHING BEFORE REUSE.

Work Hygenic Practices.....WASH HANDS BEFORE EATING, SMOKING, OR SUING WASHROOM.SMOKE IN SMOKING AREAS ONLY.

Supplemental Health/Safety Data.....*UNUSUAL FIRE:APPLIC.TO HOT SURF.REQUIRES SPECIAL PRECAUTIONS.DURING EMERG.COND.OVEREXP.TO DECOMP.PRODUCTS MAY CAUSE A HEALTH HAZARD.SYMPTOMS MAY NOT BE IMMED APPARENT.**SIGNS/INGEST:CAN RESULT IN IRRIT & POSS.CORROSIVE ACTION IN MOUTH, STOM.TISSUE & DIGEST.TRACT.VOMITING MAY CAUSE ASPIR.OF SOLV, CAUSING CHEM.PNEUMONITIS

SECTION IX - Label Data

Protect Eye.....YES

Protect Skin.....YES

Protect Respiratory.....YES

Chronic Indicator.....YES

Acute Indicator.....YES

Contact Code.....MODERATE

Fire Code.....SERIOUS

Health Code.....SERIOUS

React Code.....MODERATE

Personal Protective Equipment.....Splash Goggles, Gloves, Apron,

Specific Hazard and Precaution.....VAPORS ARE IRRIT TO EYES, NOSE, THROAT. INHAL MAY CAUSE HDACHES, DIFF.BREATHING & LOSS OF CONSCIOUSNESS.CHRONIC:PROL.CONTACT WILL CAUSE DRYING & CRACKING OF SKIN DUE TO DEFAT.ACTION.SKIN SENSITIZATION, ASTHMA OR OTHER ALLERGIC RESPONSES MAY DEVELOP.

SECTION X - Transportation Data

Container Quantity.....0.750000
Unit of Measure.....GL

SECTION XI - Site Specific/Reporting Information

Volatile Organic Compounds
Grams per Liter.....
Pounds per Gallon.....
Ounces per Gallon.....

SECTION XII - Ingredients/Identity Information

Ingredient #.....01
Ingredient Name.....N-BUTYL ACETATE
CAS Number.....123-86-4
NIOSH Number.....AF7350000
Proprietary.....NO
Percent.....5
OSHA PEL.....150PPM/200 STEL
ACGIH TLV.....150PPM/200 STEL
Vapor Pressure.....13
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....02
Ingredient Name.....BENZENE, 1-CHLORO-4-(TRIFLUOROMETHYL)-
<0.1%
CAS Number.....98-56-6
NIOSH Number.....XS9145000
Proprietary.....NO
Percent.....0.1
Vapor Pressure.....5.3
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....03
Ingredient Name.....BENZENE, 1-CHLORO-2 TRIFLUOROMETHYL
<0.1%
CAS Number.....88-16-4
NIOSH Number.....1013985CH
Proprietary.....NO
Percent.....0.1
OSHA PEL.....N/E
ACGIH TLV.....N/E
Vapor Pressure.....5.3
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....04
Ingredient Name.....METHYL N-PROPYL KETONE
CAS Number.....107-87-9
NIOSH Number.....SA7875000
Proprietary.....NO
Percent.....25
OSHA PEL.....200 PPM/250 STEL

ACGIH TLV.....200 PPM/250 STEL
Vapor Pressure.....27.8
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....05
Ingredient Name.....STRONTIUM CHROMATE
CAS Number.....7789-06-2
NIOSH Number.....GB3240000
Proprietary.....NO
Percent.....25
ACGIH TLV.....0.0005 MG/M3 AS CR

Ingredient #.....06
Ingredient Name.....C8&10 AROMATIC HYDROCARBON
CAS Number.....64742-95-6
NIOSH Number.....WF3400000
Proprietary.....NO
Percent.....5
OSHA PEL.....N/E
ACGIH TLV.....N/E
Recommended Limit.....MFG:100 PPM
Vapor Pressure.....3
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....07
Ingredient Name.....N-METHYLPYRROLIDONE
CAS Number.....872-50-4
NIOSH Number.....UY5790000
Proprietary.....NO
Percent.....1
OSHA PEL.....N/E
ACGIH TLV.....N/E
Recommended Limit.....GAF CORP:100 PPM TLV
Vapor Pressure.....5
Vapor Pressure UOM.....MMHG
Vapor Temperature.....77
Vapor Temperature UOM.....F

COMMENTS

NOTICE: For additional information, contact
BIO ENGR AT 7-7555

SECTION I - Material Identity

Item Name.....EPOXY, PART 2 OF 2 PARTS
Part Number/Trade Name.....MIL-PRF-23377G(MIL-P-23377G), 02Y040CAT
National Stock Number.....8010014166557
CAGE Code.....33461
Part Number Indicator.....B
MSDS Number.....193317
HAZ Code.....C

SECTION II - Manufacturer's Information

Manufacturer Name.....DEFT, INC.
Street.....17451 VON KARMAN AVE.
City.....IRVINE
State.....CA
Country.....US
Zip Code.....92614
Emergency Phone.....800-424-9300
Information Phone.....949-474-0400

MSDS Preparer's Information

Street.....17451 VON KARMAN AVE.
City.....IRVINE
State.....CA
Zip Code.....92614
Date MSDS Prepared/Revised.....30NOV99
Active Indicator.....Y

Alternate Vendors

SECTION III - Physical/Chemical Characteristics

Specification Number.....MIL-P-23377G
Specification Type/Grade/Class.....TYPE I, CLASS C
Appearance/Odor.....AMBER LIQUID W/SOLVENT ODOR
Boiling Point.....211-401F
Vapor Pressure.....SEE INGRED
Vapor Pressure UOM.....MMHG
Vapor Density.....>AIR
Specific Gravity......9484
Evaporation Rate.....0.63 X N-BU AC
Solubility in Water.....INSOLUBLE
Percent Volatile by Volume.....34.8
Percent Volatile by Weight.....29.7
Volatile Pounds per Gallon.....2.3492
Chemical PH.....N/A
Unit of Issue.....KT
Container Type Code.....R
Container Pressure Code.....4
Temperature Code.....8
Product State Code.....L

SECTION IV - Fire And Explosion Hazard Data

Flash Point.....= 72F
Flash Point Method.....TCC
Lower Explosive Limit.....1

Upper Explosive Limit.....9.80
 Extinguishing Media.....FOAM, ALCOHOL FOAM, CO2, DRY CHEMICAL, WATER FOG.
 Special Fire Fighting Procedures.....FULL FIREFIGHTING EQUIPMENT W/SCBA & FULL
 PROT.CLOTHING SHOULD BE WORN BY FIREFIGHTERS.
 WATER MAY BE USED TO COOL CLSD CNTRS TO PREVENT
 PRESSURE BUILD-UP,AUTO IGNITION, OR EXPLOSION.
 Unusual Fire Explosion Hazards.....KEEP CONTAINERS TIGHTLY CLOSED.ISOLATE FROM
 HEAT, SPARKS,ELECTRICAL EQUIPMENT & OPEN FLAME.
 CLOSED CNTRS MAY ELECTRICAL EQUIPMENT & OPEN
 FLAME.CLOSED CNTRS MAY EXPLODE WHEN EXPOSED TO
 EXTREME HEAT.APPLICATION TO HOT SURFACES REQUIRES
 SPECIAL PRECAUTIONS.DURING EMERGENCY CONDITIONS
 OVEREXPOSURE TO DECOMPOSITION PRODUCTS MAY CAUSE
 A HEALTH HAZARD.SYMPTOMS MAY NOT BE IMMEDIATELY
 APPARENT.

SECTION V - Reactivity Data

 Stability.....YES
 Stability Conditions to Avoid.....HIGH TEMPERATUARES,EPOXY RESINS UNDER
 UNCONTROLLED CONDITIONS.
 Materials to Avoid.....OXIDIZING MATERIALS & STRONG ACIDS.EPOXY RESINS
 UNDER UNCONTROLLED CONDITIONS.
 Hazardous Decomposition Products.....BY HIGH HEAT/TEMPERATURES:CO,CO2, OXIDES OF
 NITROGEN.
 Hazardous Polymerization.....NO
 Polymerization Conditions to Avoid.....N/A

SECTION VI - Health Hazard Data

 Route of Entry: Skin.....YES
 Route of Entry: Ingestion.....NO
 Route of Entry: Inhalation.....YES
 Health Hazards - Acute & Chronic.....VAPORS ARE IRRIT TO EYES,NOSE & THROAT.INHAL MAY
 CAUSE HEADACHES,DIFF.BREATHING & LOSS OF
 CONSCIOUSNESS.CHRONIC:PROLONGED CONTACT WILL
 CAUSE DRYING & CRACKING OF SKIN,DUE TO DEFATTING
 ACTION.SKIN SENSITIZATION,ASTHMA OR OTHER
 ALLERGIC RESPONSES MAY DEVELOP.POTENTIAL FOR
 KIDNEY & LIVER DAMAGE.
 Carcinogenicity: NTP.....NO
 Carcinogenicity: IARC.....NO
 Carcinogenicity: OSHA.....NO
 Symptoms of Overexposure.....INHAL:IRRIT OF RESP.TRACT & ACUTE NERV.SYS
 DEPRESSION
 W/HDACHE,DIZZ,STAG.GAIT,CONFUSION,UNCONS,COMA.SKI
 N:MAY CAUSE SWELLING,REDNESS,RASH.EYES:MAY CAUS
 IRRIT,TEARING,REDNESS & SWELLING W/STINGIN
 SENSATION.SKIN ABSORP:PROL CONTACT CAN CAUS
 MOD.IRRIT,DRYING,DEFATTING OF SKIN WHICH CA
 CAUSE SKIN TO CRACK.INGEST:IRRIT & POSS.COSSOSIV
 ACTION IN MOUTH,STOM.TISSUE & DIGESTIV
 TRACT.VOMITING MAY CAUSE ASPIRATION O
 SOLV.RESULTING IN CHEM.PNEUMONITIS.
 Medical Cond. Aggrevated by Exposure...ASTHMA & ANY OTHER RESPIRATORY DISORDERS.SKIN
 ALLERGIES,ECZEMA & DERMATITIS.
 Emergency/First Aid Procedures.....INHAL:MOVE TO FRESH AIR.RESTORE BREATHING.ASTHMA
 TYPE SYMPTOMS MAY DEVELOP & MAY BE IMMED OR
 DELAYED BY SEVERAL HRS.OBTAIN MED
 ATTN.SKIN:REMOVE CONTAM.CLOTHING.WASH AFFECTED

AREAS THORO W/SOAP & WATER.WASH CONTAM.CLOTHING THORO BEFORE REUSE.EYES:FLUSH W/CLEAN LUKEWARM WATER(LOW PRESSURE)FOR AT LEAST 15 MIN.,OCCAS.LIFTING EYELIDS.OBTAIN MED ATTN.INGEST:DO NOT INDUCE VOMITING.DO NOT GIVE ANYTHING TO AN UNCONSCIOUS PERSON.OBTAIN MED ATTN.

