SECTION TABLE OF CONTENTS

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 01 50

TECHNICAL REQUIREMENTS

TABLE OF CONTENTS

PART 1. GENERAL 5

1.1 GENERAL 5

1.1.1 REFERENCES 5

1.1.2 SUBMITTALS 7

1.1.3 COMPLIANCE 8

1.1.4 DESIGN PACKAGE 9

1.1.5 ASBESTOS-CONTAINING MATERIALS 9

1.1.6 SAFETY 9

1.1.7 MANDATORY AND OPTIONAL ITEMS 9

1.1.8 SITE SPECIFIC LIMITATIONS 9

1.1.8.1 Maximum Reservoir Pool 9

1.1.8.2 Valve Room 9

1.1.8.3 Irrigation Tunnel Flows 10

1.1.8.4 Intake Structure 10

1.1.8.5 Piezometers and Instrumentation Installation 10

1.1.9 TEMPORARY STRUCTURES 10

1.1.10 SUBCONTRACTORS 10

1.1.11 APPLICABLE CODES AND TECHNICAL CRITERIA 10

1.1.12 SITE DEVELOPMENT 11

1.1.12.1 Environmental Protection 11

1.1.12.2 Notification 11

1.1.12.3 Spillages 11

1.1.12.4 Demolition and Disposal 11

1.1.12.5 Project Identification 11

1.2 PROJECT: IRRIGATION TUNNEL WORKS 13

1.2.1 Robustness of Components 13

1.2.2 De-watering Plan 13

1.2.3 Mechanical Work 13

1.2.3.1 General 13

1.2.3.2 Site Inspection 13

1.2.3.3 Conduit, Chamber, and Apron - Evaluation and Report 13
1.2.3.4 Conduit Repair (OPTIONAL) 13
1.2.3.5 Valve Room Overhead Service Crane and Hoist 14
1.2.3.6 Refurbish Emergency Closure Valves (ROTOVALVES) 14
1.2.3.7 Hydraulic System for Emergency Closure Valves (ROTO-VALVES) 15
1.2.3.8 Flow Regulating Valve (HOLLOW JET VALVE) Replacement 16
1.2.3.9 Valve Actuators for Flow Regulating Valves (HOLLOW-JET VALVES) 17
1.2.3.10 Design/Manufacture for Flow Regulating (HOLLOW-JET VALVES) 17
1.2.3.11 Sump Pumps 18
1.2.3.12 Flap Gate 18
1.2.3.13 Local Water Supply – Evaluate and Report 18
1.2.3.14 Modify Local Water Supply (Optional) 18
1.2.3.15 Refurbish HVAC 19
1.2.4 Electrical Work 19
1.2.4.1 General 19
1.2.4.2 Electrical Site Inspection – Tunnel Works 19
1.2.4.3 Design 19
1.2.4.4 Valve House Sump Pumps 19
1.2.4.5 Flow Regulating Valves (HOLLOW JET) 19
1.2.4.6 Emergency Closure Valves (ROTO VALVES) 20
1.2.4.7 Products 20
1.2.4.8 Specifications 20
1.2.4.9 Installation 20
1.2.4.10 Testing 20
1.2.4.11 Diesel Generator for Powerhouse (Optional) 20
1.2.5 Valve House Hydro-electric Generating Unit 20
1.2.5.1 General 20
1.2.5.2 Site Inspection 21
1.2.5.3 Design 21
1.2.5.4 General Design Requirements 21
1.2.5.5 Generator 22
1.2.5.6 Commissioning 23
1.2.5.7 Alignment 26
1.2.5.8 Training 26
1.2.5.9 Operation and Maintenance Manual 26
1.2.6 Power House Diesel Generator (Optional) 26
1.2.7 Structural/Geotechnical Work 26
1.2.7.1 General 26
1.2.7.2 Unlined Tunnel – Evaluate and Report 27

1.2.7.3 Chamber Repair - Downstream of Jet Valve (OPTIONAL) 27
1.2.7.4 Apron Repair - Downstream of Jet Valve (OPTIONAL) 27
1.2.7.5 Bulkhead for Chamber 27
1.2.8 Spare Parts 27
1.2.8.1 Roto Valves 27
1.2.8.2 Flow Regulating Discharge Valves 28
1.2.8.3 Flow Regulating Discharge Valve Actuators 28
1.2.8.4 Valve House Hydroelectric Generating Unit 28
1.2.8.5 Electrical Controls 28
1.3 PROJECT: IRRIGATION INTAKE STRUCTURE 30
1.3.1 Mechanical Work 30
1.3.1.1 General 30
1.3.1.2 Site Inspection 30
1.3.1.3 Bridge Crane and Hoist 30
1.3.1.4 Jib Crane 31
1.3.1.5 Lifting Beams 31
1.3.1.6 Bulkhead Dogs 32
1.3.1.7 Design/Manufacture 32
1.3.1.8 Installation and Site Work 32
1.3.2 Electrical Work 33
1.3.2.1 General 33
1.3.2.2 Site Inspection 33
1.3.2.3 Design 33
1.3.2.4 Studies 33
1.3.2.5 Irrigation Intake Structure 34
1.3.2.6 Products 34
1.3.2.7 Testing 34
1.3.2.8 Diesel Generator for Intake structure 34
1.3.3 Structural Work 35
1.3.3.1 Access Bridge 35
1.3.3.2 Structural Elements of Intake Structure 35
1.3.3.3 Inspection for Trash Racks (Optional) 35
1.3.3.4 Trash Rack Replacement (Optional) 35
1.3.3.5 Trash Rack Guide Repair (Optional) 35
1.3.3.6 Irrigation Tunnel Closure Wheeled Bulkhead 35
1.3.3.7 Irrigation Tunnel Closure Concrete Bulkhead 36
1.3.3.8 Alternate Tunnel Watering System 36
1.3.4 SPARE PARTS 37
1.3.4.1 Bridge Crane 37

1.3.4.2 Electrical Controls 37
1.4 DAM SAFETY INSTRUMENTATION 38
1.4.1 Civil/Geotechnical Work 38
1.4.1.1 General 38
1.4.1.2 Geotechnical Requirements 38
1.4.1.3 Geotechnical Qualifications 38
1.4.1.4 Site Inspection 38
1.4.1.5 Design/Manufacture 39
1.4.1.6 Installation and Site Work 39
1.4.1.7 Piezometers 39
1.4.1.8 Water Level Meters 39
1.4.1.9 Survey Monuments and Pillars 39
1.4.1.10 Survey Instrumentation 40
1.4.1.11 Staff Gages 40
1.4.1.12 Project Identifications 40
1.5 SPILLWAY INVESTIGATION (OPTIONAL) 42
1.5.1 Emergency Spillway Geophysical Surveys 42
1.5.2 Emergency Spillway Foundation Drill Holes 42
1.5.3 Service Spillway Foundation Drill Holes 42
1.5.4 Spillway Surface Inspection and Geologic Mapping 43
1.5.5 Professional Geologist 43
1.5.6 Spillways Investigation Plan 43
1.5.7 Spillways Report 43
1.6 OPERATIONS AND MAINTENANCE (O&M) - 43
PART 2. PRODUCTS 43
PART 3. EXECUTION 43

PART 1. GENERAL

1.1 GENERAL

1.1.1 REFERENCES

This paragraph is used to list the sections and publications cited in the text. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title. Appendix B contains a complete list of a manuals and regulations for the entire RFP

CROSS REFERENCED SECTIONS

SECTION 00 12 00, PROPOSAL EVALUATION AND BASIS OF AWARD

SECTION 01 45 00, CONTRACTOR QUALITY CONTROL

SECTION 00 15 00, PROJECT PHASES

SECTION 01 33 16, DESIGN-BUILD AFTER AWARD

SECTION 016400 START UP TESTING AND COMMISSIONING

SECTION 017810 OPERATIONS AND MAINTENANCE DATA

SECTION 016640 TRAINING

SECTION 013315 SUBMITTAL PROCEDURES FOR DESIGN-BUILD PROJECTS

SECTION 010140 SUMMARY OF WORK

USACE ENGINEERING MANUALS AND REGULATIONS

EM 385-1-1 (2008) Safety and Health Requirements Manual, including Changes in effect at the time of advertisement

EM 1110-2-1602 (1980) Engineering and Design - Hydraulic Design of Reservoir Outlet Works

EM 1110-1-1802 Geophysical Exploration for Engineering and Environmental Investigations

EM 1110-1-1804 Geotechnical Investigations, ENG 1836, ENG 1836A

EM 1110-2-2105 (1994) Design of Hydraulic Steel Structures Change 1

EM 1110-2-2701 (1997) Vertical Lift Gates

EM 1110-2-1908 (1995) Engineering and Design - Instrumentation of Embankment Dams and Levees

EM 1110-2-1009 (2002) Engineering and Design - Structural Deformation Surveying

EM 1110-2-4300 (1980) Engineering and Design - Instrumentation for Concrete Structures

EM 1110-2-2105 (1994) Design of Hydraulic Steel Structures Change 1

EM 1110-2-2701 (1997) Vertical Lift Gates

ER 1110-2-110 (1985) Instrumentation for Safety - Evaluations of Civil Works Projects

ER 1110-1-1807 (2006) Procedures for Drilling in Earth Embankments

ASTM STANDARDS

ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

ASTM D 2487-06 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D5092 Standard Practice for Design and Installation of Ground Water Monitoring Wells

ASTM D5731 Standard Test Method for Determination of the Point Load Strength Index of Rock and Application to Rock Strength Classifications

NATIONAL ELECTRICAL MANUFACTURERS SPECIFICATIONS

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts maximum)

NEMA ICS 1 (2000, R 2008) Industrial Control and Systems General Requirements

NEMA ICS 2 (2000, R 2005) Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

NEMA ICS 5 (2000, R 2010) Industrial Control and Systems Control-Circuit and Pilot Devices

NEMA ICS 8 (2000, R 2005) Industrial Control and Systems Crane and Hoist Controllers

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

NEMA WC 70 (2009) Non-Shielded Power Cable 2000V or Less for the Distribution of Electrical Energy

MISCELLANEOUS

AMSE B30.2 (2005) Overhead and Gantry Cranes

UFC 3-320-07N (2004; R 2007) Weight Handling Equipment

TM 5-811-1 (1995) Electrical Power Supply and Distribution

NFPA 70 (2011) National Electrical Code

IES Lighting Handbook, 9th edition

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

UNITED STATES GEOLOGICAL SURVEY (USGS)

Open-File Report 2007-1137: Preliminary Earthquake Hazard Map of Afghanistan (Version1, Posted May 2007), available at: http://pubs.usgs.gov/of/2007/1137/.

The publications utilized shall be those of the most recent editions.

UFGS GUIDES

26 00 00.00 20	BASIC ELECTRICAL MATERIALS AND METHODS
26 05 00.00 40	COMMON WORK RESULTS FOR ELECTRICAL
26 05 19.00 10	INSULATED WIRE AND CABLE
26 28 00.00 10	MOTOR CONTROL CENTERS, SWITCHBOARDS AND PANELBOARDS
26 32 14.00 10	DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPS.
26 51 00	INTERIOR LIGHTING
33 70 01.00	ELECTRICAL DISTRIBUTION SYSTEM, AERIAL
33 70 02.00	ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
01 74 19	CONST & DEMO WASTE MANAGEMENT; 33
01 50 00	TEMPORARY CONSTRUCTION FACILITIES AND CONTROL

05 05 23 WELDING, STRUCTURAL
05 59 13 FABRICATION OF HYDRAULIC STEEL STRUCTURES
09 97 02 PAINTING: HYDRAULIC STEEL STRUCTURES

U.S. BUREAU OF RECLAMATION GUIDE

(1996) Inspection of Steel Penstocks and Pressure Conduits

1.1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION 01 33 15 SUBMITTAL PROCEDURES FOR DESIGN-BUILD PROJECTS.

