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USACE / NAVFAC / AFCEC / NASA **UFGS-01 86 12.07 40 (February 2018)**
Change 1 - 02/15

Preparing Activity: NASA **Superseding**
UFGS-01 86 12.07 40 (February 2012)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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02/18, CHG 1: 02/15

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SECTION 01 86 12.07 40

RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS
02/18, CHG 1: 02/15

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NOTE: This guide specification covers the requirements for Reliability Centered Building and Equipment Acceptance for Mechanical systems. The contents universally apply to mechanical systems and may be utilized by other organizations, if deemed beneficial.

Refer to Section 01 83 00.07 40 RELIABILITY CENTERED ACCEPTANCE FOR FACILITY SHELLS (foundations, structure, walls, openings, roofs, insulation and vapor barrier systems, etc.).

Refer to Section 01 83 13.07 40 RELIABILITY CENTERED ACCEPTANCE FOR SUPERSTRUCTURE PERFORMANCE REQUIREMENTS for externally exposed structures such as communication towers, launch facilities; and partially open shelters such as those for fueling chemical storage, as well as underground special structures for explosives and ordinance.

Refer to Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS for facility electrical power and distribution systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

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

1.2 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the

District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan[; G[, [____]]]

Material, Equipment, and Fixture Lists[; G[, [____]]]

SD-02 Shop Drawings

Connection Diagrams[; G[, [____]]]

Bearing Layout[; G[, [____]]]

Fabrication Drawings[; G[, [____]]]

Installation Drawings[; G[, [____]]]

SD-03 Product Data

Manufacturer's Catalog Data[; G[, [____]]]

Equipment Foundation Data[; G[, [____]]]

Specific Equipment Data[; G[, [____]]]

Spare Parts List[; G[, [____]]]

Warranty[; G[, [____]]]

SD-05 Design Data

Design Analysis and Calculations[; G[, [____]]]

SD-06 Test Reports

Alignment Test[; G[, [____]]]

Balancing Test[; G[, [____]]]

Borescope Inspection Test[; G[, [____]]]

Code and Requirements Verification Test[; G[, [____]]]

Cold Starting Test[; G[, [____]]]

Cooling System Evaluation Test[; G[, [____]]]

Ductwork Leakage Test[; G[, [____]]]

Exhaust Emissions Test[; G[, [____]]]

Flux Analysis Test[; G[, [____]]]

High-Voltage Test[; G[, [____]]]

Hydraulic Oil Test[; G[, [____]]]

Hydrostatic Test[; G[, [____]]]

Infrared Thermography Test[; G[, [____]]]

Insulation Power Factor Test[; G[, [____]]]

Insulation Resistance Test[; G[, [____]]]

Lubricating Oil Test[; G[, [____]]]

Mechanical Performance Test[; G[, [____]]]

Motor Circuit Evaluation Test[; G[, [____]]]

Noise Level Acceptance Test[; G[, [____]]]

Operational Fire Damper Test[; G[, [____]]]

Performance Test[; G[, [____]]]

Power/Output Test[; G[, [____]]]

Thermodynamic Performance Test[; G[, [____]]]

Ultrasonic (Airborne) Test[; G[, [____]]]

Ultrasonic (Pulse) Test[; G[, [____]]]

Vibration Analysis Test[; G[, [____]]]

Warranty Test[; G[, [____]]]

SD-07 Certificates

Certificates[; G[, [____]]]

SD-08 Manufacturer's Instructions

Manufacturer's Instructions[; G[, [____]]]

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals[; G[, [____]]]

SD-11 Closeout Submittals

Record Drawings[; G[, [____]]]

Acceptance Documentation[; G[, [____]]]

1.3 QUALITY CONTROL

Submit a quality control plan outlining the intended methods of receiving, testing, and installing equipment. Ensure that the plan meets the minimum requirements for test equipment specified in the RCBEA GUIDE. Use personnel who have been trained and certified in the appropriate predictive testing and inspection (PT&I) technologies to ensure that the results are accurate and consistent. Submit the following as part of the quality control plan for required acceptance testing:

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

b. Certificates showing the qualifications and certifications of test personnel.

1.4 WARRANTY

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

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

This guide specification establishes acceptance requirements to ensure building equipment and systems meet installation requirements and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize use PT&I technologies and are essential elements in the Government's Reliability-Centered Building and Equipment Acceptance (RCBEA) Program.

