

LOW ACTIVITY WASTE PRETREATMENT SYSTEM

Project No. 31269 (T5L01)

Document No. 15-2-007

Safety Related Non-Safety Related

WEATHER ENCLOSURE CRANE SPECIFICATION

210LP-PA-BC-CRN-001

Prepared for

Washington River Protection Solutions, LLC

Revision: 1 Status: Approved for Bid

REVISION PAGE

Project Name: LAWPS	Discipline: Mechanical
Client: Washington River Protection Solutions	Project Number: 31269 (T5L01)
	Latest Revision: 1

REVISION SIGNATURES

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Status	Rev. No.	Date	Prepared By	Pages	Description of Changes
Preliminary	A	3/18/15	SKB	25	Preliminary Draft w/ comments incorporated
Preliminary	B	3/14/16	J. Dixon	96	Issued for IRD
Approved for Bid	0	8/25/16	J. Dixon	89	Approved for Bid
Approved for Bid	1	9/9/16	J. Dixon	89	Approved for Bid

Safety Related: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Quality Level: Full QA <input checked="" type="checkbox"/> Enhanced QA <input checked="" type="checkbox"/> Commercial QA <input type="checkbox"/>
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Acronyms and Abbreviations	
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
AIST	Association of Iron and Steel Technology
ANSI	American National Standards Institute
AR	Approval Request
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
AVS	Acquisition Verification Services
AWS	American Welding Society
BTH	Below The Hook
CAD	Computer Aided Design
CCTV	Closed Circuit TV
CD	Compact Disk
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
CGI	Commercial Grade Item
CMAA	Crane Manufacturer's Association of America
CMTR	Certified Materials Test Report
COC	Certificate of Conformance
CQA	Commercial Quality Assurance
Cs	Cesium
CWI	Certified Weld Inspector
DBE	Design Basis Event
DCN	Design Change Notice
DPD	Design Proposal Drawing
DOE	Department of Energy
DST	Double Shell Tanks
DVD	Digital Versatile Disk
DVR	Digital Video Recorder
ECMA	Electrification and Controls Manufacturers Association
ECN	Engineering Change Notice
EQA	Enhanced Quality Assurance
ESL	Evaluated Supplier List

Acronyms and Abbreviations	
FAT	Factory Acceptance Test
FQA	Full Quality Assurance
GFCI	Ground-Fault Circuit Interrupter
Hz	Hertz
HIC	High Integrity Container
HLW	High Level Waste
ICS	Industrial Control Systems
IEC	International Engineering Consortium
IHLW	Immobilized High Level Waste
ILAC	International Laboratory Accreditation Cooperation
ILAW	Immobilized Low Level Waste
ISO	International Organization for Standardization
LAW	Low Activity Waste
LAWPS	Low Activity Waste Pretreatment System
LED	Light-Emitting Diode
M&TE	Measuring and Test Equipment
MDS	Main Disconnect Switch
MSR	Master Submittal Register
MT	Magnetic Particle
MTBF	Mean Time between Failures
MTTF	Mean Time to Failure
NACLA	National Cooperation for Laboratory Accreditation
NCSL	National Conference of Standards Laboratories
ND	Nondestructive
NDT	Nondestructive Testing
NDE	Nondestructive Examination
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NOG	Nuclear Overhead and Gantry Cranes
NPH	Natural Phenomena Hazards
NQA	Nuclear Quality Assurance
OEM	Original Equipment Manufacturer

Acronyms and Abbreviations	
OSHA	Occupational Health and Safety Administration
PC	Performance Category
PCB	Polychlorinated Biphenyl
PDF	Printer Description File
PE	Professional Engineer
PLC	Programmable Logic Controller
QA	Quality Assurance
QAP	Quality Assurance Program
QL	Quality Level
RFI	Request For Information
ROM	Read-only Memory
RCSC	Research Council on Structural Connections
SAE	Society of Automotive Engineers
SAT	Site Acceptance Test
SCI	Suspect Counterfeit Item
SDC	Seismic Design Category
SDS	Safety Data Sheet
SOW	Statement of Work
SS	Safety Significant
SSE	Safe Shutdown Earthquake
SSC	Safety Significant Components
TEBC	Totally Enclosed Blower Cooled
TEFC	Totally Enclosed Fan Cooled
TENV	Totally Enclosed Non-Ventilated
TOC	Tank Operations Contractor
SNT	Society for Non-Destructive Testing
UL	Underwriters Laboratories
UDS	Utility Disconnect Switch
UPS	Uninterruptable Power Supply
VAC	Volts Alternating Current
WAC	Waste Acceptance Criteria
WRPS	Washington River Protection Solutions
WS	With Shipment
WTP	Waste Treatment Plant

Units

U.S. customary units

Definitions

BUYER – The company for whom the VENDOR is performing work or services.

AVS Quality Clauses – The AVS Quality Clauses are standard procurement quality clauses for the procurement of items and services. The clauses establish contractual obligations for quality program systems, identification, traceability, documents submittals, testing, reporting, qualification, special process controls, inspections, etc.

Body Bound Bolt – A bolt whose fit in the hole is closely machined or reamed to have a tolerance tight enough to where it will require force to insert the bolt such as a light interference fit. These bolts are used in shear to ensure that the joints are not able to shift under load and deflection.

DESIGN BASIS EVENT - A postulated accident that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to assure public health and safety.

DESIGN CHANGE – Within the context of this specification, a DESIGN CHANGE is technically equivalent to a SUBSTITUTION (see SUBSTITUTION). However, the term DESIGN CHANGE may be used to refer to more significant changes to the design compared to a simple substitution.

DEVIATION – any departure from the requirements contained in the purchase order and specification which VENDOR proposes to incorporate if approved by BUYER.

ENHANCED QUALITY ASSURANCE (EQA) - Level of controls for those items, services, or processes where, based on an evaluation of risk or nuclear safety, additional controls beyond the providers published or stated attributes of the item, service, or process are needed to verify critical attributes.

FULL QUALITY ASSURANCE (FQA) - Level of controls applied for items services, or processes that are commensurate with the controls invoked under ASME NQA-1 or other appropriate national consensus standard.

HANDLING - The movement or transportation of items following receipt from offsite/project locations. This includes movement within storage areas and movement/transportation from receipt or storage areas to field locations. Handling requirements include the need for special handling tools and equipment, restrictions on material composition of surfaces in contact with the item, protection against damage or deterioration, which could occur during movement and placement, protection against physical damage due to excessive shock or vibration, and protection against entry of dirt, water, or other contaminants.

HOLD POINT – A mandatory inspection activity beyond which work shall not proceed until (1) the inspection is performed by an independent inspector and/or BUYER and acceptance is authenticated, or (2) a written release is authorized by the organization who established the hold point.

Jacking Pad – A structural member attached to the end truck of a crane used to attach a jack to for lifting of the end truck.

LOAD BEARING – Items identified as loading bearing in the crane design will be those that could cause a dropped load upon failure in any event up to and including a Design Basis Event.

LOAD PATH – Includes all items on a crane whose failure could result in the uncontrolled drop of the crane or crane load.

MORE CONSERVATIVE – “More conservative” shall be interpreted as “more protective of the health, safety and well-being of Site workers and facilities, the public, and environment, as applicable.”

NONCONFORMANCE – a deficiency in component characteristic, as defined in BUYER approved drawings and documents.

Primary Weld – All welds that are load bearing are considered primary welds.

PRODUCT DATA – Printed information including, but not limited to, catalog cuts, color charts, illustrations, diagrams, templates, performance curves, brochures, and other forms of product literature.

QUALITY ASSURANCE RECORDS – Quality assurance plans, procedures, and records, including completed documents that furnish evidence of the quality of an item or activities affecting quality.

RATED LOAD – The maximum load that can be lifted by the device.

SHALL / MUST – Denotes project requirements, compliance is required

SHOULD – Denotes recommendation or expectation, compliance is expected.

SHIPPING – The movement of items from an off-site/project location (Manufacturer, warehouse, etc.) to an on-site/project location, or movement from an onsite/project location to an off-site/project location. Shipping requirements include packaging and securing of items to protect against damage or deterioration which could occur during movement and transportation, protection against physical damage due to excessive shock or vibration, protection against entry of dirt, water, or other contaminants, and protection against other environmental conditions such as temperature or humidity.

SPECIFICATION – Refers to any design, fabrication or supply specification.

STORAGE – Holding of items in areas that address: the probable maximum period to be held, the inherent physical limitations of the item itself, and required protection from potential hazards such as fire, corrosion, chemical attack and environmental conditions. Storage also includes the requirements for maintaining the integrity and operability of items through routine maintenance, cleaning, or other means of preservation.

SUBSTITUTION – Any change or deviation from issued approved drawings, designs, methods, or contract terms and conditions. Changes in products, materials, equipment, methods of construction, and test criteria required by the Contract Documents proposed by the VENDOR after award of the Contract are considered to be requests for substitution.

SPECIFICATION – Refers to any design, fabrication or supply specification.

VENDOR – The Company responsible for the supply of equipment or services.

WILL – Denotes a statement of fact

WITNESS POINT – An inspection activity beyond which work shall not proceed until an inspector and/or BUYER is notified and (1) the inspection is performed and released, or (2) the inspection is deferred and can be completed at a later time, or (3) a written waiver is issued by the organization who established the witness point.

1.0 SCOPE

1.1 Introduction

The Hanford Site located in Washington State contains the largest quantity of legacy tank waste in the Department of Energy (DOE) complex. Most of these nuclear wastes, resulting from the processing operations of defense nuclear materials, are stored in underground storage tanks, containing hazardous and radioactive liquids, sludge, and saltcake. These tanks are located on the Central Plateau of the Hanford Site in 200 East and 200 West Areas, and are connected by a cross-site transfer system.

The Waste Treatment and Immobilization Plant (WTP) Project was established for processing and immobilizing Hanford tank waste by vitrification (i.e., glass). The WTP process flow was designed to pretreat feed from the tank farms, separate it into high level waste (HLW) and low activity waste (LAW) fractions, and vitrify each fraction in a separate facility. The vitrified waste would be poured directly into stainless steel canisters for containment during production. The immobilized HLW (IHLW) would be interim stored onsite and eventually disposed at a HLW geologic repository, and the immobilized low activity waste (ILAW) would be disposed on the Hanford Site.

The primary mission of the Low Activity Waste Pretreatment System (LAWPS) provides for the early production of ILAW by treating tank supernatant waste and providing treated LAW feed to the WTP LAW Facility for immobilization. Tank waste from Hanford double-shell tanks (DST) is treated for removal of solids and separation of Cesium-137 (¹³⁷Cs) isotope from the filtered waste stream to levels that are compliant with WTP LAW Immobilization Facility Waste Acceptance Criteria (WAC). The solids and concentrated Cesium (Cs) liquid waste are returned to the Tank Farm DST system. LAWPS stores the treated LAW product before transferring to the WTP. The LAWPS collects and routes system generated liquid effluent to the DST System. LAWPS transfers spent resin to a High Integrity Container (HIC) for disposal.

The LAWPS Project also includes a pipeline for routing the secondary liquid waste and out-of-specification returns from WTP to the DST system.

1.2 Purpose

The intent of this specification is to procure the design, fabrication, examination, testing, packaging, shipping, installation, and start up testing services necessary to provide a bridge crane for use in maintenance activities in the main operating area of the LAWPS Weather Enclosure. The maintenance activities identified include both manned operation and remote operation of the crane due to elevated radiation levels of some of the components being handled.

The Weather Enclosure Crane is a top running double girder bridge crane. The crane has a custom underhung auxiliary hoist system underhung on the south girder of the bridge. The auxiliary hoist system has two hoists on one trolley that can rotate about the center of the trolley.

The operation of the crane will be both wired and wireless. This allows operators to command the crane using the provided CCTV system or locally using a mobile control station.

The crane data sheet, 210LP-PA-BC-CRN-001, contains the design inputs and functional requirements (capacity, span, speeds, etc.) specific to the Weather Enclosure Crane. The design of the crane shall accommodate the installation envelope as shown in the Design Proposal Drawings (DPD). The crane is classified as Safety Significant (SS). It shall be designed and built to Full Quality Assurance (FQA) requirements for all load path components and Enhanced Quality Assurance (EQA) for the remainder of the items.

The BUYER shall be advised immediately in writing of any conflicts as soon as they are identified. No substitutes or deviations to this specification will be allowed without written approval from BUYER.

2.0 APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form a part of the BUYER basis of design to the extent specified in the applicable sections of this document and establish the Code of Record. In the event of a conflict between documents referenced herein, and the requirements of this specification or data sheet, the requirements of this specification shall take precedence only when this specifications' requirements are more stringent or conservative.

2.1 Government Documents

10 CFR 830	Nuclear Safety Management
10 CFR 835	Occupational Radiation Protection
29 CFR 1910	Occupational Safety and Health Administration (OSHA)
29 CFR 1910.179	Overhead and gantry cranes (OSHA)
29 CFR 1910.23	Guarding Floor and Wall Openings and Holes (OSHA)
29 CFR 1910.27	Fixed Ladders (OSHA)
DOE-RL-92-36, Release 74 (2014)	Hanford Site Hoisting and Rigging Manual
DOE G 414.1-3 (2004)	Suspect/Counterfeit Items Guide
DOE Order 414.1D	Quality Assurance

2.2 Non-Government Documents

ASME NQA-1, 2008 and 2009A	Quality Assurance Program Requirements for Nuclear Facilities
ASME NOG-1, 2010	Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)
ASME NUM-1, 2009	Rules for Construction of Cranes, Monorails, and Hoist (With Bridge or Trolley or Hoist of the Underhung Type)
AWS D1.1/, 2010	Structural welding Code-Steel
AWS D14.1/D14.1M, 2005	Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment
NFPA 70, 2014	National Electrical Code [NEC]

NEMA MG-1, 2014	Motors and Generators
NEMA MG-2, 2014	Safety Standard for Construction and Guide for Selection, installation and Use of Electric Motors and Generators

2.3 Non-Code of Record Documents

47 CFR 15	(FCC part 15); Radio Frequency Devices
TFC-BSM-IRM_DC-C-07	Vendor Processes
TFC-ENG-STD-12, Rev D	Tank Farm Equipment Identification Numbering and Labeling Standard
AISC/RCSC	Specification for Structural Joints Using High-Strength Bolts
AIST Technical Report #6	Specification for Electric Overhead Traveling Cranes for Steel Mill Service
AGMA 2001	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
AGMA 2015-1	Accuracy classification System – Tangential Measurements for Cylindrical Gears
AGMA 6001	Design and Selection of Components for Enclosed Gear Drives
AGMA 6109	Standard for gearmotor, Shaft Mounted and screw Conveyor Drives
AGMA 6013	Standard for Industrial Enclosed Gear Drives
AGMA 908	Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth
ANSI ECMA 15	Specifications for Cable-less (Wireless) Control
ANSI Z359	Fall Protection Code
ASME BTH-1, 2014	Design of Below-the-Hook Lifting Devices
ASME B17.1	Keys and Keyseats
ASME B18.8.2	Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series)
ASME B30.10, 2014	Hooks (Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings)
ASME B30.11, 2004	Monorails and Underhung Cranes (Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings)
ASME B30.2, 2011	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)

ASME B30.20, 2013	Below-the-Hook Lifting Devices
ASME Y14.5	Dimensioning and Tolerancing (Engineering Drawing and Related Documentation Practices)
ASNT SNT-TC-1A, 2011	Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A388	Standard Practice for Ultrasonic Examination of Steel Forgings
ASTM A490	Standard Specification for High-Strength Steel Bolts
ASTM A504	Standard Specification for Wrought Carbon Steel Wheels
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A563, 2015	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A931, 2013	Standard Test Method for Tension testing of Wire Ropes and Strand
ASTM E709	Standard Guide for Magnetic Particle Testing
ASTM F436	Standard Specification for Hardened Steel Washers
ASTM F3125/F3125M	Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
AWS QC1-2007	Standard for AWS Certification of Welding Inspectors
CMAA 70, 2010	Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes
CMAA 74, 2010	Specifications for Top Running Bridge & Under Running Single Girder electric traveling Cranes utilizing under running Trolley Hoist
NEMA ICS 8	Crane and Hoist Controllers (Industrial Control and Systems)
Wire Rope Users Manual	Wire Rope Technical Board (WRTB), 4th Edition, 2005
Form A-6009-317	Master Submittal Register (MSR)
Form A-6005-315	Transmittal Letter
Form A-6003-417	Requests for Information (RFI)
Form A-6002-544	Critical characteristics for CGI
Form A-6006-661	WRPS Quality Assurance Requirements

3.0 TECHNICAL REQUIREMENTS

This section will describe the purpose, interface and design requirements of the Weather Enclosure Crane.

3.1 Item Definition

The Weather Enclosure Crane is a top running bridge crane with an underhung dual auxiliary hoist intended for maintenance activities in the LAWPS weather enclosure.

3.2 Characteristics

3.2.1 Functional Characteristics

The crane shall be designed to remotely maintain the process equipment within the LAWPS Weather Enclosure. The crane may also be used for installation of the pit equipment during the construction phase. Some of the known items that will be maintained and lifted by the crane are:

- Shield plates (heaviest item to be picked – 19.6ton)
- Process pumps (tallest item to be picked – 32ft)
- Eductors
- Jumpers
- Ion exchange columns

The bridge of the crane will travel in the North/South direction. The crane shall be capable of uprighting and translating the process pumps. Due to the height of the pumps, this will require both hoisting and trolley motion. It is preferred that this is performed using the hoist motion alone by releasing the trolley brakes during uprighting. Releasing the trolley brakes shall be performed at both the wireless control station and the main control station. The lateral force created by hoisting and pivoting shall then translate the bridge and trolley without the use of the bridge and trolley drive power.

3.2.2 Reliability

The crane will be designed to meet the CMAA 70 Class D heavy service design to ensure reliability of the system.

3.2.3 Inspectability

The crane runway will have a maintenance platform running the length of the building under the runway to allow access to the crane anywhere in the building. The crane shall be provided with a maintenance walkway along the north girder of the crane to ensure that the trolley can be accessed by maintenance personnel no matter the location of the trolley in the facility.

3.2.4 Maintainability

The crane shall be designed and built so that any items requiring maintenance or replacement are easily accessible by maintenance personnel. Since this is a radiological environment, any items that are known to require replacement shall be designed for simple change out requiring minimal tooling. The camera on the lower block shall be designed with a quick change mount that does not require tools and have a quick change electrical fitting.

3.2.5 Environment

The crane is operated indoors and details are described in the included crane data sheet.

3.2.6 Transportation and Storage

The crane will be transported and stored by the crane VENDOR. The transportation and storage of the crane are described in section 5.0 below and the scope of work documents provided with this request for proposal.

3.2.7 Safety

The crane is classified as SS. It shall be designed and built to FQA requirements for all main hoist load path components and the below listed components that support the operation of the main hoist load path items.

- The Main Hoist Final Overtravel High Limit Switch
- Drum Over Speed Detection Switch
- Wire Rope Hoist Mis-Reeve Limit Switch
- Secondary Main Hoist Brake (Drum Brake)
- Safety Control Circuit

All other items shall be classified as EQA including the auxiliary hoists, and are not required to meet the SS requirements that the main hoist is required to meet. The VENDOR is to provide a list of load path items for approval by the BUYER.