ITEMS	PARAGRAPH
TUNNEL WORKS	
De-watering Plan; G	1.2.2
Conduit, Chamber, and Apron - Evaluation and Report; G	1.2.3.3
Report on Conduit Repairs; G	1.2.3.4
Valve Room Overhead Service Crane and Hoist – Evaluate and Report**;** G	1.2.3.5 (a)
Roto Valves – Design Package for Refurbishment; G Including designs for electrical controls	1.2.3.6, 1.2.4.6
Report on Fluid Transient Pressures or original documentation; G	1.2.3.6 g
Report on Leakage from Valves; G	1.2.3.6 h
Report on existing condition of refurbished items	1.2.3.6 l
Hollow Jet Valve – Design Package for Replacement; G Including designs for electrical controls (Hydraulic Analysis – optional requirement for alternate configuration)	1.2.3.8, 1.2.4.5
Sump Pumps – Design Package for Replacement; G	1.2.3.11
Flap Gate – Design Package for Replacement; G	1.2.3.12
Local Water Supply – Evaluate and Report**;** G	1.2.3.13
Local Water Supply – Design Package for Modified Connection	1.2.3.14
Report on Condition of Electrical Components and Drawings for Electrical Work; G • Single-Line Diagram (17-F-8) • Irrigation Tunnel – Valve Chamber and Tunnel - Power and Lighting (17-F-2) • Valve House - Power and Lighting Plans (17-F-3) • Valve House - Power and Lighting – Sections and Details (17-F-4)	1.2.4.2
Report on Service Turbine and Drawings for Hydro-Electric Work; G • Valve House - Power and Lighting Plans (17-F-3) • Valve House Switchboard Elementary Wiring (17-F-5R2) • Valve House Switchboard 3 & 4 Wire 400 Volt 50 Cycle (D-18555F-1) • Wiring Diagram Panels 1 & 2 Valve House Switchboard (D-18555F-2)	1.2.5.2

Commissioning Plan for Hydro-Electric Service	1.2.5.6
Operation and Maintenance Manual for Valve House Hydro-electric Generating Unit	1.2.5.9
Operation and Maintenance Manual for Power House Diesel Generator	1.2.6
Unlined Tunnel – Evaluate and Report	1.2.7.2
Chamber – Design Package	1.2.7.3
Apron – Design Package	1.2.7.4
Design Package for Chamber bulkhead	1.2.7.5
Spare Parts Manual	1.2.8
Electrical Design Package Diesel Generator at Powerhouse	1.2.4.11
Report on Refurbished HVAC Systems	1.2.3.15
INTAKE TOWER	
Report on Crane Inspection	1.3.1.2
Design Package for Bridge Crane and Hoist, Lifting Beam, and Bulkhead Dogs	1.3.1.3, 1.3.1.4, 1.3.1.5, 1.3.1.6
Electrical Inspection and Load Study	1.3.2.2, 1.3.2.4
Electrical Design Package for the Intake Tower	1.3.2.3
Design Package for Diesel Generator at Intake Tower	1.3.2.8
Structural Analysis and Report on Access Bridge to Intake Tower	1.3.3.1
Inspection report on structural elements including Independent review of designs and operational history of the intake structure	1.3.3.2
Reinforcement design of the structural elements of the intake structure if necessary to account for the rehabilitated Bridge Crane	1.3.3.2
Trash Rack and Guides - Report on Inspection and Design package	1.3.3.3
Design Package for STOP LOG and WHEEL GATE, and Alternate Watering System	1.3.3.6, 1.3.3.7, 1.3.3.8
Manual for Spare Parts at Intake Tower	1.3.4
DAM SAFETY INSTRUMENTATION	
Report on Dam Safety Instrumentation including Site Inspections and design package	1.4.1.1, 1.4.1.4
Spillways Exploration Plan	1.5.6
Spillways Exploration Report	1.5.7
Project identification and drawings	1.1.1.12

1.1.3 COMPLIANCE

The Contractor's design and construction shall comply with technical requirements contained herein. The Contractor shall provide design and construction using the best blend of cost, construction efficiency, system durability, ease of maintenance and environmental compatibility. Criteria for proposal evaluation is in Section 00 12 00 PROPOSAL EVALUATION AND BASIS OF AWARD. Qualifications for site inspection personnel shall be in accordance with Section 01 45 00, CONTRACTOR QUALITY CONTROL.

1.1.4 DESIGN PACKAGE

a. Technical requirements within this section shall be used to prepare Plans & Specifications in accordance with SECTION 01 33 16, DESIGN-BUILD AFTER AWARD.
b. Design Submittals identified within this section shall be submitted under the Interim Design submittal requirements of SECTION 01 33 16, DESIGN-BUILD AFTER AWARD.
c. These design and product requirements are minimum requirements.

1.1.5 ASBESTOS-CONTAINING MATERIALS

Asbestos-containing material (ACM) shall not be used in the design and construction of this project. ACM is defined as a material composed of 1% or more asbestos by weight.

1.1.6 SAFETY

Designs and finished products shall conform to EM 385-1-1.

Hearing protection shall be issued and used in the area of work in the presence of grinding, operating equipment or other loud processes. Additional hearing protection equipment will be readily available at the work site in the vicinity of the work

1.1.7 MANDATORY AND OPTIONAL ITEMS

All items in this section are considered mandatory work items to be performed by the Contractor, unless the paragraph title is indicated to be (OPTIONAL). For those items listed as optional, only the portion of work under that specific paragraph title and related subparagraphs shall be considered as optional.

1.1.8 SITE SPECIFIC LIMITATIONS

The Contractor shall become familiar with the nature of the work to be done and identify constraints which must be considered for design and construction. A list of notable items is included below. This list is not comprehensive, and failure to identify additional site constraints does not relieve the Contractor from the responsibility to become familiar with all aspects of work.

1.1.8.1 Maximum Reservoir Pool

The maximum reservoir pool elevation for design purposes is 1045m.

1.1.8.2 Valve Room

a. The emergency closure valves are located at the end of a tunnel. The Contractor shall supply forced ventilation as required to ensure adequate working conditions **(**See EM 385-1-1 0.6.G.01 Portable and Temporary Ventilation Systems required under the Safety and Health Requirements of this Contract**).** The contractor shall provide mechanically delivered fresh air to the furthest point in the tunnel (approximately 450ft) at a rate of no less than 80% of the exhaust quantity or as specified in 29 CFR 1910.94 and 29 CFR 1926.57, whichever requirement is more stringent. For historical reference, see paragraph 11. Tunnel Ventilation, Section III- page 30 of Appendix C – 1956 Final Design Report.

b. Equipment shall fit through existing access doorways and hatches.

1.1.8.3 Irrigation Tunnel Flows

The irrigation tunnel must not be shut for more than [14 days]. Outside that window, no more than [2] valves may be locked shut for a period of more than [30 days].

1.1.8.4 Intake Structure

a. The intake structure bridge crane hoist is currently inoperable. The design drawings conservatively rate the existing hoist at 75 tons which is for the center of the bridge, not the lift points at the columns.

b. Access to the intake structure is via a pedestrian footbridge. The original O&M Manual specified a weight restriction limited to "hand carry only". The design documents indicate 93 psf. The footbridge loading shall be limited to hand transport or small cart not to exceed 1,000 lbs total. Deviation from this weight limitation is not acceptable unless the Contractor performs an inspection of the condition of the bridge and submits a report along with a structural analysis by a licensed structural engineer showing the structural system is adequate to support the proposed loading.

c. The concrete bulkhead is supported at its current elevation and cannot be moved with the existing hoist.

d. The O&M manual specifies that the gates must not be closed unless one of the downstream valves is still open.

e. The pressure diagram for the wheel gate design is on drawing 15-F-11 (R1).

f. The operational requirements of the intake structure are extremely important to the appropriate rehabilitation of the Irrigation Intake Structure. The government has performed a review of the design documents and O&M manual to facilitate developing this request for proposal. A copy of this government review is attached – See Engineering Alternative MS1-2-5. The Contractor's engineer must perform an independent review of the design documents and the O&M manual as part of this contract.

1.1.8.5 Piezometers and Instrumentation Installation

a. The Contractor shall determine detailed access requirements for installation of all instrumentation during a site inspection and submit a report.

The reservoir pool is currently limited to a lower elevation than originally designed, due to the incomplete service and emergency spillways. The current reservoir has never been impounded to a level higher than about Elevation 1037m. All new designs and equipment shall be based on the potential maximum pool at Elevation 1050m as if these spillways were complete.

1.1.9 TEMPORARY STRUCTURES

The Contractor shall erect suitable temporary fences, lighting, and necessary structures to safeguard the site, materials and plant against damage or theft and for the protection of the general public and shall adequately maintain the same throughout the course of the contract.

1.1.10 SUBCONTRACTORS

Compliance with the provisions of this section by subcontractors will be the responsibility of the contractor.

1.1.11 APPLICABLE CODES AND TECHNICAL CRITERIA

The codes and guide specifications found in Appendix B shall be required for this project. This list is not comprehensive. Additional required codes and specific technical standards are referenced in other sections and paragraphs. The publications utilized shall be those of the most recent editions.

Any Code or Reference that can be determined to be substantially equivalent to those specified in this document may be used, but it is the Contractor's responsibility to show the equivalency of the alternate Code or Reference and the Contracting Officer must approve its use prior to implementation. A partial listing of references is included within the Request for Proposal.

1.1.12 SITE DEVELOPMENT

1.1.12.1 Environmental Protection

The Contractor shall comply with all Host Nation laws, rules, regulations or standards concerning environmental pollution control and abatement with regard to discharge of liquid waste into natural streams or manmade channels. The contractor shall review host nation regulations with the contracting officer prior to design and discharge of any liquid wastes into natural streams or manmade channels.

1.1.12.2 Notification

The Contracting Officer will notify the Contractor in writing of any observed non-compliance with the foregoing provisions. The Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until he (she) is satisfied corrective action has been taken. No extension of time or damages will be awarded to the Contractor unless it was later determined that the Contractor was in compliance.

1.1.12.3 Spillages

Measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, waste washings, herbicides and insecticides, and construction materials from polluting the construction site and surrounding area.

1.1.12.4 Demolition and Disposal

Demolition and proper disposal needs to occur anywhere systems are being replaced or abandoned. At the end of the project all unused equipment, wiring, controls, conduit, pads, mounting structures should be removed and disposed of safely according to Host Nation Laws and Regulations.

Disposal of any materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., shall be taken to a dumpsite approved by the Contracting Officer. Burning at the project site for the disposal of refuse and debris will not be permitted.

1.1.12.5 Project Identification

The Contractor shall provide project identification in accordance with Section 01 58 00 PROEJCT IDENTIFCATION and as specified in the paragraph for Dam Safety Instrumentation below.

INTENTIONAL PAGE BREAK

1.2 PROJECT: IRRIGATION TUNNEL WORKS

1.2.1 Robustness of Components

The installation is occurring in an area of political instability and there may be extended periods of time, perhaps years, where the plant will not receive scheduled maintenance. The contractor is encouraged to select equipment and materials with this in mind, choosing simplicity of maintenance and robust construction where feasible.

1.2.2 De-watering Plan

Contractor shall submit a Dewatering Plan to support all aspects of design and construction in the tunnel works. The Dewatering Plan shall include but not be limited to sequence of work, schedule, ventilation and all safety requirements. The De-watering plan shall be subject to the criteria listed under paragraph SITE SPEIFIC LIMITATIONS.

1.2.3 Mechanical Work

1.2.3.1 General

Prepare construction plans & specifications, as well as perform construction, testing and commissioning for the valve house sump pumps and flap gate on discharge line, flow regulating valves (HOLLOW JET-VALVES), emergency closure valves (ROTO-VALVES), and overhead service crane and hoist, and local water supply connection.