SECTION VII - Precautions For Safe Handling And Use

 Steps if Material Released/Spilled.....EVACUATE ALL NON-ESSENTIAL PERSONNEL.REMOVE ALL IGNIT.SOURCES.(FLAME,SPARK SOURCES,HOT SURFACES).VENTILATE AREA.CONTAIN & REMOVE W/INERT ABSORBENT & NON-SPARKING TOOLS.
 Waste Disposal Method.....DO NOT INCINERATE CLOSED CONTAINERS.WASTE MUST BE DISPOSED OF IAW FEDERAL,STATE & LOCAL ENVIRONMENTAL CONTROL REGUL.EMPTY CNTRS MUST BE HANDLED W/CARE,DUE TO PRODUCT RESIDUE & FLAMMABLE VAPOR..
 Handling & Storage Precautions.....STORE IN BLDGS DESIGNED TO COMPLY W/OSHA 1910.106.AVOID STORING NEAR HIGH TEMPS,FIRE,OPEN FLAMES,SPARK SOURCES.TORE IN TIGHTLY CLSD CNTRS.STORE IN WELL VENTILATED AREAS.
 Other Precautions.....KEEP CNTRS TIGHT & UPRIGHT TO PREVENT LEAKAGE.PREVENT PROL BREATHING OF VAPOR OR SPRAY MIST.PROL OVEREXP MAY CAUSE ALLERGIC REACTION.AVOID SKIN/EYE CONTACT.DO NOT TAKE INTERNALLY.DO NOT HANDLE UNTIL MFGRS SAFETY PRECAUTIONS HAVE BEEN READ/UNDERSTOOD.

SECTION VIII - Control Measures

 Respiratory Protection.....A RESP.THAT IS RECOM OR APPRVD FOR USE IN AN ORGANIC VAPOR ENVIRONMENT(AIR PURIFYING OR FRESH AIR SUPP)IS NECESSARY.OBSERVE OSHA REGUL FOR RESP.USE.VENTILATION SHOULD BE PROVIDED TO KEEP EXPOSURE LEVELS BELOW THE OSHA PERMISSIBLE LIMITS.
 Ventilation.....EXHAUST VENT.SUFFICIENT TO KEEP AIRBORN CONC OF SOLV VAP/VIST BELOW TLV'S.
 Protective Gloves.....COTTON,NEOPRENE,RUBBER,POLYETHYLENE
 Eye Protection.....SPLASHGUARDS,SIDESHIELDS,CHEMICAL GOGGLES OR FACESHIELDS.
 Other Protective Equipment.....LONG SLEEVE & LONG LEG CLOTHING RECOMMENDED.REMOVE & WASH CONTAM.CLOTHING BEFORE REUSE.
 Work Hygenic Practices.....WASH HANDS BEFORE EATING,SMOKING,OR USING WASHROOM.SMOKE IN SMOKING AREAS ONLY.

SECTION IX - Label Data

 Protect Eye.....YES
 Protect Skin.....YES
 Protect Respiratory.....YES
 Chronic Indicator.....YES
 Acute Indicator.....YES
 Contact Code.....SLIGHT
 Fire Code.....EXTREME
 Health Code.....MODERATE
 React Code.....SLIGHT
 Personal Protective Equipment.....Splash Goggles, Gloves, Apron,
 Specific Hazard and Precaution.....VAPORS ARE IRRIT TO EYES,NOSE & THROAT.INHAL MAY

CAUSE HEADACHES, DIFF. BREATHING & LOSS OF CONSCIOUSNESS. CHRONIC: PROLONGED CONTACT WILL CAUSE DRYING & CRACKING OF SKIN, DUE TO DEFATTING ACTION. SKIN SENSITIZATION, ASTHMA OR OTHER ALLERGIC RESPONSES MAY DEVELOP. POTENTIAL FOR KIDNEY & LIVER DAMAGE.

SECTION X - Transportation Data

Container Quantity.....0.250000
Unit of Measure.....GL

SECTION XI - Site Specific/Reporting Information

Volatile Organic Compounds
Grams per Liter.....
Pounds per Gallon.....
Ounces per Gallon.....

SECTION XII - Ingredients/Identity Information

Ingredient #.....01
Ingredient Name.....PHENOL, 4,4'-(1-METHYLETHYLIDENE)BIS- CONTAINS BISPHENOL A (CAS #80-05-7) LESS THAN 55%
CAS Number.....80-05-7
NIOSH Number.....SL6300000
Proprietary.....NO
Percent.....5
OSHA PEL.....N/E
ACGIH TLV.....N/E

Ingredient #.....02
Ingredient Name.....PHENOL, NONYL- CONTAINS BISPHENOL A (CAS #80-05-7) LESS THAN 55%
CAS Number.....25154-52-3
NIOSH Number.....SM5600000
Proprietary.....NO
Percent.....5
OSHA PEL.....N/E
ACGIH TLV.....N/E

Ingredient #.....03
Ingredient Name.....BENZYLDIMETYLAMINE - CONTAINS BISPHENOL A (CAS # 80-05-7) LESS THAN 55%
CAS Number.....103-83-3
NIOSH Number.....DP4500000
Proprietary.....NO
Percent.....1
OSHA PEL.....N/E
ACGIH TLV.....N/E

Ingredient #.....04
Ingredient Name.....AMINOETHYL PIPERAZINE - CONTAINS BISPHENOL A (CAS # 80-05-7) LESS THAN 55%
CAS Number.....140-31-8
NIOSH Number.....TK8050000
Proprietary.....NO
Percent.....5
OSHA PEL.....N/E

ACGIH TLV.....N/E

Ingredient #.....05
Ingredient Name.....2-BUTANOL
CAS Number.....78-92-2
NIOSH Number.....EO1750000
Proprietary.....NO
Percent.....30
OSHA PEL.....100 PPM
ACGIH TLV.....100 PPM
Vapor Pressure.....12.5
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....06
Ingredient Name.....SOLVENT NAPHTHA, PETROLEUM, LIGHT AROM. <5%
CAS Number.....64742-95-6
NIOSH Number.....WF3400000
Proprietary.....NO
Percent.....5
OSHA PEL.....N/E
ACGIH TLV.....N/E
Recommended Limit.....MFRG PEL:100 PPM
Vapor Pressure.....3
Vapor Pressure UOM.....MMHG

Ingredient #.....07
Ingredient Name.....N-(3-(TRIMETHOXYSILYL) PROPYL) ETHYLENEDIAMINE <1%
CAS Number.....1760-24-3
NIOSH Number.....KV7400000
Proprietary.....NO
Percent.....1
OSHA PEL.....200 PPM/250 STEL
ACGIH TLV.....200 PPM/250 STEL

Ingredient #.....08
Ingredient Name.....2,4,6-TRI(DIMETHYLAMINOMETHYL) PHENOL, DMP-30

<5%
CAS Number.....90-72-2
NIOSH Number.....SN3500000
Proprietary.....NO
Percent.....5
OSHA PEL.....N/E
ACGIH TLV.....N/E
Vapor Pressure.....0
Vapor Pressure UOM.....MMHG
Vapor Temperature.....70
Vapor Temperature UOM.....F

Ingredient #.....09
Ingredient Name.....EPOXY RESIN HARDENER <1%

CAS Number.....71074-89-0
NIOSH Number.....N/K
Proprietary.....NO
Percent.....1
OSHA PEL.....N/E
ACGIH TLV.....N/E

Vapor Pressure.....0
Vapor Pressure UOM.....MMHG
Vapor Temperature.....70
Vapor Temperature UOM.....F

COMMENTS

NOTICE: For additional information, contact
BIO ENGR AT 7-7555

SECTION I - Material Identity

Item Name.....POLYURETHANE COATING , PART 1 OF 2 PARTS
Part Number/Trade Name.....MIL-PRF-85285C(MIL-C-85285B);03GY321:36173
National Stock Number.....8010013480385
CAGE Code.....33461
Part Number Indicator.....A
MSDS Number.....193491
HAZ Code.....C

SECTION II - Manufacturer's Information

Manufacturer Name.....DEFT, INC.
Street.....17451 VON KARMAN AVE.
City.....IRVINE
State.....CA
Country.....US
Zip Code.....92614
Emergency Phone.....800-424-9300 CHEMTREC
Information Phone.....949-474-0400

MSDS Preparer's Information

Street.....17451 VON KARMAN AVE.
City.....IRVINE
State.....CA
Zip Code.....92614
Date MSDS Prepared/Revised.....30MAY00
Active Indicator.....N

Alternate Vendors

SECTION III - Physical/Chemical Characteristics

Specification Number.....MIL-C-85285B
Specification Type/Grade/Class.....TYPE I
Appearance/Odor.....GREY LIQUID WITH SOLVENT ODOR
Boiling Point.....260-475F
Vapor Pressure.....SEE INGRED
Vapor Pressure UOM.....MMHG
Vapor Density.....>AIR
Specific Gravity.....1.2281
Evaporation Rate.....0.4 X N-BUTYL ACETATE
Solubility in Water.....INSOLUBLE
Percent Volatile by Volume.....53.5
Percent Volatile by Weight.....37.5
Volatile Pounds per Gallon.....3.8409
Unit of Issue.....KT
Container Type Code.....F
Container Pressure Code.....4
Temperature Code.....8
Product State Code.....L

SECTION IV - Fire And Explosion Hazard Data

Flash Point.....= 67F
Flash Point Method.....TCC
Lower Explosive Limit.....0.76%
Upper Explosive Limit.....11.40%

Extinguishing Media.....FOAM, ALCOHOL FOAM, CO2, DRY CHEMICAL, WATER FOG,
WATER SPRAY.

Special Fire Fighting Procedures.....FULL FIREFIGHTING EQUIPMENT W/SCBA AND FULL
PROTECTIVE CLOTHING SHOULD BE WORN BY
FIREFIGHTERS. WATER MAY BE USED TO COOL CLOSED
CONTAINERS TO PREVENT PRESSURE BUILD-UP, AUTO
IGNITION OR EXPLOSION.