The following items are identified as the safety functions of the Weather Enclosure Crane:

- Prevent damaging interactions with SS SSCs during design basis NPH events.
- Maintain control of lifted loads during normal operations
- Maintain control of lifted loads during design basis seismic event (and after the DBE)

The crane is required to meet these requirements for a SDC-3 seismic event and meet Limit State A as well as the NOG-1 requirements for allowable stresses in a seismic event.

3.3 Design and Construction

All portions of the crane design shall be performed by, or under direct supervision of, a competent engineer experienced in the particular engineering discipline. The engineer shall be intimately familiar with the crane contract specification and the details of the proposed crane design. The engineer shall be an in-house employee of the crane VENDOR unless otherwise approved by the BUYER.

3.4 VENDOR Supplied Items

Equipment and services provided by the crane VENDOR shall include, but not be limited to, the following:

- 3.4.1 The VENDOR shall provide the engineering services, labor, materials, tools, drawings, and equipment necessary to design, fabricate, assemble, shop test, and deliver the crane, including all associated components specified herein, to an intermediate storage site, near the LAWPS facility on the Hanford site outside Richland Washington.
- 3.4.2 The VENDOR shall provide an installation consultant for the crane in the new facility. The duration is to be estimated by the VENDOR and explained in the response to this crane specification.
- 3.4.3 The VENDOR shall provide a test director and other technical personnel as needed to perform the Crane Start-up Procedure, Site Acceptance Testing, Maintenance Inspection, and Initial Load Testing in the facility.
- 3.4.4 The VENDOR shall provide, at no additional cost, such support as may be determined and required to address VENDOR-accountable design and fabrication issues that emerge during the installation and start up testing period.
- 3.4.5 The VENDOR shall provide training to the BUYERS operators in operation, inspection, troubleshooting and maintenance.

3.5 BUYER Supplied Items

- 3.5.1 BUYER will provide the building mounted crane runway girder, rails, and the building mounted maintenance walkway.
- 3.5.2 BUYER will provide the building mounted electrical supply interface. 480VAC, 3 phase, 60 Hz
- 3.5.3 BUYER will provide inspection personnel, certified test weights, and rigging gear to perform the crane start-up procedure, site acceptance testing, maintenance inspections, and load testing in the LAWPS facility.

3.6 General Design

- 3.6.1 Crane design shall meet the requirements of CMAA 70, CMAA 74, NFPA 70, 29 CFR 1910.179, ASME B30.2, ASME NOG-1 (seismic only), all applicable portions of ASME NQA-1a Part II-Subpart 2.15, and other standards and specifications as specified herein. When differences exist between the specifications, the specification takes precedence. If questions arise, the VENDOR shall discuss the issue(s) and come to a conclusion with the BUYER via the RFI process (form A-6003-417).
- 3.6.2 In addition, any reference to the term "should" in CMAA 70 or ASME B30.2, shall be a firm design requirement, rather than optional, under this contract.
- 3.6.3 The design of the crane components shall be for the CMAA 70 service class D as indicated in the crane data sheet.
- 3.6.4 Refer to the crane data sheet for crane operating environment, rated speeds, and other crane information.
- 3.6.5 Clearance shall be maintained between the crane and the building, as described in CMAA 70, with the following exceptions and clarification:
 - 3.6.5.1 All clearances identified will be met with worse case scenarios (worst roof deflection and worst wheel float as defined by CMAA 70)
 - 3.6.5.2 A minimum of 12 inches of clearance in the vertical direction and 4 inches in the horizontal.
- 3.6.6 The crane shall be designed to meet a 40 year life span for all components. Items that may need replacement during this time frame will be designed to be easily accessible and replaced utilizing quick disconnect fittings whenever possible.

3.7 Structural Design

3.7.1 Design Factors

In addition to load Cases 1 and 2 of CMAA 70, the crane shall be evaluated for the following Case 3 scenarios:

- Collision with end stops
 - Test loads.
- 3.7.1.1 The hoist ropes or chains shall meet the design factors of CMAA 70.
 - 3.7.1.2 Design factors for structural members shall meet CMAA 70 requirements except for in the conditions of seismic loading.
 - 3.7.1.3 Design and calculations for the auxiliary hoist shall follow CMAA 74 except for seismic evaluation.

- 3.7.1.4 Allowable stress levels due to seismic loading shall be in accordance with ASME NOG-1 and ASME NUM-1 for the auxiliary hoists.

3.7.2 Test Loads

The crane shall be capable of load testing at 125% of rated capacity for the main hoist and the auxiliary hoist at the same time.

3.7.3 Seismic Forces

- 3.7.3.1 The seismic analysis shall be performed using the methodology of ASME NOG-1 Section 4150 for a safe shutdown earthquake (SSE). Seismic response spectras are included in the procurement documents. If non-linear behavior is found in the structure, time histories shall be provided to the VENDOR for analysis including possible slack rope conditions.
- 3.7.3.2 The credible critical load to be considered in the seismic analysis shall be the maximum rated capacity of the crane. This includes loading of the auxiliary hoists and should consider the possibility of the auxiliary hoist trolley being co-located with the main trolley or separate.
- 3.7.3.3 All load bearing components shall be analyzed for the applicable seismic and non-seismic loads.
- 3.7.3.4 The bridge and trolley shall be equipped with passive seismic restraints. The seismic restraints shall prevent lateral dislodgement and, if necessary, vertical lift-off. They shall engage the flange of the structural rail support member. The information for the final design of the structural rail support member shall be provided by the BUYER for analysis.
- 3.7.3.5 The trolley and bridge seismic restraints shall be designed to allow sliding along their respective rails.
- 3.7.3.6 The crane shall be designed appropriately to prevent a dropped load and must remain in place during and after a seismic event with all three hoists loaded. The crane does not need to remain operational during or after the seismic event. The wheels and axles are not considered part of the load path if a drop stop is provided and an analysis shows that failed wheels/axles shall not cause the bridge, trolley, or load to drop. The drop stop would be required to meet the seismic forces as well as the shock load from the wheel or axle failure if considered a load path item.
- 3.7.3.7 The upper and lower hook positions to consider in seismic analysis shall correspond to the operating range shown in the design proposal drawings.

3.7.4 Structural Connections

3.7.4.1 Welding

- 3.7.4.1.1 Except as noted below, all welding and inspections, including procedure and performance qualifications, shall be in accordance with the requirements of AWS D1.1 or D14.1.

- 3.7.4.1.2 All welding procedures, inspection and test procedures, and procedure qualification records shall be submitted for approval prior to start of fabrication. All modifications must have tracked changes.
- 3.7.4.1.3 For all structural welds, the VENDOR shall maintain record of identifying the following:
 - Weld inspector who performed the inspection
 - Form of Non Destructive Examination (NDE) used with the record number for the inspection
 - Signatures of all inspectors and welders
 - Equipment model and calibration information
 - Weld map showing weld identification and weld location.
 - Weld procedure specification and weld procedure qualification record.
- 3.7.4.1.4 Field welding will only be performed with prior approval by the BUYER and limited to non-structural welds.
- 3.7.4.1.5 External welds shall not contain pitting or porosity. Weld spatter shall not be permitted.
- 3.7.4.1.6 Girder flange to web welds shall be made using a submerged arc welding process.
- 3.7.4.1.7 Welding inspection requirements are described in Section 3.18.5.14.

3.7.4.2 Bolted

- 3.7.4.2.1 Bolted structural connections and bolt installation shall comply with the AISC/RCSC Specification for Structural Joints Using High-Strength Bolts.
- 3.7.4.2.2 Structural bolted connections in the hook load path, including bridge girder to end tie/end truck connections shall be either Pre-tensioned or Slip Critical joints designed and installed in accordance with the requirements of the AISC/RCSC Specification for Structural Joints Using High-Strength Bolts for bolted connections and made with unaltered ASTM A325, ASTM A490 bolts, ASTM F436 washers (where required), and ASTM A563 nuts (galvanized or coated bolts and/or nuts shall not be used).
- 3.7.4.2.3 Field installed structural fasteners shall be provided in sufficient quantity to accommodate pre-installation tension testing in accordance with the requirements of Section 7 of the AISC/RCSC Specification for Structural Joints Using High-Strength Bolts. Testing equipment to be provided by the VENDOR.
- 3.7.4.2.4 Bolted structural connections that are made in the field shall be designed for ease of installation. The use of hydraulic torque wrenches should be considered.
- 3.7.4.2.5 Final assembly shall use either body bound bolts, or shall be reamed and pinned, to maintain squareness of the joint during the lifespan of the crane.
- 3.7.4.2.6 VENDOR shall provide suspect/counterfeit fastener certification for all the fasteners used on the project.

3.7.4.3 Pins

3.7.4.3.1 Pins are defined as non-rotating mechanical members in which the transverse shear stress is a major contributor to the combined stress. Structural pins shall be solid steel forgings. The loads on pins may be considered to be static for design purposes. The loss of strength due to any drilled holes or lubrication passages in pins shall be considered in the design of the pins.

3.7.4.3.2 Pins must have a method of containment if utilized for any structural joints.

3.7.5 Structural Members

3.7.5.1 Bridge Girders

3.7.5.1.1 Bridge girders shall be built-up box sections cambered to compensate for the dead and live load deflections. The ends of the bridge girders should be notched (stepped) to fit over the end truck and the girders shall be reinforced at the notches with vertical diaphragms and horizontal stiffeners.

3.7.5.2 Bridge Rails

3.7.5.2.1 Bridge rails shall be selected from the sizes listed in CMAA 70, Table 4.13.3-4.

3.7.5.2.2 The bridge rails shall be centered over the top flange and secured with rail clips or clamps.

3.7.5.2.3 Rail joints shall be staggered and located directly over girder diaphragms.

3.7.5.2.4 The rail clips or clamps shall be welded directly to the top flange. The clips or clamps shall not be spaced more than 36 inches apart. Hook bolts may not be used.

3.7.5.2.5 The rails should be free to shift longitudinally but the amount of movement shall be limited. Rails are to have creep bars welded in place at each end.

3.7.5.2.6 The minimum rail section shall not be less than 15 ft. in length.

3.7.5.3 End Tie/End Truck Connections

3.7.5.3.1 Travel truck drives shall be easily removable as a subcomponent from the end truck.

3.7.5.3.2 Removable jacking pads shall be provided to assist in the removal of a wheel assembly.

3.7.5.3.3 Alignment pins or body bound bolts shall be used to maintain square alignment between the bridge girders and the end ties/end trucks.

3.7.5.3.4 Wheel axle bearing seats shall be designed so that wheel/axle bearing assembly can be removed with no more than 3 inches of jacking.

3.7.5.4 Trolley Frame

3.7.5.4.1 The bolted joints shall be made with fitted (body-bound) bolts, or alignment pins, to ensure alignment.

3.8 Bumpers

- 3.8.1 Bridge and trolley bumpers shall be able to absorb and dissipate the kinetic energy of the crane(s) or crane component(s) traveling at 40 percent rated speed with the power off, per CMAA 70. Bridge crane bumpers shall also meet the additional requirements of CMAA 70 and ASME B30.2.
- 3.8.2 Runway end stops shall be provided by the building vendor, and shall meet the requirements of AIST TR No. 06. The crane designer shall interface with the building designer regarding proper mate-up of runway end stops and bridge bumpers.
- 3.8.3 End stops that engage the wheel shall not be used.
- 3.8.4 Hydraulic bumpers shall not be used.

3.9 Mechanical Design

3.9.1 General Requirements

- 3.9.1.1 The mechanical design of the crane shall conform to CMAA 70, ASME B30.2, and other requirements specified herein.
- 3.9.1.2 Each hoist shall be designed for true vertical lift.
- 3.9.1.3 The bridge drive arrangement shall be A4, Type 2, per CMAA 70, Part 4.10 and shall be configured to ensure that both drives travel at the same speed regardless of loading conditions.
- 3.9.1.4 The crane auxiliary hoists shall conform to CMAA 74, ASME B30.2, and ASME B30.11.

3.9.2 Design Factors

- 3.9.2.1 The minimum design factors for mechanical components shall meet CMAA 70 requirements for standard loading and ASME NOG-1 for seismic loadings.
- 3.9.2.2 The auxiliary hoists shall meet requirements of CMAA 74 for standard loading.

3.9.3 Alignment

- 3.9.3.1 Each coupled pair of shafts and shaft/drum couplings shall be corrected for soft foot and aligned to within the coupling Manufacturer's installation tolerances.

3.9.4 Fasteners and Connections

- 3.9.4.1 The holes or slots of commercial components shall not be enlarged to accept a larger fastener to obtain the design factor required for custom designed assemblies.

3.9.4.2 All SAE and ASTM fasteners shall be permanently marked by embossing or indentation. Galvanized fasteners shall not be used.

3.9.4.3 Washers

3.9.4.3.1 Threaded connections of built-up assemblies shall have a hardened steel flat washer under each turned element, either the head or nut.

3.9.4.3.2 Mounting connections with slotted holes in the feet or flanges of housings shall have a thick steel cover plate with a drilled hole to match the fastener diameter and overall dimensions to completely cover the slot.

3.9.4.4 Shims

3.9.4.4.1 Shims, when used, shall be corrosion resistant for all applications and environments. Shim stacks shall be limited to four shims.

3.9.4.5 Set Screws

3.9.4.5.1 Set screws should be avoided whenever possible. Set screws seating on threads shall have a soft non-metallic tip to preclude marring the threads.

3.9.5 Shafts and Axles

3.9.5.1 All shafts and axles shall be steel.

3.9.5.2 Trolley and bridge axles shall be of the rotating type.

3.9.5.3 No shafts, including the wire rope drum shaft or speed reducer output shaft, may be mounted in a three (or more) bearing configuration.

3.9.5.4 All gears and travel wheels shall be pressed on and turn with their shafts or axles.

3.9.5.5 Criteria for Custom Designs

3.9.5.5.1 Each custom designed shaft and axle shall have a comprehensive fatigue analysis per AGMA 6001.

3.9.5.5.2 Shafts and axles shall be designed for an infinite fatigue life.

3.9.5.5.3 The fatigue design factor shall be a minimum of 1.5, except for custom hoist shafts, which shall have a minimum fatigue design factor of 2.0.

3.9.6 Main Hoist

3.9.6.1 The main hoist shall be designed to stop and hold a load upon loss of power.

3.9.6.2 The load block shall be centered between the girders.

3.9.6.3 The design and arrangement of the load block shall be such that the wire ropes will not be pinched or cut in case of two-blocking.

3.9.6.4 The hoist capacity shall be clearly marked, in pounds, on both sides of the load block.

3.9.6.5 Standard commercial blocks may be used at their published ratings when their published design factors meet CMAA requirements or greater.

3.9.6.6 Block internal arrangement and clearances shall prevent the wire ropes from leaving the sheave grooves under any conditions.

3.9.6.7 The main hoist shall be equipped with a load weighing device per Section 3.12.18.

3.9.7 Main Hook Rotate

3.9.7.1 The hook and nut shall be mounted on an electric powered rotate assembly.

3.9.7.2 The hook rotate shall be designed to allow the hook to rotate freely while under test load.

3.9.7.3 The required information to calculate the rotational inertial of the lifted items shall be supplied to the VENDOR prior to detailed design.

3.9.8 Auxiliary Hoists

The Weather Enclosure Crane shall be provided with two 1 ton auxiliary hoists. These auxiliary hoists shall work in unison to perform the remote task of changing piping jumpers.

3.9.8.1 The auxiliary hoists shall have true vertical lift to ensure they are capable of performing the remote operations required for jumper exchanges.

3.9.8.2 Both auxiliary hoists shall be mounted to a single frame. On the frame, the auxiliary hoists should be separated a reasonable distance without interfering with the travel of the main hoist. A difference in mounting height of the aux hoist is acceptable.

3.9.8.3 The frame shall be mounted to an electric powered rotate. The rotate shall be capable of 360 degrees and shall not require a slip ring for any services provided to the hoist.

3.9.8.4 The hoist frame and rotate shall be mounted to a trolley bottom running on the south girder of the Weather Enclosure Crane. The trolley shall be provided with drop stops to prevent possible drop of the trolley if wheels fail.

3.9.8.5 The auxiliary hoist frame rotate shall also be provided with drop stops to prevent possible drop of the auxiliary hoist if the rotate mechanism fails.

3.9.8.6 One of the two hoists shall be provided with an electric supply reel to provide services for a remotely deployed impact wrench. The impact wrench requires 480VAC, 3 phase, 60Hz, 1.4 Amp.

3.9.8.7 The auxiliary hoists shall be designed to stop and hold a load upon loss of power.

3.9.8.8 The auxiliary hoists shall be designed to be tested at 125% (+0 / -5%) of rated capacity.

3.9.8.9 The auxiliary hoists are not required to be provided with load weighing.

3.9.9 Drip Pans

- 3.9.9.1 The crane shall be designed to preclude leakage of lubricants onto lifted loads or the floor.
- 3.9.9.2 Speed reducers and gearboxes shall be fitted with suitable corrosion resistant steel drip pans or shall have the foundations seal welded to create a dam.
- 3.9.9.3 The hoist reducer(s) drip pans shall be equipped with a drain to a lubricant holding tank. The tank shall have the capacity to hold the lubricant volume of one hoist reducer. The tank shall be equipped with a drain valve and plug.

3.9.10 Hooks

- 3.9.10.1 Hooks shall be commercially available and shall have a minimum design factor of 5 based on the material ultimate tensile strength.
- 3.9.10.2 Hook material shall be forged, carbon or alloy steel and exhibit a minimum elongation of 18 percent in 2.00 inches. Carbon steel is preferred due to Nondestructive Testing (NDT) periodicity requirements.
- 3.9.10.3 Hooks shall have a hook latch to prevent an attached item from coming free under a slack condition. It is the intension that custom lifting hooks/fixtures will be hung from the crane hooks for remote work.
- 3.9.10.4 Hooks shall not be welded, except by the original hook manufacturer prior to heat treatment.
- 3.9.10.5 Hooks and nuts shall be proof tested as an assembly in accordance with the hook proof test requirements of ASME B30.10.
- 3.9.10.6 The hook and nut shall be uniquely identified (serial number) with a permanent marking in order to provide a positive traceability to its NDT and proof test report. The markings shall be visible with the hook installed on the crane.
- 3.9.10.7 All surfaces of the hook and nut shall be unpainted and have a surface finish as a minimum 125-Ra or better.
- 3.9.10.8 Hooks shall deploy custom lifting devices for remote application to ensure flexibility in operations.

3.9.11 Wire Rope Drum

- 3.9.11.1 The drum, drum shaft and related components used to support the load shall be considered part of the load path and made safety significant even if the failure of one of these components does not constitute a loss of control of the load.
- 3.9.11.2 The drum shall be a one-piece steel weldment; finish-machined after all welding and stress relieving have been completed.

- 3.9.11.3 The longitudinal and circumferential welds of drum barrels shall be full depth penetration welds.
- 3.9.11.4 The drum shall be a single wrap design with not less than two dead wraps remaining on the drum at the lowest position. Drum grooves shall be helical and machined right and left hand.
- 3.9.11.5 The drum groove radius and depth shall be within minimum and maximum range recommended by the Wire Rope User's Manual.
- 3.9.11.6 The wire rope dead ends shall be anchored on the drum barrel by clamping or by inserting end fittings into reinforced pockets.
- 3.9.11.7 Drum end anchoring by means of wedge sockets shall not be used.
- 3.9.11.8 A combination gear reducer output/drum shaft or any other, rigid, three bearing support arrangement of the drum is prohibited. The wire rope drum shall not be driven through a drum bull gear and pinion set.