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

2.1.1 Design Requirements

Submit applicable design analysis and calculations for the equipment

listed below.

[a. Blowers

][b. Boilers

][c. Compressors

][d. Condensers

][e. Cranes

][f. Diesel engine

][g. Diesel generator

][h. Gearboxes

][i. Fans

][j. Fluid piping

][k. Heat exchangers

][l. Heat exchange cooling tower

][m. HVAC ducts

][n. Material handling conveyor

][o. Miscellaneous safety wash

][p. Motors

][q. Pumps

][r. Valves

][s. Steam traps

][t. Turbine expander

][u. Turbines, gas

][v. Turbines, steam

]2.2 PRODUCT DATA

Submit material, equipment, and fixture lists for equipment, materials, and fixtures planned for use to complete the job before starting work. Include the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. List construction equipment to be used.

2.2.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties. Ensure that drawings contain details on fabrication and assembly to be performed in the factory.[Show cutaway and sectional views in gearbox fabrication

drawings.]

Submit manufacturer's catalog data for equipment listed in paragraph PRODUCT DATA section. Include manufacturer's standard catalog data, at least [5 weeks][_____] before the purchase or installation of a particular component, highlighted to show material, size, options, and equipment performance data charts and curves in adequate detail to demonstrate compliance with contract requirements. Include the manufacturer's instructions and procedures for installation. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit product data for each specified component.

Submit bearing layout drawings detailing the type, size, and orientation of bearings for equipment containing bearings, including motors, pumps, fans, cranes, and gearboxes.

Submit manufacturer product data for equipment listed in the paragraph PRODUCT DATA. Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and the size and location of anchor bolts.

Submit manufacturer's catalog data and equipment foundation data for the following equipment:

[a. Blowers

][b. Boilers

][c. Compressors

][d. Condensers

][e. Cranes

][f. Diesel engine

][g. Diesel generator

][h. Gearboxes

][i. Fans

][j. Fluid piping

][k. Heat exchangers

][l. Heat exchange cooling tower

][m. VAC ducts

][n. Material handling conveyor

][o. Miscellaneous safety wash

][p. Motors

][q. Pumps

][r. Valves

][s. Steam traps

][t. Turbine expander

][u. Turbines, gas

][v. Turbines, steam

]2.2.2 Certification Data

Submit certificates for the equipment listed below, showing conformance with test requirements and laboratory certifications.

[a. Blowers

][b. Boilers

][c. Compressors

][d. Condensers

][e. Cranes

][f. Diesel engine

][g. Diesel generator

][h. Gearboxes

][i. Fans

][j. Fluid piping

][k. Heat exchangers

][l. Heat exchange cooling tower

][m. HVAC ducts

][n. Material handling conveyor

][o. Miscellaneous safety wash

][p. Motors

][q. Pumps

][r. Valves

][s. Steam traps

][t. Turbine expander

][u. Turbines, gas

][v. Turbines, steam

]2.2.3 Specific Equipment Data

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

[a. Blowers

][(1) Blower type

][(2) Number of rotating vanes

][(3) Number of stationary vanes

][(4) Rotating Speeds

][(5) Number of belts (if belt-driven)

][(6) Belt lengths – measured at the pitch line (if belt-driven)

][(7) Diameter of the drive sheave at the drive pitch line (if belt-driven)

][(8) Diameter of the driven sheave at the drive pitch line (if belt-driven)

][b. Boilers

][(1) Boiler type

][c. Compressors

][(1) Compressor type

][(2) Number of compressor sections

][(3) Number of blades per section

][(4) Number of diffusers

][(5) Number of gear teeth on drive gear

][(6) Number of driven shafts

][(7) Number of gear teeth per driven shaft

][(8) Rotating speed of each rotor

][(9) Lubricating oil information, viscosity grade in ISO units, AGMA or SAE classification and identification of additives

][(10) Grease lubricant information, type of base stock, NLGI number, type and percent of thickener dropping point, and base oil viscosity range in SUS

][d. Condensers

][(1) Condenser type

][e. Cranes

][(1) Crane type, duty class and capacity

][(2) Operating speeds

][(3) Hoist lift

][(4) Number of hoists per crane

][f. Diesel engines

][(1) Engine type

][(2) Engine specifications

][g. Diesel generator

][(1) Engine type

][(2) Generator type

][(3) Engine specifications

][h. Fans

][(1) Fan type

][(2) Number of rotating fan blades/vanes

][(3) Number of stationary fan blades/vanes

][(4) Rotating speeds

][(5) Number of belts (if belt-driven)