1.2.3.2 Site Inspection

Become familiar with all aspects of the site, including size, weight, and environmental constraints. All inspections shall be performed by a qualified engineer of a relevant discipline. Perform visual inspection of equipment and structures not intended for demolition. Submit reports described below on the condition of existing equipment and structures, including recommendations for correcting deficiencies.

1.2.3.3 Conduit, Chamber, and Apron - Evaluation and Report

Contractor shall inspect the entire length of conduit upstream and downstream of the centerline of the existing valves. Submit a report on the condition of existing equipment and structures, including recommendations for correcting deficiencies. Conduit inspections shall include but are not limited to: videography, coating condition, non-destructive examination (NDE) assessment of wall thicknesses, weld defects, voids in concrete encasement and signs of erosion, corrosion and cavitations. A grouping of NDE measurements, of the shell thickness, shall be taken approximately every 5 feet for the length of the conduits. A grouping of measurements shall consist of 4 readings taken equidistant around the ring of the conduit. A similar grouping of measurements is to be taken of the welds at each joint. Use U.S. Department of the Interior Bureau of Reclamation, *Facilities Instructions, Standards, and Techniques Volume 2-8*, "Inspection of Steel Penstocks and Pressure Conduits" as an inspection guide (document available in Appendix B). Inspection is also required for elements of the Chamber and Apron that may have been subject to cavitations damage (below normal high water and jet spray) downstream of the Jet valves. The Chamber shall be inspected visually after dewatering. The Apron shall be inspected with underwater video where required to evaluate corrosion/erosion.

1.2.3.4 Conduit Repair (OPTIONAL)

Repair any damage to each conduit to an as-new condition. Scope of repairs shall extend from any location beyond the existing joints with the roto and jet valves up to the tunnel plug. The exact nature of the repairs cannot be determined until the evaluation and report has been completed. Contractor shall assume there is erosion and small cracks from cavitations that will require full depth penetration welds. Provide a report on the type and extent of repairs.

1.2.3.5 Valve Room Overhead Service Crane and Hoist

a. Evaluate & Report. Contractor shall evaluate and report on the condition of the service crane and track, see Informational drawing 15-F-52 *Irrigation Tunnel Rotovalve Chamber Hoist and Rail.*
b. Repair Crane (OPTIONAL). Contractor shall repair the crane rails, anchors, and structures in the valve room to restore the crane to original capacity. Crane repair shall include but is not limited to paint systems or coatings, replacement of corroded components, and repair of deficient or damaged structural members or welds. The hoist and track shall be capable of lifting all the valve components.

1.2.3.6 Refurbish Emergency Closure Valves (ROTOVALVES)

These valves are described as ROTOVALVES on informational drawings. These three valves were manufactured by S. Morgan Smith Company, which is now owned by Rodney Hunt. The valves were purchase by Morrison-Knudsen Afghanistan Incorporated under purchase order number 11.5031. The Operations and Maintenance Instructions list the three (3) – 84" diameter Rotovalve of steel construction, 125# standard A.S.A flanges, 115 psi working pressure, for water service. Special assembly required for multi-components. No controls or special equipment. Serial nos. VB-1844, VB-1845, VB-1846. See Appendix C- Rotovalve Operation & Maintenance.

For a brief description of the installation procedure of the valves during irrigation releases, see Appendix C -1956 Final Design Report.pdf, Section III, page 37, paragraph 5. Irrigation Outlets.

Refurbish the three 84-inch irrigation emergency closure valves, operators, and ancillary equipment. Refurbished valves shall meet the following requirements:

a. The operating mechanism components shall be replaced with new components. The guide rods for the crosshead shall be replaced with new stainless steel rods.

b. The hydraulic cylinders shall be replaced with new.

c. The trunnion greasing system shall be replaced with new.

d. The valve exterior and interior of the valve mechanism and mechanism components shall be painted with two coats of high solids epoxy.

e. Valves shall operate under full flow when the reservoir is at maximum pool.

f. Valves shall have a maximum operating time of five minutes from the fully open to fully closed position.

g. Valves shall have a minimum operating time sufficient to prevent detrimental fluid transients within the irrigation tunnel system. Contractor shall provide design calculations and submit a report for approval or provide some original documentation if it can be located.

h. Contractor shall submit both a plan and a report to determine the amount of leakage in gallons per minute. The results shall be contained in a single report.

i. Seals shall be resistant to dirt and debris.

j. Each valve shall have a means to visually indicate valve position.

k. Each valve shall have a means to positively lock the valve in position and prevent undesired or un-commanded operation during the refurbishment. The existing valves have no known locking mechanism in their design, therefore something will need to be fabricated for an external fit.

l. Submit a report on the existing condition of all items included in the refurbishment.

1.2.3.7 Hydraulic System for Emergency Closure Valves (ROTO-VALVES)

Replace existing hydraulic system with a new hydraulic system designed for and capable of operating the Emergency Closure Valves (ROTO-VALVES). The system shall meet the following requirements:

a. The hydraulic system overall shall be capable of delivering the volume and pressure of hydraulic fluid required to operate all three emergency closure valves at once.

b. The electrical supply shall be sized to operate all three valves at once.

c. Each valve shall be equipped with its own hydraulic power unit (HPU). Each HPU shall be capable of providing the pressure required to close and open the emergency closure valves at maximum reservoir pool.

d. Each HPU shall be attached to the hydraulic circuit using quick-connect fittings. Fittings shall be liquid-tight, such that disconnecting a hose does not introduce air into or allow fluid to leak out of the system.

e. HPUs shall be interchangeable between valves.

f. The valve room shall be outfitted with at least one manually powered hydraulic unit. The manual unit shall be easily connected to any individual valve, and capable of developing the full operating pressure required to open and close the valves at maximum reservoir pool.

g. Each hydraulic unit shall be push-button operated, for CLOSE, OPEN, and STOP operations.

h. Hydraulic units shall be protected from overpressure by means of a mechanical device.

i. Each HPU shall be provided with a pressure gage, indicating pressure in Pascals (MPa, kPa, or Pa as appropriate to the application)..

j. Each HPU shall have provisions (disconnect switch) to individually isolate it from electrical energy.

k. Each HPU shall have a means to safely depressurize the system.

l. Hydraulic fluid shall be filtered. Filters shall be of an automotive type, readily available on the regional market. Filter shall be mounted in an easily accessible location for maintenance purposes.

m. Hydraulic fluid shall be desiccated by means of replaceable-media desiccant breathers.

n. Pipe or hard-lines and fittings for the hydraulic system shall be corrosion-resistant.

o. Each HPU shall be skid-mounted, with all operating components less hoses and input power supply contained therein. Skids shall be provided with features that allow the unit to be moved with a standard lift truck or forklift.

p. Skids shall be leveled and anchored after final placement.

q. Individual skids shall be grounded.

r. Each skid shall be provided with a seven-pound ABC-type dry chemical fire extinguisher.

s. Demolish existing HPU system and appropriately dispose of hydraulic oils according to Afghan environmental regulations.

1.2.3.8 Flow Regulating Valve (HOLLOW JET VALVE) Replacement

These specifications cover the three existing 84-inch diameter valves located at the irrigation tunnel discharge to the tailrace. These valves are described as HOLLOW JET VALVES on informational drawings.

Flow Regulating Valves

Remove and replace the three existing 84-inch irrigation flow-regulating discharge valves. New valves shall meet the following requirements:

a. Valves shall be of a size, shape, and weight to interface with the existing discharge piping. Valve inlet diameter shall be 84 inches. The valve shall be complete with flanges to mate with adjacent equipment. Alternate size valves (e.g. smaller valves with reducer) may be acceptable if the Contractor provides a hydraulic system analysis (i.e. Intake Tower to Valve Outlet) supporting the use of the proposed valve and consistency with intended original design (i.e. energy dissipation for flows in the range of 58 to 77 cubic meters per sec).

b. Valves shall be able to completely stop the flow of water. Acceptable leakage is two gallons per minute at maximum reservoir pool during the warranty period.

c. Seals or valve seats shall be resistant to dirt and debris. Valves shall be able to pass dirt and debris that pass through the intake trash racks.

d. Allowable stresses in valve components shall not exceed one-half of the yield stress for the material.

e. Valve design shall exhibit a design life expectancy of at least 50 years.

f. Valves shall be designed with corrosion-resistant features. Where galvanic corrosion may take place, components shall be protected by a sacrificial galvanic cell.

g. Valves shall operate throughout the entire range of flow at any possible head condition of the reservoir.

h. Valves shall be able to fully open and close when no flow is present.

i. Valves shall be free of cavitations or vibration through the full range of operation and at any possible head condition of the reservoir.

j. The valve discharge pattern shall not contact structures. Depending on manufacturer a steel jet deflector hood may be required to reduce the discharge spray by confining the exiting water jet.

k. The valve discharge shall have energy dissipated such that erosion in the tailrace does not occur.

l. Valves shall be outfitted with a mechanical device to indicate valve position. The device shall be readable from the local operator station, and indicate from fully-opened to fully-closed in increments of 10 percent or less.

m. Valves shall be mechanically actuated.

n. Valves shall have a minimum operating time sufficient to prevent detrimental fluid transients within the irrigation tunnel system. Contractor shall provide design calculations and submit a report for approval unless some original documentation can be located.

o. Demolish existing HPU system and appropriately dispose of hydraulic oils according to Afghan environmental regulations.

p. Design and install a stoplog using the existing slots if the original stoplog is not available. Stoplogs shall be capable of dewatering the chamber for the jet valves. Contractor shall assume dewatering is required to a depth of 2m. The actual tail water elevation will depend on dam operations and work must be coordinated with the powerhouse manager and the COR. Stoplogs shall become the property of the government after construction is completed.

1.2.3.9 Valve Actuators for Flow Regulating Valves (HOLLOW-JET VALVES)

Replace the actuating mechanisms for each valve. Actuators shall meet the following requirements:

a. Each valve shall be actuated independently of the others.

b. Each actuator shall be capable of fully opening and closing the valve at any possible head condition of the reservoir.

c. Actuators shall be powered by an electric motor. A manual backup shall be provided that may be engaged via a clutch. Force required to actuate the valve manually shall not exceed 20 pounds-force (lbf).

d. Actuators shall be mounted on new pedestals located on the deck (EL. 973.10) above the valves.

e. Each actuator unit shall be push-button operated, for CLOSE, OPEN, and STOP operations.

f. Absolute limit switches shall be installed to prevent over travel of valves and to protect equipment from damage.

g. Each actuator shall have provisions (disconnect switch) to individually isolate it from electrical energy.

h. All actuation system components shall be capable of forgoing maintenance for five years with no adverse affects on operation. This does not mean that regular, routine maintenance should not be scheduled and accomplished as recommended by the equipment manufacturer.

i. Actuator design shall exhibit a design life expectancy of 50 years.

j. Actuators shall be designed with corrosion-resistant features.

k. All grease fittings for each actuator shall be plumbed to a single manifold.

l. Actuators shall be provided with a cover that prevents damage from dirt, debris, and the environment.

m. Actuators shall be provided with provisions for rigging or lifting with a crane or hoist.

1.2.3.10 Design/Manufacture for Flow Regulating (HOLLOW-JET VALVES)

Use U.S. Army Corps of Engineers Engineering Manual EM 1110-2-1602 as a guide in developing technical specifications for the design or purchase of valves. Develop a hydraulic analysis of flow conditions through the range of valve operation and head conditions. Develop and provide a table of flow rates, with one axis showing valve percent open and the other showing the range of reservoir pool elevations, with the tabular values expressed in cubic feet per second and cubic meters per second.