3.9.12 Sheaves

- 3.9.12.1 Sheaves shall be forged steel. The grooves shall be machined or ground to contour and rim toughened to not less than 320 BHN.
- 3.9.12.2 The groove depth shall be at least 1.15 times the wire rope diameter, the groove included (throat) angle 30 to 40 degrees, and the groove diameter shall be in accordance with the Wire Rope User's Manual.

3.9.13 Wire Ropes

- 3.9.13.1 Wire rope usage shall comply with Original Equipment Manufacturers (OEM) recommendations and in accordance with Wire Rope Users Manual; Wire Rope Technical Board (WRTB).
- 3.9.13.2 Hoist reeving systems shall be double reeved with left lay and right lay wire ropes equalized by an equalizer bar for the main hoist.
- 3.9.13.3 Wire rope selection shall be in accordance with CMAA 70.
- 3.9.13.4 Hoist wire ropes shall be improved, extra-improved, or extra-extra improved plow steel, bright (uncoated, non-galvanized), preformed, regular lay, with a strand core or independent wire rope core. The classification shall be appropriate for the usage.
- 3.9.13.5 Wire rope fleet shall meet the more strict of the limits described in CMAA 70 or wire rope Manufacturer's recommendations. The fleet angle shall be designed so as to eliminate the possibility of the lead ropes contacting or scrubbing against the adjacent wraps on the drum.

3.9.13.6 Wire Rope End Fittings

- 3.9.13.6.1 Wire rope dead end connections to equalizer bars shall be, by means of permanent swaged or poured end fittings, capable of standing the full breaking strength of the wire rope.

- 3.9.13.6.2 Swaged end fittings shall be selected in accordance with the swage fitting and wire rope Manufacturer's recommendations and shall be installed using the manufacturers recommended procedures.
- 3.9.13.6.3 Wire rope end fittings shall be 100% MT inspected except the swage sleeve portion of a swaged fitting.
- 3.9.13.7 The VENDOR shall perform a non-destructive proof test of the finished wire rope with sockets installed per ASTM A931 with a proof load of 200% of Working Load Limit.

3.9.14 Equalizers

- 3.9.14.1 Adjustable limit stops shall be provided on the equalizer frame to allow limited rotation of the equalizer bar for equalizing rope tension.
- 3.9.14.2 Bronze bushings shall include provisions for grease lubrication of the bore. Oil impregnated sintered bushings may be used on smaller pins and provisions for grease lubrication may be omitted. Pin seats in the support structure where there is no relative motion between the surfaces in contact, do not require lubrication.

3.9.15 Shear Bars and Dowel Pins

- 3.9.15.1 Foot (base) mounted components and housings that are subjected to shear loads which exceed the holding capacity of the mounting fasteners or where maintaining alignment is critical to proper component operation shall use shear bars or dowel pins to maintain their alignment. Dowel pins are preferred for alignment aids while shear bars are preferred for load carrying capacity.
- 3.9.15.2 Welds between the shear bars and the foundation shall be designed and placed in order for the shear bar to maintain contact with the foundation as the weld cools.
- 3.9.15.3 Dowel pins shall be designed and installed in accordance with ASME B18.8.2.

3.9.16 Couplings

- 3.9.16.1 Torque carrying components of couplings shall be steel.
- 3.9.16.2 Full-flexible couplings shall be used on connecting shafts and axles with adjacent bearing supports.
- 3.9.16.3 Semi-flexible couplings shall be used for floating shafts and for shafts of lengths more than 16 shaft diameters between the coupling and the farthest bearing.
- 3.9.16.4 Rigid couplings may be used where the distance between the coupling and the farthest bearing is greater than 32 shaft diameters.
- 3.9.16.5 Brake wheel, disc or diaphragm couplings, chain couplings, and elastomeric couplings shall not be used. Gear couplings shall be bolted flange type.
- 3.9.16.6 Couplings within 4 feet of a hoist brake shall be separately guarded so as to prevent coupling grease from spreading to the braking surfaces.

- 3.9.16.7 Where applicable, zero backlash type couplings shall be used between encoders/resolvers and rotating machinery. Couplings used between rotating machinery and geared limit switches and encoders/resolvers shall have a means of positive retention.
- 3.9.16.8 If a coupling is used for connecting the wire rope drum flange directly to the speed reducer output shaft (without the use of a drum stub shaft), that coupling shall be a barrel coupling.

3.9.17 Wheels

- 3.9.17.1 Bridge and main trolley travel wheels shall be double flanged and shall meet the requirements ASTM A504. The auxiliary hoist trolley wheels shall be single flanged and shall meet the requirements of CMAA 74.
- 3.9.17.2 Wheels shall be rim-toughened to not less than 320 BHN, as supported by Brinell hardness test reports. Wheel hardness values in excess of those given in ASTM A504 are allowed so long as they are in accordance with the recommendations given in CMAA 70 Section 4.13.
- 3.9.17.3 Hollow stamped wheels and gray cast iron wheels shall not be used. Wheels shall not be manufactured from plate steel.
- 3.9.17.4 All wheels shall have press-fit live-axles with the wheel/axle interference fit in the FN2 to FN3 fit range.

3.9.18 Rail Sweeps

- 3.9.18.1 The design of bridge and trolley rail sweeps shall comply with ASME B30.2. The design of bridge and trolley rail sweeps shall not allow contact between the rail and rail sweep under the worst case conditions of wheel float, skewing, and design tolerance stack-up.

3.9.19 Bearings

- 3.9.19.1 All bearings, except where specifically permitted or required otherwise, shall be of the antifriction type with both inner and outer races.
- 3.9.19.2 CMAA 70 Performance Standards shall be used to determine bearing life criteria.
- 3.9.19.3 Sealed, permanently lubricated anti-friction bearings shall be used except where otherwise approved.
- 3.9.19.4 Any approved grease lubricated bearings shall be provided with means for lubrication through easily accessible lubrication fittings, and shall include provisions for the purging of old grease – either past the seal lips or through relief fittings.
- 3.9.19.5 Lubrication points shall be accessible from work platforms without having to be on a ladder. Lubrication points and frequency should be minimized to the maximum extent possible. Lubrication points shall be accessible without requiring fall protection.

3.9.19.6 Following final assembly the VENDOR shall verify that all lines are full of grease and application of grease at the fitting provides lubrication at the intended location.

3.9.19.7 Bridge and Trolley Wheel Bearings

3.9.19.7.1 Bridge and trolley wheel bearings may utilize open bearings.

3.9.19.7.2 Grease fittings for the bridge and trolley end trucks shall be collected at manifolds accessible from the bridge walkway, one manifold each for the bridge and trolley trucks.

3.9.19.8 Mounted Bearings

3.9.19.8.1 The housings of pillow block bearings in the hoist drive train shall be made of steel – either as castings or machined from rolled plate as a custom made component. Weldments are prohibited for pillow block housings in these applications.

3.9.19.8.2 Piloted flanged cartridge bearing housings that are subjected to structural loading shall be ductile iron or steel castings; those supporting only the weight of mechanical components may be cast iron of any class.

3.9.20 Bushings and Thrust Washers

3.9.20.1 Bushings and thrust washers located on the bridge end-trucks may be grease lubricated.

3.9.20.2 Lead shall not be used in bushing material.

3.9.21 Gearing

3.9.21.1 Gearing shall conform to AGMA 2001, ADMN 2015-1, and AGMA 908.

3.9.21.2 Gear quality shall be A5 or higher, per AGMA 2015-1.

3.9.21.3 Hoist gearing shall be mounted on shafts supported by two outboard bearings. Three bearing shafts shall not be used.

3.9.21.4 Split gears are not permitted

3.9.21.5 Overhung or cantilevered pinions are not permitted on speed reducer output shafts.

3.9.21.6 All gearing shall be of the enclosed (speed reducer) type.

3.9.21.7 Speed reducers shall be standard commercial products, and conform to AGMA 6001.

3.9.21.8 Back-driving (overhauling) capability of the unit as well as the static and dynamic efficiency shall be considered when selecting speed reducers.

3.9.21.9 Enclosed gearing (including gearmotors) shall conform to AGMA 6013 and AGMA 6109 as permitted. Each speed reducer unit rating, divided by the appropriate service factor from the service factor table of the applicable AGMA standard, shall be greater than or equal to the rated motor torque. The minimum speed reducer service factor shall conform to AGMA 6013 and 6109 for load durations of 10 hours per day ,

unless operating conditions justify a different load duration. Cranes with a CMAA rated service class “D” shall use “Mill Duty” service factors.

- 3.9.21.10 Application of the primary and secondary hoist brakes shall be considered as a momentary peak load condition with respect to speed reducer selection.
- 3.9.21.11 All gears shall be steel and worm gears shall not be used.
- 3.9.21.12 Speed reducers shall have a convenient means of lubricant level indication and draining and shall have inspection covers that are accessible without removing other components or draining oil.
- 3.9.21.13 All speed reducers shall have a liquid capturing device/tray under them that is capable of containing all of the oil in the gearbox without spilling.

3.9.22 Shaft to Hub Connections

- 3.9.22.1 All components that transmit hoist drive or brake torque shall be keyed with the exception of spline connections installed as original equipment on commercial off the shelf items.
- 3.9.22.2 All components that transmit bridge or trolley motion drive or brake torque shall be interference fitted (pressed) onto their shafts or axles.

3.9.22.3 Keys, Keyseats and Keyways

- 3.9.22.3.1 Keys, keyseats and keyways shall be designed in accordance with ASME B17.1.
- 3.9.22.3.2 The manner of key installation shall preclude any possibility of a key shifting out of its intended position.
- 3.9.22.3.3 Single keys shall be fitted in their keyseats and keyways to ASME B17.1 Class 2 requirements and double keys may be fitted to ASME B17.1 Class 1 requirements.

3.9.22.4 Keyless Connections

- 3.9.22.4.1 Where applicable, keyless coupling hubs shall be used on the travel or rotate drives.
- 3.9.22.4.2 Keyless hub-shaft connections (i.e. shrink disks) shall be used on travel or rotate drives for mounting hollow shaft gearmotor units.
- 3.9.22.4.3 Keyless connection interference fits shall transmit peak load torque and not less than 200 percent rated motor torque.

3.9.23 Footwalks, Platforms, and Guard Rails

- 3.9.23.1 Guardrails and toe guards shall be provided on all maintenance platforms, footwalks and trolley platforms. Their design shall be according to CMAA-70.
- 3.9.23.2 The crane shall have a full-length walkway on the north bridge girder and have access to the trolley at any location on the bridge.

3.9.23.3 The crane shall be accessed from the building walkways by means of a ladder permanently attached to the crane as shown in the DPD's. This ladder shall be retractable to ensure it does not interfere with any operations on the walkway. Ladder design to meet 29 CFR 1910.27, *Fixed Ladders (OSHA)*.

3.9.23.4 Footwalks and steps shall be solid with a slip-resistant walking surface.

3.9.23.5 Footwalks and Platforms

3.9.23.5.1 Footwalks and platforms are to be of rigid construction and designed to sustain a distributed load of at least 50 pounds per square foot.

3.9.23.5.2 Self-closing swinging gates or hinged hatch covers shall close guard rail and walkway openings, including ladder openings that expose a drop to a lower level of 4 feet or more along the passageway. They shall have the same profile as the standard railing (without the toeboards) and shall have the same strength as the standard railing, both in the open and closed position.

3.9.23.5.3 Access to and egress from bridge footwalks, platforms and crane components that require regular access for maintenance, testing and inspection shall be possible without requiring the use of safety harnesses or other extraordinary means.

3.9.23.5.4 Handrail shall be designed to meet 2015 IBC, 29 CFR 1910.179, and 29 CFR 1910.23.

3.9.23.6 Fixed Ladders and Cages

3.9.23.6.1 Ladders shall be designed to meet OSHA guidelines.

3.9.23.6.2 Floor openings into which persons can accidentally walk shall be guarded either with a standard railing and toeboard on all exposed sides or a cover of standard strength and construction.

3.9.23.7 Anchorages

3.9.23.7.1 All platforms that cannot be guarded by full height guardrails shall be equipped with anchorages for fall arrest equipment.

3.9.23.7.2 Anchorages shall be designed in accordance with ANSI Z359 Fall Protection Code standards.

3.9.24 Lift Lugs

3.9.24.1 Lift features shall be provided on the bridge girders, endtrucks, and trolley to provide for three or four point picks. Removable lift lugs are acceptable. Lift feature placement shall be visually displayed in the VENDOR Installation and Lifting Plan.

3.9.24.2 The crane shall be designed to minimize the number of picks required for installation. If possible, the crane will be designed to be lifted as one piece onto the runway girders.

3.9.25 Manual Movement (Crane Recovery)

- 3.9.25.1 All crane motions shall be equipped so that manual repositioning may be accomplished in the event of a crane casualty or loss of power. This includes main hoist, auxiliary hoists, bridge, and main trolley. The auxiliary hoists do require hook recovery but do not require manual trolley recovery capabilities.
- 3.9.25.2 The crane design shall provide safe access (no fall hazards requiring the use of personal fall protection equipment) to bridge, trolley and main hoist components and equipment necessary to perform manual repositioning, for any bridge or trolley position within the crane envelope. Auxiliary hoist will require the use of a man lift to access manual recovery.
- 3.9.25.3 Both the primary and secondary hoist brakes must be capable of being released under load and maintaining a controlled lowering of the load without power to the crane.
- 3.9.25.4 Manual movement shall be possible without disassembly of any load bearing components.
- 3.9.25.5 All tools necessary for setting up and providing manual movement shall be provided by the VENDOR.

3.10 Mechanical Electrical Design

3.10.1 Drive Mechanism Motors

- 3.10.1.1 The hoist drive motors shall be AC single speed, squirrel cage induction type, vector duty, with a continuous duty rating. Encoders shall have a minimum resolution of 1024 pulses per revolution. Encoders shall be mounted on the non-drive end of the motor and shall be removable without removal of brake wheels, couplings, or the motor itself if practical.
- 3.10.1.2 The bridge, trolley, and rotate motors shall be AC single speed, squirrel cage induction type, inverter duty, with a minimum of 60-minute duty rating.
- 3.10.1.3 AC motors shall be Totally Enclosed Non Ventilated (TENV), Totally Enclosed Fan Cooled (TEFC), or Totally Enclosed Blower Cooled (TEBC). TENV is the preferred option. If TEBC motors are used, the fans shall be driven by independent blower motors that only operate when the associated drive motor is operating.
- 3.10.1.4 Motor insulation shall be Class F minimum. Motor temperature rise shall not exceed that specified in NEMA Standards for Class B insulation. Unless specified otherwise, all motors shall be designed for full voltage starting.
- 3.10.1.5 All motors shall be provided with an anti-condensation heater.
- 3.10.1.6 All hoist motors shall have their rotors press-fitted and keyed to their motor shafts.
- 3.10.1.7 All motors, including blower motors, shall have permanently lubricated bearings.
- 3.10.1.8 CMAA 70 calculations for motor horsepower shall be used in selecting bridge, trolley, and hoist drive motors.

- 3.10.1.9 Thermal protection shall be provided for all motors by automatic-reset type temperature sensors embedded in the motor windings. A tripped sensor shall disable individual motion(s) for the affected drive only and be indicated on the control station as an overheat condition. The hoist motor shall be capable of lowering in the overheat condition.

3.10.2 Hoist Brakes

- 3.10.2.1 The hoist shall have two brakes. Both brakes will be self-setting upon power loss. Each hoist brake shall be capable of independently holding the test load and 125% of the rated motor torque.
- 3.10.2.2 Each hoist brake shall be provided with a manual lever-type, self-return to ON, release mechanism so that it may be released by hand (release force not greater than 50 lbs.) (Screw type, maintained OFF, release mechanisms are not permitted). The manual release mechanism shall be operable without tie offs.
- 3.10.2.3 The VENDOR shall provide a certification that the supplied hoist brakes meet the brake manufacturer's assembly and quality requirements. See section 3.18.5.22.
- 3.10.2.4 Factory acceptance testing shall be performed at the brake manufacturer's facility to verify the minimum and maximum torque settings for each hoist brake. This shall include testing at the maximum allowed air gap settings. Test results shall confirm the braking torque equals or exceeds the rated torque value. This test shall be provided by the VENDOR to the BUYER for information.

3.10.2.5 Primary Hoist Brake

The primary hoist brake shall act on the motor shaft or gear reducer high speed shaft.

3.10.2.6 Secondary Hoist Brake (SS)

- 3.10.2.7 The secondary hoist brake shall act on the wire rope drum.
- 3.10.2.8 The secondary hoist brake shall be capable of stopping the hoist drum while lowering the rated load at rated speed (with motor de-energized, and without the aid of the primary hoist brake).
- 3.10.2.9 The secondary hoist brake shall be designed to stay in contact and operable with the hoist drum upon hoist drum shaft failure.

3.10.3 Travel Motor Brakes

- 3.10.3.1 Brakes shall be provided on the bridge, main trolley, and auxiliary trolley motors and shall be sized in accordance with CMAA 70 or CMAA 74 as appropriate.
- 3.10.3.2 The travel brakes shall be spring-applied, electrically released, and shall set whenever power is removed from the motor.
- 3.10.3.3 The travel brakes shall be provided with a manual lever-type, self-return to ON, release mechanism so that it may be released by hand.

3.10.3.4 Brakes shall not be self-adjusting.

3.10.4 Electrical Criteria for Brakes

3.10.4.1 All brakes and brake systems shall be rated for continuous duty in the released position.

3.10.4.2 Hoist primary brakes and all travel motor brakes shall be non-time delayed on setting and shall set after the drive decelerates the motor to a controlled stop. The hoist primary brake shall set after the load float time has ended.

3.10.4.3 The main hoist secondary brake shall be time delayed with respect to the primary brake when setting during normal operation. There shall be no secondary brake delay in the event of hoist drive train failure, overspeed detection, loss of power, and crane shutdown (emergency stop).

3.10.4.4 The main hoist secondary brake shall be connected to a separate output (within the hoist drive or independent of the drive) from the primary brake.

3.10.4.5 Conductors for brake coils shall be protected by a fuse or other protective device. The device shall be chosen to protect the brake circuit conductors from ground-faults or short-circuits.

3.10.4.6 Auxiliary hoists are not required to have a secondary brake.

3.11 Electrical Design

3.11.1 General Requirements

3.11.1.1 The electrical design and fabrication shall conform to the latest issue of standards publications CMAA 70, NFPA 70, ASME B30.2, 29 CFR 1910.179, NEMA MG-1, NEMA MG-2, and other standards and specifications as specified herein. The electrical equipment, protection, disconnecting means, grounding, and wiring installations shall be in accordance with NEC 2014 Article 610-Cranes and Hoists.

3.11.1.2 Only commercially available components that are of proven design for the intended application and that comply with the requirements of the National Electrical Manufacturers Association (NEMA) Industrial Control Systems (ICS) standards or of Underwriters Laboratories (UL) documents, or those of other established nationally or internationally recognized approving organizations, shall be used. AVS Procurement Quality Clause B65 and B66 apply to this procurement.

3.11.1.3 All SS designated electrical items shall be on a separate independent safety control circuit to ensure that failures of non-SS equipment will not affect the operation of the SS items.