][(6) Belt lengths – measured at the pitch line (if belt-driven)

][(7) Diameter of the drive sheave at the drive pitch line (if belt-driven)

][(8) Diameter of the driven sheave at the drive pitch line (if belt-driven)

][i. Fluid piping

][(1) Pipe material

][(2) Pipe size and schedule

][j. Gearboxes

][(1) Gearbox type

][(2) Type of gear tooth

][(3) Gear material

][(4) Number of teeth on each gear

][(5) Gear ratio

][(6) Input and output speeds

][k. Heat exchangers

][(1) Heat exchanger type

][l. Heat exchange cooling tower

][(1) Cooling tower identification (type)

][m. HVAC ducts

][(1) Type of duct installed

][n. Material handling conveyor

][(1) Conveyor type

][o. Miscellaneous safety wash

][(1) Type

][p. Motors

][(1) Motor type

][(2) Bearing information

][(3) Frame size

][(4) Motor class

][(5) Full load and locked rotor current

][(6) Winding resistance

][(7) Winding inductance

][(8) Cooling fan blades

][(9) Number of rotor bars

][(10) Number of stator slots

][(11) SCR firing sequence

][q. Pumps

][(1) Pump type

][(2) Number of stages

][(3) Number of vanes per stage

][(4) Number of gear teeth on each pump gear

][(5) Type of impeller or gear

][(6) Rotating speed

][(7) Number of volutes

][(8) Number of diffuser vanes

][r. Steam traps

][(1) Steam trap type

][s. Turbine expanders

][(1) Power turbine type

][(2) Manufacturer/PT model number

][(3) Major component list

][(4) Number of turbine stages with speed, blades per each row

][(5) Coupling type and information

][(6) Baseplate supports

][(7) Lube oil system

][(8) Exhaust system

][(9) Control and data output systems

][(10) Vibration system

][(11) Fire/gas/extinguishing system

][(12) Water wash system

][(13) Performance Test by the original equipment manufacturer with customer verification/1-yr HR-Output

][t. Turbine, gas

][(1) Gas turbine type

][(2) Site design conditions

][(3) Manufacturer/GT model number

][(4) Major component list

][(5) Number of compressor/turbines with speeds, blades per each row

][(6) Number of combustors and number of fuel nozzles per each combustor

][(7) Gear box, drive, turbine cycle descriptions

][(8) Fuel types along with combustion system info to control emissions

][(9) Baseplate supports

][(10) Acoustic enclosure – noise control

][(11) Air inlet information – with filtration details

][(12) Starting system

][(13) Lube oil system

][(14) Exhaust system

][(15) Control and data output systems

][(16) Vibration system

][(17) Emergency power system along with DC battery and controls info

][(18) Fire/gas/extinguishing system

][(19) Water wash system

][(20) Performance Test Criteria by OEM with customer verification/1-yr. HR/Output Warranty

][u. Turbine, steam

][(1) Steam turbine type

][(2) Design conditions

][(3) Manufacturer/ST model number

][(4) Major component list

][(5) Pressure sections, turbines with speed, blades per each row

][(6) Bearings/gear box, drive, turbine cycle descriptions

][(7) Baseplate supports

][(8) Steam conditions at various locations – flow/pressure/temperature – heat balance diagram

][(9) Lube oil system

][(10) Starting system/emergency power system

][(11) Control and data output systems

][(12) Vibration system

][(13) Fire/gas/extinguishing system

][(14) Water wash system

][v. Valves

][(1) Valve type

]2.2.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and at least [_____] months before the date of beneficial occupancy. List parts and supplies, providing current unit prices and source of supply, and list spare parts list recommended for [12][_____] months of operation. List parts that the manufacturer recommends replacing after [1] [and] [_____] years of service.

PART 3 EXECUTION

3.1 EXAMINATION

Visually inspect the equipment listed below. Correct abnormalities or defects as directed by the Contracting Officer.