Installation

a. Shop-fit and assemble components and assemblies to the fullest extent possible prior to transportation to the site, to ensure proper fit. Match mark individual components for ease of field assembly. Perform a factory test on at least one of the three Flow Regulating Valves, to be witnessed by the Government. Testing shall include a full cycle of open and close operations using a power HPU, and an open-to-close cycle using the manual hydraulic unit.

b. After ensuring that components are acceptable, disassemble to a degree required for shipping.

c. Remove three existing (old) valves, valve actuators, and ancillary equipment. Old equipment becomes property of the Contractor. Transport old equipment off-site.

d. Install three new valves, valve actuators, and ancillary equipment.

e. Perform operational testing of valves in a no-flow condition. Make adjustments or rectify defects as necessary to meet manufacturer's specifications. Testing shall be performed in accordance with SECTION 016400 START UP TESTING AND COMMISSIONING.

f. Perform operational testing of valves under flow, from fully closed to fully open position. Make adjustments or rectify defects as necessary to meet manufacturer's specifications. Testing shall be performed in accordance with SECTION 016400 START UP TESTING AND COMMISSIONING.

1.2.3.11 Sump Pumps

Locate and replace the two valve house sump pumps that serve the powerhouse waste system. Contractor shall also locate and replace the sump to the Roto Valve pit. New pumps shall be similar in design, capacity, and horsepower as the existing. A photo of the sump pumps is listed in the 'Sump Pumps' folder of Appendix A. See drawings 17-F-1-R1, and 13-F-46 for some information.

1.2.3.12 Flap Gate

Locate and replace the flap gate for small diameter discharge line that exits near the jet valves. That pipe allows water to backup into tunnel when tail water is high. Drawings (15-F-61, and 13-F-46 Section C-C) indicate there is small diameter (about 4 inches) flap valve at elevation 961.5 meters. The pipe exits below the pier in one of the jet valve chambers.

1.2.3.13 Local Water Supply – Evaluate and Report

The water supply for the adjoining camp and village across the river is obtained at the discharge of one of the jet valves. A 6-inch pipe from the camp has been mounted to the outer frame of a jet valve so that as high velocity water is discharged from the jet valve it enters the open end of the pipe, ramming water into the pipe. During valve replacement this pipe will be removed and the local population will lose their source of piped water. Replacement of this source of water is part of this project, however, there is some concern that the current methodology may be unsafe to maintain, and may affect jet valve operation or warranty. The current system is also dependent on having the particular jet valve open. As a result the water supply is not consistently reliable.
The contractor shall investigate and report on the existing conditions concerning the water system and recommend options that are consistent with the ability of an impoverished village to operate and maintain its source of water. The report should present several options, with different levels of costs and benefits. One of the options shall be an in-kind replacement of the method currently being used (assuming the method does not affect operation or warranty of the new jet valve). Another option to be considered shall be a tap into the existing 12-inch line that feeds the service turbine (See optional bid items). The report shall include information as to the extent of the water system and how the water is being used. Due to the potentially sensitive nature of the subject to the local population as well as the potential for an open-ended investigation, the contractor shall coordinate his efforts with the COR and exercise care not to create unrealistic expectations among the local population.

Appendix A includes two pictures of the existing conditions.

1.2.3.14 Modify Local Water Supply (Optional)

Provide a replacement for the water supply to the downstream camp and village. The new system shall be similar in capacity as the existing, and shall be plumbed independent of the irrigation outlet works. Contractor shall provide and install one, 6-inch tap into the existing line that feeds the service turbine, a 6-inch valve, and 450 lineal feet of 6-inch diameter Schedule 80 steel pipe that extends to the end of the tunnel works. A pressurized connection to the existing water supply line shall be made to restore the flow of water once the valve is opened.

1.2.3.15 Refurbish HVAC

Refurbish the existing ventilation systems in the tunnel and valve house. Replace the in-kind the electric motors (See Drawing 19-F-59, and 19-F-60). Submit a report on the condition of the existing and refurbished equipment and controls.

1.2.4 Electrical Work

1.2.4.1 General

Prepare construction plans & specifications, as well as perform construction, testing and commissioning for the valve house sump pumps, flow regulating valves, emergency closure valves and associated power distribution system. Design and installation shall conform to requirements of NFPA 70 and IEEE C2.

The designs will be complicated by a lack of available information, pending Load Study and design-build work by others on the Irrigation Intake Structure Therefore, the Contractor is directed to assume an in-kind replacement of existing components if not items are not otherwise specified herein

1.2.4.2 Electrical Site Inspection – Tunnel Works

Original As-constructed drawings required to facilitate design under this contract are not available. The available drawings are considered "Informational" since they are not certified "As-Constructed". Therefore, the Contractor shall conduct site inspections to gather the required information for preparation of as-constructed drawings required to complete design. All inspections shall be performed by a qualified electrical engineer. Submit a report on the condition of existing equipment, including recommendations for correcting deficiencies. A list of drawings required to be as-constructed is provided below:

Single-Line Diagram (17-F-8)
Irrigation Tunnel – Valve Chamber and Tunnel - Power and Lighting (17-F-2)
Valve House - Power and Lighting Plans (17-F-3)
Valve House - Power and Lighting – Sections and Details (17-F-4)

Drawings can be found in Appendix A.

1.2.4.3 Design

Design shall utilize guide specifications and industry standards referenced within this Section. Controls shall not use any solid-state devices unless similar electro-mechanical type devices are not available or will not provide the required function. Electrical materials shall be dust-tight, corrosion-resistant and have an operating temperature suitable for the harsh conditions found at this site. Existing electrical distribution system characteristics can be found on the Informational Drawings. See Appendix A for list of Informational Drawings.

1.2.4.4 Valve House Sump Pumps

a. Replace power conductors for valve house lift pump(s). Reference Dwgs 17-F-3, 17-F-4, and 17-F-8.
b. Replace control system and control conductors for valve house lift pumps. Controls shall conform to the requirements of NEMA ICS 1, ICS 2 and ICS 5.

1.2.4.5 Flow Regulating Valves (HOLLOW JET)

a. Provide new power conductors and conduits (as necessary) to the new flow regulating valve actuators.
b. Provide new control cabinet and all control components, conduits and conductors for each regulating valve actuator. Controls shall conform to the requirements of NEMA ICS 1, ICS 2 and ICS 5.

1.2.4.6 Emergency Closure Valves (ROTO VALVES)

a. Replace power conductors and conduits (as necessary) for each emergency closure valve hydraulic pump unit.
b. Replace control system and control conductors for each emergency closure valve hydraulic pump unit. Controls shall conform to the requirements of NEMA ICS 1, ICS 2 and ICS 5.

1.2.4.7 Products

Power and control conductors shall be stranded copper with cross-linked thermosetting polyethylene insulation and non-PVC jacket conforming to NEMA WC 70. Switchboard conductors shall be type SIS. Enclosures shall constructed of steel and conform to NEMA 250. Enclosures indoors shall be Type 12 and enclosures outdoors or in damp locations shall be Type 4X. Indicating (pilot) lights shall be push-to-test type. All exposed conduit shall be rigid galvanized steel conform to UL 6. All buried conduit shall be PVC-coated rigid galvanized steel conforming to NEMA RN 1**.**

1.2.4.8 Specifications

See Appendix B for a list of guide specifications to be tailored (by the contractor) to fit the required design.

1.2.4.9 Installation

Remove all unused electrical equipment & materials (control panels, conduit, wire, etc.) prior to installation of new equipment. Removed equipment and materials are the property of the Contractor and shall be removed from site. Installation of new equipment shall conform to applicable codes and standards, as well as manufacturer's recommendations.

1.2.4.10 Testing

Field and operating testing shall be conducted in accordance with SECTION 016400 START UP TESTING AND COMMISSIONING**.** As well, all new wire shall be given insulation resistance (Meggar) and continuity tests.

Operations and Maintenance

O&M Manual covering all equipment shall be prepared in accordance with SECTION 017810 OPERATIONS AND MAINTENANCE DATA.

1.2.4.11 Diesel Generator for Powerhouse (Optional)

Contractor shall inspect and replace in kind the existing Station Service diesel generator (SSG) located outside of the hydroelectric powerhouse. The contractor shall repair all power and control connections to the generator. The generator power rating is 121 kW based upon field photos of nameplate data. The cooling system shall be designed for both 50 degrees C ambient temperature, and the altitude at the location. Controls and instrumentation shall not use any solid-state devices unless similar electro-mechanical type devices are not available or will not provide the required function. Electrical control cabinets shall be dust-tight, corrosion-resistant and have an operating temperature suitable for the harsh conditions found at this site. See Informational Drawings GG-47-501(R5) and GG-47-531(R7) in Appendix A. Photos of the generator are also located in Appendix A. The emergency diesel generator shall be tested in accordance with Technical Specification 263214.00.

1.2.5 <u>Valve House Hydro-electric Generating Unit</u>

1.2.5.1 General

The contractor shall replace the Valve House generating unit consisting of turbine, generator, exciter, controls and protection with a new hydro-electric generating unit that meets the requirements listed below. This generating unit

is shown on pictures in Appendix A. The contractor shall furnish and install the new generating unit and commission it. The contractor shall replace the control equipment and the power and control cables to the generator and to the governor and exciter.

The contractor shall either provide a new governor or rehabilitate the existing governor.

The contractor shall also replace in kind the service supply line valve. The Contractor shall coordinate work on the supply valve with any evaluations for local water supply connections. Alternate valve configurations are permissible if it meets the requirements of feeding the service turbine and the local water supply.

1.2.5.2 Site Inspection

Original As-constructed drawings required to facilitate design under this contract are not available. The available drawings are considered "Informational" since they are not certified "As-Constructed". Therefore, the Contractor shall conduct site inspections to gather the required information for preparation of as-constructed drawings required to complete design. All inspection shall be performed by a qualified electrical engineer. Submit a report on the condition of existing equipment, including recommendations for correcting deficiencies. A list of drawings required to be as-constructed is provided below:

Valve House Power and Lighting Plans (17-F-3)
Valve House Switchboard Elementary Wiring (17-F-5R2)
Valve House Switchboard 3 & 4 Wire 400 Volt 50 Cycle (D-18555F-1)
Wiring Diagram Panels 1 & 2 Valve House Switchboard (D-18555F-2)

The as-constructed drawings shall include all electrical characteristics of the electrical equipment.

1.2.5.3 Design

Design shall utilize guide specifications and industry standards referenced within this section. Controls shall be electro-mechanical and shall not use any solid-state type devices. Electrical equipment shall be dust-tight and corrosion –resistant suitable for the harsh environment found at this site. Existing generator and control design and characteristics can be found on the Informational Drawings. See Appendix A for a list of the Informational Drawings.

1.2.5.4 General Design Requirements

All new equipment shall be air cooled.

Equipment and performance conditions shall conform to the requirements of IEC 60193, IEC 60041, and IEC 60609.

The available hydraulic head at the site shall be determined as part of the design.

The turbine and generator shall be able to withstand operation at full runaway speed for an unlimited amount of time with no damage to the equipment.

The maximum efficiency of the turbine generator unit, at the design hydraulic head, shall not be less than 80%. Input energy will be calculated as the difference between the total energy in the water at the turbine intake minus the total energy in the water one runner diameter downstream of the runner discharge. Output energy shall be calculated at the generator terminals, under the conditions of equalized phase load and unity power factor.

All equipment shall have a two year warranty. In the event that a component or piece of equipment requires service or repair under the terms of the warranty, the warranty for that piece of equipment shall be restarted for an additional two years at the completion of the repair.

a. The generating unit including all auxiliary equipment shall be supplied by a manufacturer that has manufactured similar equipment for a minimum of 5 years. The manufacturer must have manufactured a minimum of 5 generating units that are 50kW or larger each year for the past 5 years.

b. All Equipment shall be tested per manufacturer's recommended testing before shipment from the factory. Factory testing shall meet the requirements of SECTION 016400 STARTUP TESTING AND COMMISSIONING.