Unusual Fire/Explosion Hazards.....KEEP CONTAINERS TIGHTLY CLOSED. ISOLATE FROM
HEAT, SPARKS, ELECTRICAL EQUIPMENT & OPEN
FLAME. CLOSED CNTRS MAY EXPLODE WHEN EXPOSED TO
EXTREME HEAT. APPLICATION TO HOT SURFACES
REQUIRES SPECIAL PRECAUTIONS. DURING EMERGENCY
CONDITIONS OVEREXPOSURE TO DECOMPOSITION PRODUCTS
MAY CAUSE A HEALTH HAZARD. SYMPTOMS MAY NOT BE
IMMEDIATELY APPARENT.

SECTION V - Reactivity Data

Stability.....YES

Stability Conditions to Avoid.....HIGH TEMPERATURES, SPARKS, OR OPEN FLAMES.

Materials to Avoid.....STRONG OXIDIZING AGENTS

Hazardous Decomposition Products.....BY HIGH HEAT/TEMPERATURE: CO, CO2 AND OXIDES OF
NITROGEN.

Hazardous Polymerization.....NO

Polymerization Conditions to Avoid.....N/A

SECTION VI - Health Hazard Data

Route of Entry: Skin.....YES

Route of Entry: Ingestion.....NO

Route of Entry: Inhalation.....YES

Health Hazards - Acute & Chronic.....ACUTE: VAPORS ARE IRRIT TO EYES, NOSE, &
THROAT. INHALATION MAY CAUSE HEADACHES, DIFF
BREATHING & LOSS OF CONSCIOUSNESS. CHRONIC:
PROLONGED CONTACT WILL CAUSE DRYING & CRACKING OF
THE SKIN, DUE TO DEFATTING ACTION. SKIN
SENSITIZATION, ASTHMA OR OTHER ALLERGIC RESPONSES
MAY DEVELOP.

Carcinogenity: NTP.....NO

Carcinogenity: IARC.....YES

Carcinogenity: OSHA.....NO

Explanation of Carcinogenity.....IARC HAS DETERMINED THAT ETHYLBENZENE IS POSSIBLY
CARCINOGENIC TO HUMANS.

Symptoms of Overexposure.....INHAL: IRRIT OF RESP TRACT & ACUTE NERV SYS
DEPRESSION
W/HDACHE, DIZZ, STAG. GAIT, CONFUSION, UNCONS, COMA. SKI
N: MAY CAUSE IRRIT, SWELLING, REDNESS, RASH. EYES: IRRI
& MAY CAUSE TEARING, REDNESS, SWELLING W/STINGIN
SENSATION. SKIN ABSORP: PROL/REPEATED CONTACT CA
CAUSE MOD. IRRIT, DRYING, DEFATTING OF SKIN WHIC
CAN CAUSE SKIN TO CRACK. INGEST: CAN CAUSE IRRIT
POSS. CORROSIVE ACTION IN MOUTH, STOMACH TISSUE
DIGESTIVE TRACT. VOMITING MAY CAUSE ASPIRATION O
SOLV, RESULTING IN CHEM. PNEUMONITIS.

Medical Cond. Aggravated by Exposure...ASTHMA & ANY OTHER RESP. DISORDERS. SKIN
ALLERGIES, ECZEMA & DERMATITIS.

Emergency/First Aid Procedures.....INHAL: MOVE TO FRESH AIR. RESTORE
BREATHING. ASTHMATIC TYPE SYMPTOMS MAY DEVELOP &
MAY BE IMMED OR DELAYED BY SEVERAL HRS. OBTAIN MED
ATTN. SKIN: REMOVE CONTAM. CLOTHING. WASH AFFECTED

AREAS THORO W/SOAP & WATER. WASH CONTAM. CLOTHING BEFORE REUSE. EYES: FLUSH W/CLEAN LUKEWARM WATER (LOW PRESSURE) FOR AT LEAST 15 MIN., OCCASIONALLY LIFTING EYELIDS. OBTAIN MED ATTN. INGEST: DO NOT INDUCE VOMITING. DO NOT GIVE ANYTHING TO AN UNCONSCIOUS PERSON. OBTAIN MED ATTN.

SECTION VII - Precautions For Safe Handling And Use

Steps if Material Released/Spilled.....EVACUATE ALL NON-ESSENTIAL PERSONNEL. REMOVE ALL IGNIT. SOURCES (FLAME, SPARK SOURCES, HOT SURFACES). VENTILATE AREA. CONTAIN & REMOVE WITH INERT ABSORBENT AND NONN-SPARKING TOOLS.

Waste Disposal Method.....DO NOT INCINERATE CLOSED CONTAINERS. WASTE MUST BE DISPOSED OF IAW FEDERAL, STATE & LOCAL ENVIRONMENTAL REGUL. EMPTY CNTRS MUST BE HANDLED W/CARE, DUE TO PRODUCT RESIDUE AND FLAMMABLE VAPOR.

Handling & Storage Precautions.....STORE IN BLDGS DESIGNED TO COMPLY W/OSHA 1910.106. AVOID STORING NEAR HIGH TEMPERATURES, FIRE, OPEN FLAMES, & SPARK SOURCES. STORE IN TIGHTLY CLOSED CONTAINERS. STORE IN WELL VENTILATED AREAS.

Other Precautions.....KEEP CNTRS TIGHT & UPRIGHT TO PREVENT LEAKAGE. PREVENT PROL BREATHING OF VAPORS/SPRAY MISTS. PROL OVEREXP MAY CAUSE ALLERGIC REACTION. AVOID SKIN/EYE CONTACT. DO NOT TAKE INTERNALLY. DO NOT HANDLE UNTIL MFGRS SAFETY PRECAUTIONS HAVE BEEN READ & UNDERSTOOD.

SECTION VIII - Control Measures

Respiratory Protection.....RESP. RECOM. OR APPROVED FOR USE IN AN ORGANIC VAPOR ENVIRONMENT (AIR PURIFYING OR FRESH AIR SUPP) IS NECESSARY IF TLV LIMITS CAN BE MAINTAINED & DOCUMENTED BELOW THE OSHA/ACGIH LIMITS. AN AIR SUPP RESP MAY NOT RE REQD. HOWEVER, OTHER OSHA/NIOSH APPRVD RESP. MAY BE USED.

Ventilation.....EXHAUST VENT. SUFFICIENT TO KEEP AIRBORNE CONC OF SOLV VAPORS/MISTS BELOW THEIR TLV'S MUST BE UTILIZED.

Protective Gloves.....COTTON, NEOPRENE, RUBBER, POLYETHYLENE

Eye Protection.....SAFETY EYEWEAR, INCLUDING SPLASHGUARDS OR SIDESHIELDS, CHEM. GOGGLES OR FACESHIELDS.

Other Protective Equipment.....LONG SLEEVE & LONG LEG CLOTHING RECOM. REMOVE & WASH CONTAM. CLOTHING BEFORE REUSE.

Work Hygenic Practices.....WASH HANDS BEFORE EATING, SMOKING, OR USING WASHROOM. SMOKE IN SMOKING AREAS ONLY.

SECTION IX - Label Data

Protect Eye.....YES

Protect Skin.....YES

Protect Respiratory.....YES

Chronic Indicator.....YES

Acute Indicator.....YES

Contact Code.....SLIGHT

Fire Code.....EXTREME

Health Code.....MODERATE

React Code.....SLIGHT

Personal Protective Equipment.....Splash Goggles, Gloves, Apron,

Specific Hazard and Precaution.....ACUTE: VAPORS ARE IRRIT TO EYES, NOSE, & THROAT. INHALATION MAY CAUSE HEADACHES, DIFF BREATHING & LOSS OF CONSCIOUSNESS. CHRONIC: PROLONGED CONTACT WILL CAUSE DRYING & CRACKING OF THE SKIN, DUE TO DEFATTING ACTION. SKIN SENSITIZATION, ASTHMA OR OTHER ALLERGIC RESPONSES MAY DEVELOP.

SECTION X - Transportation Data

Container Quantity.....0.750000
Unit of Measure.....QT

SECTION XI - Site Specific/Reporting Information

Volatile Organic Compounds
Grams per Liter.....
Pounds per Gallon.....
Ounces per Gallon.....

SECTION XII - Ingredients/Identity Information

Ingredient #.....01
Ingredient Name.....ACETIC ACID, BUTYL ESTER
CAS Number.....123-66-4
NIOSH Number.....AF7350000
Proprietary.....NO
Percent.....5
OSHA PEL.....150 PPM/200 STEL
ACGIH TLV.....150 PPM/200 STEL
Vapor Pressure.....13
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....02
Ingredient Name.....ETHYL 3-ETHOXYPROPIONATE
CAS Number.....763-69-9
NIOSH Number.....UF3225000
Proprietary.....NO
Percent.....5
OSHA PEL.....N/E
ACGIH TLV.....N/E
Recommended Limit.....MFGR:50 PPM/100 STEL
Vapor Pressure.....7
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....03
Ingredient Name.....BENZENE, DIMETHYL-
CAS Number.....1330-20-7
NIOSH Number.....ZE2100000
Proprietary.....NO
Percent.....1
OSHA PEL.....100 PPM/150 STEL
ACGIH TLV.....100 PPM/150 STEL
Vapor Pressure.....5.1
Vapor Pressure UOM.....MMHG

<1%

NIOSH Number.....WH7000000
Proprietary.....NO
Percent.....0.1
OSHA PEL.....1 MG/M3
ACGIH TLV.....N/E
Vapor Pressure.....2
Vapor Pressure UOM.....MMHG
Vapor Temperature.....320
Vapor Temperature UOM.....F

Ingredient #.....10
Ingredient Name.....2,4-PENTANEDIONE

<5%

CAS Number.....123-54-6
NIOSH Number.....SA1925000
Proprietary.....NO
Percent.....5

Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....04
Ingredient Name.....BENZENE, ETUYL-

<1%

CAS Number.....100-41-4
NIOSH Number.....DA0700000
Proprietary.....NO
Percent.....1
OSHA PEL.....100 PPM/125 STEL
ACGIH TLV.....100 PPM/125 STEL
Vapor Pressure.....7.1
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....05
Ingredient Name.....ANTI-FLOAT AGENT

<1%

CAS Number.....1317-65-3
NIOSH Number.....EV9580000
Proprietary.....NO
Percent.....1
OSHA PEL.....10 MG/M3
ACGIH TLV.....10 MG/M3

Ingredient #.....06
Ingredient Name.....ANTI MAR AGENT

<0.1%

CAS Number.....9038-95-3
NIOSH Number.....1007597AL
Proprietary.....NO
Percent.....0.1
OSHA PEL.....N/E
ACGIH TLV.....N/E

Ingredient #.....07
Ingredient Name.....ANTI MAR AGENT - TRADE SECRET
<0.1%

NIOSH Number.....N/K
Proprietary.....NO
Percent.....0.1
OSHA PEL.....N/E
ACGIH TLV.....N/E