3.11.1.4 Power, control, DC analog, RTD's, DC control, signal or measurement circuits shall be segregated as follows:

- Separate each 480V or 120V power feeder. separate terminal blocks shall be provided for termination of 480V power and 120V control wiring.
 - Separate thermocouple terminal boxes shall be provided. Shields shall be wired to separate terminal points adjacent to circuit conductors.
 - DC analog, RTD's, DC control, signal or measurement circuits may occupy the same instrumentation terminal box, but shall be terminated on separate terminal blocks. Shields shall be wired to separate terminal points adjacent to circuit conductors.
 - Signal cables shall be separated from power cables or other cables that could induce voltages into the signal cables per NFPA 70, National Electrical Code.
- 3.11.1.5 The design shall allow simultaneous operation of the largest hoist drive and all travel drives.
- 3.11.1.6 The use of Programmable Logic Controllers (PLC) are permitted.
- 3.11.1.7 Uninterruptible Power Supplies (UPS) are not required.
- 3.11.1.8 Electronic controls of foreign manufacturers are prohibited unless documented technical support is available in the U.S.
- 3.11.1.9 Electrical components shall not be mounted on the doors of electrical control panel enclosures.
- 3.11.1.10 Except where otherwise allowed, all VENDOR-supplied enclosures for control panels and auxiliary devices shall be NEMA Type 4.
- 3.11.1.11 LED type indicating lights, unless noted otherwise, shall be suitable for operation on 120 VAC and supplied with resistor or transformer to allow use of low voltage bulb. Lamps and color caps shall be replaceable from the front.
- 3.11.1.12 Color caps shall be as follows unless otherwise specified or approved by the Buyer:
- Motors, Circuit Breakers and Electrical Devices:
 - RED - means RUN
 - GREEN - means READY
 - YELLOW - means CAUTION
 - WHITE - means BUS ENERGIZED, or HEATER CIRCUIT AVAILABLE, or DC VOLTAGE AVAILABLE, or etc.
- 3.11.1.13 LAMP OFF (no color) - Not energized Electrical Supply
- 3.11.1.14 Runway and Trolley Electrification**

- 3.11.1.14.1 The crane will operate on a 480VAC, three-phase, four-wire, grounded 60Hz electrification system.
- 3.11.1.14.2 The cranes power and control signals are to be transmitted via festoon. This is to ensure that the controls have a backup to the wireless system. The festoon system is to be sized and provided with the crane by the VENDOR.
- 3.11.1.14.3 Twenty percent (20%) of the control conductors included in the festoon systems shall be spares.

3.11.2 Main Disconnect Switch and Line Contactors

- 3.11.2.1 The crane disconnecting means shall be a lever arm type main disconnect switch (MDS) that is lockable in the OFF position and located in a separate enclosure (provided by the BUYER).
- 3.11.2.2 The MDS shall de-energize all electrical circuits on the crane except the Utility Circuit described in section 3.12.17.

3.11.3 Motor Drives

- 3.11.3.1 Hoist drives shall be selected such that the continuous rating of the controller is not less than 130 percent of the calculated full load motor current based on CMAA 70, paragraph 5.2.9.1.1.1 (or equivalent) and NEC Table 430.250.
- 3.11.3.2 The hoist, trolley, bridge, and rotate drives shall develop sufficient starting torque to initiate their respective motions from standstill with 125% rated load on the hook.
- 3.11.3.3 Motion in the direction selected by the operator should occur without noticeable delay (positive control).
- 3.11.3.4 Each hoist and travel drive shall have two variable speed ranges. The first range will be to maximum operating speed and the second range will be 1/10th of the rated speed. The required speeds are defined in the crane data sheet.
- 3.11.3.5 The hoist drive torque limit setting shall be adjusted to prevent gross overloads when the capacity overload protective device is being bypassed.

3.11.4 Dynamic Braking Resistors

- 3.11.4.1 Dynamic braking resistors shall be provided for each drive and shall be sized per the drive manufacturer's requirements, with a minimum of Class E for travel and rotate drives, and Class F for hoist drives.
- 3.11.4.2 A regenerative braking system may alternatively be provided if approved by the BUYER.

3.11.5 Operator Controls

- 3.11.5.1 The crane shall be controlled from a remotely located operator station or by a wireless controller.
- 3.11.5.2 The crane controls shall have a first-come first-serve priority. The use of either the hardwired controls or the wireless controls to energize the mainline contactor shall engage electrical interlocks to prevent any commands from the other control method.
- 3.11.5.3 Both the hardwired operator station and the wireless station will have a keyed switch that will be used to lock out use of the auxiliary hoists. This switch will be administratively controlled so that the auxiliary hoist cannot be used while the LAWPS systems are pressurized.

3.11.5.4 Radio Remote Control Units

- 3.11.5.4.1 Wireless radio control systems shall be designed and installed in accordance with ANSI ECMA 15, CMAA 70, and NEMA ICS 8, Part 9. Radio control units and associated receivers shall be approved for crane applications. All hardware technology shall be proven to work in comparable applications.
- 3.11.5.4.2 Two radio control units shall be provided and shall each include the following additional functions beyond the requirements of the hardwired control station:
 - Key operated battery power switch.
 - Indication of battery power.
 - Indication of transmitting status.
- 3.11.5.4.3 Radio control unit batteries shall be of rechargeable type and two sets of batteries shall be provided for each control unit. Two battery chargers shall be provided.
- 3.11.5.4.4 The radio control units will be provided with a tether feature allowing hard wired connection of radio control units to the hardwired control station.
- 3.11.5.4.5 The system shall allow programmable adjustment to the system frequency. The system programming shall also allow frequency hopping protocol.
- 3.11.5.4.6 The VENDOR shall fill out the Hanford Site Spectrum Dependent Communications Authorization form included in Appendix A: Engineering Forms for approval prior to purchase of the wireless control units.
- 3.11.5.4.7 A crane shutdown due to radio communication loss, caused by either radio frequency interference or weak/blocked radio signals, shall be clearly indicated to the crane operator by the indicator lights on the radio control unit as well as a light on the crane.

3.11.5.5 Hardwired Control Station

- 3.11.5.5.1 The hardwired control station shall be remotely located in a non-contaminated area of the Weather Enclosure and will not have direct view of the crane operating area.
- 3.11.5.5.2 To operate the crane from the hardwired control station, the Closed Circuit Television (CCTV) system installed on the crane must be utilized. The cameras

will provide multiple views allowing the crane to access any part of the crane envelope with full visibility.

- 3.11.5.5.3 The hardwired control station shall be equipped with all controls required for crane operation as well as the additional controls that allow interlock bypass as required.
- 3.11.5.5.4 The hardwired control station will display the load and elevation of the main hoist.

3.11.5.6 Master Switches

The following section describes the master switches for both the wireless and the wired control stations.

- 3.11.5.6.1 Each hoist shall be controlled using a single-axis lever-actuated master switch.
- 3.11.5.6.2 Bridge and main trolley shall be controlled with a two-axis lever-actuated master switch.
- 3.11.5.6.3 The auxiliary hoists trolley and trolley rotate shall be controlled with a two-axis lever-actuated master switch.
- 3.11.5.6.4 Main hook rotate shall be controlled with a single-axis lever-actuated master switch.
- 3.11.5.6.5 The master switch for each motion shall provide stepless adjustable speed control in both directions.
- 3.11.5.6.6 When released, each master switch shall spring return to the OFF position with an OFF position detent.
- 3.11.5.6.7 Each master switch shall incorporate an integrated deadman switch (style not defined). The control circuit shall require that the master switch be in the OFF position before the associated motion can be initiated.
- 3.11.5.6.8 In addition to the master switches, the following controls shall be on the hard wired or wireless controllers:

- 3.11.5.6.8.1 **POWER ON:** A guarded, spring return to normal, black pushbutton switch shall be provided that energizes the main line contactor.
- 3.11.5.6.8.2 **EMERGENCY STOP/POWER OFF:** A spring-return to normal, red mushroom-head, pushbutton switch shall be provided that opens the main line contactor.
- 3.11.5.6.8.3 **SPEED RANGE:** A two position selector switch shall be provided. The selector switch shall have the following functionality:
SLOW: hoist and travel drives shall allow infinitely variable speed adjustment up to 10% of rated speed.

NORMAL: hoist and travel drives shall allow infinitely variable speed adjustment from 0% to 100% of rated speed.

TROLLEY/BRIDGE BRAKE RELEASE: there shall be one, spring return to center, switch that releases and sets all trolley and bridge brakes simultaneously to facilitate centering and uprighting of a load. The switch turned to the RELEASE position releases and maintains released all trolley and bridge brakes. This must be held to keep brakes released. Releasing the switch returns them to normal operating mode. This is on both the radio control pendant as well as the main control station.

3.11.5.6.8.4 Bridge floodlight ON/OFF switch.

3.11.6 CCTV

- 3.11.6.1 The crane will be provided with 4 high resolution remote pan/tilt/zoom cameras for remote operations. The final locations of these cameras will be decided during final design of the crane using 3D views from CAD models of the crane in the facility to ensure that all viewing areas are visible. If it is found that one location for each camera is not sufficient, multiple mounting locations for each camera may be utilized.
- 3.11.6.2 All bridge mounted cameras are to be high resolution color commercial cameras. Radiation hardening is not required as these cameras will be commercial and replaced if they fail due to radiation. They will be mounted to quick disconnect mounts and be provided with connectors on the back of the assembly to ease camera changes.
- 3.11.6.3 A radiation hardened camera is required to be mounted to the main hoist load block for views in the deep pits. This camera shall be a pan/tilt/zoom camera (monochrome acceptable) and shall have protection from impact during operations. The protection cannot interfere with either the horizontal or down views of the camera.
 - 3.11.6.3.1 The main load block camera will be used to give close proximity views of both the main hoist and the auxiliary hoist remote actions. It shall be provided with integral high intensity lighting and the camera system should have a minimum total allowable total integrated dose of $1.0E+7$ Rad and a maximum instant rate of 40 Rad/hr.
- 3.11.6.4 A Digital Video Recorder (DVR) shall be provided with the camera control system to provide a record of actions as required during operations. The DVR will be capable of recording a minimum of 4 simultaneous camera signals without loss of quality. DVR memory as a minimum shall be 1 TeraByte.
- 3.11.6.5 At the hardwired control station, there shall be 2 monitors of 24" or larger for viewing of the signals from the CCTV system. Each monitor will be able to display 2 cameras or just one camera for a larger view through a signal switch.
- 3.11.6.6 The CCTV control system shall offer the capability for frame capture and programmable preset camera fields of view.
- 3.11.6.7 Controls for the CCTV system are not required to be integral to the crane controls.

3.12 Limit Switches and Safety Devices

3.12.1 Main Hoist First High Limit

- 3.12.1.1 The First High Limit Switch will be used to stop the hoisting motion before load block contact with the trolley. The switch will be a control circuit device and shall remove power from the motor and set the hoist brakes. The operator may lower the hoist when the limit switch is actuated without a bypass of the system.

3.12.2 Main Hoist Final Overtravel High Limit (SS)

- 3.12.2.1 The Final Overtravel High Limit switch shall be used to stop the hoisting motion before the load block can contact the trolley. The switch shall operate through a separate control circuit from the first high limit switch to cause the removal of power to the hoist motor and set the hoist brakes. This switch should only be reached if the First High Limit Switch fails. The separation between the limit switch actuation points must be set so that drift of the hook will not actuate the Final Overtravel High Limit. The location of this switch must also be located so that the drift of the hook when actuated will provide an acceptable clearance between the lower block and any obstructions. If this switch is actuated, the system shall be evaluated for safety of lowering out of the position prior to any additional motions.
- 3.12.2.2 The main hoist final overtravel high limit switch shall be on a control circuit that is independent of non-safety systems.

3.12.3 Main Hoist First Low Limit

- 3.12.3.1 The Main Hoist Lower Limit Switch shall be used to stop the lowering motion and set the hoist brakes. The switch will be a control circuit device and shall remove power from the motor. The operation of this switch shall not prevent hoisting.

3.12.4 Main Hoist Final Overtravel Low Limit

- 3.12.4.1 The Main Hoist Final Overtravel Low Limit shall be used to stop the lowering motion of the hoist and set the hoist brakes. The switch shall be of the control circuit type that shall be mechanically and electrically independent of the first low limit. If this switch is actuated, the system shall be evaluated for safety of raising out of the position prior to any additional motions.

3.12.5 Hoist Mis-Reeve Limit Switch (SS)

- 3.12.5.1 A hoist mis-reeve limit switch shall be provided to prevent further hoisting but shall allow lowering.
- 3.12.5.2 The hoist mis-spool limit switch will be tested periodically and a method for performing this test shall be provided by the crane VENDOR and addressed in the crane technical manual. The testing method must test the entire system and not just the operation of the switch.

- 3.12.5.3 The hoist mis-reeve limit switch shall be on a control circuit that is independent of non-safety systems.

3.12.6 Main Hoist Unbalanced Load Limit Switch

- 3.12.6.1 An unbalanced load limit switch shall be provided to detect potential unequal loading of the wire ropes. Upon detection of an unbalanced load the limit switch shall prevent further hoist motion. The switch shall automatically clear once the load is balanced, otherwise, further hoist motion shall require the use of a keyed bypass switch to override the limit switch.

3.12.7 Bridge Slow Down

- 3.12.7.1 A Bridge Slow Down shall be provided to limit bridge speed as the crane approaches the building end stop. Activation of the slow down shall reduce maximum available bridge speed in the building end stop direction to a 20% limit of rated speed. The location of this switch must allow for deceleration to 20% prior to activation of the end of travel limit switch.

3.12.8 Bridge End of Travel Limit Switches

- 3.12.8.1 Bridge end of travel limit switches shall be provided to stop bridge motion prior to making contact with the building end stops. The location of this switch shall be adjustable to ensure that the bridge traveling at 20% of full speed will stop prior to contact with the building end stops.

3.12.9 Trolley Slow Down

- 3.12.9.1 Trolley Slow Down switches shall be provided. The switches shall be adjustable and activation shall reduce maximum available trolley speed, toward the associated end stop to 20% of rated speed. The maximum available speed away from the associated end stop shall not be affected by the switch. The location of this switch must allow for decelerated to 20% prior to activation of the end of travel limit switch.

3.12.10 Trolley End of Travel

- 3.12.10.1 Trolley end of travel limit switches shall be provided to stop trolley motion prior to making contact with the trolley bumpers. They shall be adjustable and capable of stopping the trolley traveling at 20% of rated speed prior to contact with the end stops.

3.12.11 Overspeed Detection (SS)

- 3.12.11.1 The main hoist shall incorporate an overspeed detection system that utilizes a separate safety control circuit that is independent of non-safety systems.
- 3.12.11.2 The overspeed switch shall be actuated by contact with the wire rope drum or drum shaft.

- 3.12.11.3 The overspeed switch shall not depend upon PLC, VFD or any software for operation.
- 3.12.11.4 The hoist line contactor shall open immediately upon detection of an overspeed condition from the overspeed detector, thereby setting both primary and secondary brakes, and de-energizing the motor.
- 3.12.11.5 The overspeed switch shall be capable of testing and inspection without requiring the system to enter an actual overspeed condition.

3.12.12 Broken Shaft Detection

- 3.12.12.1 For hoist designs utilizing a single path of torque transfer between the hoist motor and the wire rope drum, the hoist drive shall incorporate broken shaft detection. Upon detecting discontinuity in hoist drive train the hoist brakes shall immediately be set.

3.12.13 Motor Over-Temperature

- 3.12.13.1 Activation of an integral motor over-temperature device shall de-energize the associated function as follows: Hoist (hoisting direction only), Trolley, Bridge, and Rotate (motion in either direction).

3.12.14 Capacity Overload Protection

- 3.12.14.1 The main hoist shall be provided with hoist overload protection. A capacity overload condition, if detected by the weigh system electronics, shall prevent further hoisting of a load.
- 3.12.14.2 Capacity overload protection shall initially be set to trip at 110% of the hoist rated capacity.
- 3.12.14.3 The capacity overload protection shall be on a control circuit that is independent of non-safety systems.

3.12.15 Indicating Lights and Warning Devices

- 3.12.15.1 The following indicator lights shall be provided on the hardwired control station:
 - Power Available
 - Main Contactor
 - Motor Over-Temperature
 - Slow Drive Enabled
 - Upper Limit Switch Engaged
 - Hoist Brake Failure
 - Broken Shaft Detection
 - Overspeed Detection
 - Hoist Mis-Reeve
 - Hoist Unbalanced Load
 - Capacity Overload
 - Trolley/Bridge Brake Release
 - Radio Enabled

3.12.15.2 Indication and Warning Lights

3.12.15.2.1 The following items will be displayed through warning lights on both control stations:

- Indication of fault or interlock status (Must go to hardwired station to identify failure).

3.12.15.3 The following indicating lights shall be mounted to the bridge structure in order to allow remote observation. They shall be visible from any point on the main floor, and accessible from the bridge footwalk for maintenance. The lights shall be labeled with lettering of sufficient size to be readable from the main floor.

- Power Available
- Main Contactor
- Slow Drive Enabled
- Upper Limit Switch Engaged
- Radio Enabled

3.12.15.4 A horn, bell, or siren warning device shall be provided that is automatically sounded upon any crane motion control signal.

3.12.16 Bridge Floodlights

3.12.16.1 Lighting shall be provided at the base of the bridge girders for reducing shadowing caused by the crane and increase viewing inside the vaults. The lighting shall be designed to meet the requirement of a minimum of 34.5 footcandles at the operating floor or brighter if required by CCTV components.

3.12.16.2 Exact location of the lighting shall be decided during final design using 3D views from VENDOR developed CAD models of the crane in the facility to ensure that all viewing areas are visible.

3.12.16.3 The flood lights shall be long life equipment with high reliability.

3.12.16.4 The flood lights shall be controllable from both the radio control unit and the hardwired control station.

3.12.16.5 Floodlights shall be equipped with safety cables to prevent the fixture from falling if dropped while being serviced.

3.12.17 Utility Circuit

3.12.17.1 A utility circuit shall be provided to supply nominal 120 VAC for the bridge and trolley receptacles, lights (not including flood lights), and enclosure lights. This utility branch circuit shall be energized via the Utility Disconnect Switch (UDS) whenever the crane is energized.

3.12.17.2 The BUYER shall supply a separate power feed for the Utility Circuit at the same location as the MDS.

3.12.17.3 A utility circuit breaker panelboard shall be supplied with a main breaker and with a minimum of 2 spare circuit breakers installed.

- 3.12.17.4 Receptacles shall be 20 Amp heavy duty AFCI/GFCI protected type. Circuit breakers supplying receptacles shall be rated at 20 Amps. One duplex receptacles shall be supplied on each end of the bridge walkway and not mounted to any enclosure. Two duplex receptacles shall be provided on the trolley.
- 3.12.17.5 Fixed work LED lights supplied by the UDS shall be mounted within each control enclosure and controlled by a door switch. The wiring shall be insulated such that there are no exposed conductors.