1.2.5.5 Generator

Generator shall produce 75 kW output at the generator terminals at 0.8 power factor.

Generator shall be a synchronous three phase, four wire, resistor grounded, 50Hz, 240/416V, at 0.8 power factor.

Generator insulation shall be class 155 insulation as defined in NEMA MG-1, and shall be insulated for 600 Volts AC or higher.

a. The generator shall conform to NEMA MG-1

Turbine

a. The contractor shall determine the operating ranges (head and flow) that the turbine will encounter in service.
b. The Turbine shall be designed such that at the worst case combination of load rejection, head and flow, the maximum stress in any turbine component shall not exceed 67% of the material yield strength.
c. The turbine shall operate smoothly, without water passageway pressure pulsation, torque fluctuation or load swing at all power outputs between 5% and 100% of maximum power;
d. The turbine runner, wicket gates, and stay vanes shall be made of stainless steel, either austenitic or martinsitic.
e. No 'greaseless' or self lubricating bushings or bearing pads shall be used.
f. All wicket gate mechanism bushings, wicket gate stem bushings and bearing pads shall be greased bronze.
g. Standard manual zerk grease fittings shall be fitted to the equipment at each grease point.
h. Cloth type packing shall be used at shaft sealing points—no 'O' rings or elastomer type seals shall be allowed where mating pieces have relative motion with respect to each other.
i. Main shaft bearings shall be either grease lubricated, sealed anti-friction roller bearings or they shall be babbited journal bearings immersed in an oil bath. Anti-friction rollers bearings shall be grease-able and shall have a pressure relief fitting. Oil baths shall not require external cooling.
j. The wicket gate actuator shall be hydraulically driven.
k. All consumables (such as filter elements) shall be readily available on the local market. As an example, in the case of filters—use an automotive engine filter, and make the filter fitting / connection adaptable to accommodate future filter design changes.
l. The turbine shall have a torque limiting mechanism that prevents overstressing of the wicket gate stems.
m. The turbine shall have a Wicket Gate operating ring. Individual wicket gate actuators shall not be allowed.
n. The turbine power shaft shall have a replaceable shaft sleeve at the turbine shaft packing area. The shaft sleeve shall have a wall thickness not less than 9 millimeters.
o. The Generator rotor / shaft assembly shall be supported by at least two shaft bearings. If a flexible coupling between the turbine and generator shaft is used, then the turbine shaft shall be supported by two bearings. If there is a rigid coupling between the turbine and generator shafts, then the turbine shaft need only have one bearing. If the turbine runner is mounted directly on the generator shaft, then a two bearing system is acceptable. Main shaft bearings shall have an infinite bearing life and loads shall be calculated based on coupled turbine and generator shafts.

Governor

a. If the contractor chooses to supply a new governor, the frequency tolerance shall be not more than +/- 1HZ over a range of 5% to 100% of the maximum turbine power output. The new governor shall include a Hydraulic Pumping Unit.
b. At his option the contractor may choose to rehabilitate the existing governor rather than supply a new governor. If the governor is rehabilitated, the work shall be performed by a firm that specializes in the rehabilitation and repair of mechanical governors. In this case, the specialty firm shall have rehabilitated a minimum of five (5) generating units that are 50kW or larger each year

for the past five (5) years. Qualifications shall be submitted to the Contracting Officer's Representative (COR) to substantiate that the specialty firm meets this requirement.

c. All components comprising the governor system, including but not limited to Hydraulic Pumping Unit, Servo-motor, ball head and ball head motor shall be restored to 'as new' fits and tolerances.

Exciter

The exciter shall be a brushless, rotating exciter that is sized to meet the requirements of the generator.

Control Equipment

All equipment and control wiring located in Panel no. 1 of the Valve House Switchboard shown in drawings 17-F-5R2, D-18555F-1, and D-18555F-2 shall be replaced in kind with equal equipment. Where the equipment cannot be replaced in kind with new equipment, it shall be replaced with new equipment that is functionally equal to the original equipment. The new equipment shall not use integrated circuits, digital controls, solid state components or computers.

Power and Control Cables

Remove and replace the power and control cables that run between Panel no. 1 of the Valve House Switchboard and the station service generator. Perform cable size and voltage drop calculations. Size the new cables to meet the current carrying capacity allowed by NFPA 70 when the generator is running at full load, per the requirements of Section 1.12.2.

1.2.5.6 Commissioning

After completing installation of all components, testing to confirm the unit operates and functions per design specifications, and per contract requirements, shall be conducted. The contractor shall create a test program that identifies the tests to be performed and the detailed procedures for conducting the tests. The test program shall be submitted to the Contracting Officer for approval. In addition to the testing identified here, the testing and commissioning program shall comply with the requirements of SECTION 016400 START UP TESTING AND COMMISSIONING. In the event of conflicting requirements, the requirements stated in this section shall apply.

At a minimum, the test program shall include, and conform to, the following requirements as stated in IEEE Standard 1248-1998.

Turbine/Generator/Governor System
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Vibration Check (9.1.81)
Calibration (9.1.11)
Lubrication Check (9.1.54)
Function Check (9.1.37)
Leak Testing (9.1.49)
Shaft Runout (9.1.69)
Bearing Heat Run (9.1.6)
Overspeed (9.1.61)
Load Rejection, including a load rejection at 100% power output (9.1.51)
Initial Rotation (9.1.45)
Initial Operation (9.1.44)

Turbine
Runner
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Calibration (9.1.11)

Wicket Gates

Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Vibration Check (9.1.81)
Calibration (9.1.11)
Lubrication Check (9.1.54)
Function Check (9.1.37)
Leak Testing (9.1.49)

Shaft
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Vibration Check (9.1.81)
Shaft Runout (9.1.69)
Guide Bearing
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Vibration Check (9.1.81)
Calibration (9.1.11)
Lubrication Check (9.1.54)
Shaft Runout (9.1.69)
Bearing Heat Run (9.1.6)
Bearing Insulation (9.1.7)
Flushing (9.1.35)
Leak Testing (9.1.49)

Head Cover and bottom ring
Leak Testing (9.1.49)
Pressure Test (9.1.66)

Shaft Seal
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Flushing (9.1.35)
Leak Testing (9.1.49)
Lubrication Check (9.1.54)

Servomotors
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Lubrication Check (9.1.54)
Function Check (9.1.37)
Pressure Test (9.1.66)
Flushing (9.1.35)

Spiral Case
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Pressure Test (9.1.66)
Flushing (9.1.35)
Bolted Joint Torque (9.1.8)

Turbine Generator Shaft Coupling
Visual Inspection (9.1.82)
Clearance Measurement (9.1.14)
Bolted Joint Torque (9.1.8)
Initial Rotation (9.1.45)

---Generator---

Stator Testing
- DC winding resistance test (9.1.21)
- Insulation resistance (9.1.48)
- High potential (9.1.42)
- Insulation Power Factor (9.1.47)

Rotor Field Windings
- DC Winding resistance (9.1.21)
- Insulation resistance (9.1.48)
- High potential (9.1.42)
- Turn insulation (9.1.80)

Exciter
- Insulation resistance test (9.1.48)

Potential Transformers
- Insulation resistance (9.1.48)
- Phase relation (9.1.62)
- Ground connection (9.1.39)
- Ratios (9.1.67)
- Polarity (ac) (9.1.64)
- Instrument transformer burden (9.1.46)
- Accuracy test (9.1.2)

Current Transformers
- Phase Relation (9.1.62)
- Ratios (9.1.67)
- Polarity (ac) (9.1.64)
- Instrument transformers burden (9.1.46)
- CT saturation (9.1.19)
- Accuracy test (9.1.2)

Power Cables
- Insulation Resistance (9.1.48)
- High potential (9.1.42)
- Phase relation (9.1.62)
- DC winding resistance (9.1.21)

Meters
- Polarity (dc) (9.1.65)
- Calibration (9.1.11)
- Continuity checks (9.1.16)

Switches
- Functional checks (9.1.37)

Relays
- Polarity (dc) (9.1.65)
- Calibration (9.1.11)
- Continuity checks (9.1.16)
- Functional checks (9.1.37)

1.2.5.7 Alignment

The Turbine-Generator shafts shall be aligned per the equipment manufacturer's tolerances and instructions.

1.2.5.8 Training

The contractor shall provide training to indigenous staff, providing information on how to operate and maintain the equipment supplied for the Valve House Hydroelectric Power System. Training shall conform to SECTION 016640 TRAINING.

1.2.5.9 Operation and Maintenance Manual

An operation and maintenance (O&M) manual for the equipment shall be provided. The O&M Manual shall comply with the requirements of SECTION 017810 OPERATION AND MAINTENANCE DATA and at a minimum shall contain:

Detail drawings of each component of the equipment

Specific instructions for the operation of the equipment, including but not limited to:

- Start-up sequences
- Steady State Operation
- Normal operating ranges for temperatures and pressures of bearings, oil and water.
- Shut down sequences
- Trouble shooting and repair instructions.
- Procedures for replacing wear parts
- Adjustment procedures for movable parts, including wicket gate closure and fit.
- Packing box and seal maintenance, adjustment and repair
- Gate Closure Timing settings
- Maintenance Intervals and schedule for each maintenance activity.
- Recommended types of oil and grease for each lubrication point.

1.2.6 Power House Diesel Generator (Optional)

Contractor shall inspect and replace in kind the existing Station Service diesel generator (SSG) located outside of the hydroelectric powerhouse. The contractor shall repair all power and control connections to the generator. The generator power rating is 121 kW based upon field photos of nameplate data. The cooling system shall be designed for both 50 degrees C ambient temperature, and the altitude at the location. Controls and instrumentation shall not use any solid-state devices unless similar electro-mechanical type devices are not available or will not provide the required function. Electrical control cabinets shall be dust-tight, corrosion-resistant and have an operating temperature suitable for the harsh conditions found at this site. See Informational Drawings GG-47-501(R5) and GG-47-531(R7) in Appendix A. Photos of the generator are also located in Appendix A. The emergency diesel generator shall be tested in accordance with Technical Specification 263214.00 IRRIGATION INTAKE STRUCTURE DIESEL GENERATOR (OPTIONAL). Contractor shall provide an operations and maintenance manual.

1.2.7 Structural/Geotechnical Work

1.2.7.1 General

Perform all evaluations and reports as specified below. Perform construction and prepare plans & specifications perform construction, testing and commissioning for the chamber repair, and apron repair.

1.2.7.2 Unlined Tunnel – Evaluate and Report

Contractor shall inspect and evaluate the unlined tunnel. This assumes that the bulkhead gate on the intake structure is operational and has been closed which is necessary for all of the valve and conduit work. The valuation will take place coincident with the valve replacement.

A qualified geotechnical engineer shall oversee dewatering operations and evaluate and report on the condition of the unlined irrigation tunnel. The concrete portal extends 30m into the tunnel and also should be evaluated by a qualified structural engineer. The original tunnel designs accounted for significant hydraulic and earthquake loading when the pool was at El. 1045 meters. The geotechnical evaluation shall follow the format outlined in the USACE EM 1110-1-1804. A review of the available foundation treatment drawings is required and a visual assessment on the condition of the grouting made. Peripheral geologic mapping is required since it was not done or the documentation has been lost. A video graphic log of the periphery is also required.

A qualified structural engineer shall evaluate the portal structure behind the bulkhead. A photographed and well documented assessment of the concrete is required.