Ingredient #.....08
Ingredient Name.....FLOW AGENT

<1%

CAS Number.....26376-86-3

SECTION I - Material Identity

Item Name.....POLYURETHANE COATING, GRAY 36173 PART 1 OF 2
 Part Number/Trade Name.....3:1, MIL-C-85285B, 36173 PC03GY321
 National Stock Number.....8010013480385
 CAGE Code.....33461
 Part Number Indicator.....A
 MSDS Number.....12344
 HAZ Code.....C

SECTION II - Manufacturer's Information

Manufacturer Name.....DEFT, INC.
 P.O.Box.....N/K
 Street.....17451 VON KARMAN AVE
 City.....IRVINE
 State.....CA
 Country.....US
 Zip Code.....92714-6205
 Emergency Phone.....714-474-0400
 Information Phone.....714-474-0400

MSDS Preparer's Information

MSDS Preparer Name.....NORM GAUL
 Street.....17451 VON KARMAN AVENUE
 City.....IRVINE
 State.....CA
 Zip Code.....92714
 Date MSDS Prepared/Revised.....19MAR92
 Date of Technical Review.....03FEB93
 Active Indicator.....Y
 Item Manager.....GSA

Alternate Vendors

Vendor #5 CAGE.....BQDVK

SECTION III - Physical/Chemical Characteristics

Specification Number.....MIL-C-85285B
 Specification Type/Grade/Class.....TYPE 1/KIT 1
 Hazard Storage Compatibility Code.....F3
 NRC License Number.....N/K
 Net Propellant Weight (Ammo).....N/K
 Appearance/Odor.....GRAY LIQUID WITH SOLVENT ODOR
 Boiling Point.....175-401F
 Melting Point.....N/K
 Vapor Pressure.....N/K
 Vapor Density.....> THAN AIR
 Specific Gravity.....1.23289
 Decomposition Temperature.....N/K
 Evaporation Rate.....1.26 X N-BUTYL ACETATE
 Solubility in Water.....INSOLUBLE
 Percent Volatile by Volume.....54.8
 Volatile Pounds per Gallon.....
 Chemical PH.....N/K
 Corrosion Rate.....N/K
 Unit of Issue.....KT
 Container Type Code.....F

Container Pressure Code.....1
 Temperature Code.....8
 Product State Code.....L

SECTION IV - Fire And Explosion Hazard Data

Flash Point.....= 23F
 Flash Point Method.....TCC
 Lower Explosive Limit.....1.00%
 Upper Explosive Limit.....11.40%
 Extinguishing Media.....FOAM, ALCOHOL FOAM, CO2, DRY CHEMICAL, WATER FOG
 Special Fire Fighting Procedures.....FULL FIRE FIGHTING EQUIPMENT W/SCBA AND FULL
 PROTECTIVE CLOTHING. MAY USE WATER TO COOL CLSD
 CONTAINERS TO PREVENT PRESSURE BUILD-UP, AUTO
 IGNITION OR EXPLOSION
 Unusual Fire/Explosion Hazards.....KEEP CNTNR CLSD TIGHT-MAY EXPLODE W/HEAT. ISOLATE
 FROM HEAT/IGNIT SOURCES. SPECIAL PRECAUTION
 W/APPLIC TO HOT SURFACES. OVEREXPOSURE-HEALTH
 HAZ-SYMPTOMS DELAYED

SECTION V - Reactivity Data

Stability.....YES
 Stability Conditions to Avoid.....HIGH TEMPERATURES, SPARKS, OR OPEN FLAMES
 Materials to Avoid.....STRONG OXIDIZING AGENTS
 Hazardous Decomposition Products.....BY HIGH HEAT/TEMPERATURE: CARBON MONOXIDE, CARBON
 DIOXIDE, AND OXIDES OF NITROGEN
 Hazardous Polymerization.....NO
 Polymerization Conditions to Avoid.....N/K
 LD50 - LD50 Mixture.....N/K

SECTION VI - Health Hazard Data

Route of Entry: Skin.....YES
 Route of Entry: Ingestion.....NO
 Route of Entry: Inhalation.....YES
 Health Hazards - Acute & Chronic.....ACUTE: VAPORS ARE IRRITATING TO EYES, NOSE, AND
 THROAT. INHALATION MAY CAUSE HEADACHES, DIFFICULT
 BREATHING, LOSS OF CONSCIOUSNESS. CHRONIC: MAY
 CAUSE DRYING AND CRACKING OF SKIN, DUE TO
 DEFATTING ACTION. SKIN SENSITIZATION, ASTHMA OR
 OTHER ALLERGIC RESPONSES MAY DEVELOP. MAY CAUSE
 LIVER AND KIDNEY DAMAGE.
 Carcinogenity: NTP.....NO
 Carcinogenity: IARC.....NO
 Carcinogenity: OSHA.....NO
 Explanation of Carcinogenity.....N/K
 Symptoms of Overexposure.....INHAL: RESP TRACT IRRIT, NERV SYS DEPRESS
 W/HEADACHE-DIZZINESS-STAGGERING
 GAIT-CONFUSION-UNCONSCIOUSNESS-COMA. EYE: IRRIT,
 TEARING-REDNESS-SWELLING W/STINGING SENSATION.
 SKIN: IRRIT W/SWELLING-REDNESS-RASH. INGEST:
 IRRIT, CORROSIVE ACTION IN MOUTH-STOMACH
 TISSUE-DIGEST TRACT. ASPIRATION WITH
 VOMITING-CHEM PNEUMONITIS
 Medical Cond. Aggravated by Exposure...ASTHMA AND ANY OTHER RESPIRATORY DISORDERS. SKIN
 ALLERGIES, ECZEMA, AND DERMATITIS.
 Emergency/First Aid Procedures.....INHAL: MOVE TO FRESH AIR. RESTORE BREATHING.
 ASTHMATIC TYPE SYMPTOMS-MAY BE IMMEDIATE OR
 DELAYED BY SEVERAL HOURS-GET MED AID. SKIN:

REMOVE CONTAMINATED CLOTHING-WASH BEFORE REUSE.
 WASH WITH SOAP AND WATER. EYES: FLUSH WITH WATER
 (LOW PRESSURE) 15 MINUTES, LIFTING LIDS-GET MED
 AID. INGEST: DO NOT INDUCE VOMITING. DO NOT GIVE
 ANYTHING TO AN UNCONSCIOUS PERSON-GET MED AID.

SECTION VII - Precautions For Safe Handling And Use

Steps if Material Released/Spilled.....EVACUATE ALL NON-ESSENTIAL PERSONNEL. REMOVE ALL
 SOURCES OF IGNITION (FLAME, SPARK SOURCES, HOT
 SURFACES). VENTILATE AREA. CONTAIN AND REMOVE
 WITH INERT ABSORBENT AND NON-SPARKING TOOLS.

Neutralizing Agent.....N/K

Waste Disposal Method.....DISPOSE OF IN ACCORDANCE W/FEDERAL-STATE-LOCAL
 ENVIRONMENTAL CONTROL REGULATIONS. EMPTY
 CONTAINERS MUST BE HANDLED W/CARE-DUE TO PRODUCT
 RESIDUE AND FLAMMABLE VAPOR. DO NOT INCINERATE
 CLOSED CONTAINERS. EPA HAZARDOUS WASTE
 NUMBER/CODE: D001-F003-F005

Handling & Storage Precautions.....RE IN BLDG THAT COMPLY W/OSHA 1910.106. AVOID
 STORAGE NEAR HIGH TEMP/FIRE/OPEN FLAMES/SPARK
 SOURCES. STORE IN TIGHTLY CLSD CNTNRS IN WELL
 VENT AREA KE

Other Precautions.....KEEP CONTAINERS TIGHT AND UPRIGHT TO PREVENT
 LEAKAGE. PREVENT BREATHING OF VAPORS/SPRAY MIST.
 POSSIBLE ALLERGIC REACTION. AVOID CONTACT WITH
 EYES AND SKIN. DO NOT INGEST. DO NOT HANDLE UNTIL
 MFR SAFETY PRECAUTIONS ARE READ AND UNDERSTOOD.

SECTION VIII - Control Measures

Respiratory Protection.....RESP FOR ORGANIC VAPOR ENVIRONMENT (AIR
 PURIFYING-FRESH AIR SUPPLIED). OBSERVE OSHA REG.
 PROVIDE VENT TO KEEP EXPOS LEVELS BELOW PEL. IF
 TLV LIMITS MAINTAINED BELOW OSHA/ACGIH LIMITS-AIR
 RESP MAY NOT BE REQ. MAY USE OTHER OSHA/NIOSH RESP

Ventilation.....EXHST VENT TO KEEP AIRBORNE CONC OF SOLVENT
 VAPORS/MIST BELOW TLV'S MUST BE UTILIZED. REMOVE
 ALL IGNITION SOURCES.

Protective Gloves.....COTTON-NEOPRENE-RUBBER-POLYETHYLENE

Eye Protection.....SPLSH GUARD/SIDE-FACE SHIELD/CHEM GOGGLE

Other Protective Equipment.....THE USE OF LONG SLEEVE AND LONG LEG CLOTHING IS
 RECOMMENDED. REMOVE AND WASH CONTAMINATED
 CLOTHING BEFORE REUSE.

Work Hygenic Practices.....WASH HANDS BEFORE EATING, SMOKING OR USING
 WASHROOM. SMOKE IN SMOKING AREAS ONLY.

Supplemental Health/Safety Data.....N/K

SECTION IX - Label Data

Protect Eye.....NO

Protect Skin.....NO

Protect Respiratory.....NO

Chronic Indicator.....UNKNOWN

Acute Indicator.....UNKNOWN

Contact Code.....UNKNOWN

Fire Code.....UNKNOWN

Health Code.....UNKNOWN

React Code.....UNKNOWN

Personal Protective Equipment.....UNKNOWN

Specific Hazard and Precaution.....ACUTE: VAPORS ARE IRRITATING TO EYES, NOSE, AND THROAT. INHALATION MAY CAUSE HEADACHES, DIFFICULT BREATHING, LOSS OF CONSCIOUSNESS. CHRONIC: MAY CAUSE DRYING AND CRACKING OF SKIN, DUE TO DEFATTING ACTION. SKIN SENSITIZATION, ASTHMA OR OTHER ALLERGIC RESPONSES MAY DEVELOP. MAY CAUSE LIVER AND KIDNEY DAMAGE. INHAL: RESP TRACT IRRIT, NERV SYS DEPRESS W/HEADACHE-DIZZINESS-STAGGERING GAIT-CONFUSION-UNCONSCIOUSNESS-COMA. EYE: IRRIT, TEARING-REDNESS-SWELLING W/STINGING SENSATION. SKIN: IRRIT W/SWELLING-REDNESS-RASH. INGEST: IRRIT, CORROSIVE ACTION IN MOUTH-STOMACH TISSUE-DIGEST TRACT. ASPIRATION WITH VOMITING-CHEM PNEUMONITIS

SECTION X - Transportation Data

Container Quantity.....0.250000
 Unit of Measure.....QT

SECTION XI - Site Specific/Reporting Information

 Volatile Organic Compounds
 Grams per Liter.....
 Pounds per Gallon.....
 Ounces per Gallon.....