[a. Blowers

][b. Boilers

][c. Compressors

][d. Condensers

][e. Cranes

][f. Diesel engine

][g. Diesel generator

][h. Gearboxes

][i. Fans

][j. Fluid piping

][k. Heat exchangers

][l. Heat exchange cooling tower

][m. HVAC ducts

][n. Material handling conveyor

][o. Miscellaneous safety wash

][p. Motors

][q. Pumps

][r. Valves

][s. Steam traps

][t. Turbine expander

][u. Turbines, gas

][v. Turbines, steam

]3.2 INSTALLATION

Submit installation drawings for installed equipment. Ensure that the drawings consist of equipment layouts including assembly, manufacturer's instructions, installation details and electrical connection diagrams. Ensure that layout and installation details include support structures, piping, and related system components. Include on the drawings information required to demonstrate that the system has been coordinated and will function within the [HVAC] [_____] system, and show the relationship of equipment to other parts of the work, including clearances required for operation and maintenance.

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

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

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

****

NOTE: The acceptance criteria, as defined in this specification, may also be used to establish the required baselines for future maintenance.

At the Government's option, the Government may elect not to have the Contractor perform acceptance testing, but instead the acceptance testing may be performed either by Government personnel or other designated third-party personnel. This option can be exercised on a case-by-case basis. Regardless of who performs the acceptance testing, Contractor compliance with the requirements of acceptance is mandatory.

****

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

3.3.1 Predictive Testing and Inspection

****

NOTE: Predictive Testing and Inspection (PT&I) involves the use of acceptance and inspection techniques that are nonintrusive and nondestructive in order to avoid introducing problems. It also involves the use of data collection devices, data analysis, and computer databases to store and trend information. Typical PT&I technologies used during equipment acceptance include vibration analysis, oil and hydraulic fluid analysis, temperature monitoring, airborne ultrasonics, electrical system testing, and fluid flow and process analysis.

The PT&I tests prescribed in this section are MANDATORY for all assets and systems identified as Critical, Configured, or Mission-Essential. Unless the PT&I test is designated as "optional," do not remove the requirement from this specification. If the system is noncritical, nonconfigured, and not mission-essential, use sound engineering discretion to assess the value of adding these test and acceptance requirements.

Enhanced acceptance criteria increase the contractor costs, which increases the Government's cost. These acceptance criteria are not intended to unnecessarily drive up the cost of equipment installations and contractor work. If the cost of the added inspections and the cost of enhanced equipment designs outweigh their value of their performance and their life-cycle value, then overly restrictive acceptance criteria should not be used. The acceptance criteria should define the “minimum” limits essential for a high-quality installation. See the RCBEA Guide for additional information regarding cost feasibility of PT&I.

****

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

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

[a. Perform Alignment Test for:

][(1) Blowers (laser preferred)

][(2) Compressors (laser preferred)

][(3) Cranes (laser preferred)

][(4) Fans (laser preferred)

][(5) Heat exchange cooling tower (laser preferred)

][(6) Material-handling conveyor (laser preferred)

][(7) Motors (laser preferred)

][(8) Pumps (laser preferred)

][(9) Turbine expander (laser preferred)

][(10) Turbines, gas (laser preferred)

][(11) Turbines, steam (laser preferred)

][b. Perform Balancing Test for:

][(1) Blowers

][(2) Compressors

][(3) Cranes

][(4) Fans

][(5) Heat exchange cooling tower

][(6) Material-handling conveyor

][(7) Motors

][(8) Pumps

][(9) Turbine expander

][(10) Turbines, gas

][(11) Turbines, steam

][c. Perform Borescope Inspection Test for:

][(1) Turbine expander

][(2) Turbines, gas

][(3) Turbines, steam

][d. Perform Code And Requirements Verification Test for:

][(1) Miscellaneous safety wash

][e. Perform Cold Starting Test for:

][(1) Diesel engine

][(2) Diesel generator

][(3) Motors

][f. Perform Cooling System Evaluation Test for:

][(1) Diesel engine

][(2) Diesel generator

][g. Perform Ductwork Leakage Test for:

][(1) HVAC ducts

][h. Perform Exhaust Emissions Test for:

][(1) Diesel engine

][(2) Diesel generator

][(3) Turbines, gas

][i. Perform Flux Analysis Test for:

][(1) Motors

][j. Perform High Voltage Test for:

][(1) Motors [optional]

][k. Perform Hydraulic Oil Test for:

][(1) Gearboxes

][(2) Compressors [optional]

][(3) Cranes [optional]

][(4) Pumps [optional]

][(5) Turbine expander [optional]

][(6) Turbines, gas [optional]

][(7) Turbines, steam [optional]