3.12.18 Weigh System Electronics

- 3.12.18.1 Load indication displays showing the loads lifted shall be provided on the main hoist. Auxiliary hoist do not have load indication.
- 3.12.18.2 A load-weighing device mounted in the upper sheave nest shall be provided for the main hoist.
- 3.12.18.3 If the load-weighing device is put into the load path, it shall provide, at rated hoist capacity, a design factor not less than 5.0 based on material ultimate or shear strengths.
- 3.12.18.4 Each weigh system shall accommodate the maximum scheduled test load – that is, 125% (+0 / -5%) of rated capacity for the associated hoist.
- 3.12.18.5 The weigh system shall include wire rope compensation to account for the weight of the wire rope seen by the load cell at any hook position.
- 3.12.18.6 The minimum accuracy of each load-weighing device shall be within 2% of full range (hoist rated capacity). Certification of the load-weighing system shall be provided with the data package.
- 3.12.18.7 The weigh system electronics shall consist of a hardwired controller mounted display and a bridge mounted scoreboard display that is visible from the floor.
- 3.12.18.8 The weigh system shall incorporate capacity overload protection as discussed earlier in this specification.
- 3.12.18.9 The weigh system(s) shall be hardwired (i.e., no radio transmission), and shall have the following features:
 - ON-OFF switch on the hardwired controller.
 - ZERO function on both controllers.
 - Adjustable HIGH LOAD LIMIT and LOW LOAD LIMIT alarms:
 - These alarms shall have operator adjustable setpoints, and shall alert crane operators when either preset load limit is exceeded.
 - Alarm setpoint shall be adjustable at the wired control station. Both audible and visual indicators shall respond to each new alarm condition with steady, continuous output.
- 3.12.18.10 Loss of crane power shall not cause the weigh system to lose the current zero (tare) value or the wire rope compensation amount.

3.12.19 Hook Height Indicating System

- 3.12.19.1 All hoists shall be equipped with a hook height indicating system. The display shall read in inches, with resolution to 0.1 inch. The accuracy of the system shall be not less than +/- 0.20% of full stroke with a repeatability of not less than +/- 0.04% of full stroke.
- 3.12.19.2 Loss of crane power shall not cause the hook height system to lose the hook zero position.
- 3.12.19.3 An hook height system will be displayed on the hardwired control station only.

3.12.20 Equipment Labeling

- 3.12.20.1 A heavy gauge engraved stainless steel nameplate per the requirements of the Tank Farm Equipment Identification Numbering and Labeling Standard, TFC-ENG-STD-12, Rev D shall be provided for all equipment and major components furnished.
- 3.12.20.2 The crane shall be clearly marked with the rated capacity on each side of the bridge. The marking shall be clearly visible from the operating floor.
- 3.12.20.3 Individual hoist units shall have their rated capacity marked on both sides of their load block.
- 3.12.20.4 All operator control devices, pushbuttons, indicating lights and similar devices shall be clearly labeled to indicate their intended function.
- 3.12.20.5 A warning label shall be placed on both the main disconnect and the utility disconnect switches to identify the equipment that is not isolated by the switch.

3.12.21 Materials General Requirements

- 3.12.21.1 AVS Procurement Quality clauses B37 and B43 shall apply to this procurement.
- 3.12.21.2 Material shall be free from defects and imperfections which might affect the serviceability and appearance of the finished product. All VENDOR supplied material shall be new and unused.
- 3.12.21.3 Structural and mechanical materials subject to load path shall be specified by a nationally recognized standard that requires chemical and physical properties.
- 3.12.21.4 Mechanical and electrical components that are not SS shall be industrial grade products of manufacturer's specializing in the production of this type of equipment.
- 3.12.21.5 Drive components of hoists—those that transmit the driving torque, braking torque, and their supports/housings shall be steel, except where otherwise allowed by this specification.
- 3.12.21.6 Gray cast iron may be used only in the following components of the bridge and trolley travel drives: motor housings, speed reducer housings, and brakes. Gray cast iron shall not be used in any other components.

- 3.12.21.7 Brake wheels and discs may be ductile or malleable cast iron. Speed reducer and electric motor housings may be ductile or malleable cast iron. These ductile and malleable cast iron components shall have a minimum elongation of 10 percent. They will be designed to meet ASTM A536 - Standard Specification for Ductile Iron Castings or equivalent.
- 3.12.21.8 Castings shall be sound and free from warping, misplaced coring, or other defects which might render the casting defective. Any weld repairs of castings to correct dimensions or other defects shall be performed only after written approval of such repairs is obtained from the BUYER. All weld repairs shall be items of permanent record.
- 3.12.21.9 The provided material shall contain no asbestos, lead paint, Polychlorinated Biphenyl's (PCB's), Chromates, or elemental mercury.
- 3.12.21.10 Components that utilize hydraulic fluid (e.g. hydraulic bumpers and electro-hydraulic thruster brakes) shall not be permitted on the crane.
- 3.12.21.11 Precipitation hardening steel shall not be used without prior, written approval (welding prohibited).

3.13 Approved Materials

All materials designated during design by the VENDOR for fabrication of load path structures or components shall be a previously approved material by the BUYER or submitted for approval prior to use.

- 3.13.1 Materials used by the VENDOR for fabrication of structures or components that are not in the load path do not have to be approved, however the VENDOR shall provide BUYER with the specification and grade of all welded materials.
- 3.13.2 BUYER approval of the specific materials used in commercially available components in the load path is not required, provided that these materials comply with design factors and other applicable portions of this specification.

3.14 Material Traceability

- 3.14.1 The VENDOR shall supply a certified material test report (CMTR) for every piece of structural steel in the load path including weld filler material, for material used to fabricate the wire rope drums, and for all material used to fabricate keys. AVS Procurement Quality Clause B49 applies to this procurement. The CMTR shall identify the item, the material specification, applicable grade and/or type, the heat treat condition, the heat number, actual chemical properties and actual physical properties.
- 3.14.2 Every load bearing weld shall be traceable by heat or lot number to a weld filler material CMTR that lists the weld specification, weld material classification, and representative test results for the diameter(s) used.

3.14.3 General

Unless otherwise specified, items required by the Purchase Order shall be procured directly from the original equipment manufacturer or an authorized master distributor. Items delivered under this Purchase Order will be inspected by the BUYER for indications of suspect or counterfeit conditions per Section 4.7. Detection by the BUYER of any suspect or counterfeit item leading to evidence of deliberate misrepresentation of any supplied item, may result in an investigation into the validity of certification, fraud, and/or forgery. AVS Procurement Quality Clause B76 applies to this procurement.

3.14.4 Fasteners

High Strength fasteners (i.e., Grades 5, 8, 8.2, A325, and A490) received under this Purchase Order, shall exhibit both grade marks and the manufacturer's identification symbol (headmark) as per section 4.7. Mixed lots and fasteners without headmarking are prohibited. AVS Procurement Quality Clause B73 applies to this procurement.

3.14.5 Metals Bulk

Bulk metal products delivered under this Purchase Order (plate, bar, sheet, angle, channel, structural, round, tubing, etc.), shall clearly exhibit and maintain all markings as required by the applicable ordering data or specification(s).

3.15 Surface Preparation and Finish

- 3.15.1 Except as noted below, steel surfaces exposed to the atmosphere require painting for protection against corrosion.
- 3.15.2 All items to be painted shall have all scale, rust, dirt, grease, and oil removed, in accordance with the paint manufacturer's requirements for surface preparation, prior to priming.
- 3.15.3 Primers and topcoats shall be compatible products of the same manufacturer.
- 3.15.4 The finish coat shall be a 2 part epoxy or better in safety yellow (manufacturer not identified).
- 3.15.5 The paint system shall be smooth, even, free of runs, sags, orange peel, or other defects.
- 3.15.6 Caution shall be exercised not to paint the following items:
 - A. Machined surfaces that are bearing surfaces
 - B. Lubrication fittings
 - C. Corrosion resistant metals and plating
 - D. Nonferrous metals, other than aluminum that has not been anodized
 - E. Nameplates
 - F. Working surfaces subjected to rolling, sliding, or pivoting motion (wire rope drums, sheaves, rails, wheel treads, etc.)
 - G. Wire ropes, hooks, and hook nuts.

- H. Contact surfaces underneath assembly and mounting fasteners of mechanical components (except for a primer coat).
 - I. Flexible metal conduit
 - J. Threaded portion of components intended for making adjustments or changing settings.
 - K. Couplings and rotating shafts
 - L. Gaskets of enclosures and fixtures
 - M. Other items not normally painted
- 3.15.7 Primers on faying surfaces of structural bolted connections shall meet the requirements of the RCSC Specification for Structural Joints Using High-Strength Bolts. The faying surfaces shall not be finish-painted.
- 3.15.8 Structural bolts, nuts, washers, couplings and rotating shafts shall be coated only with a clear rust inhibitor.
- 3.15.9 The cardinal directions (north/south/east/west) and directional arrows shall be stenciled on the underside of the North girder near the center. The markings shall be visible from the floor and correctly oriented after crane installation.
- 3.15.10 The VENDOR shall provide a coating inspection report ensuring that the coatings are applied and performing to vendor requirements.

3.16 Control of Nonconforming Items

Reports documenting nonconforming items identified by the VENDOR shall be submitted to the BUYER for approval if the recommended disposition is use-as-is or repair. If the item is being corrected by rework or replacement, the nonconformance report should be submitted as information only. AVS Procurement Quality Clause B22 applies to this procurement.

3.17 Environment

The Weather Enclosure Crane will be installed and operated in the Weather Enclosure on the LAWPS site. The crane is not subject to outdoor environmental conditions other than for delivery and temporary storage.

3.17.1 Radiation

The crane is subject to low levels of radiation except for the load blocks. The load blocks shall be lowered into the shielded pits and will be subject to radiations levels of up to (40 Rad/hr) infrequently and for short periods of time. Materials used for the load blocks, including the rotation motor, shall be selected to survive this level of radiation. The total integrated dose for the load block components is estimated at 1.0E+7 Rad for a life span of 40 years. If the items require replacement due to radiation, they must be modular and easily replaced by operators wearing multiple pairs of gloves.

The crane components not including the load block shall be subject to a radiation dose of 5 mrad/hr general area dose and infrequently will be subject to the radiation of the open pit. The total integrated dose to be used for crane components is 1.0E+4 Rad.

Confirmation by way of calculation of the ability of the crane components to be able to survive the identified radiation levels is to be included as part of the crane reliability study.

3.18 Submittals and Technical Documentation

3.18.1 General

This section provides the general procedures and requirements for preparing and processing engineering, design, fabrication, testing, and other submittals.

- 3.18.1.1 Refer to TFC-BSM-IRM_DC-C-07 for BUYER submittal process.
- 3.18.1.2 For each formal submittal (regardless document type), VENDOR shall complete transmittal letter A-6005-315, provided by the BUYER.
- 3.18.1.3 The VENDOR shall track and record delivery and review status of submittals by maintaining a submittals list and retaining copies of Submittal Forms, and letters of transmittal, itemizing delivered items and reports during the course of work. Copies shall be retained until construction completion. Notes or markings added by hand shall be legible, utilizing permanent non-smearing marking media, such as ink or felt tip markers, in a contrasting color. An alternate means of recording delivery may be used with BUYER approval.

3.18.2 Design Submittals

The VENDOR shall submit to the BUYER the documents shown below. Each document shall be identified with a number, be marked with the respective issue dates, revision, and include an index listing of all documentation supplied. Refer to the - Master Submittal Register (MSR) - form A-6009-317.

3.18.2.1 Arrangement Drawings

- 3.18.2.1.1 The arrangement drawings shall include, as a minimum, in plan, elevation, and end views:
 - Structural components
 - Mechanical components
 - Walkways, hatches, and guardrails
 - Electrical enclosures
 - Motors and brakes
 - Limit switches, transformers, resistors, light fixtures, and other electrical equipment
 - Bridge and Trolley Festoon arrangement
 - Hook approaches for the main and auxiliary hooks

- Lift height with respect to the runway rail
- Bridge wheel loading
- Crane-to-building clearance dimensions
- OEM part numbers

3.18.2.1.2 The arrangement drawings shall confirm sufficient clearance with building structures.

3.18.2.1.3 A drawing shall be submitted that shows bridge and trolley wheel float as well as how items such as rails sweeps, limit switches, and building approach clearances (at a minimum) are affected by wheel float. The drawing shall indicate clearances for these items when the wheels are centered as well as at both extremes of wheel float.

3.18.2.2 Assembly Drawings

3.18.2.2.1 Assembly drawings shall be submitted for approval prior to the start of fabrication.

3.18.2.2.2 Assembly drawings shall show equipment dimensions and mounting for the electrical and mechanical components. These drawings shall include plan, elevation, and end views.

3.18.2.2.3 Assembly drawings shall identify any special installation requirements or procedures. These include, but are not limited to, the following:

- Alignment procedures - where applicable, coupling manufacturer's installation tolerances shall be clearly identified
- Assembly procedures
- Complete Bill of Materials

3.18.2.2.4 The VENDOR shall generate tables specifying installation torque for all sizes of fasteners, and their respective pre-assembly conditions (e.g., lubricated with a specified lubricant or specified thread locking compound). The Installation Torque Table(s) shall be included as applicable among assembly drawings.

3.18.2.2.5 Jacking arrangements for the removal of the wheel assemblies shall be shown on the Assembly Drawings.

3.18.3 Detail (Shop) Drawings

Detail drawings shall be submitted for approval prior to the start of fabrication.

3.18.3.1.1 These drawings shall show all detailed shop information necessary for fabrication of all parts that are not standard commercial products.

3.18.3.1.2 The drawings shall show compliance with specification requirements and shall include the following:

- Bill of Materials
- Dimensions – per ASME Y14.5
- Tolerances – per ASME Y14.5
- Material identification – including specification and grade

- Material heat treatment records
- Material ultimate tensile strength and yield strength records (where not identified in the material standard)
- Welding per AWS D14.1
- Welding symbols including nondestructive testing requirements – AWS A2.4
- For Primary welds - Weld Map identifying weld location and spaces for the welders ID, weld filler used, weld inspectors ID, inspection method used, and weld inspection report number.
- Unique part identification numbers
- Shoulder radii, key chamfers, and keyseat radii shall be included

3.18.3.1.3 The drawings shall show which joints contain primary welds and the inspection requirements for each primary weld. Each individual primary weld shall be traceable to unique inspection record and welder identification.

3.18.3.2 Electrical Drawings

The drawings shall include the following:

3.18.3.2.1 Layout of electrical equipment on the crane, including control system enclosures, panelboards, motors, brakes, transformers, resistors, limit switches, lighting fixtures, conduit, wiring, schematic and electrification. Layout drawings shall show the required clearances for transformer and resistor ventilation.

3.18.3.3 Design Calculations

Design calculations shall be provided to the BUYER for approval prior to finalization of the design. Engineering calculations and analysis shall be fully checked by a qualified individual other than the originator, and shall be signed and dated as checked. All final submittals of calculations shall be bound and shall include the title and purpose of the calculation, a table of contents or index, complete list of references, design basis and complete list of assumptions (if any), methodology, and sufficient information to allow independent verification of the calculation.

3.18.3.3.1 The VENDOR shall implement and maintain a quality assurance program in accordance with applicable requirements of ASME NQA-1 2008/2009 addendum Part II, Subparts 2.7 and 2.14 for control of software used for calculation or analysis where the results are not checked by alternate methods.

3.18.3.3.2 Crane design calculations shall, as a minimum, include analyses for each identified load combination and operating condition or configuration.

3.18.3.3.3 All material shall be fully identified – including their condition, mechanical properties, and allowable stress levels. Calculations shall demonstrate that the calculated stresses do not exceed the allowable values including any required design factors.

3.18.3.3.4 Calculations shall use minimum mechanical property requirements as specified by the standards.

- 3.18.3.3.5 All calculations shall include the source of all supporting information (e.g. catalog cut sheets) and shall reference paragraphs from applicable standards (e.g. NEC or CMAA 70) where this information adds clarity or can speed review.
- 3.18.3.3.6 The VENDOR shall identify any software used in calculations, and version used or applied with each document, calculation, and/or analysis which shall be traceable to a documented verification and validation.
- 3.18.3.3.7 Procured safety-related software shall be supported by an audit of the software provider. Commercial off-the-shelf software used in safety related applications, such as those used for safety related calculations, shall be dedicated in accordance with ASME NQA-1 Subpart 2.14 requirements. AVS Procurement Quality Clause B15 and B18 apply to this procurement.
- 3.18.3.3.8 Verification and validation shall be documented covering the range of the results and shall be conducted in accordance with the VENDOR's QA program.
- 3.18.3.3.9 All revisions to submitted calculations, as a result of comments by the BUYER or design changes by any sub suppliers, however minor, shall be resubmitted.
- 3.18.3.3.10 Structural Calculations

Structural calculations shall, at a minimum, include the following:

- Seismic dynamic structural analysis per ASME NOG-1. GT STRUDL is the preferred software for this analysis. The analysis shall supply the following information for use by the building designer:
 - Total mass and center of gravity location for crane, bridge, trolley, and associated equipment in all calculated configurations
 - Maximum wheel loads in all three directions
 - Seismic characteristics of the crane, including mass and mass distribution, section properties and moments of inertia of bridge girders, mass participation, primary mode shapes, and primary structural frequencies
 - Seismic restraint details and expected restraint loads imparted to crane runway girder
- GIRDERS. For each of the load cases, provide the following analyses:
 - Normal stress at mid-span (including that due to warping)
 - Shear stress (including that due to torsion) at end notches
 - Weld stresses (flange-to-web)
 - Buckling (flange and web)
 - For CMAA 70 Cases 1 and 2, provide:
 - Fatigue analysis (web-to-flange welds structural bolting at girder connections)
 - For CMAA 70 Case 3, provide:
 - Full depth diaphragm or vertical stiffener spacing
 - Short diaphragm spacing

- Using TL, LL, and DL, provide:
 - Calculation of mid-span deflection
 - Calculation of camber Bottom flange stress and deflection per CMAA 74 including seismic force calculated from NOG-1 seismic calculations. The flange of the bridge girder requires seismic evaluation.
- END TIES/END TRUCKS AND TROLLEY FRAME. For each of the load cases provide the following analyses:
 - Normal stresses
 - Shear stresses (including that due to torsion),
 - Weld stresses
 - Bumper impact force
- STRUCTURAL BOLTING AT GIRDER CONNECTIONS. For each of the load cases provide:
 - Combined shear and tension stress calculations for girder-to-end tie/end truck connections

3.18.3.3.11 Mechanical Calculations

Mechanical calculations shall, at a minimum, include the following:

- Coupling selection
- Design calculations for components that are not standard commercial assemblies
- Bearing L-10 lives
- Bushing-bearing pressures, based on projected area
- Shaft, axle, and drum stub shaft static and fatigue stress analyses
- Key bearing and shear stress analysis
- Lifting point stresses
- Motor sizing calculation
- Verification that wire rope clamp design is adequate to prevent wire rope pull-out

NOTE: Standard commercial purchased assemblies, i.e. load blocks and hooks, need not be analyzed in detail if a pro-rating calculation is provided. For example, if a 7.5-ton load block with a minimum design factor of 3.5 is proposed for a 5-ton hoist requiring a 5.0 minimum design factor, the proposed load block may be pro-rated as: $(7.5/5.0) (3.5) = 5.25$ minimum design factor. This result would be acceptable without further analysis. Standard commercial products and assemblies shall still meet all other requirements of this specification. In addition, there shall be documentation of the design factors from the original manufacturer.