SECTION XII - Ingredients/Identity Information

 Ingredient #.....01
 Ingredient Name.....N-BUTYL ACETATE (VP: 13 MMGH @ 68F)
 CAS Number.....123-86-4
 NIOSH Number.....AF7350000
 Proprietary.....NO
 Percent.....< 5
 OSHA PEL.....150 PPM/STEL 200
 ACGIH TLV.....150 PPM/STEL 200
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....02
 Ingredient Name.....ETHYL-3-ETHOXYPROPIONATE (VP: .7 MMGH @ 68F)
 CAS Number.....763-69-9
 NIOSH Number.....UF3325000
 Proprietary.....NO
 Percent.....5
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV.....NOT ESTABLISHED
 Recommended Limit.....50 PPM TWA/STEL 100

Ingredient #.....03
 Ingredient Name.....ANITSETTLING AGENT
 CAS Number.....UNKNOWN
 NIOSH Number.....1003375AA
 Proprietary.....NO
 Percent.....< 0.1
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV.....NOT ESTABLISHED
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....04
 Ingredient Name.....TOLUENE (SARA 313) (VP: 22 MMGH @ 68F)
 CAS Number.....108-88-3
 NIOSH Number.....XS5250000
 Proprietary.....NO
 Percent.....< 1
 OSHA PEL.....200 PPM/150 STEL
 ACGIH TLV.....50 PPM; 9293
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....05
 Ingredient Name.....XYLENE (SARA 313) (VP: 21 MMGH @ 100F)
 CAS Number.....1330-20-7
 NIOSH Number.....ZE2100000
 Proprietary.....NO
 Percent.....< 1
 OSHA PEL.....100 PPM/STEL 150
 ACGIH TLV.....100 PPM/STEL 150
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....06
 Ingredient Name.....ETHYL BENZENE (SARA 313) (VP: 7.1 MMGH @ 68F)
 CAS Number.....100-41-4
 NIOSH Number.....DA0700000
 Proprietary.....NO
 Percent.....< 1
 OSHA PEL.....100 PPM/STEL 125
 ACGIH TLV.....100 PPM/STEL 125
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....07
 Ingredient Name.....ANTI-FLOAT AGENT
 CAS Number.....PROPRIETARY
 NIOSH Number.....1004702AF
 Proprietary.....NO
 Percent.....< 1
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV.....NOT ESTABLISHED
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....08
 Ingredient Name.....FLOW AGENT
 CAS Number.....TRADE SECR
 NIOSH Number.....1001678FA
 Proprietary.....NO
 Percent.....< 1
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV.....NOT ESTABLISHED
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....09
 Ingredient Name.....METHYL ISOBUTYL KETONE (SARA 313) (VP: 15 MMGH @
 68F)
 CAS Number.....108-10-1
 NIOSH Number.....SA9275000
 Proprietary.....NO
 Percent.....20
 OSHA PEL.....100 PPM/75 STEL
 ACGIH TLV.....50 PPM/75 STEL; 9293
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....10
 Ingredient Name.....METHYL ETHYL KETONE (SARA 313) (VP: 70 MMGH @ 68F)
 CAS Number.....78-93-3
 NIOSH Number.....EL6475000
 Proprietary.....NO
 Percent.....< 5
 OSHA PEL.....200 PPM/STEL 300
 ACGIH TLV.....200 PPM/STEL 300
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....11
 Ingredient Name.....ANTI MAR AGENT
 CAS Number.....UNKNOWN
 NIOSH Number.....1001519AA
 Proprietary.....NO
 Percent.....< 1
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV.....NOT ESTABLISHED
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....12
 Ingredient Name.....FLOW AGENT
 CAS Number.....UNKNOWN
 NIOSH Number.....1004866MO
 Proprietary.....NO
 Percent.....< 1
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV.....NOT ESTABLISHED
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....13
 Ingredient Name.....DIBUTYL TIN DILAUATE (VP: .2 MMGH @ 320F)
 CAS Number.....77-58-7
 NIOSH Number.....WH7000000
 Proprietary.....NO
 Percent.....< 0.1
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV......1MG/M3
 Recommended Limit.....NONE SPECIFIED

Ingredient #.....14
 Ingredient Name.....2-4 PENTANEDIONE (VP: 6.9 MMGH @ 68F)
 CAS Number.....123-54-6
 NIOSH Number.....SA1925000
 Proprietary.....NO
 Percent.....< 5
 OSHA PEL.....NOT ESTABLISHED
 ACGIH TLV.....NOT ESTABLISHED
 Recommended Limit.....TLV 20 PPM-TWA

 COMMENTS

NOTICE: For additional information, contact
 BIO ENGR AT 7-7555

SECTION I - Material Identity

Item Name.....POLYURETHANE COATING, GRAY 36173 PART 2 OF 2
Part Number/Trade Name.....3:1, CAT, MIL-C-85285, 36173, PC 03GY321CAT
National Stock Number.....8010013480385
CASE Code.....33461
Part Number Indicator.....B
MSDS Number.....10009
HAZ Code.....C

SECTION II - Manufacturer's Information

Manufacturer Name.....DEFT, INC.
P.O.Box.....N/K
Street.....17451 VON KARMAN AVE
City.....IRVINE
State.....CA
Country.....US
Zip Code.....92714-6205
Emergency Phone.....714-474-0400
Information Phone.....714-474-0400

MSDS Preparer's Information

MSDS Preparer Name.....NORM GAUL
Street.....17451 VON KARMAN AVENUE
City.....IRVINE
State.....CA
Zip Code.....92714
Date MSDS Prepared/Revised.....12JUN92
Date of Technical Review.....03FEB93
Active Indicator.....Y
Item Manager.....GSA

Alternate Vendors

Vendor #5 CAGE.....BQDVL

SECTION III - Physical/Chemical Characteristics

Specification Number.....MIL-C-85285B
Specification Type/Grade/Class.....TYPE 1/KIT 1
Hazard Storage Compatibility Code.....F4
NRC License Number.....N/K
Net Propellant Weight (Ammo).....N/K
Appearance/Odor.....AMBER LIQUID WITH SOLVENT ODOR
Boiling Point.....260-338F
Melting Point.....N/K
Vapor Pressure.....N/K
Vapor Density.....> THAN AIR
Specific Gravity.....1.08043
Decomposition Temperature.....N/K
Evaporation Rate.....0.15 X N-BUTYL ACETATE
Solubility in Water.....INSOLUBLE
Percent Volatile by Volume.....30.1
Volatile Pounds per Gallon.....
Chemical PH.....N/K
Corrosion Rate.....N/K
Unit of Issue.....KT
Container Type Code.....F

Container Pressure Code.....1
 Temperature Code.....8
 Product State Code.....L

SECTION IV - Fire And Explosion Hazard Data

Flash Point.....= 76F
 Flash Point Method.....TCC
 Lower Explosive Limit.....1.00%
 Upper Explosive Limit.....7.60%
 Extinguishing Media.....FOAM, ALCOHOL FOAM, CO2, DRY CHEMICAL, WATER FOG
 Special Fire Fighting Procedures.....FULL FIRE FIGHT EQUIP W/SCBA AND FULL PROTECT
 CLOTHING. MAY USE WATER TO COOL CLSD
 CNTNRS-PREVENT PRESSURE BUILD-UP/AUTO
 IGNIT/EXPLOS. IRRIT VAPORS W/COMBUSTN
 Unusual Fire/Explosion Hazards.....KEEP CNTNR CLSD TIGHT-MAY EXPLODE W/HEAT. ISOLATE
 FROM HEAT/IGNIT SOURCES. SPECIAL PRECAUTION
 W/APPLIC TO HOT SURFACES. OVEREXPOSURE-HEALTH
 HAZ-SYMPTOMS DELAYED

SECTION V - Reactivity Data

Stability.....YES
 Stability Conditions to Avoid.....CONTACT WITH MOISTURE, MATERIAL WHICH REACT WITH
 ISOCYANATES AND HIGH TEMPERATURES.
 Materials to Avoid.....WATER, AMINES, STRONG BASES, ALCOHOLS, METAL
 COMPOUNDS AND SURFACE ACTIVE MATERIALS.
 Hazardous Decomposition Products.....BY HIGH HEAT/TEMPERATURE: CARBON MONOXIDE, CARBON
 DIOXIDE, AND OXIDES OF NITROGEN, TRACES OF HCN
 AND HDI
 Hazardous Polymerization.....NO
 Polymerization Conditions to Avoid.....N/K
 LD50 - LD50 Mixture.....N/K

SECTION VI - Health Hazard Data

Route of Entry: Skin.....YES
 Route of Entry: Ingestion.....NO
 Route of Entry: Inhalation.....YES
 Health Hazards - Acute & Chronic.....ACUTE: VAPORS IRRIT TO EYES-NOSE-THROAT. INHAL
 MAY CAUSE HEADACHES-DIFFICULT BREATH-LOSS OF
 CONSCIOUSNESS. CHRONIC: AS A RESULT OF PREVIOUS
 REPEAT OVEREXPOS/SINGLE LG DOSE, SOME INDIVIDUALS
 WILL DEVELOP ISOCYANATE SENSITIZATION CAUSING A
 REACTION TO LATER EXPOS OF ISOCYANATE LEVELS WELL
 BELOW TLV VALUE OF ISOCYANATES
 Carcinogenity: NTP.....NO
 Carcinogenity: IARC.....NO
 Carcinogenity: OSHA.....NO
 Explanation of Carcinogenity.....N/K
 Symptoms of Overexposure.....INHAL: RESP TRACT IRRIT, NERV SYS DEPRESS
 W/HEADACHE-DIZZINESS-STAGGERING
 GAIT-CONFUSION-UNCONSCIOUS-COMA. EYE: IRRIT,
 TEARING-REDNESS-SWELLING W/STING SENSATION. SKIN:
 IRRIT W/SWELLING-REDNESS-RASH-DRY-DEFAT. INGEST:
 IRRIT, CORROSIVE ACTION IN MOUTH-STOMACH
 TISSUE-DIGEST TRACT. ASPIRATION W/VOMITING-CHEM
 PNEUMONITIS
 Medical Cond. Aggravated by Exposure...ASTHMA AND ANY OTHER RESPIRATORY DISORDERS. SKIN
 ALLERGIES, ECZEMA, AND DERMATITIS. ISOCYANATE

Emergency/First Aid Procedures..... SENSITIZATION.
 INHAL: MOVE TO FRESH AIR. RESTORE BREATHING.
 ASTHMATIC TYPE SYMPTOMS-MAY BE IMMEDIATE OR
 DELAYED BY SEVERAL HOURS-GET MED AID. SKIN:
 REMOVE CONTAMINATED CLOTHING-WASH THOROUGHLY
 BEFORE REUSE. WASH AFFECTED AREAS WITH SOAP AND
 WATER. EYES: FLUSH WITH WATER (LOW PRESSURE) 15
 MINUTES, LIFTING LIDS-GET MED AID. INGEST: DO NOT
 INDUCE VOMITING. DO NOT GIVE ANYTHING TO AN
 UNCONSCIOUS PERSON-GET MED AID.