1.2.7.3 Chamber Repair - Downstream of Jet Valve (OPTIONAL)

Repair any erosion or damage from cavitations to the Chamber to an as-new condition. Scope of repairs shall be that portion of the chamber exposed to flow outside the jet valve and confined by the concrete bulkheads. Placement of bulkheads may be required due to tailwater conditions. Contractor shall assume the tailwater conditions as illustrated in the Government review documentation of Appendix D. Bulkheads required to dewater the chamber are included under mandatory items and should not be included in this option. Work shall include placing concrete bulkheads and dewatering the chamber. The exact nature of the repairs cannot be determined until the evaluation and report has been completed. Contractor shall assume a sawcut and patch of 4-inch depth across 30 square feet of area.

1.2.7.4 Apron Repair - Downstream of Jet Valve (OPTIONAL)

Repair any erosion or cavitations damage to the Apron to an as-new condition. Scope of repairs shall include that portion of the chamber exposed to flow outside chamber beyond the bulkheads. Work shall include placing a temporary cofferdam and dewatering the Apron. Contractor shall assume dewatering is required to a depth of 2m. The actual tail water elevation will depend on dam operations and work must be coordinated with the powerhouse manager and the COR. The exact nature of the repairs cannot be determined until the evaluation and report has been completed. Contractor shall assume a saw cut and patch of 4-inch depth across 300 square feet of area.

1.2.7.5 Bulkhead for Chamber

Contractor shall design, fabricate and place a single bulkhead for the downstream Chamber to facilitate the inspections in the conduits and construction work on the chamber. The Contractor shall fabricate a single bulk head for placement in the slots for any three of the chambers.

1.2.8 Spare Parts

Provide a spare parts list with associated annotated photographs for all parts actually delivered written in English and Pashto for all sub items listed below.

1.2.8.1 Roto Valves

a. Furnish a new set of nuts, bolts, gaskets (if any) to be shipped with valves as the original might get damaged during assembly and disassembly process. This is to avoid costly delays that may result from damage and the extreme transportation distances required.
b. Furnish four (4) complete sets of valve seals.

c. Furnish one (1) complete set of special tools specific to valve components.

d. Furnish five (5) years worth of consumables for servicing, based on the manufacturer's recommended service intervals.

e. Furnish three (3) replacement sets of hoses and fittings for hydraulic units.

f. Furnish three (3) complete sets of standard replacement parts and wear items for the HPUs.

g. Furnish one (1) set of hoses and fittings long enough to reach from any one HPU to any other HPU.

h. Furnish one (1) complete set of special tools specific to HPU components.

1.2.8.2 Flow Regulating Discharge Valves

a. Furnish four (4) complete sets of valve seals.

b. Furnish one (1) complete set of special tools specific to valve components.

c. Furnish five (5) years worth of consumables for servicing, based on the manufacturer's recommended service intervals.

1.2.8.3 Flow Regulating Discharge Valve Actuators

a. Furnish one (1) complete spare Valve Actutator.

b. Furnish one (1) complete set of special tools specific to valve components.

c. Furnish five (5) years worth of consumables for servicing, based on the manufacturer's recommended service intervals.

1.2.8.4 Valve House Hydroelectric Generating Unit

a. Furnish one (1) complete set of brushes for the exciter and for the generator

b. Furnish three (3) spare fuses for each fuse used in the control circuit for the generators

c. Provide two complete sets of packing for each location that packing is used. For the wicket gate packing this means two spare sets for each wicket gate.

d. If the wicket gate torque limiting device uses a breakable or consumable device (for example a shear pin or breaking link), two complete sets of consumable devices shall be supplied as spares.

1.2.8.5 Electrical Controls

a. Furnish four (4) indicating light assemblies of each type used

b. Furnish four (4) indicating light lens of each color used

c. Furnish two (2) control relays of each type used

d. Furnish five (5) fuses of each type and rating used

e. Furnish two (2) control transformers of each type and rating used

f. Furnish two (2) control (selector) switches of each type used

g. Furnish two (2) pushbutton assemblies of each type used

h. Furnish a minimum of two (2) for any other replaceable control component used.

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1.3 PROJECT: IRRIGATION INTAKE STRUCTURE

1.3.1 Mechanical Work

1.3.1.1 General

Prepare construction plans & specifications, as well as perform inspections, construction, testing and commissioning for the sub items listed below.

1.3.1.2 Site Inspection

All inspections should be performed by a qualified mechanical engineer. Perform visual inspection of crane structure, welds, rails, and paint system. Submit a report on the condition of existing equipment and structures, including recommendations for correcting deficiencies.

1.3.1.3 Bridge Crane and Hoist

Rehabilitate the irrigation intake structure bridge crane. The new hoist and trolley are estimated to weigh approximately 10,000 lbs. The actual weight of the hoist and trolley shall be determined prior to installation. All weights shall be coordinated with the appropriate agency to ensure that it is within the capacity of the proposed hoisting method. The rehabilitated bridge crane shall meet the following requirements:

a. The crane shall be able to be operated by one individual.

b. The crane shall be up-rated from the current capacity of 75 tons up to 100 tons (200,000 pounds-force, lbf). The Contractor shall perform a full analysis of the bridge crane and determine the modifications required. Contractor may assume an alternate method of watering the tunnel thus reducing the maximum load on the gate that would otherwise be required (See Paragraph "Alternate Tunnel Watering System". The Contractor shall prepare new lifting diagrams. The intake tower structure, crane structure, and hoist components shall have a capacity adequate for all live and dead loads resulting from the rated load.

c. The crane shall be able to completely lower and raise each of the two closure bulkheads (i.e., both WHEEL GATE and STOP LOG) under static conditions.

d. The hoist block shall travel at least four feet per minute up or down at rated load. The hoist shall be electrically powered and push-button operated.

e. Replace all wire rope. The designers shall determine if stainless steel or galvanized wire rope is required for withstanding the environmental conditions, and provide design criteria accordingly.

f. The trolley traverse mechanism shall be able to traverse the trolley at rated load.

g. The trolley traverse may either be electrically powered and push-button operated, or manually operated with a maximum of 20 lbf manual input at rated load. If electrically powered, the trolley traverse shall operate at a minimum of five feet per minute.

h. The bridge traverse mechanism shall be able to traverse the bridge at least twenty feet per minute at rated load.

i. All hoist and bridge traverse components shall be rated for and capable of continuous operation. The bridge traverse shall be electrically powered and push-button operated.

j. Crane hoist, trolley, and bridge traverse mechanisms each shall be equipped with a brake capable of preventing movement that is not commanded.

k. All crane components shall be protected from damage due to corrosion, dust and debris, sun, weather, and lightning.

l. All crane components shall be capable of forgoing maintenance for five years with no adverse affects on operation.

m. The crane shall be outfitted with a pendant control to allow operation from the intake structure deck.

n. Motor starters shall be rated for plugging duty.

o. Motor functions shall be protected from over travel by limit switches or other means.

p. The bulkheads (i.e., both WHEEL GATE and STOP LOG) shall be protected from gate skew by slack cable switches or other means.

1.3.1.4 Jib Crane

Replace the jib crane located on the bridge crane. The jib crane is intended solely for crane service items, such as lubricants, hand tools, and small replacement pieces.

The jib crane shall meet the following requirements:

a. The jib crane shall be able to lift objects between the bridge crane deck and the intake structure deck.

b. The jib crane boom shall be high enough off the deck that normal service items will be fully suspended in the air over the crane deck at the upper limit of travel.

c. The jib crane shall be able to be operated by one individual.

d. The jib crane shall have a rated capacity of ¼ ton (500 lbf). If outfitted with a manual hoist, the operator shall be able to lift the rated load with a maximum of 20 lbf effort.

e. The jib crane hoist shall be outfitted with a brake capable of holding the rated load. The brake shall be operated from the operator station.

f. The jib crane shall be able to smoothly swing 360 degrees about the upright member at rated load. The crane shall have a provision to swing the boom from the operator station. All crane components shall be protected from damage due to corrosion, dust and debris, sun, weather, and lightning.

The jib crane may be upsized to assist with lifting components required for rehabilitation of the Bridge Crane.

1.3.1.5 Lifting Beams

Rehabilitate the two lifting beams for the intake bulkheads (i.e., both WHEEL GATE and STOP LOG). The lifting beams shall meet the following requirements for their respective bulkheads:

a. Each lifting beam shall be able to interface with the bulkhead.

b. Each lifting beam shall be able to fully lower the bulkhead, disengage, and be hoisted back to the intake structure deck with operation by a single person and without fouling or binding in the guide slots.

c. Each lifting beam shall be able to travel to the bottom of the guide slot, engage a bulkhead, and fully raise the bulkhead to the dogging position at the intake structure deck.

d. The lifting beam shall engage and disengage the bulkhead with the pull of a rope, at no more than 40 lbf.

e. The lifting beam shall have a mechanism or design that prevents the beam from being oriented in a manner which would prevent engagement or disengagement from the bulkhead.

f. The lifting beam shall have a mechanism that prevents inadvertent release of the bulkhead.

g. All lifting beam components shall be protected from damage due to corrosion, dust and debris, sun, and weather.

1.3.1.6 Bulkhead Dogs

Rehabilitate or replace the dogs for both bulkhead types (i.e., both WHEEL GATE and STOP LOG). Perform design analysis to ensure that the dogs have an adequate capacity as described below. New or existing dogs shall meet the following requirements:

a. Stops shall have a capacity of twice the weight of the held bulkhead.

b. Stops shall be operated/placed/installed with a maximum of 40 lbf manual input.

c. All dog/stop components shall be protected from damage due to corrosion, dust and debris, sun, and weather.

Rehabilitation of the dogs shall include:

d. Complete removal of the existing paint system.

e. 100% visual inspection of the dogs for structural deficiencies, and correction of any findings. Submit a report on the condition of existing equipment including recommendations for correcting deficiencies.

f. Repainting with an approved vinyl-based paint system. The system shall include primer, intermediate, and top coats and in thicknesses as specified by the paint manufacturer for the application.

If necessary, replacement of the dogs shall include:

g. Design, fabrication, and installation of new dogs. Dogs shall meet the performance requirements listed above.

1.3.1.7 Design/Manufacture

Use ASME B30.2-2005 and Unified Facilities Criteria UFC 3-320-07N for the development of technical specifications for the design, construction, and installation of all crane components. In the event of a conflict or an overlap in governance between the two standards, the most stringent requirements shall apply.

1.3.1.8 Installation and Site Work

a. Shop-fit and assemble components to the fullest extent possible prior to transportation to the site, to ensure proper fit. Match mark individual components for ease of field assembly. Disassemble as required for shipping.

b. Replace end truck wheel bearings on the bridge crane.

c. Replace all bridge crane drive components.

d. Replace entire jib crane.

e. Replace entire bridge crane trolley, hoist, and all hoisting equipment.

f. Replace all power/control wire and equipment. See paragraph 1.11.2. ELECTRICAL WORK.

g. Remove any existing rust, corrosion, or failed paint system. Repaint exposed surfaces.

h. Install grease distribution system.

i. Lubricate all components requiring lubrication.

j. Test bridge drive mechanism at no load. Correct any deficiencies. Test at rated load. Correct any deficiencies.

k. Test hoist and trolley mechanisms at no load. Correct any deficiencies. Test at rated load. Correct any deficiencies.

1.3.2 Electrical Work

1.3.2.1 General

Prepare construction plans & specifications, as well as perform construction, testing and commissioning for the irrigation intake crane, emergency diesel generator and associated power distribution system. Design and installation shall conform to requirements of NFPA 70 and IEEE C2.