3.18.3.3.12 Electrical Calculations

Electrical calculations shall, at a minimum, include the following:

- Minimum conductor sizes for mainline and motor branch circuits, including voltage drop calculations. The calculations shall demonstrate the conductors are properly sized for simultaneous operation of bridge, trolley, the largest hoist drive, and any continuous loads and show the applicable ampacity reductions in accordance with NEC Table 610.14(A).
- Crane disconnect switch selection.
- Overcurrent protection selection for mainline and motor branch circuits.
- Lighting calculations demonstrating specified illumination level.
- Conduit fill shall be calculated and meet the requirements of NEC, Chapter 9. For a cable run in conduit, either shielded or unshielded, or a conductor with stranding not included in NEC Chapter 9, its actual cross-sectional area shall be used in the calculation of percentage of fill. The cross-sectional area of equipment grounding conductors shall be included in the calculation.

3.18.3.3.13 Reliability Analysis

The VENDOR shall perform a reliability analysis to provide MTBF (Mean Time Between Failures) or MTTF (Mean Time To Failure) for all components subject to wear or failure. The basis for this data shall be provided in the analysis.

3.18.3.4 Catalog Cut Sheets

3.18.3.4.1 Selection of standard commercial assemblies and components shall be accompanied by manufacturer's technical literature (catalog cut sheets). Catalog cut sheets shall, at a minimum, be submitted for the following items:

- Motors
- Brakes
- Electrical components used in crane control circuits
- Electrical enclosures
- Utility circuit components
- Weigh system components
- Terminal strips
- Electrical wiring
- Festoon system hardware
- Couplings
- CCTV components
- Hardwired control station components
- Radio controller components

3.18.3.4.2 Catalog cut sheets shall clearly identify the model, size, and all options to demonstrate compliance with specified requirements. Catalog cut sheets shall also identify the component(s) to which they apply.

3.18.3.4.3 If required, catalog cut sheets shall be supplemented with additional sheets of data or information to demonstrate specification compliance. Catalog cut sheets which show modifications beyond the standard options, and all

supplemental pages, shall bear the original signatures and dates of the VENDOR's authorized representative or the responsible PE.

3.18.3.4.4 Approved catalog cut sheets shall also be included in the Technical Manual.

3.18.3.4.5 AVS Quality Clause B34 apply to this procurement.

3.18.4 Programmable Device Settings

3.18.4.1.1 Initial settings for drives and other programmable devices shall be submitted for BUYER approval to demonstrate crane programming meets specification requirements, and show the crane is adequate to commence factory and site acceptance testing.

3.18.4.1.2 If parameters are adjusted during site installation and testing, the VENDOR shall submit for BUYER approval the final parameter settings.

3.18.4.2 VENDOR Installation and Lifting Plan

3.18.4.2.1 The VENDOR shall develop, in conjunction with the building design team, and submit for approval a detailed installation plan. The plan shall include:

- A narrative section describing the transportation requirements for the crane to the LAWPS site.
- Type of equipment necessary for unloading the crane at the lay down area.
- Storage and protection of crane components at the lay down area.
- The crane installation procedures.
- Step by step instructions for all parts to be installed.
- A list of all structural fasteners requiring pre-installation tension testing. The purpose of this list is to allow WRPS to verify that the appropriate tension calibrator and adapters are available for pre-installation tension testing of structural fasteners during field installation of the crane.

3.18.4.2.2 All major components shall be designed for installation (and removal) using either permanently or temporarily attached lifting devices.

3.18.4.2.3 Details about the equipment to be used, capacities, placement, connections and limitations such as head room, effective hook envelope and equipment movement paths shall be included.

3.18.4.2.4 The VENDOR Installation and Lifting Plan shall be developed in conjunction with the crane design and shall be submitted for approval to the BUYER with the design approval requests for the major structural components.

3.18.4.2.5 The minimum facility conditions necessary for crane installation and testing, and protection of the crane from the weather during and subsequent to installation, shall be identified.

3.18.4.2.6 The estimated time envelope necessary to complete the installation and testing.

3.18.4.3 SDSs for Lubricants and Paints

- 3.18.4.3.1 The VENDOR shall submit the most current revision of Safety Data Sheets (SDSs) for all paints and lubricants used in the design of the crane and in its installation at the LAWPS site.

3.18.5 Other Submittals

3.18.5.1 Release for Fabrication or Procurement of Material

- 3.18.5.1.1 The VENDOR shall obtain written release from the BUYER prior to fabrication or procurement of materials. An Approval Request shall be submitted to request the release for procurement and fabrication.

- 3.18.5.1.2 Prior to requesting BUYER written release for procurement of material, the VENDOR shall obtain BUYER approval for the following submittals.

- VENDOR list of all load bearing items
- Design Drawings (Arrangement, Assembly, Detail, and Electrical)
- Design Calculations
- Catalog Cut Sheets
- Radio Remote Control System Design Description (Not required prior to procurement of non-radio components)
- VENDOR Fabrication Work Control Documents
- SDSs for Lubricants and Paints (Not required for procurement of components prior to painting or filling with lubricants)
- Control of Temporary Fasteners Plan
- Structural Steel Repair Plan
- NDE Inspector Qualification Records

- 3.18.5.1.3 The VENDOR shall also supply:

- a) NDE qualification and certification procedures
- b) Copies of all welding procedures, procedure qualification records, and welder qualification records to be employed in the performance of this purchase order/contract order as per AVS Procurements Quality Clause B28.
- c) CWI personnel Level I, II, and III qualifications and certifications which include objective evidence of NDE training, formal education, examinations, experience, date of hire, and current eye examination. Certified weld Inspector Qualification to include current AWS CWI certificates, current and valid visual acuity examination; the examination must be performed annually, and visual weld inspection procedures as Per AVS Procurement Quality Clauses B25
- d) NDE method/examination procedures that are in accordance with the applicable codes/standards specified in procurement documents. Per AVS Procurement Quality clause B31

3.18.5.1.4 Lift Point Marking

Lift points for packages and individual components shall be clearly identified.

3.18.5.1.5 Special Lifting Devices

Any special handling devices needed for assembly or installation shall be identified and supplied with the equipment. VENDOR provided structural and mechanical lifting devices, as defined by ASME B30.20 Below-the-Hook Lifting (BTH) Devices, shall conform to the requirements of ASME B30.20 and ASME BTH-1 Design of Below-The-Hook Lifting Devices. BTH devices shall be load tested to 125% of the rated load. All lifting devices shall be rated for outdoor service.

3.18.5.2 Control of Temporary Fasteners

3.18.5.2.1 If temporary fasteners will be used during fabrication, testing, or installation of the crane, either in the VENDOR's shop or at LAWPS, the VENDOR shall submit, for BUYER approval, a plan for identification and control of temporary fasteners.

3.18.5.3 Recommend Spare Parts List

The VENDOR shall provide a recommended spare parts list for commissioning and one year of operation. This list shall be provided prior to start of procurement to ensure the ability to order spares at the time of the initial procurements, as needed. AVS Procurement Quality Clause B82 applies to this procurement.

3.18.5.4 Structural Steel Repair

3.18.5.5 Before performing any straightening of structural steel with the use of heat, within the scope of this Specification, the VENDOR shall submit a procedure for BUYER approval. Submitted procedures shall be in accordance with AWS D14.1.

3.18.5.6 Qualification of Welding and NDE Procedures

3.18.5.7 Before performing any welding or nondestructive examination (NDE), within the scope of this Specification, the VENDOR shall submit for BUYER approval all welding and NDE procedures per applicable AWS and/or ASTM standards. Test data shall be submitted with procedures when procedure qualification testing is required by AWS D14.1.

3.18.5.8 Welders and Welding Operators, Performance Qualification Records

3.18.5.9 Before assigning any welder or welding operator to the work covered by this Specification, the VENDOR shall provide the names of the welders and welding operators to be employed in the work, together with associated Performance Qualification Records, to the BUYER for approval. These records shall document that each welder and welding operator has passed the qualification test(s) as prescribed by Standard AWS D14.1, for the type of welding operation to be performed, and that such qualifications are effective as defined in AWS D14.1.

3.18.5.10 AVS Procurement Quality Clauses B28 and B31 apply to this procurement.

3.18.5.11 Weld Inspector Qualification

3.18.5.12 Welding inspectors shall be qualified in accordance with ASNT SNT-TC-1A for NDE inspections, and in accordance with AWS QC-1 or SNT-TC-1A for visual inspections. Before assigning any welding inspector or nondestructive examination personnel to the work covered by this Specification, the VENDOR shall provide the associated personnel qualification records to the BUYER for approval.

3.18.5.13 AVS Procurement Quality Clause B25 applies to this procurement.

3.18.5.14 Weld Inspections

3.18.5.14.1 All weld inspection reports for load bearing weldments shall be submitted to the BUYER for approval.

3.18.5.14.2 The inspections shall include at a minimum the following:

- Names of Project and manufacturer
- Weld inspection number
- Component description and weldment number
- Reference to applicable calculations tied to the weldment
- Name and signature of BUYER approved welder(s)
- Certification number, name and signature of BUYER approved weld inspector(s)
- Reference to BUYER approved weld procedure used in weldment
- Reference to BUYER approved weld inspection procedure used in inspection
- Record of heat number or reference to drawing showing heat number and CMTR reference of the materials and weld fillers used in the weldment.
- Inspection findings and results
- Applicable photographs as required
- Additional notes

3.18.5.15 Weld Maps

3.18.5.15.1 Every load bearing weld shall be traceable by heat or lot number to a weld filler material CMTR, weld specification, weld material classification, and representative test results for the diameter(s) used. This can be documented in the VENDOR's standard method per their QAP requirements and submitted to the BUYER for approval.

3.18.5.15.2 Every weld shall be traceable to a welder, weld inspector and date/time. The welder and weld inspector shall sign the document showing what welds they performed/check and that will be submitted as part of the weld map.

3.18.5.16 Certified Material Test Reports

3.18.5.16.1 The VENDOR shall provide Certified Material Test Reports per section 3.18.5.22.7

3.18.5.17 VENDOR Test Procedures

3.18.5.17.1 Factory Acceptance Test (FAT) Procedure:

The FAT procedure shall follow the requirements ASME NOG-1 - 2010 and ASME NQA-1a 2008/2009 Addendum Part II-Subpart 2.15 and shall verify that all of the specification requirements are met. When discrepancies are found between the requirements, the specification takes precedence. The crane shall be assembled to the maximum extent that is reasonably achievable for the FAT. The test procedure shall include identification of personnel, recorded test data, records of certification of test equipment, acceptability of test data, observed test conditions, and locations for BUYER inspection personnel to sign and date for satisfactory performance of test step. The test procedure shall identify where temporary wiring, temporary parameter adjustments, or other test equipment (e.g. switches installed to simulate limit switches) will be required for performance of this test.

At a minimum, this testing shall include the following:

- Verify proper operation of all drive controllers and motors
- Verify proper operation of all brakes
- Verify proper operation of all limit switch and safety device circuits
- Verify proper operation of all indicating lights and warning devices
- Verify proper operation of all test, bypass, and diagnostic components
- Verify dimensions that define the crane envelope
- Verify dimensions and check/certify no interferences between bridge or trolley and the identified building structures (accounting for wheel float)
- Verify CCTV system operation
- Verify lockout of controls
- Verify correct operation of emergency stops
- Verify correct operation of bridge and control station indications

3.18.5.17.2 Site Acceptance Test Procedure:

This test procedure shall verify that the provided equipment meets the specification requirements and has been properly installed and set up per the VENDOR's drawings.

When developing site acceptance test procedures, the VENDOR shall pay particular attention to the testing of items that could not be checked during factory acceptance testing. The testing of these items shall include additional instructions, as necessary, to ensure proper fit-up and function of these items.

The test procedure shall include identification of participating personnel, recorded test data, acceptability of test data, observed test conditions, and locations for BUYER inspection personnel to sign and date for satisfactory performance of step. The test procedure shall not include energized electrical

work or other work that poses safety concerns to personnel performing the work, unless otherwise approved by the BUYER.

At a minimum, this testing shall include the following:

- Verify proper operation of all drive controllers and motors
- Verify proper operation of all brakes
- Verify proper operation of all limit switch and safety device circuits
- Verify proper operation of all indicating lights and warning devices
- Verify proper operation of all test, bypass, and diagnostic components
- Measurement of lift height and hook approaches
- Verify minimum and maximum operating speeds
- Verify CCTV system operation
- Verify lockout of controls
- Verify correct operation of emergency stops
- Verify correct operation of bridge and control station indications

3.18.5.18 Completion of Crane Testing Report

3.18.5.18.1 This report shall include signed copies of the following to show that all testing has been satisfactorily completed:

- Factory Acceptance Testing
- Site Acceptance Testing
- Maintenance Inspection
- Load Testing
- Reliability Testing

3.18.5.19 Non-Conformance Reports

Nonconformance reports shall be used by the VENDOR to track all nonconforming items. They shall be submitted in accordance with section 3.16.

3.18.5.20 Commercial Grade Item Dedication (CGD) Reports

Commercially dedicated items shall be identified, evaluated, and meet ASME NQA-1 Subpart 2.14 requirements.. The dedication reports shall be submitted to the BUYER for approval. The approved CGD reports shall be part of the quality documentation packaged delivered with the crane. For further details see section 4.6.4.

3.18.5.21 Technical Manual

3.18.5.21.1 At a minimum, the Technical Manual shall include the following:

- Table of Contents
- Detailed Crane Operating Instructions
- Instructions for performing manual movement of all crane motions
- Hoist and travel brake settings – including allowable adjustment tolerances

- Required Preventative Maintenance, including a complete listing of all lubricants, as installed, a table showing recommended lubricants for specific temperature ranges and applications, a lubrication schedule showing service interval frequency, and charts with schematic diagram(s) of the equipment showing lubrication points, recommended types and grades of lubricants, and lubrication levels and capacities.
- Drawing List
- Catalog Cut Sheets
- All required material testing for above listed items including impact, hardness and chemical properties (CMTR's).
- Component manufacturer's literature for maintenance, adjustment, inspection, troubleshooting, and repair instructions.
- Instruction manuals for computer controlled or processor-controlled components and systems (including variable frequency drives, weight indicating systems, etc.) installed on the crane
- Recommended Spare Parts List for commissioning and for one year of operation
- Detailed instructions on removal and replacement of the barrel coupling, speed reducer, and wire rope drum (applicable only if a barrel coupling is used in the hoist design)
- Photographs of motor and gearbox OEM nameplates.

3.18.5.21.2 Two paper copies and one electronic copy of the approved technical manual shall be provided to the BUYER.

3.18.5.22 Certifications

The VENDOR shall provide certifications for the following to the BUYER. The certifications shall identify the crane, component, calibration identification for measuring and test equipment, date, and original signature of the authorized representative of the VENDOR. Measurements shall be obtained with appropriate equipment which shall be calibrated and traceable to National Institute of Standards and Technology (NIST) or other nationally recognized standards.

3.18.5.22.1 Certificate of Conformance

The VENDOR shall certify that items(s) or services(s) delivered under this specification and associated Purchase Order conforms in all respects to the requirements. Certificate of Conformance (C of C). shall be complete, accurate, legible, and reproducible. Incomplete or inaccurate certifications will be refused. Each certification shall be issued by the designated VENDOR certifying authority in accordance with established VENDOR QA Program or other certification procedures. Unless otherwise authorized, the VENDORS C of C shall be submitted With Shipment (WS) to the shipping destination. Acceptance of the VENDOR generated Certificate of Conformance (COC) form rests with the Buyer's Quality Assurance organization.

3.18.5.22.2 Wire Rope Certification

The VENDOR shall provide the wire rope manufacturer's certifications and test reports that the ropes meet the published breaking strengths and that the actual breaking strengths are greater than or equal to the published breaking strengths.

3.18.5.22.3 End Socket Certification

The Seller shall provide the wire rope end socket NDE records and records of a non-destructive proof test for the finished wire rope, with sockets installed, per ASTM A931 with a proof load of 200% of Working Load Limit.

3.18.5.22.4 Hook Test Reports

The Seller shall submit certified reports of the hook and swivel-eye NDE and proof tests as required.

3.18.5.22.5 Periodic Load Testing Certification

The VENDOR shall provide certification that all provided components are capable of periodic (annual or after repairs) load testing at 125% of specified capacity without any detrimental effects on the equipment and continued validity of the VENDOR's warranty.

3.18.5.22.6 Hazardous Materials Certification

The VENDOR shall provide certification that the provided material contains no asbestos, lead paint, Polychlorinated Biphenyl's (PCB's), or elemental mercury.

3.18.5.22.7 Material Certification

The VENDOR shall supply a certified material test report for every piece of structural steel and weld filler material in the load path, for material used to fabricate the wire rope drums, and for all material used to fabricate keys. The certified material test report shall identify the item, the material specification, applicable grade and/or type, the heat treat condition, the heat number, actual chemical properties and actual physical properties.

3.18.5.22.8 Gear Reducer Certification

For gear reducers the reducer manufacturer shall provide certification that the reducer meets the applicable AGMA service factor based on the particular crane drive application and crane duty classification.

3.18.5.22.9 Manufacturers Brake Certification

For brakes produced by an independent manufacturer that will undergo testing by that manufacturer to ensure that they meet the intended requirements shall be provided with a certification that these requirements

are met. The VENDOR shall provide this certification to the BUYER as per section 3.10.2.3.

3.18.5.22.10 Suspect/Counterfeit Fastener Certification

All fasteners used on the project are subject to the suspect/counterfeit fastener inspection and require certification provided by the VENDOR.

3.18.5.22.11 Bolted Structural Connections Certification

For bolted structural connections designed per the requirements of the AISC Steel Construction Manual the VENDOR shall provide certification that includes:

- Acceptable torque value range
- Installed Torque Value
- Tool Numbers (If Applicable)
- Signature of the person performing the work
- Suspect counterfeit inspection verification
- Signature of the VENDOR's Quality Assurance representative

3.18.6 Computer Based System Software

3.18.6.1 The VENDOR shall submit all software and associated manuals required to operate and maintain all computer controlled or processor-controlled components and systems that are installed on the crane.

3.18.6.2 Vendor shall provide software licenses, copy of software applications and passwords.

3.18.6.3 These shall include any VENDOR-compiled programs and third-party applications required to modify, edit, upload, download, and communicate between a computer, and the crane drives and/or any display or other devices installed on the crane.

3.18.6.4 Instruction manuals for computer controlled or processor controlled components, CCTV components, and systems installed on the crane shall also be included in the crane Technical Manual.

3.18.6.5 Final Drawings

3.18.6.5.1 The VENDOR shall submit all revised (final) drawings for BUYER approval. Final drawings and calculations shall match the final configuration of all Weather Enclosure Crane structures, systems and components including electrical, instrument and controls including any changes made during crane component installation. All change notices shall be incorporated into final drawings and calculations.

3.18.6.5.2 The BUYER will perform verification that final drawings match the configuration of equipment prior to final acceptance. Discrepancies shall be corrected by the VENDOR at no additional cost to the BUYER.

3.18.6.5.3 The as-built drawings shall include the hook approach, with respect to the end stops and runway rail, and lift height dimensions from the floor. Measurements shall be taken by the VENDOR after installation and setup.

3.18.6.6 Release for Use

3.18.6.6.1 Subsequent to successful completion of Reliability Testing the VENDOR shall submit a letter to BUYER releasing the crane for productive use.

3.18.6.7 Final Data Package

3.18.6.7.1 The VENDOR shall prepare a documentation Final Data Package. The package shall include the final version of all the items listed in Section 3.18. Drawing and Calculation Paper Copies and CDs

3.18.6.7.1.1 The VENDOR shall submit one full size paper copy of all final approved drawings.

3.18.6.7.1.2 The VENDOR shall submit a paper copy of all final design calculations.

3.18.6.7.1.3 The VENDOR shall also submit all final approved drawings on CD(s) in AutoCAD .dwg format and a separate copy in .pdf format. The CD(s) shall include an index of all drawings.