SECTION VII - Precautions For Safe Handling And Use

Steps if Material Released/Spilled.....EVACUATE ALL NON-ESSENTIAL PERSONNEL. REMOVE ALL
 SOURCES OF IGNITION (FLAME, SPARK SOURCES, HOT
 SURFACES). VENTILATE AREA. CONTAIN AND REMOVE
 WITH INERT ABSORBENT AND NON-SPARKING TOOLS.

Neutralizing Agent.....N/K

Waste Disposal Method.....DISPOSE OF IN ACCORDANCE W/FEDERAL-STATE-LOCAL
 ENVIRONMENTAL CONTROL REGULATIONS. EMPTY
 CONTAINERS MUST BE HANDLED W/CARE-DUE TO PRODUCT
 RESIDUE AND FLAMMABLE VAPOR. DO NOT INCINERATE
 CLOSED CONTAINERS. EPA HAZARDOUS WASTE
 NUMBER/CODE: D001-F003-F005

Handling & Storage Precautions.....RE IN BLDG THAT COMPLY W/OSHA 1910.106. AVOID
 STORAGE NEAR HIGH TEMP/FIRE/OPEN FLAMES/SPARK
 SOURCES. STORE IN TIGHTLY CLSD CNTNRS IN WELL
 VENT AREA KE

Other Precautions.....KEEP CONTAINERS TIGHT AND UPRIGHT TO PREVENT
 LEAKAGE. PREVENT BREATHING OF VAPORS/SPRAY MIST.
 POSSIBLE ALLERGIC REACTION. AVOID CONTACT WITH
 EYES AND SKIN. DO NOT INGEST. DO NOT HANDLE UNTIL
 MFR SAFETY PRECAUTIONS ARE READ AND UNDERSTOOD.

SECTION VIII - Control Measures

Respiratory Protection.....RESP FOR ORGANIC VAPOR ENVIRONMENT (AIR
 PURIFYING-FRESH AIR SUPPLIED). OBSERVE OSHA REG.
 PROVIDE VENT-KEEP EXPOS LEVELS BELOW PEL. VAPOR
 PARTIC RESP (TC23C NIOSH/MSHA) WHERE DEMONSTRATED
 THAT VAPOR LEVELS BELOW TEN TIMES APPLIC EXPOS
 LIMITS

Ventilation.....UTILIZE EXHST VENT TO KEEP AIRBORNE CONC OF
 SOLVENT/HDI/POLYISOCYANATES BELOW RESPECTIVE
 TLV'S. RMV ALL IGNIT SOURCES

Protective Gloves.....COTTON-NEOPRENE-RUBBER-POLYETHYLENE

Eye Protection.....SPLSH GUARD/SIDE-FACE SHIELD/CHEM GOGGLE

Other Protective Equipment.....THE USE OF LONG SLEEVE AND LONG LEG CLOTHING IS
 RECOMMENDED. REMOVE AND WASH CONTAMINATED
 CLOTHING BEFORE REUSE.

Work Hygenic Practices.....WASH HANDS BEFORE EATING, SMOKING OR USING
 WASHROOM. SMOKE IN SMOKING AREAS ONLY.

Supplemental Health/Safety Data.....N/K

SECTION IX - Label Data

Protect Eye.....NO

Protect Skin.....NO

Protect Respiratory.....NO

Chronic Indicator.....UNKNOWN

Ingredient #.....03
Ingredient Name.....C8 & 10 AROMATIC HYDROCARBON (VP: 3 MMGH @ 68F)
CAS Number.....64742-95-6
NIOSH Number.....1004285AH
Proprietary.....NO
Percent.....< 5
OSHA PEL.....NOT ESTABLISHED
ACGIH TLV.....NOT ESTABLISHED
Recommended Limit.....NONE SPECIFIED

Ingredient #.....04
Ingredient Name.....N-BUTYL ACETATE (VP: 13 MMGH @ 68F)
CAS Number.....123-86-4
NIOSH Number.....AF7350000
Proprietary.....NO
Percent.....< 5
OSHA PEL.....150 PPM/STEL 200
ACGIH TLV.....150 PPM/STEL 200
Recommended Limit.....NONE SPECIFIED

Ingredient #.....05
Ingredient Name.....ETHYL-3-ETHOXYPROPIONATE (VP: .7 MMGH @ 68F)
CAS Number.....763-69-9
NIOSH Number.....UF3325000
Proprietary.....NO
Percent.....20
OSHA PEL.....NOT ESTABLISHED
ACGIH TLV.....NOT ESTABLISHED
Recommended Limit.....50 PPM-TWA/100 STEL

COMMENTS

NOTICE: For additional information, contact
BIO ENGR AT 7-7555

APC I

SECTION I - Material Identity

Item Name.....PAINT - PART 1 OF 2 PARTS
 Part Number/Trade Name.....DEFTHANE ELT 36173; PRODUCT 99GY001
 National Stock Number.....8010014790449
 CAGE Code.....33461
 Part Number Indicator.....A
 MSDS Number.....193702
 HAZ Code.....C

SECTION II - Manufacturer's Information

Manufacturer Name.....DEFT, INC.
 Street.....17451 VON KARMAN AVE.
 City.....IRVINE
 State.....CA
 Country.....US
 Zip Code.....92614
 Emergency Phone.....800-424-9300 CHEMTREC
 Information Phone.....949-474-0400

MSDS Preparer's Information

MSDS Preparer Name.....JULIETTE LIN
 Street.....17451 VON KARMAN AVE.
 City.....IRVINE
 State.....CA
 Zip Code.....92614
 Date MSDS Prepared/Revised.....30MAY00
 Active Indicator.....Y

Alternate Vendors

SECTION III - Physical/Chemical Characteristics

Appearance/Odor.....GRAY LIQUID W/SOLVENT ODOR
 Boiling Point.....260-480F
 Vapor Pressure.....SEE INGRED
 Vapor Density.....>AIR
 Specific Gravity.....1.1128
 Evaporation Rate.....0.37 X N-BUTYL ACETATE
 Solubility in Water.....INSOLUBLE
 Percent Volatile by Volume.....55.3
 Percent Volatile by Weight.....42.4
 Volatile Pounds per Gallon.....3.935
 Chemical PH.....N/A
 Unit of Issue.....KT
 Container Type Code.....F
 Container Pressure Code.....4
 Temperature Code.....8
 Product State Code.....L

SECTION IV - Fire And Explosion Hazard Data

Flash Point.....= 67F
 Flash Point Method.....TCC
 Lower Explosive Limit.....81
 Upper Explosive Limit.....14
 Extinguishing Media.....FOAM, ALCOHOL FOAM, CO2, DRY CHEMICAL, WATER

Special Fire Fighting Procedures..... FOG, WATER SPRAY.
 FULL FIREFIGHTING EQUIP W/SCBA & FULL PROT
 CLOTHING SHOULD BE WORN BY FIREFIGHTERS. WATER MAY
 BE USED TO COOL CLSD CNTRS TO PREVENT
 PRES. BU/UP, AUTO IGNIT, EXPLOS.
 Unusual Fire/Explosion Hazards..... KEEP CNTRS TIGHTLY CLSD. KEEP FROM
 HEAT, SPARKS, ELECT. EQUIP & OPEN FLAME. CLSD CNTRS
 MAY EXPLODE WHEN EXPOSED EXTREME HEAT. APPLICATION
 TO HOT SURFACES REQ SPECIAL PRECAUTIONS. DURING
 EMERGENCY CONDITIONS OVEREXP. TO DECOMP. PRODUCTS
 MAY CAUSE A HEALTH HAZARD. SYMPTOMS MAY NOT BE
 IMMED APPARENT.

SECTION V - Reactivity Data

 Stability..... YES
 Stability Conditions to Avoid..... HIGH TEMPERATURES, SPARKS, OR OPEN FLAMES.
 Materials to Avoid..... STRONG OXIDIZING AGENTS
 Hazardous Decomposition Products..... BY HIGH TEMPERATURES: CARBON MONOXIDE, CARBON
 DIOXIDE, OXIDES OF NITROGEN..
 Hazardous Polymerization..... NO
 Polymerization Conditions to Avoid..... N/A

SECTION VI - Health Hazard Data

 Route of Entry: Skin..... YES
 Route of Entry: Ingestion..... NO
 Route of Entry: Inhalation..... YES
 Health Hazards - Acute & Chronic..... VAPORS ARE IRRIT TO EYES, NOSE & THROAT. INHAL MAY
 CAUSE HEADACHES, DIFF BREATHING & LOSS OF
 CONSCIOUSNESS. CHRONIC: PROL CONTACT WILL CAUSE
 DRYING & CRACKING OF THE SKIN, DUE TO DEFATTING
 ACTION. SKIN SENSITIZATION, ASTHMA OR OTHER
 ALLERGIC RESPONSES MAY DEVELOP.
 Carcinogenity: NTP..... NO
 Carcinogenity: IARC..... NO
 Carcinogenity: OSHA..... NO
 Symptoms of Overexposure..... INHAL: IRRIT OF RESP. TRACT & ACUTE NERV SYS
 DEPRESSION
 W/HDACHE, DIZZ, STAG. GAIT, CONFUSION, UNCONS, COMA. SKI
 N: CAN CAUSE IRRI
 W/SWELLING, REDNESS, RASH. EYES: IRRIT & MAY CAUS
 TEARING, REDNESS, SWELLING W/STINGIN
 SENSATION. SKIN ABSORP: PROL CONTACT MAY CAUS
 MOD. IRRIT, DRYING, DEFAT OF SKIN, WHICH CAN CAUS
 SKIN TO CRACK. INGEST: IRRIT & POSS CORROSIV
 ACTION IN MOUTH, STOM. TISSUE, DIGEST. TRACT. VOMITIN
 MAY CAUSE ASPIR. OF SOLV, RESULTING I
 CHEM. PNEUMONITIS.
 Medical Cond. Aggrevated by Exposure... ASTHMA & ANY OTHER RESPIRATORY DISORDERS, SKIN
 ALLERGIES, ECZEMA, DERMATITIS.
 Emergency/First Aid Procedures..... INHAL: MOVE TO FRESH AIR, RESTORE
 BREATHING. ASTHMATIC TYPE SYMPTOMS MAY DEVELOP &
 MAY BE IMMED OR DELAYED BY SEV. HRS. OBTAIN MED
 ATTN. SKIN: RMEOVE CONTAM CLOTHING. WASH EFFECTED
 AREAS THORO W/SOAP & WATER. WASH CONTAM CLOTHING
 THOROUGHLY BEFORE REUSE. EYES: FLUSH W/CLEAN
 LUKEWARM WATER (LOW PRESSURE) FOR AT LEAST 15
 MIN, OCCAS. LIFTING EYELIDS. OBTAIN MED
 ATTN. INGEST: DO NOT INDUCE VOMITING. DO NOT GIVE

ANYTHING TO AN UNCONSCIOUS PERSON.OBTAIN MED ATTN.