1.3.2.2 Site Inspection

All inspections should be performed by a qualified electrical engineer. Original As-constructed drawings required to facilitate design under this contract are not available. The available drawings are considered "Informational" since they are not certified "As-Constructed". Therefore, the Contractor shall conduct site inspections to gather the required information for preparation of informational drawings required to complete design. Site inspections will also be necessary to determine condition of existing electrical systems where indicated below. All inspections shall be performed by a qualified electrical engineer. A list of drawings required to be as-constructed is provided below:

Single-Line Diagram (17-F-8)
Aerial Distribution Line – Plan and Details (17-F-6)
Intake Tower Access Bridge – Bent and Girder (15-F-65)
These drawings can be found in Appendix A**.**

1.3.2.3 Design

Design shall utilize guide specifications and industry standards referenced within this Section. Controls shall not use any solid-state devices unless similar electro-mechanical type devices are not available or will not provide the required function. Electrical materials shall be dust-tight, corrosion-resistant and have an operating temperature suitable for the harsh conditions found at this site. Existing electrical distribution system characteristics can be found on the Informational Drawings. See Appendix A for list of Informational Drawings.

1.3.2.4 Studies

a. Conduct load study and voltage drop study (and fault study if required) on the aerial distribution line (or optional buried line) to verify it has adequate capacity to service the existing connected loads plus the intake crane structure loads. Contractor shall notify the Contracting Officer of any unauthorized connections.

1.3.2.5 Irrigation Intake Structure

b. Replacement of electrical equipment for irrigation intake crane. Equipment includes, but not limited to: lighting fixtures/switches, crane control devices, motor starters, transformers, power distribution panels. Motor starters shall be reduced voltage, non-solid state type; wye-delta, primary impedance, partial-winding, or primary resistive Use Technical Specification 412213.13, BRIDGE CRANES for guidance. Controls shall conform to the requirements of NEMA ICS 1, ICS 2, ICS 5 and ICS 8. Lighting shall utilize HID fixtures capable of producing a minimum level of illumination at the structure's main platform in accordance with IES Lighting Handbook guidance.
c. Replacement of power/control conductors for the irrigation intake crane (existing conduits may be used if undamaged, adequately sized, and conform to applicable standards).
d. Replace crane rail electrification systems for damage. Perform continuity tests on runway conductors and current collectors. See informational drawings 9698D20 and 9798D8.
e. Restore power to the Intake Structure by replacement of conductors between irrigation intake structure and overhead line. Design of aerial distribution components shall conform to requirements of TM 5-811-1.

1.3.2.6 Products

Power and control conductors shall be stranded copper with cross-linked thermosetting polyethylene insulation and non-PVC jacket conforming to NEMA WC 70. Enclosures shall constructed of steel and conform to NEMA 250. Enclosures indoors shall be Type 12 and enclosures outdoors or in damp locations shall be Type 4X. Indicating (pilot) lights shall be push-to-test type. All exposed conduit shall be rigid galvanized steel conform to UL 6. All buried conduit shall be PVC-coated rigid galvanized steel conforming to NEMA RN 1**.**

Installation

Remove all unused electrical equipment & materials (control panels, conduit, wire, etc.) prior to installation of new equipment. Removed equipment and materials are the property of the Contractor and shall be removed from site. Installation of new equipment shall conform to applicable codes and standards, as well as manufacturer's recommendations.

1.3.2.7 Testing

Field and operating testing shall be conducted in accordance with SECTION 016400 START UP TESTING AND COMMISSIONING**.** The emergency diesel generator shall be tested in accordance with Technical Specification 263214.00. As well, all new and reused wire shall be given insulation resistance (Meggar) and continuity tests.

Operation & Maintenance

O&M Manual covering all equipment shall be prepared in accordance with SECTION 017810 OPERATIONS AND MAINTENANCE DATA. O&M data for the emergency diesel generator shall include instructions on manual exercising in accordance with manufacturer's recommendations

1.3.2.8 Diesel Generator for Intake structure

Provide a new emergency diesel generator to serve as standby power for the intake structure crane. Controls and instrumentation shall not use any solid-state devices unless similar electro-mechanical type devices are not available or will not provide the required function. Electrical control cabinets shall be dust-tight, corrosion-resistant and have an operating temperature suitable for the harsh conditions found at this site. Provide manufacturer's weatherproof enclosure mounted on a concrete pad or, at contractor's option, provide a generator building similar to that originally provided, with power receptacles and lighting. Power distribution configuration shall be similar to that originally designed. See Informational Drawings 17-F-7 and 17-F-8. Generator shall be sized to carry the full load of the irrigation intake structure. See Informational Drawing 17-F-8 for electrical characteristics of original emergency generator. Provide electrical plans and specifications for the power service to the intake tower.

The generator set shall meet the following requirements:

a. The generator set shall provide power to the intake structure.

b. The generator set shall be sized such that it is capable of providing power to all equipment and lighting on the intake structure simultaneously.

c. The generator set shall be provided with a fuel tank supply (i.e. a “belly tank”) adequate for 24 hours of continuous use under load. Fuel tanks shall have secondary containment integral to the generator.

d. The generator set shall be designed for outdoor and extreme-duty use. . The cooling system shall be designed for both 50 degrees C ambient temperature, and the altitude at the location.

There will be no load on the generator set when started. Provide an Operation and Maintenance manual for the diesel generator.

1.3.3 Structural Work

Provide all inspection reports, plans and inspections for all sub items below.

1.3.3.1 Access Bridge

The access bridge will require an inspection and structural analysis by a qualified engineer if used for moving heavy loads beyond the Site Specific Limitations in paragraph 1.6.

1.3.3.2 Structural Elements of Intake Structure

Contractor shall inspect the structural elements of the intake structure and prepare a reinforcement design if necessary to account for the rehabilitated Bridge Crane. A government review of the history of operations and the original design drawings indicates the proposed loads for the rehabilitated Bridge Crane will not exceed the original designs. Contractor’s engineer shall verify the loading by performing an independent review designs and operational history of the intake structure.

1.3.3.3 Inspection for Trash Racks (Optional)

Inspect the existing trash racks and associated guide slots. Submit a report on the condition of existing equipment and structures, including recommendations for correcting deficiencies.

1.3.3.4 Trash Rack Replacement (Optional)

Replace trash racks according to original design. Trash racks shall exhibit corrosion-resistance, through an approved paint system, or bitumen coating according to original design. Galvanization is not required.

1.3.3.5 Trash Rack Guide Repair (Optional)

The government assumes the guides will have experienced less corrosion than the exterior racks due to their partial encasement in concrete. Contractor shall verify the corrosion with the results of the inspection. The trash racks and associated guide slots shall be repaired according to original design.

1.3.3.6 Irrigation Tunnel Closure Wheeled Bulkhead

This paragraph covers the smaller of the two intake tunnel closure bulkheads. It is listed on drawings as the WHEEL GATE. Analyze the design of the existing wheeled bulkhead to ensure an adequate design and capacity. Rehabilitate the wheeled bulkhead. Rehabilitation shall include:

a. Complete removal of existing paint or coating system to bright metal.

b. 100% visual inspection of welds and structural steel. Repair of defects or cracks discovered.

c. Complete replacement of wheels, bearings, and shafts.

d. Complete replacement of seals.

e. Modification of lifting points or rigging as necessary to interface with new lifting equipment.

f. Repainting with an approved vinyl-based paint system. The system shall include primer, intermediate, and top coats and in thicknesses as specified by the paint manufacturer for the application.

g. Functional testing to ensure the bulkhead meets the performance requirements set forth below and as outlined in SECTION 016400 START UP TESTING and COMMISSIONING.

The wheeled bulkhead shall meet the following performance requirements:

a. The bulkhead shall be inspected for conformance with current design in accordance with EM 1110-2-2105 and EM 1110-2-2701 for the reservoir at maximum pool.

b. If the bulkhead does not meet current design standard, then the Contractor shall prepare designs and upgrade the bulkhead to bring it into conformance.

c. The bulkhead shall interface with existing dogs.

d. Bulkhead travel shall be smooth throughout the entire range of travel up and down, without hesitation or binding on guide slots.

e. The bulkhead shall fully seat against the irrigation tunnel intake and prevent leakage, permitting the tunnel to be dewatered. Acceptable leakage is fifteen gallons per minute.

f. Depending on Contractor design, install valve in the face of the bulkhead to provide an alternate method of watering the tunnel. See Paragraph on Mechanical Work.

1.3.3.7 Irrigation Tunnel Closure Concrete Bulkhead

This paragraph covers the larger of the two intake tunnel closure bulkheads. It is listed on the informational drawings as the STOP LOG.

The existing concrete bulkhead shall be rehabilitated by lifting the bulkhead up clear of the structural elements and replacing the seals. The contractor shall provide the necessary scaffolding, and other temporary features. The contractor shall provide protection as necessary to assure that the existing intake tower and inlet structure is not damaged during the repair. The contractor shall repair any damage at no cost to the government.

The refurbished bulkhead shall meet the following requirements:

a. The bulkhead seals shall be replaced according to the original design.

b. Bulkhead travel shall be smooth throughout the entire range of travel up and down, without hesitation or binding on guide slots.

c. The bulkhead shall fully seat against the irrigation tunnel intake portal and prevent leakage, permitting the tunnel to be dewatered. Acceptable leakage is fifteen gallons per minute.

d. Remove corrosion, inspect welds and metal components for cracking (e.g., lifting eyes). Repair by welding and paint the steel surface.

1.3.3.8 Alternate Tunnel Watering System

Contractor shall design and install an alternate tunnel watering system to ultimately reduce the load on the hoist while lifting the wheeled bulkhead. The Government presumes that a valve system may be installed on the Wheeled Bulkhead. The Contractor may develop alternate designs. The O&M manual currently states that the time required to water the tunnel under current operations (6-inch lift on wheel gate) takes 3-4 hours. The Contractor shall design a system that takes no longer than 8 hours to water the tunnel.

1.3.4 SPARE PARTS

1.3.4.1 Bridge Crane

a. Furnish two (2) replacement bearings and couplings of each size for the bridge drive, trolley drive, and hoist.
b. Furnish one (1) complete set of standard replacement parts and wear items for all motors, speed reducers, bearings, and couplings.
c. Furnish one (1) complete set of special tools specific to crane components.
d. Furnish five (5) years worth of consumables for servicing, based on the manufacturer's recommended service intervals.

1.3.4.2 Electrical Controls

a. Furnish four (4) indicating light assemblies of each type used
b. Furnish four (4) indicating light lens of each color used
c. Furnish two (2) control relays of each type used
d. Furnish five (5) fuses of each type and rating used
e. Furnish two (2) control transformers of each type and rating used
f. Furnish two (2) control (selector) switches of each type used
g. Furnish two (2) pushbutton assemblies of each type used
h. Furnish a minimum of two (2) for any other replaceable control component used.

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1.4 DAM SAFETY INSTRUMENTATION

1.4.1 Civil/Geotechnical Work

1.4.1.1 General

Instrumentation type, location, depth (as applies), installation, and completion (finish) shall be in accordance with the Instrumentation Plan and applicable USACE and ASTM standards for embankment dam instrumentation for design, monitoring, and operation. The Instrumentation Plan and Elevation View are included Appendix A and should be used as a guide to required type and locations. Contractor shall provide a design package including the results of all site inspections, plans and specifications, equipment installed, equipment provided with operational procedures.

1.4.1.2 Geotechnical Requirements

Any site-specific geotechnical data required to develop geotechnical related design and construction activities for this project shall be the Contractor's responsibility. The Contractor shall develop all pertinent geotechnical design and construction parameters by appropriate field and laboratory investigations and analyses using appropriate ASTM and USACE Standards. The Contractor shall submit a detailed geotechnical report containing field exploration and testing results, laboratory testing results (particle sizes and distribution, liquid and plastic limit test, and moisture and density test) and any other tests as needed to properly conduct necessary calculations to determine the engineering properties of the soil). Information in the report shall include, but not be limited to: existing geotechnical (e.g. surface and subsurface) conditions, location of subsurface exploration logs on site plan, exploration point, ground-water levels, and construction materials (e.g. concrete cement, asphalt, and aggregates). For standard penetration test (SPT), the Contractor shall use ASTM D1586. For rock coring, perform core logging following the methodology in Section 5-10, Core Logging, in EM 1110-1-1804, Geotechnical Investigations. All geotechnical laboratory and field work shall be based on standards set forth in the ASTM. . Soil investigations shall conform to AED Design Requirements: Geotechnical Investigations for USACE Projects, latest version, or most recent version.