3.18.6.7.1.4 The VENDOR shall submit all final approved calculations on CD(s) in .pdf format. The CD(s) shall include an index of all calculations.

4.0 QUALITY ASSURANCE REQUIREMENTS

Top level Quality Assurance Requirements are summarized on form A-6006-661. All specific requirements of NQA-1 Part I and Part II that apply to this procurement have been identified on this document.

4.1 General

4.1.1 This section delineates the quality assurance (QA) requirements and processes that will be utilized to execute this contract. Additional QA requirements may be delineated in the design documents and other contractual documents.

4.1.2 Below are the identified AVS Quality Clauses that are applicable to this procurement:

B13	FABRICATION/INSPECTION/TEST PLAN
B15	SUPPLIER USE OF COMMERCIAL-OFF-THE-SHELF SOFTWARE
B16	SOURCE INSPECTION
B18	SUPPLIER USE OF SPREADSHEET CALCULATIONS USING COMMERCIAL-OFF-THE-SHELF SOFTWARE
B22	NONCONFORMANCE DOCUMENTATION AND REPORTING
B25	CERTIFIED WELD INSPECTOR (CWI)
B28	WELDING PROCEDURES AND QUALIFICATIONS
B31	NONDESTRUCTIVE EXAMINATION PROCESS
B34	IDENTIFICATION OF ITEMS
B37	IDENTIFICATION AND TRACEABILITY OF ITEMS
B43	IDENTIFICATION OF AGE CONTROL ITEMS
B49	CERTIFIED MATERIAL TEST REPORT
B52	INSPECTION AND TEST REPORT
B61	CERTIFICATION OF CALIBRATION
B65	NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) LISTED OR LABELED
B66	NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) LISTED OR LABELED COMPONENTS IN A SYSTEM
B73	CONTROL OF GRADED FASTENERS
B76	PROCUREMENT OF POTENTIALLY SUSPECT OR COUNTERFEIT ITEMS
B79	CERTIFICATE OF CONFORMANCE
B80	CERTIFICATE OF CONFORMANCE FOR COMMERCIAL GRADE SURVEYED PROCUREMENTS
B82	RECOMMENDED SPARE PARTS LISTING
B85	PACKAGING/SHIPPING PROCEDURES

4.1.3 The VENDOR agrees to incorporate the appropriate QA requirements of this section and those requirements specified elsewhere in the contract into their subcontracts and purchase orders for flow down to all lower-tier manufacturers and suppliers utilized in the performance of this contract, as the QA requirements apply for the services or items being provided. The VENDOR shall communicate these QA requirements to their personnel, suppliers, and

lower-tier manufacturers so that items and work activities provide for safe and reliable construction.

- 4.1.4 The VENDOR shall provide access to its facility, documents and records, applicable to the performance of this contract for BUYER's review and assessment. The VENDOR shall flow down this "right of access" requirement to its sub-tier manufacturers and suppliers. The VENDOR shall coordinate the review or assessment of sub-tier manufacturers and suppliers' facilities, documents and records with the BUYER.
- 4.1.5 The VENDOR is required to have and use a quality assurance program that is consistent with the requirements of ASME NQA-1, Quality Assurance Requirements for Nuclear Facility Applications, including applicable addenda requirements. The VENDOR's QA program will be reviewed, evaluated, and approved by the BUYER through an onsite audit and has been added to their Evaluated Supplier List (ESL) prior to award of the contract.
- 4.1.6 If selected for oversight by the BUYER, BUYER personnel will co-ordinate with the VENDOR to conduct scheduled and periodic oversight of activities or products associated with this scope of work.

4.2 Inspection and Testing

- 4.2.1 Inspections and testing including the documentation required by the contract shall be performed by qualified VENDOR Quality Control personnel or third party, who is independent of the work being performed. Quality Control personnel or third party shall be trained and qualified in accordance with the VENDOR's or third party approved QAP.
- 4.2.2 AVS Quality Clause B13 applies to this procurement.
- 4.2.3 The VENDOR shall develop and submit work control documents (e.g., fabrication, inspection, and test plans) for items to be fabricated by the VENDOR or their lower-tier supplier. The work control document shall delineate details for performing the fabrication including inspections and testing required by the contract. The BUYER will identify BUYER's required inspection points, including third party inspections, during review of the work control documents.
- 4.2.4 The VENDOR shall submit completed fabrication work control documents to the BUYER for approval. The VENDOR shall perform a final acceptance review to verify that all steps have been completed and that required documentation (e.g., weld inspection reports, installation inspection reports, material inspection reports, coating inspection reports, electrical inspection reports [continuity resistance test, megger tests, etc.]) has been included. Final acceptance shall be signified by signature and date on the work control document.

4.3 Inspection of Work

4.3.1.1 General

- 4.3.1.1.1 The VENDOR is responsible for the performance of all inspections necessary to assure the supplies and services provided to the BUYER conform to all Contract and Specification requirements.
- 4.3.1.1.2 The BUYER reserves the right to witness or perform any inspections it deems necessary to assure such conformance. All BUYER inspections shall be in addition to those required by the VENDOR, and shall not relieve the VENDOR of any inspection responsibility.
- 4.3.1.1.3 Completed inspection reports and inspection data sheets shall be provided at BUYER request and all completed inspection reports and inspection data sheets shall be included in the submitted Quality Assurance Documentation Package.

4.3.1.2 Calibration System

The VENDOR shall implement and maintain a calibration system in accordance with ISO/IEC 17025:2005, General Requirements for the Competence of Testing and Calibration Laboratories; or as an alternative, a calibration system that complies with ANSI/NCSL Z540-3 Requirements for the Calibration of Measuring and Test Equipment. The BUYER may accept accreditation of the VENDOR's calibration system if the identified accredited body is recognized by either the National Cooperation for Laboratory Accreditation (NACLA) or the International Laboratory Accreditation Cooperation (ILAC) in lieu of BUYER review and approval. AVS Quality Clause B61 applies to this procurement.

4.3.1.3 Welding

- 4.3.1.3.1 Weld inspections shall be performed for all completed welds prior to priming and painting. All inspections shall be fully documented and submitted for approval. The inspection, and when applicable, test record documents shall include as a minimum: reference to the test or inspection procedure used, acceptance criteria, identification of the item or weld tested, test results, and identification of the personnel performing the test/inspection.
- 4.3.1.3.2 Weld inspection and acceptance criteria shall be in accordance with AWS D14.1. All load bearing welds shall be considered primary welds per AWS D14.1.
- 4.3.1.3.3 All welds shall be visually inspected and satisfy the acceptance criteria of AWS D14.1.
- 4.3.1.3.4 In addition to visual inspection, all primary welds shall be magnetic particle (MT) inspected for 100 percent of the length of each weld and satisfy the requirements of AWS D14.1 and ASTM E709, Standard Guide for Magnetic Particle Testing.

4.3.1.3.5 In addition to visual and magnetic particle inspection, all full penetration primary welds shall be ultrasonically examined for 100 percent of the length of each weld and satisfy the acceptance criteria of AWS D14.1.

4.3.1.3.6 Visual inspection of welds shall be performed by Certified Welding Inspectors (CWIs) qualified in conformance to the provisions of AWS QC1. Magnetic particle and ultrasonic inspection of welds shall be performed by inspectors qualified in accordance with ASNT SNT-TC-1A.

4.3.1.3.7 All weld inspection (NDE Reports) shall be submitted for approval.

4.3.1.4 Steel Forging Examination

4.3.1.4.1 Steel forgings will be examined by ultrasonic examination. The inspections shall follow ASTM A388 Standard Practice for Ultrasonic Examination of Steel Forgings.

4.3.1.5 Electrical

4.3.1.5.1 After electrical installation and wiring has been completed, the VENDOR shall inspect electrical components to verify compliance with this specification. The electrical inspection reports shall be provided to the BUYER for approval. Attention should be paid to the following areas of inspection:

- Electrical fabrication and wiring matches what is shown on the design drawings.
- Electrical terminals on terminal boards or other electrical components are not used for more than one conductor unless supporting documentation is on hand to show the terminal is rated for the number and size of conductors landed on it. The VENDOR shall compile a table listing all instances where electrical terminals are used for more than one conductor and attach all supporting documentation.
- Electrical components and wiring are labeled in accordance with specification requirements.
- Equipment clearances are met as required by this specification, by design and safety standards, and as required by component manufacturers for components such as transformers, resistors, electrical enclosures,
- Ground wires are routed with all ungrounded conductors (limit switches, etc.)
- Conduit is supported in accordance with NEC requirements.

4.3.1.6 Safety/Access

4.3.1.6.1 Prior to the final BUYER source inspection, the VENDOR shall inspect crane access areas (e.g. walkways, ladders, stairs, guardrail systems) to verify these areas meet the requirements of this specification and provide a report of the completed inspection to the BUYER. This includes but is not limited to the following:

- Gaps between guardrails and adjacent structures are less than 2" where a fall hazard exists

- Openings in walkways and platforms are protected according to specification requirements.
- Guards on rotating machinery are installed per specification requirements.
- Ladder clearances meet applicable requirements.

4.3.1.7 Source Inspection

- 4.3.1.7.1 The VENDOR shall provide sufficient time for the BUYER representatives to perform source inspections of the cranes. Mechanical, structural, and electrical assemblies will be inspected to verify fabrication was performed in conformance with design drawings, specification requirements, and component manufacturer recommendations.
- 4.3.1.7.2 After fabrication has been completed, the BUYER representatives will perform a final source inspection at the VENDOR's facility. The VENDOR shall ensure at least 2 working days are available for the crane for the final source inspection. Additional days may be required at no additional cost to the BUYER if the final source inspection warrants additional inspections or issues resolution.
- 4.3.1.7.3 Each crane shall be fully assembled for the final BUYER source inspection, unless otherwise approved by BUYER. Full access to the crane, including the trolley, shall be available. Provisions for lockout/tagout of the crane power shall also be available for this inspection.
- 4.3.1.7.4 AVS Quality Clause B16 applies to this procurement.

4.3.2 Prerequisites to Equipment Delivery

- Source Inspections have been completed by the BUYER and all identified deficiencies resolved.
- Factory Acceptance Testing has been completed and all identified deficiencies resolved.
- Crane Technical Manual has been submitted to the BUYER.
- All VENDOR certifications listed in section 3.18.5.22 have been received.
- The Quality Documentation Package has been submitted and approved by the BUYER.
- Upon approved request, the BUYER will provide written release to the VENDOR allowing delivery of equipment.

4.3.3 Manufacturing Hold Points

4.3.3.1 Painting

- 4.3.3.1.1 The VENDOR shall notify the BUYER not less than five working days prior to painting any weldment. The BUYER may, at its option, perform a source inspection at this hold point. This inspection will inspect the material condition and readiness for paint as well as the exposed welds.

4.3.3.2 Welding

- 4.3.3.2.1 The VENDOR shall notify the BUYER no less than five working days prior to the first weld for the crane load bearing components (i.e. girders and end

trucks). The BUYER may, at its option, perform a source inspection at this hold point.

4.3.3.2.2 The VENDOR shall notify the BUYER no less than five working days prior to closing up any weldment on load bearing components that would make the internal welds inaccessible for inspection. The BUYER may, at its option, perform a source inspection at this hold point.

4.3.3.2.3 The VENDOR shall not close up any weldment that would make internal welds inaccessible for inspection without written release from the BUYER.

4.3.3.3 Hoist Brake Testing

4.3.3.3.1 The VENDOR shall notify the BUYER not less than five working days prior to performance of the hoist primary and secondary brake torque testing at the brake manufacturer's facility such that the BUYER may, at its option, witness this testing.

4.3.3.4 Factory Acceptance Testing

4.3.3.4.1 The VENDOR shall notify the BUYER not less than five working days prior to performance of crane factory acceptance testing.

4.4 Receipt Inspection

4.4.1 VENDOR's procured permanent plant items shall be receipt-inspected by the VENDOR in accordance with their QAP prior to delivery to the work site. Items may be receipt inspected at the site shops but prior to delivery at the installation area.

4.4.2 When VENDOR fabricates BUYER permanent plant items, the Fabrication Work Control Document shall identify the final inspection(s) necessary for the BUYER to accept the fabrication. The BUYER's inspection personnel shall perform final inspection(s). The BUYER's inspection personnel shall indicate final acceptance of the fabricated item on behalf of the BUYER. Normally, application of an acceptance tag will indicate acceptance and authorize the VENDOR to install the fabricated item.

4.4.3 When BUYER permanent plant items are provided, the VENDOR shall inspect and document all furnished items prior to accepting custodial responsibility. Discrepancies identified during inspection shall be immediately brought to the BUYER's attention. The inspection shall include as applicable:

- Labels, tagging and/or general identification of items.
- Quantity of items received.
- Any visible damage to packaging (e.g., water marks, oil stains, crushed container, etc.).
- Any visible damage to items (e.g., corrosion, scaling, cracks, broken pieces, obstruction or damage to rotating equipment, etc).
- Condition of visible coatings and/or paint.
- Protective covers and seals installed.
- Cleanliness of items.

4.5 Non-compliances and Non-conformance

- 4.5.1 The VENDOR shall assure that services and processes that do not meet the requirements of the contract are identified, mitigated or controlled, and corrected. Non-compliances that have significant cost, schedule, quality, safety, health or environmental implications shall be investigated to determine the extent of the noncompliance and its causes.
- 4.5.2 The VENDOR shall verify that actions taken to correct non-compliances are complete and adequate to prevent recurrence. The relevant responses, actions required, verifications, and other documentation shall be transmitted to the BUYER upon closure.
- 4.5.3 The VENDOR shall either correct nonconforming items immediately, or control them to prevent inadvertent use, installation, or testing.
- 4.5.4 The VENDOR shall control nonconforming items by segregating affected items in a clearly identified and designated hold area, marking or tagging the items to indicate they are nonconforming, or instituting other measures approved by the BUYER.
- 4.5.5 The VENDOR shall notify the BUYER for approval whenever nonconforming items cannot be restored to their original, specified condition (i.e., nonconformance dispositioned "REPAIR" or "USE-AS-IS").
- 4.5.6 In selected cases, nonconforming item may be conditionally released for work or installation provided the nonconforming condition is not affected and the corrective action can still be performed. The BUYER shall be notified of such cases to authorize a conditional release. Otherwise, nonconforming items shall not be released until corrective actions have been completed and verified.

4.6 VENDOR Procurement of Safety Significant Items/Materials

- 4.6.1 Items designated by the BUYER as Safety Significant (SS) shall be procured by the VENDOR when contractually indicated to do so in the Statement of Work.
- 4.6.2 SS items shall be procured to Full Quality Assurance level as described in this document.
- 4.6.3 AVS Quality Clause B80 applies to this procurement.
- 4.6.4 When the SS item or material is procured from an evaluated supplier on BUYER's Evaluated Supplier List (ESL), the procurement must be conducted strictly in the following manner.
 - The SS item or material must be available from a supplier listed on the BUYER's ESL or requires BUYER approval.
 - The Safety Significant item or material must be within the scope of provision of the ESL supplier, as indicated on the ESL (e.g., pipe is provided by pipe suppliers, not by structural steel suppliers).
 - For SS purchases from vendors not on the VENDOR ESL, the VENDOR submits for BUYER approval a proposed procurement document specifying the SS item or material,

the intended supplier, the Quality Assurance requirements, the BUYER's safety classification, the procurement quality clauses to be invoked, and acceptance criteria at receipt.

NOTE: the BUYER's Procurement Quality Clauses (i.e., "B" clauses) shall be used as a shortcut method for delineating the VENDOR's procurement requirements to the supplier.

- The Quality Assurance requirements listed on the VENDOR's proposed procurement document must equal the Quality Assurance requirements specified for the supplier on the BUYER's ESL.

4.6.5 When the SS item or material is not available from a supplier on the BUYER's ESL, the SS item or material must undergo a commercial grade item dedication. The provisions of ASME NQA-1 2008/2009 Addendum Part II Subpart 2.14 requirements for Commercial Grade Items (CGI) shall not apply to the VENDOR unless the VENDOR's QA program is approved by the BUYER to perform commercial grade dedication. The VENDOR may procure items or materials that are intended for dedication by the BUYER. The dedication process for such materials shall be in accordance with the BUYER's process.

To facilitate the procurement of items or materials that are intended to be dedicated, the VENDOR must submit their proposed procurement document (part of the CGD) to the BUYER for approval before ordering, in accordance with the following.

- The BUYER identifies the critical characteristics for the item or material. Critical characteristics for CGI shall be formally identified on a BUYER-provided form (A-6002-544). A CGI dedication plan shall be prepared and approved by the BUYER and furnished to the VENDOR prior to the VENDOR ordering items or material to be dedicated.
- The VENDOR submits for BUYER approval a proposed procurement document specifying the CGI item or material, the BUYER's CGI dedication plan number, the intended supplier, the Quality Assurance requirements, the procurement quality clauses to be invoked, and acceptance criteria at receipt.

NOTE: The acceptance criteria for receipt may relate to one or more critical characteristics for the item or material identified by the BUYER. In such an instance, VENDOR receipt-inspection activities may need to be repeated by qualified BUYER personnel during processing of the CGI dedication plan package. The VENDOR shall review the BUYER's CGI dedication planning documentation to ensure that inspections at receipt in the VENDOR's facility are coordinated with BUYER inspection personnel.

- The VENDOR shall order the SS item or material upon receipt of written authorization from the BUYER.

NOTE: VENDOR's personnel, equipment, and facilities may be required to conduct CGI dedication. Inspections or tests called for by the BUYER's CGI dedication plan shall be performed only by qualified BUYER personnel. VENDOR personnel may assist BUYER personnel, but VENDOR personnel may not sign the BUYER's CGI dedication

documentation for methods of accepting commercial grade items and acceptance of critical characteristics.

4.7 Suspect/Counterfeit Items

Items furnished for this subcontract shall not include Suspect/Counterfeit Items (SCI) nor shall such items be used in performing any work under this subcontract. The VENDOR shall implement the following requirements:

- 4.7.1 Assure adequate controls are in place to prevent delivery of suspect/counterfeit items to the project site.
- 4.7.2 The VENDOR shall verify during receipt inspections of items that none of the characteristics of suspect/counterfeit items are present. These characteristics are described in TFC-ESHQ-Q_C-C-03.
- 4.7.3 Include the SCI requirements in all purchasing agreements, lower-tier subcontracts, suppliers, and rental or leasing agreements.

4.8 Measuring and Test Equipment

- 4.8.1 Measuring and Test Equipment (M&TE) shall be properly calibrated, maintained, and controlled. When M&TE is used to perform inspections and tests, the M&TE calibration certificate shall be included with the inspection and test report.
- 4.8.2 Perform calibration at specified intervals based on the type of equipment, required accuracy, range, frequency of use, stability characteristics, and other conditions affecting performance. Calibration shall have accuracy traceable to national standards (where they exist), and calibration standards shall have the accuracy to ensure that the M&TE will have the required tolerances. Maintain records and mark equipment to show calibration status.
- 4.8.3 When M&TE is found to be out of calibration, the VENDOR shall have a method to identify its use since the last calibration and methods to re-verify acceptability of items previously tested.