SECTION VII - Precautions For Safe Handling And Use

Steps if Material Released/Spilled.....EVAC.ALL NON-ESSENTIAL PERSONNEL. REMOVE ALL SOURCES OF IGNITION (FLAME, SPARK SOURCES, HOT SURF). VENTILATE AREA. CONTAIN & REMOVE W/INERT ABSORBENT & NON-SPARKING TOOLS.

Waste Disposal Method.....WASTE MUST BE DISPOSED OF IAW FEDERAL, STATE & LOCAL ENVIRONMENT CONTROL REGUL. EMPTY CNTRS MUST BE HANDLED W/CARE, DUE TO PRODUCT RESIDUE & FLAM. VAPOR. DO NOT INCINERATE CLOSED CONTAINERS.

Handling & Storage Precautions.....STORE IN BLDGS DESIGNED TO COMPLY W/OSHA 1910.106. AVOID STORING NEAR HIGH TEMPS, FIRE, OPEN FLAMES, SPARK SOURCES. STORE IN TIGHTLY CLSD CNTRS. STORE IN WELL VENTILATED AREAS.

Other Precautions.....KEEP CNTRS TIGHT & UPRIGHT TO PREV LEAK. PREVENT PROL INHAL OF VAPS/SPRAY MISTS. PROL OVEREXP MAY CAUSE ALLERGIC REACTION. AVOID CONTACT W/SKIN/EYES. DO NOT TAKE INTERNALLY. DO NOT HANDLE UNTIL THE MFRS SAFETY PRECAUT HAVE BEEN READ/UNDERSTOOD.

SECTION VIII - Control Measures

Respiratory Protection.....A RESP THAT IS RECOM OR APPROVED FOR USE IN AN ORGANIC VAPOR ENVIRONMENT (AIR PURIFYING OR FRESH AIR SUPP) IS NEC. OBSERVE OSHA REGUL FOR RESP. USE. IF TLV LIMITS CAN BE MAINTAINED & DOCUMENTED BELOW THE OSHA/ACGIH LIMITS, AN AIR SUPP RESP. MAY NOT BE REQD. HOWEVER, OTHER OSHA/NIOSH APPRVD RESP. MAY BE USED.

Ventilation.....EXHAUST VENT. SUFFICIENT TO KEEP AIRBORNE CONC OF SOLV VAPORS/MISTS BELOW THEIR RESPECTIVE TLV'S MUST BE UTILIZED. *SUPP.

Protective Gloves.....COTTON, NEOPRENE, RUBBER POLYETHYLENE

Eye Protection.....SAFETY EYEWEAR, INCLUDING SPLASHGUARDS OR SIDESHIELDS, CHEMICAL GOGGLES OR FACESHIELDS.

Other Protective Equipment.....LONG SLEEVE & LONG LEG CLOTHING IS RECOM. REMOVE & WASH CONTAM CLOTHING BEFORE REUSE.

Work Hygenic Practices.....WASH HANDS BEFORE EATING, SMOKING, OR USING WASHROOM. SMOKE IN SMOKING AREAS ONLY.

Supplemental Health/Safety Data.....*VENTILATION: REMOVE ALL IGNITION SOURCES (HEAT, SPARKS, FLAME, HOT SURFACES.)

SECTION IX - Label Data

Protect Eye.....YES

Protect Skin.....YES

Protect Respiratory.....YES

Chronic Indicator.....YES

Acute Indicator.....YES

Contact Code.....MODERATE

Fire Code.....EXTREME

Health Code.....SERIOUS

React Code.....SLIGHT

Personal Protective Equipment.....Safety Glasses, Gloves

Specific Hazard and Precaution.....VAPORS ARE IRRIT TO EYES, NOSE & THROAT. INHAL MAY CAUSE HDACHES, DIFF BREATHING & LOSS OF CONSCIOUSNESS. CHRONIC: PROL CONTACT WILL CAUSE

DRYING & CRACKING OF SKIN, DUE TO DEFATTING
ACTION. SKIN SENSITIZATION, ASTHMA OR OTHER
ALLERGIC RESPONSES MAY DEVELOP.

SECTION X - Transportation Data

Container Quantity.....0.750000
Unit of Measure.....GL

SECTION XI - Site Specific/Reporting Information

Volatile Organic Compounds
Grams per Liter.....
Pounds per Gallon.....
Ounces per Gallon.....

SECTION XII - Ingredients/Identity Information

Ingredient #.....01
Ingredient Name.....METHYL N-AMYL KETONE
CAS Number.....110-43-0
NIOSH Number.....MJ5075000
Proprietary.....NO
Percent.....25
OSHA PEL.....100 PPM
ACGIH TLV.....50 PPM
Vapor Pressure.....2.1
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....02
Ingredient Name.....PROPYLENE GLYCOL MONOMETHYL ETHER ACETATE
CAS Number.....108-65-6
NIOSH Number.....AI8925000
Proprietary.....NO
Percent.....1
OSHA PEL.....N/E
ACGIH TLV.....N/E
Vapor Pressure.....3.7
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....03
Ingredient Name.....N-BUTYL ACETATE
CAS Number.....123-86-4
NIOSH Number.....AF7350000
Proprietary.....NO
Percent.....1
OSHA PEL.....150 PPM/200 STEL
ACGIH TLV.....150 PPM/200 STEL
Vapor Pressure.....13
Vapor Pressure UOM.....MMHG
Vapor Temperature.....68
Vapor Temperature UOM.....F

Ingredient #.....04
Ingredient Name.....DIPROPYLENE GLYCOL MONOMETHYL ETHER <1%
CAS Number.....34590-94-8
NIOSH Number.....JM1575000

Proprietary.....NO
 Percent.....1
 OSHA PEL.....100 PPM/150 STEL
 ACGIH TLV.....100 PPM/150 STEL
 Vapor Pressure.....6
 Vapor Pressure UOM.....MMHG
 Vapor Temperature.....77
 Vapor Temperature UOM.....F

Ingredient #.....05
 Ingredient Name.....XYLENE
 CAS Number.....1330-20-7
 NIOSH Number.....ZE2100000
 Proprietary.....NO
 Percent.....5
 OSHA PEL.....100 PPM/150 STEL
 ACGIH TLV.....100 PPM/150 STEL
 Vapor Pressure.....5.1
 Vapor Pressure UOM.....MMHG
 Vapor Temperature.....68
 Vapor Temperature UOM.....F

Ingredient #.....06
 Ingredient Name.....BENZENE, ETHYL-
 CAS Number.....100-41-4
 NIOSH Number.....DA0700000
 Proprietary.....NO
 Percent.....5
 OSHA PEL.....100 PPM/125 STEL
 ACGIH TLV.....100 PPM/125 STEL
 Vapor Pressure.....7.1
 Vapor Pressure UOM.....MMHG
 Vapor Temperature.....68
 Vapor Temperature UOM.....F

<5%

Ingredient #.....07
 Ingredient Name.....DIISOBUTYL KETONE
 CAS Number.....108-83-8
 NIOSH Number.....MJ5775000
 Proprietary.....NO
 Percent.....0.1
 OSHA PEL.....25 PPM
 ACGIH TLV.....25 PPM
 Vapor Pressure.....1.4
 Vapor Pressure UOM.....MMHG
 Vapor Temperature.....68
 Vapor Temperature UOM.....F

<0.1%

Ingredient #.....08
 Ingredient Name.....ETHYL 3-ETHOXYPROPIONATE
 CAS Number.....769-69-9
 NIOSH Number.....UF3325000
 Proprietary.....NO
 Percent.....5
 OSHA PEL.....N/E
 ACGIH TLV.....N/E
 Recommended Limit.....MFG:50PPM/100 STEL
 Vapor Pressure.....7

Vapor Pressure UOM.....MMHG
 Vapor Temperature.....68
 Vapor Temperature UOM.....F

Ingredient #.....09
 Ingredient Name.....C8&10 AROMATIC HYDROCARBON
 CAS Number.....64742-95-6
 NIOSH Number.....WF3400000
 Proprietary.....NO
 Percent.....1
 OSHA PEL.....N/E
 ACGIH TLV.....N/E
 Recommended Limit.....MFGR PEL=100 PPM
 Vapor Pressure.....3
 Vapor Pressure UOM.....MMHG
 Vapor Temperature.....68
 Vapor Temperature UOM.....F

Ingredient #.....10
 Ingredient Name.....ANTI MAR AGENT
 CAS Number.....9038-95-3
 NIOSH Number.....1002162PF
 Proprietary.....NO
 Percent.....0.1
 OSHA PEL.....N/E
 ACGIH TLV.....N/E

Ingredient #.....11
 Ingredient Name.....ANTI MAR AGENT - TRADE SECRET
 Proprietary.....NO
 Percent.....0.1
 OSHA PEL.....N/E
 ACGIH TLV.....N/E

Ingredient #.....12
 Ingredient Name.....2,4-PENTANEDIONE
 CAS Number.....123-54-6
 NIOSH Number.....SA1925000
 Proprietary.....NO
 Percent.....5
 OSHA PEL.....N/E
 ACGIH TLV.....N/E
 Recommended Limit.....UNION CARBIDE:20 PPM
 Vapor Pressure.....6.9
 Vapor Pressure UOM.....MMHG
 Vapor Temperature.....68
 Vapor Temperature UOM.....F