The contractor shall conduct soils classification per ASTM D 2487-06. The contractor shall submit a geotechnical investigation plan prior to commencing any field investigation to the USACE-AED Engineering Branch through the COR for review and approval. Once the plan is reviewed and approved, the Contractor can start the field investigation. The Geotechnical report shall be submitted with all the design review submittals. No design review submittal shall be considered complete without an approved geotechnical report. Geotechnical investigation plans and report of investigations shall be submitted promptly in accordance with SECTION 013316 DESIGN BUILD AFETR AWARD.

1.4.1.3 Geotechnical Qualifications

A geotechnical engineer that is a member of a geotechnical firm responsible to the Contractor shall oversee all geotechnical engineering design parameters. The geotechnical engineer shall be qualified by: education in geotechnical engineering; professional registration; and a minimum of ten (10) years of experience in geotechnical engineering design. The geotechnical firm conducting the field investigation and laboratory work shall be certified by the Chief, Quality Assurance Branch USACE-AED. Certification document shall be submitted as part of the Geotechnical Report.

1.4.1.4 Site Inspection

Perform visual inspection of the embankment dam crest, abutment areas, Powerhouse grounds and walls, and Irrigation Intake Tower for proposed instrumentation installation locations. Location of instrument sites, access for installation, and site required work for access and disposal of cuttings from drilling shall be determined from the site inspection and coordination with the Government. All personnel and equipment needed to perform a thorough analysis shall be included in this inspection. Upon completion of the inspection, the contractor shall submit a formal Inspection Report (additional detail found in SECTION 013316 DESIGN BUILD AFETR AWARD). At a

minimum, the report shall provide additional detail, pictures, and findings of every location or component as found in the BID SCHEDULE, SECTION 010140 SUMMARY OF WORK and within this section.

1.4.1.5 Design/Manufacture

Instrumentation type shall be in accordance with applicable standards for materials, assembly, installation, and testing so that it will be complete and acceptable for use.

Designs and catalogue sheets for all equipment shall make reference to and be appended to the Site Inspection Report.

1.4.1.6 Installation and Site Work

Locks for all instruments shall be keyed alike where possible. Provide approved locks and keys. Use the following references for design.

a. Piezometers - reference for design include ASTM D5092, ER 1110-1-1807, and EM 1110-2-1908.

b. Survey monuments and pillars – reference for design includes EM 1110-2-1009, EM 1110-2-1908, EM 1110-2-4300, and associated references.

Piezometer and survey monuments on roadways and parking areas shall be designed to support the loads from vehicles and other equipment that the roadways and parking areas are rated for.

1.4.1.7 Piezometers

Install two piezometers in the left abutment as illustrated in the Base Instrumentation - Plan View, and Instrumentation - Elevation View drawings in Appendix A. Install the same number of open tube piezometers and corresponding sensing zone(s) as shown. Contractor shall install the piezometers according to ASTM D5092 and USACE guidance, as applicable, shall be used to design the piezometers, including locking cover or caps mounted flush to the ground surface over each piezometer. Take initial water level readings, then before and after tunnel dewatering operations at a sufficient interval to evaluate any changes.

1.4.1.8 Water Level Meters

Provide three (3) portable battery operated water level meter sensing units with light and sounding buzzer to indicate water with markings in meters and millimeters. Two sensing units shall have 100 meter length cables and one unit shall have a 50 meter cable. Sensing units shall be Stevens Water Monitoring Systems, In. Contact Meter or the Durham Geo Slope Indicator Water Level Indicator (230 mm reel – 100 m cable and 180 mm reel – 50 m cable), or equivalent.

1.4.1.9 Survey Monuments and Pillars

Install permanent survey monuments and survey pillars for the alignment lines shown as approved on Base Instrumentation - Plan View in Appendix A. All monument points and pillars shall include covers or caps mounted flush to the ground surface to provide secure installations, complete and ready for use. Monuments should be located at the edge of travelled areas to avoid vehicles and should be designed for protection from vehicle loads. Work to be designed and installed in accordance with EM 1110-2-1009, EM 1110-2-1908, EM 1110-2-4300, and associated references. Typical installation designs drawings are included in Appendix A. Initial survey reference elevations and survey monument data will be provided by the Government (See Topographic Survey Report – 2005 in the attached Appendix). Pillar types and monument point installations are shown in the drawings to provide a design basis.

1.4.1.10 Survey Instrumentation

The Contractor shall provide the necessary survey instrumentation and training to project staff. The intent is to allow project staff to detect movement and once detected the standard operating procedure would be to obtain the services of a qualified land surveyor capable of a deformational survey. Reference EM1110-2-1009 Structural Deformation Surveying – Embankment Structures Earth-Rockfill Dams and Levees. The deflection tolerances for measurement are ±25mm for slope/crest stability and alignment, and ±10mm for settlement.

Contractor shall provide a low technology system for measuring movement of the monuments. Survey system examples include an optical transit, or line laser used in tandem with simple staff gauges. The proposed low tech system and monument design should not preclude the use of future systems that include higher precision.

1.4.1.11 Staff Gages

Install staff gages for visual reference of pool elevation and tailrace elevation. Porcelain enameled staff gages similar to Stevens Water Monitoring Systems Style M metric measurement staff gages shall be installed with figure plates to denote pool elevation from elevation 1007 m to 1050 m and for tailrace elevation from elevation 962 m to 974 m. Staff gages panel or board and mounting to be Contractor designed. Equipment to be supplied shall include an optical spotting scope or binocular of sufficient magnification to read the pool elevation staff gage from a distance of 200m, or the distance from the Power Intake to the Irrigation Intake Structure where the pool staff gage will be mounted on the northwest leg of the intake structure. The tailrace staff gage shall be mounted on the upstream wall of the Powerhouse facility near the elevation reference point.

1.4.1.12 Project Identifications

Design and install signs identifying major features of the site according to Section 01 58 00 PROJECT IDENTIFICATION. The project identification shall include the following;

a. Construction Project Signage; one for project identification and one for on-the-job safety performance of the contractor.
b. Rendered Drawing of the overall facility.

Signage for all major features will be provided along all vehicle and pedestrian ways where construction site workers and project facility workers are required to travel.

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1.5 SPILLWAY INVESTIGATION (OPTIONAL)

1.5.1 Emergency Spillway Geophysical Surveys

c. The Contractor shall perform geophysical surveys to explore the limestone foundation for faults, voids, or other features. The geophysical surveys shall use the electrical resistivity method. As a minimum, the Contractor shall perform electrical resistivity surveys along the six lines (ER-1 through ER-6) shown in the contract drawings. The surveys shall be designed to provide information to an elevation of 1018 m or below. EM 1110-1-1802, Geophysical Exploration for Engineering and Environmental Investigations, shall be used as a reference in the Contractor's survey design. In the Spillways Report, provide a plan map showing the survey lines and locations of any anomalies or features identified, and provide sections showing the geophysical results with depth along each survey line.
d. The Contractor may propose an alternative geophysical method to provide the same or more foundation information. The Contractor shall perform the specified method unless the COR approves the alternative method.
e. Appendix D includes survey data for the emergency spillway from 2005. The centerline and toe of walls were surveyed.

1.5.2 Emergency Spillway Foundation Drill Holes

a. The Contractor shall drill six holes in the foundation. The holes, labeled DH-111 through DH-116, shall be drilled at the locations shown on the contract drawings. The COR may modify the locations of the drill holes based on the results of the geophysical surveys. The bottom elevation of each drill hole shall be 1018 m. The Contractor shall use rock core drilling in the limestone rock.
b. A borehole TV camera shall be used in each drill hole for the entire depth of the hole.
c. The Contractor shall perform core logging following the methodology in Section 5-10, Core Logging, in EM 1110-1-1804, Geotechnical Investigations, with any gouge material classified per ASTM D2487.
d. The groundwater elevation shall be noted for each drill hole. The Contractor shall perform pressure tests (see Section 5-21 of EM 1110-1-1804, Geotechnical Investigations) in each hole at a testing interval of 3m, with permeability expressed in terms of Lugeon Value.
e. Perform Point Load Testing on rock samples on minimum 3 m spacing with depth, per ASTM D5731.
f. All rock core samples shall be stored at the dam site in core boxes according to Section 5-29, Disposition of Rock Cores, a., Care and storage. Assume outside storage and provide core boxes that will not deteriorate rapidly in the outside environment.
g. All drill holes shall be backfilled with grout and abandoned per EM 1110-1-1804, Geotechnical Investigations, Chapter F-14, and Paragraph 14-2.

1.5.3 Service Spillway Foundation Drill Holes

a. The Contractor shall drill thirteen holes in the foundation. The holes, labeled DH-121 through DH-133, shall be drilled at the locations and to the depths shown on the contract drawings. The Contractor shall use rock core drilling.
b. A borehole TV camera shall be used in each drill hole for the entire depth of the hole.
c. The Contractor shall perform core logging following the methodology in Section 5-10, Core Logging, in EM 1110-1-1804, Geotechnical Investigations, with any gouge material classified per ASTM D2487.
d. The groundwater elevation shall be noted for each drill hole. The Contractor shall perform pressure tests (see Section 5-21 of EM 1110-1-1804, Geotechnical Investigations) in holes DH-121, -122, and -123 at a testing interval of 3 m, with permeability expressed in terms of Lugeon Value.
e. Perform Point Load Testing on rock samples on minimum 3 m spacing with depth, per ASTM D5731.
f. All rock core samples shall be stored at the dam site in core boxes according to Section 5-29, Disposition of Rock Cores, a., Care and storage. Assume outside storage and provide core boxes that will not deteriorate rapidly in the outside environment.
g. All drill holes shall be backfilled with grout and abandoned per EM 1110-1-1804, Geotechnical Investigations, Chapter F-14, and Paragraph 14-2.

1.5.4 Spillway Surface Inspection and Geologic Mapping

Both the service spillway and emergency spillway shall be inspected visually and the condition of the rock shall be assessed. A color photo log shall be developed to accompany the written description of the spillway documenting rock condition and location, jointing, shearing, bedding, and foundation treatment.

1.5.5 Professional Geologist

A professional geologist shall be responsible for overseeing the emergency spillway geophysical surveys, emergency spillway foundation drill holes, and spillway surface inspection and geologic mapping. A professional geologist shall direct the testing for the drill holes, perform the core logging, and conduct the geologic mapping. The professional geologist shall have a minimum of 10 years experience logging drill core and geologic mapping for large civil works projects.

1.5.6 Spillways Investigation Plan

Prior to mobilizing to the site, the Contractor shall submit a Spillways Investigation Plan for submittal describing, at a minimum, the details of the geophysical surveys operation, the equipment that will be used for the rock coring, the borehole TV camera technology that will be used, and the name(s) and experience of professional geologist(s) that will perform the work.

1.5.7 Spillways Report

The Contractor shall provide a Spillways Report documenting all the work performed in this section of the specification. The report shall include, at a minimum, the results of the geophysical surveys, drill hole logs showing all the data collected, findings from the borehole TV camera investigation, a color photographic record of the core samples, and the findings from the spillway surface investigation and geologic mapping. Video from the borehole TV camera investigation shall be provided to the Government.

1.6 OPERATIONS AND MAINTENANCE (O&M) -

See SECTION 017810 OPERATION AND MAINTENANCE DATA for shop, assembly, and operations and maintenance drawing and data requirements.

PART 2. PRODUCTS

Not used.

PART 3. EXECUTION

Not used.

-- END OF SECTION --