4.9 Acceptance Criteria

All design, fabrication, and testing shall meet or exceed the acceptance criteria contained in this Specification and referenced codes and standards. Deviations from acceptance criteria shall be reported and resolved as described below. The definition of quality levels for LAWPS design & fabrication is provided below:

- Full Quality Assurance (FQA): Level of controls applied for items, services, or processes that are commensurate with the controls invoked under ASME NQA-1 or other appropriate national consensus standard.

- Enhanced Quality Assurance (EQA): Levels of controls for those items, services, or processes where, based on an evaluation of risk or nuclear safety, additional controls beyond the providers published or stated attributes of the item, service, or process are needed to verify critical attributes.
- Commercial Quality Assurance (CQA): Level of controls for those items, services, or processes where, based on an evaluation of risk or nuclear safety, no additional quality controls beyond the providers published or stated attributes of the item, service, or process is required. Methods used to accept an item or service shall be a Certificate of Conformance, source verification, receiving inspection, Factory Acceptance Test (FAT), or post installation test on site, or a combination of these methods.

4.10 Certificate of Conformance:

1. AVS Quality Clause B79 applies to this procurement.
2. The certificate shall identify the purchased material or equipment, such as by purchase order number.
3. The certificate shall identify the specific procurement requirements met by the purchased material or equipment, such as codes, standards, and other specifications. The procurement requirements identified shall include any approved changes, waivers, or deviations applicable to the subject material or equipment.
4. The certificate shall identify any procurement requirements that have not been met, together with an explanation and the means for resolving the nonconformance.
5. The certificate shall be signed or otherwise authenticated by a person who is responsible for the quality assurance function and whose function and position are described in the VENDOR's Quality Assurance Program.
6. The certification system, including the procedures to be followed in filling out a certificate and the administrative procedures for review and approval of the certificates, shall be described in the VENDOR's Quality Assurance Program.
7. Means shall be provided to verify the validity of the VENDOR's certificates and the effectiveness of the certification system.
8. Verification of VENDOR's certificates and certification system shall be conducted at intervals commensurate with the VENDOR's past quality performance.
9. In certain procurement actions that do not involve source verification, an item or service may be accepted from a VENDOR based on a receiving inspection and a VENDOR's Certificate of Conformance stating that the specified requirements have been met and any specific supplemental documentation, such as material certificates or reports of tests performed, may be required by procurement documents. Acceptance by this method is satisfactory when the item or service is of simple design and involves standard materials, processes, and tests.

4.11 Verification

Design verification shall be performed for the Weather Enclosure Crane to ensure the design adequately meets design criteria, the design is technically adequate, and the design meets applicable requirements for quality, safety, and performance. The VENDOR shall have

responsibility for the performance and documentation of all design verifications associated with this specification. The Vendor shall submit to the BUYER a report for total design verification.

4.11.1 Responsibility for Verification

4.11.1.1 All verification documents will be submitted to the BUYER for approval.

4.11.2 Verification Methods

4.11.2.1 The LAWPS design shall be verified in accordance with the VENDOR's NQA-1 compliant design verification procedures.

4.11.3 Quality Documentation Package

4.11.3.1 A quality documentation package shall be provided as part of the technical manual with the final Data Package. It shall be compiled with the items listed in Section 3.18.5.22

4.11.3.2 All items of technical documentation shall be organized in a logical manner and shall identify the crane part or component to which they apply.

4.11.3.3 The VENDOR shall submit one hard copy of the approved quality documentation package to the BUYER.

4.12 Testing

4.12.1 General

4.12.1.1 AVS Quality Clause B13 and B52 applies to this procurement.

4.12.2 SAT Load Testing

4.12.2.1 Prior to Load Testing of the crane at the LAWPS facility, the VENDOR shall submit for BUYER approval the Bolted Structural Connections Certification.

4.12.2.2 Load testing shall be performed by the VENDOR and will include static and dynamic load testing of crane. This will include traversing of the main trolley and auxiliary trolley simultaneously.

4.12.2.3 The VENDOR provided wire rope break in procedure shall be performed in conjunction with load testing.

4.12.2.4 The VENDOR shall provide a test director, written procedure, operators, riggers, mechanics, electricians, and other technical personnel as needed to provide operation and testing of the crane.

4.12.2.5 The BUYER will provide the inspection personnel, certified test weights, and rigging gear to perform the Load Test.

- 4.12.2.6 Load testing will include a Loss of Power Test (Panic Test). While lowering a test load of 100% (+0/- 5) of rated capacity at a slow speed, the main disconnect switch [MDS] will be opened to verify proper reaction of a hoisting unit in the event of a power failure during a lift.
- 4.12.2.7 Dynamic testing of the hoist secondary brake will be performed by simulating a broken shaft while lowering a test load of 100% (+5/-0). The hoist primary brake will be disabled to verify the secondary brake stops the load.

4.12.3 SAT Reliability Testing

- 4.12.3.1 Reliability testing shall be performed per VENDOR written procedure and will include repetitive operations with varying test weight up to rated crane capacity. This testing will involve all hoist and travel motions at varying speeds.
- 4.12.3.2 VENDOR will provide the written procedure, a test director, operators, riggers, inspection personnel, and rigging gear to perform Reliability Testing. The crane will be operated by BUYER operators during Reliability Testing.
- 4.12.3.3 The VENDOR shall provide training to the BUYER operators in conjunction with Reliability Testing in order to ensure a safe transition of operations from crane VENDOR to BUYER operators. The VENDOR shall also provide technical assistance if needed to achieve successful completion of Reliability Testing.

4.12.4 Prerequisites to Factory Acceptance Testing

- 4.12.4.1 Prior to factory acceptance testing of the crane at the VENDOR's shop facility, the VENDOR shall submit the Factory Acceptance Test procedure for BUYER approval.
- 4.12.4.2 The crane shall be assembled to the maximum extent that is reasonably achievable for factory acceptance testing. The assembly status of the crane shall be as specified in the FAT procedure.
- 4.12.4.3 Initial settings for motor drives and other programmable devices shall be submitted for BUYER approval prior to FAT testing.
- 4.12.4.4 The crane VENDOR shall verify, prior to FAT, that all adjustable settings for hoist and travel brakes are within the allowed adjustment tolerances.
- 4.12.4.5 The crane electrical system shall be inspected to the design prints and ensured that the system matches the plan and is completely operational. This report shall be included as part of the FAT.
 - 4.12.4.5.1 The electrical inspection shall include insulation, continuity and grounding test.
- 4.12.4.6 To the extent practical, the crane VENDOR shall perform a run through of the factory acceptance test steps prior to BUYER arrival.

4.12.5 Factory Acceptance Testing

- 4.12.5.1 BUYER representatives will witness VENDOR performance of the Factory Acceptance Testing of the crane.

- 4.12.5.2 The crane shall be fully assembled, wired, and shop tested in the VENDOR's shop prior to shipment. Testing will utilize the electrification systems to be provided for the crane, and shall include testing of all control functions and safety features. Tests shall be performed using both primary and back-up control systems that will operate the crane when it is placed in service. Load testing will be performed in the VENDORS shop and after reassembly of the crane system in the field. Shop testing does not require full pick height.
- 4.12.5.3 If the equipment performance is found to be unsatisfactory during testing or operation, due to any deficiency in the VENDOR's equipment, the VENDOR shall make the necessary repairs/adjustments at no additional expense to the Buyer. If any supplementary tests are required as a result of such a deficiency, the VENDOR shall provide all additional testing equipment and instruments, furnish testing personnel, and incur all expenses connected with the supplementary tests.
- 4.12.5.4 Computer Analyses
When used for equipment design, computer analyses shall incorporate the following requirements:
 - 4.12.5.4.1 The program title and version along with a concise description of program approach, methodology, and assumptions shall be shown in the submittal.
 - 4.12.5.4.2 Computer program inputs shall be clearly and fully defined. The model used in the analysis is included and any application default settings that were changed are noted.
 - 4.12.5.4.3 Input data files, output data files, and document files shall be provided on CD/DVD ROM or submitted electronically to the BUYER.

4.12.6 Design Reviews

- 4.12.6.1 General Design Review
 - 4.12.6.1.1 Following the VENDOR's initial submittal, and BUYER review of the Arrangement drawings, the VENDOR shall conduct an 8-hour (one-day) design review conference at the BUYER site, at no additional cost to BUYER, to identify and resolve problems early in the design phase of the contract.
 - 4.12.6.1.2 Prior to the design review, the VENDOR shall submit an agenda to the BUYER for review and approval. The agenda shall contain sufficient detail for the BUYER to determine that all relevant topics will be properly covered.
 - 4.12.6.1.3 The VENDOR shall be prepared, at a minimum, to present to the review team a discussion of selection of components for commonality and ease of maintenance; and the failsafe devices and features, and safety factors utilized.
- 4.12.6.2 Seismic Design Review
 - 4.12.6.2.1 Following the VENDOR's initial submittal, and BUYER review, of the seismic dynamic structural analysis calculations, the VENDOR shall conduct a 16-hour

(two-day) design review at the VENDOR's site, at no additional cost to BUYER, to identify and resolve problems early in the design phase of the contract.

- 4.12.6.2.2 Prior to the design review, the VENDOR shall submit an agenda to the BUYER for review and approval. The agenda shall contain sufficient detail for the BUYER to determine that all relevant topics will be properly covered.
- 4.12.6.2.3 VENDOR shall provide the seismic model in native software electronic format to BUYER upon request, so buyer's structural engineers can perform independent evaluation of seismic model results is desired.

4.12.7 Fabrication

- 4.12.7.1 Fabrication shall be in accordance with the approved drawings. All weld repairs shall be in accordance with AWS D14.1 or AWS D1.1. All weld repairs will require BUYER approval prior to the work being performed.

5.0 PREPARATION FOR DELIVERY

5.1 General

VENDOR shall receive, clean, package, store, preserve, handle, and ship Structures, Systems and Components to protect against physical damage, or any effect that would affect quality or cause deterioration at all times while items are located on the VENDOR's premises in accordance with ASME NQA-1-2008/2009A, Quality Assurance Requirements for Nuclear Facility Applications, Part II, Subpart 2.2, QA Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Facilities. Classification of items and packaging will follow the guidelines of ASME NQA-1. All crane components shall be classified as Level B Items. VENDOR shall submit a Packaging, Storage, Shipping, Installation/Lifting/Assembly Plan. These plans shall include all plans, procedures, and drawings that address how items will be packaged, stored, shipped, and handled in accordance with the requirements described throughout this specification.

AVS Quality Clause B85 applies to this procurement.

5.2 Cleanness and Foreign Material Exclusion

Prior to packaging an item, debris/contamination shall be removed using VENDOR's documented and approved standard procedure, unless specified otherwise. The surface shall appear clean and free of organic films and contaminates, when examined in accordance with ASTM A380-78, and show no deleterious contamination when subjected to a wipe test of ASTM A 380-78. Wipe tests shall be made prior to the application of any preservative film (if required to maintain level B level during storage period, prior to installation). Exterior surfaces of the crane shall meet the requirements of Class C Cleanness. The VENDOR shall provide cleaning records that show the item has been cleaned as appropriate prior to packaging.

All equipment openings shall be capped, plugged or sealed in accordance with NQA-1-2008/2009A to prevent entry of foreign material and humidity and protected against corrosion and physical damage.

5.3 Marking

Package marking shall follow the requirements of NQA-1-2008/2009A, Part II Subpart 2.2 and at a minimum shall appear on two sides of a container, preferably on one side and one end. Package markings shall be applied with waterproof ink or paint in characters that are legible.

When information relative to handling and special instructions is required, such information shall be preceded by the word CAUTION in letters that are at least 1/2 in. (12.7 mm), as permitted by package size. Alternatively if tags or labels are used, they shall be affixed to the container using a waterproof adhesive, tacks where practical, or a corrosion-resistant wire.

Clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly. Prior to shipment, all packages shall be clearly and suitably tagged to identify, at a minimum:

1. BUYERS name with destination address
2. VENDOR's name with return address
3. Package numbers showing the Purchase Order (PO) Number followed by the package number and the total number of packages
4. Package contents description
5. Weight of package
6. Center of gravity
7. Parts list (for each package)
8. Handling instructions and stacking limitations, as appropriate
9. Special instructions (Desiccant Inside, Special Inspection, Storage, Unpacking Restrictions, etc.) as appropriate
10. Marking of items not within a container, shall exhibit the above specified information in a location that is in plain unobstructed view.
11. If any hazardous chemicals are included with shipments, the transport vehicle shall display the relevant Department of Transportation labels/placards.

5.4 Shipping and Storage

- 5.4.1 All equipment shall be shipped in accordance with the applicable DOT standards and in an orientation ready for lifting. Additional handling of the equipment to orientate it for lifting is not acceptable.
- 5.4.2 All components, unless specified otherwise in this section or related sections, shall be compatible with being transported by public roadway to contract specified destination. Items shall either be self-supporting or provided with packing and dunnage so as to ensure their stability and protection from damage.
- 5.4.3 VENDOR shall be responsible for all equipment damage which occurs as a result of improper shipping or storage.

5.4.4 Transport and Tie-Down Instructions

- 5.4.4.1 VENDOR shall provide instructions and diagrams for securing all shipping packages. Transportation tie-down points shall be identified on the equipment. Lift points shall not be used for tie-downs. Calculations will be required for the design of all transport tie-down attachment points.

5.4.5 Equipment Delivery to Interim Storage Facility

- 5.4.5.1 All crane components shall be clearly marked with part numbers, quantities and packaged for indoor storage in a non-condensing environment. The BUYER will verify items and quantities in conjunction with packaging.

6.0 INSTALLATION

6.1 Installation, Start-up, and Site Testing

- 6.1.1 The scope of installation shall be performed by the BUYER. The VENDOR shall provide a consultant to assist in planning and execution of the installation. This should be the same consultant who partakes in the start-up and site testing.
- 6.1.2 Installation shall be performed in accordance with the BUYER approved Installation and Lifting Plan.
- 6.1.3 Installation shall be accomplished via the use of external mobile cranes through a hatch in the roof of the facility.
- 6.1.4 Field installed structural fasteners shall be provided in sufficient quantity to accommodate pre-installation tension testing in accordance with the requirements of Section 7 of the AISC/RCSC Specification for Structural Joints Using High-Strength Bolts.
- 6.1.5 Any field changes made during crane installation and start up require the same level of review and approval as the original crane design.
- 6.1.6 The Vendor shall provide an installation inspection report upon completion of the installation. This shall be submitted for approval.
- 6.1.7 The VENDOR shall provide, at no additional cost, such support as may be determined and required by the BUYER to address the VENDOR-accountable design and fabrication issues that emerge during the installation, start up, and testing period.

6.2 Site Inspections and Testing

- 6.2.1 After installation is complete, the following inspections and testing will be performed at the LAWPS Facility:
 - 6.2.1.1 Crane Start Up**
 - 6.2.1.1.1 Prior to crane start up at LAWPS, the VENDOR shall submit for BUYER approval the Crane Start Up plan.
 - 6.2.1.1.2 The crane VENDOR shall perform the approved Crane Start Up plan. These checks must be witnessed by the BUYER.
 - 6.2.1.1.3 The VENDOR shall provide a test director, operators, riggers, mechanics, electricians, and other technical personnel as needed to provide operation and testing of the crane. The VENDOR's technical personnel shall be responsible for performing adjustments or repairs to equipment if needed to complete the Crane Start Up Plan.

6.2.1.1.4 The BUYER will provide the inspection personnel necessary to witness the Crane Start Up Plan.

6.2.1.2 Site Acceptance Testing

6.2.1.2.1 Prior to Site Acceptance Testing of the crane at LAWPS, the VENDOR shall submit for BUYER approval the Site Acceptance Test procedure.

6.2.1.2.2 The Site Acceptance Test procedure shall be performed by the VENDOR to verify equipment meets the specification requirements and has been installed in accordance with applicable drawings.

6.2.1.2.3 BUYER representatives will witness the VENDORS performance of the Site Acceptance Testing of the crane.

6.2.1.2.4 The BUYER will provide inspection personnel, certified test weights, and rigging gear to perform Site Acceptance Testing.

6.2.1.2.5 All Site Acceptance Test procedure steps requiring a lifted load shall be performed after successful completion of Load Testing.

6.2.2 Acceptance

6.2.2.1 The BUYER will transmit, in writing, formal acceptance of the crane after the following conditions have been met:

6.2.2.1.1 Completion of Site Acceptance Testing Report has been submitted and approved by the BUYER.

6.2.2.1.2 All technical documentation and submittals have been received and formally approved by the BUYER.

6.2.2.1.3 All of the contract requirements contained within this specification have been met.

AECOM

ATKINS

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AREVA

Project Number: 31269 (T5L01)

Doc. No.: 15-2-007

Date: September 9, 2016

Revision: 1

7.0 NOTES

Appendix A: Engineering Forms

Hanford Site Spectrum Dependent Communications Authorization Form

Hanford Site Spectrum Dependent Communications Authorization

Operator Information	
Name:	
Organization:	
Company:	
Phone Number	
Address/Mail Stop:	

Description of proposed system or modification, and justification			
Attachments:	<input type="checkbox"/> Map*	<input type="checkbox"/> Diagram	<input type="checkbox"/> Chart

*Required

Spectrum Requirements			
Frequency (MHz / GHz)		MHz	
Bandwidth (KHz / MHz)		KHz	
Repeater			
Time Period Required	From:		To:
Type of Emission	<input type="checkbox"/> Voice	<input type="checkbox"/> Data	<input type="checkbox"/> Telemetry <input type="checkbox"/> Video <input type="checkbox"/> Radar
Modulation Type			
Station Types	<input type="checkbox"/> Fixed	<input type="checkbox"/> Mobile	<input type="checkbox"/> Handheld <input type="checkbox"/> Other: <input type="checkbox"/>
User Need Date			

Approvals			
	<u>Requester</u>	<u>Site Frequency Management</u>	<u>Wireless Engineering</u>
Name:			
Organization:			
Company:			
Signature:			

Base Station Information				
Location [list all][name and latitude/longitude] (if more than 5, attach additional pages)				
	Latitude	Longitude	Height AGL	Azimuth
Site 1:				
Site 2:				
Site 3:				
Site 4:				
Site 5:				
Transmitter/Receiver Information (if multiple types, add additional copies)				
Transmitter and Receiver nomenclature and model:				
FCC Type Acceptance/Certification Number				
Transmitter power (in watts):				
Transmitter Equivalent Isotropically Radiated Power (in watts):				
Emission designator (modulation type and bandwidth):				
Transmitter and Receiver antenna model:				
Transmitter and Receiver antenna type:				
Transmitter and Receiver mainbeam antenna gain (in dBi):				
Transmitter and Receiver antenna polarization:				

Subscriber Station Information			
Number of Subscribers: Quantity			
Location (s): List all Areas			
If fixed locations, list name and latitude/longitude below (if more than 10, attach additional pages)			
	Latitude	Longitude	Height AGL
Site 1:			
Site 2:			
Site 3:			
Site 4:			
Site 6:			
Site 7:			
Site 8:			
Site 9:			
Site 10:			
Transmitter/Receiver Information			
Transmitter and Receiver nomenclature and model:			
Transmitter power (in watts):			
Transmitter Equivalent Isotropically Radiated Power (in watts):			
Emission designator (modulation type and bandwidth):			
Transmitter and Receiver antenna model:			
Transmitter and Receiver antenna type:			
Transmitter and Receiver mainbeam antenna gain (in dBi):			
Transmitter and Receiver antenna polarization:			