Ingredient #.....13
 Ingredient Name.....DIBUTYLTIN DILAURATE-<0.1% (SKIN/EYE
 IRRIT,HARMFUL IF SWALLOWED OR ABSORBED THRU
 SKIN,MAY CAUSE KIDNEY/LIVER DAMAGE.)
 CAS Number.....77-58-7
 NIOSH Number.....WH7000000
 Proprietary.....NO
 Percent.....0.1
 OSHA PEL.....1 MG/M3

ACGIH TLV.....N/E
Vapor Pressure.....2
Vapor Pressure UOM.....MMHG
Vapor Temperature.....320
Vapor Temperature UOM.....F

COMMENTS

NOTICE: For additional information, contact
BIO ENGR AT 7-7555

APC-II

SECTION I - Material Identity

Item Name.....CATALYST - PART 2 OF 2 PARTS
 Part Number/Trade Name.....CAT,DEFTHANE ELT 36173; 99GY001CAT
 National Stock Number.....8010014790449
 CAGE Code.....33461
 Part Number Indicator.....B
 MSDS Number.....193703
 HAZ Code.....C

SECTION II - Manufacturer's Information

Manufacturer Name.....DEFT, INC.
 Street.....17451 VON KARMAN AVE.
 City.....IRVINE
 State.....CA
 Country.....US
 Zip Code.....92614
 Emergency Phone.....800-424-9300 CHEMTREC
 Information Phone.....949-474-0400

MSDS Preparer's Information

MSDS Preparer Name.....JULIETTE LIN
 Street.....17451 VON KARMAN AVE.
 City.....IRVINE
 State.....CA
 Zip Code.....92614
 Date MSDS Prepared/Revised.....03JUL97
 Active Indicator.....Y

Alternate Vendors

SECTION III - Physical/Chemical Characteristics

Appearance/Odor.....AMBER LIQUID W/SOLVENT ODOR
 Boiling Point.....300-482F
 Vapor Pressure.....SEE MSDS
 Vapor Density.....>AIR
 Specific Gravity.....1.06963
 Evaporation Rate.....0.06 X N-BUTYLE ACETATE
 Solubility in Water.....INSOLUBLE
 Percent Volatile by Volume.....25.4
 Percent Volatile by Weight.....31.3
 Volatile Pounds per Gallon.....2.7921
 Chemical PH.....N/A
 Container Pressure Code.....4
 Temperature Code.....8
 Product State Code.....L

SECTION IV - Fire And Explosion Hazard Data

Flash Point.....= 102F
 Flash Point Method.....TCC
 Lower Explosive Limit.....1
 Upper Explosive Limit.....8
 Extinguishing Media.....FOAM,ALCOHOL FOAM,CO2, DRY CHEMICAL, WATER
 FOG, WATER SPRAY.
 Special Fire Fighting Procedures.....FULL FIREFIGHTING EQUIP W/SCBA & FULL PROT

CLOTHING SHOULD BE WORN BY FIREFIGHTERS. WAT MAY BE USED TO COOL CLSD CNTRS TO PREV. PRES. BU/UP, AUTO IGNIT, EXPLOSION. DURING A FIRE HDI VAPORS & OTHER IRRITATING VAPORS MAY BE GENERATED BY COMBUSTION OR THERMAL DECOMPOSITION. Unusual Fire/Explosion Hazards.....KEEP CNTRS TIGHTLY CLSD. KEEP FROM HEAT, SPARKS, ELECT EQUIP, OPEN FLAME. CLSD CNTRS MAY EXPLODE WHEN EXPOSED TO EXT. HEAT. APPLIC TO HOT SURF REQ SPECIAL PRECAUTIONS. DURING EMERGENCY CONDITIONS OVEREXPOSURE TO DECOMPOSITION PRODUCTS MAY CAUSE A HEALTH HAZARD. SYMPTOMS MAY NOT BE IMMEDIATELY APPARENT.

SECTION V - Reactivity Data

Stability.....YES
 Stability Conditions to Avoid.....MOISTURE, MATERIAL WHICH REACT WITH ISOCYANATES & HIGH TEMPERATURES..
 Materials to Avoid.....WATER, AMINES, STRONG BASES, ALCOHOLS, METAL COMPOUNDS & SURFACE ACTIVE MATERIALS.
 Hazardous Decomposition Products.....BY HIGH HEAT/TEMPERATURE: CO, CO2, OXIDES OF NITROGEN, TRACES OF HCN & HDI.
 Hazardous Polymerization.....NO

SECTION VI - Health Hazard Data

Route of Entry: Skin.....YES
 Route of Entry: Ingestion.....NO
 Route of Entry: Inhalation.....YES
 Health Hazards - Acute & Chronic.....VAPS ARE IRRIT TO EYES, NOSE, THROAT. INHAL MAY CAUSE HDACHES, DIFF BREATHING & LOSS OF CONSCIOUSNESS. CHRONIC: AS A RESULT OF PREVIOUS REPEATED OVEREXP OR A SINGLE LG DOSE, CERTAIN INDIVID. WILL DEVELOP ISOCYANATE SENSIT. WHICH WILL CAUSE THEM TO REACT TO A LATER EXPOS OF ISOCYANATE LEVELS WELL BELOW TLV VALUE OF ISOCYANATES.
 Carcinogenity: NTP.....NO
 Carcinogenity: IARC.....NO
 Carcinogenity: OSHA.....NO
 Symptoms of Overexposure.....INHAL: IRRIT OF RESP TRACT & ACUTE NERV SYS DEPRESSION
 W/HDACHE, DIZZ, STAG. GAIT, CONFUSION, UNCONS, COMA. SKIN: ISOCYANATES REACT W/SKIN PROTEIN & MOISTURE CAN CAUSE IRRIT, MAY CAUS SWELL, REDNESS, RASH. EYES: MAY CAUSE IRRIT & MA CAUSE TEARING, REDNESS & SWELLING W/STIN SENSATION. SKIN ABSORP: PROL CONTACT CAN CAUSE MO IRRIT, DRYING, DEFATTING OF SKIN WHICH CAN CAUS SKIN TO CRACK. INGEST: CAN CAUSE IRRIT & POS CORROSIVE ACTION IN MOUTH, STOM. TISSUE, DIGESTIV TRACT. VOMIT MAY CAUSE ASPIR OF SOLV, CAUSIN CHEM. PNEUMONITIS.
 Medical Cond. Aggravated by Exposure...ASTHMA & ANY OTHER RESPIRATORY DISORDERS, SKIN ALLERGIES, ECZEMA, & DERMATITIS. ISOCYANATE SENSITIZATION.
 Emergency/First Aid Procedures.....INHAL: MOVE TO FRESH AIR. ASTHMA TYPYS SYMPTOMS MAY DEVELOP & MAY BE IMMED OR DELAYED BY SEV. HRS. OBTAIN MED ATTN. SKIN: REMOVE CONTAM CLOTHING. WASH AREAS THORO W/ SOAP & WATER. WASH

CONTAM CLOTHING THORO BEFORE REUSE.EYES:FLUSH
W/CLEAN LUKEWARM WATER(LOW PRESSURE)FOR AT LEAST
15 MIN.,OCCAS LIFTING EYELIDS.OBTAIN MED
ATTN.INGEST:DO NOT INDUCE VOMITING.DO NOT GIVE
ANYTHING TO AN UNCONSCIOUS PERSON.OBTAIN MED ATTN.

SECTION VII - Precautions For Safe Handling And Use

Steps if Material Released/Spilled.....EVAC.ALL NON-ESSENTAL PERSONEL.REMOVE ALL SOURCES
OF IGNIT(FLAME, SPARK SOURCES, HOT
SURFACES).VENT.AREA.CONTAIN & REMOVE W/INERT
ABSORBENT & NON-SPARKING TOOLS.
Waste Disposal Method.....WASTE MUST BE DISPSOED OF IAW FEDERAL, STATE, LOCAL
ENVIRONMENTAL CONTROL REGUL.EMPTY CNTRS MUST BE
HANDLED W/CARE,DUE TO PRODUCT RESIDUE & FLAMMABLE
VAPOR.DO NOT INCINERATE CLOSED CNTRS..
Handling & Storage Precautions.....STORE IN BLDGS DESIGNED TO COMPLY W/OSHA
1910.106.AVOID STORING NEAR HIGH TEMPS, FIRE, OPEN
FLAMES, SPARK SOURCES.STORE IN TIGHTLY CLSD
CNTRS.STORE IN WELL VENT.AREAS.
Other Precautions.....KEEP CNTRS TIGHT & UPRIGHT TO PREVENT
LEAK.PREVENT PROL BREATHING OF VAPORS OR SPRAY
MISTS.PROL OVEREXP MAY CAUSE ALLERGIC
REACTION.AVOID SKIN/EYE CONTACT.DO NOT TAKE
INTERNALLY.DO NOT HANDLE UNTIL MFGR SAFETY
PRECAUTIONS READ/UNDERSTOOD.

SECTION VIII - Control Measures

Respiratory Protection.....A RESP THAT IS RECOM OR APPRVD FOR USE IN ORGANIC
VAPOR ENVIRONMENT(AIR PURIFYNG OR FRESH AIR
SUPP)IS NEC.OBSERVE OSHA REGUL FOR RESP.USE.VENT
SHOULD BE PROVIDED TO KEEP EXPOS LIV BELOW OSHA
LIMITS.AN AIR SUPP RESP IS RECOM.A VAPOR
PARTICULATE RESP(TC23C,NIOSH/MSHA)MAY BE APPROP
WHERE AIR MONITORING DEMONSTRATES VAPOR LEV BELOW
10X THE APPLIC LIMIT
Ventilation.....EXHAUST VENT SUFFICIENT TO KEEP AIRBORNE CONC OF
SOLV,HDI & POLYISOCYANATES BELOW THEIR RESPECTIVE
TLVS.REMOVE ALL IGNIT
Protective Gloves.....COTTON, NEOPRENE, RUBBER, POLYETHYLENE
Eye Protection.....SAFETY EYEWEAR, SPLASHGRDS, SIDESHIELDS, CHEMICAL
GOGGLES, FACESHIELDS.
Other Protective Equipment.....THE USE OF LONG SLEEVE & LONG LEG CLOTHING IS
RECOM.REMOVE & WASH CONTAM.CLOTHES BEFORE REUSE.
Work Hygenic Practices.....WASH HANDS BEFORE EATING, SMOKING, USING
WASHROOM.SMOKE IN SMOKING AREAS ONLY.

SECTION IX - Label Data

Protect Eye.....YES
Protect Skin.....YES
Protect Respiratory.....YES
Chronic Indicator.....YES
Acute Indicator.....UNKNOWN
Contact Code.....MODERATE
Fire Code.....MODERATE
Health Code.....SERIOUS
React Code.....MODERATE
Personal Protective Equipment.....Safety Glasses, Gloves