][l. Perform Hydrostatic Test for:

][(1) Boilers

][(2) Fluid piping

][(3) Heat exchangers

][(4) A valves

][m. Perform Infrared Thermography Test for:

][(1) Compressors

][(2) Condensers

][(3) Fans

][(4) HVAC ducts

][(5) Pumps

][(6) Turbine expander

][(7) Turbines, gas

][(8) Turbines, steam

][(9) Boilers [optional]

][(10) Fluid piping [optional]

][(11) Heat exchangers [optional]

][(12) Motors [optional]

][(13) Valves [optional]

][n. Perform Insulation Power Factor Test for:

][(1) Motors

][o. Perform Insulation Resistance Test for:

][(1) Cranes [optional]

][(2) Motors [optional]

][p. Perform Lubricating Oil Test for:

][(1) Blowers

][(2) Compressors

][(3) Cranes

][(4) Diesel engine

][(5) Diesel generator

][(6) Fans

][(7) Gearboxes

][(8) Heat exchange cooling tower

][(9) Material-handling conveyor

][(10) Motors

][(11) Pumps

][(12) Turbine expander

][(13) Turbines, gas

][(14) Turbines, steam

][q. Perform Mechanical Performance Test for:

][(1) Cranes

][(2) Diesel engine

][(3) Diesel generator

][r. Perform Motor Circuit Evaluation Test for:

][(1) Motors

][s. Perform Noise Level Acceptance Test for:

][(1) Cranes

][(2) Diesel engine

][(3) Diesel generator

][(4) Turbines, gas

][t. Perform Operational Fire Damper Test for:

][(1) HVAC ducts

][u. Perform Performance Test for:

][(1) Material-handling conveyor

][v. Perform Power/Output Test for:

][(1) Turbines, gas

][(2) Turbines, steam

][w. Perform Thermodynamic Performance Test for:

][(1) Blowers

][(2) Boilers

][(3) Compressors

][(4) Condensers

][(5) Fans

][(6) Fluid piping

][(7) Heat exchangers

][(8) Heat exchange cooling tower

][(9) HVAC ducts

][(10) Pumps

][(11) Turbine expander

][(12) Turbine, gas

][(13) Turbine, steam

][(14) Valves [optional]

][x. Perform Ultrasonic (Airborne) Test for:

][(1) Boilers

][(2) Compressors

][(3) Condensers

][(4) Fans

][(5) HVAC ducts

][(6) Motors

][(7) Pumps

][(8) Steam traps

][(9) Turbines, gas

][(10) Turbines, steam

][(11) Fluid piping [optional]

][(12) Heat exchangers [optional]

][(13) Valves [optional]

][y. Perform Ultrasonic (Pulse) Test for:

][(1) Fluid piping [optional]

][(2) Heat exchangers [optional]

][z. Perform Vibration Analysis Test for:

][(1) Blowers

][(2) Cranes

][(3) Compressors

][(4) Diesel engine

][(5) Diesel generator

][(6) Fans

][(7) Gearboxes

][(8) Heat exchange cooling tower

][(9) Material-handling conveyor

][(10) Motors

][(11) Pumps

][(12) Turbine expander

][(13) Turbines, gas

][(14) Turbines, steam

][aa. Perform Warranty Test for:

][(1) Turbines, gas

][(2) Turbines, steam

]3.4 OPERATIONS AND MAINTENANCE

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

[a. Blowers

][b. Boilers

][c. Compressors

][d. Condensers

][e. Cranes

][f. Diesel engine

][g. Diesel generator

][h. Gearboxes

][i. Fans

][j. Fluid piping

][k. Heat exchangers

][l. Heat exchange cooling tower

][m. HVAC ducts

][n. Material-handling conveyor

][o. Miscellaneous safety wash

][p. Motors

][q. Pumps

][r. Valves

][s. Steam traps

][t. Turbine expander

][u. Turbines, gas

][v. Turbines, steam

] Submit [six][_____] complete copies of operations and maintenance manuals in bound 216 mm by 279 mm 8-1/2 inch by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of items of equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When publications are provided in electronic format, only two copies of the document are required. Submit operations and maintenance manuals [30][_____] calendar days before testing equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing, the Contracting Officer will provide acceptance documentation to the Contractor. Complete, sign, and date this documentation and submit the documentation to the Contracting Officer for processing and approval.

-- End of Section --