FOUR 25 TON PORTAL CRANES

for

PUGET SOUND NAVAL SHIPYARD AND INTERMEDIATE MAINTENANCE FACILITY at NAVAL BASE KITSAP

BREMERTON and BANGOR, WASHINGTON

PREPARED BY:

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PART 1.0 GENERAL

1.1 REFERENCES

The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein. In case of difference between the following documents and this specification, this specification shall govern to the extent of such difference. If standards other than those listed below are used, proof of equivalence shall be provided. NEMA, OSHA, ASME, AWS, AISC, and NFPA rules shall govern.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION (ANSI/AGMA)

2001 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth

2015 - Accuracy Classification System

6013 - Standard for Industrial Enclosed Gear Drives

6034 - Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors

6035 - Design, Rating and Application of Industrial Globoidal Wormgearing

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

360 - Specification for Structural Steel Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS INTERNATIONAL (ASME)

B30.4 - Portal, Tower, and Pedestal Cranes

B30.10 - Hooks

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A27 - Standard Specification for Steel Castings, Carbon, for General Application

A36 - Structural Steel

A992 - Standard Specification for Structural Steel Shapes

A148 - Standard Specification for Steel Castings, High Strength, for Structural Purposes

A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service

A275 - Standard Practice for Magnetic Particle Examination of Steel Forgings

A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A434 - Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered

A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

A504 - Standard Specification for Wrought Carbon Steel Wheels

A521 - Standard Specification for Steel, Closed Impression Die Forgings for General Industrial Use

A536 - Standard Specification for Ductile Iron Castings

A563 - Standard Specification for Carbon and Alloy Steel Nuts

A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

A668 - Standard Specification for Steel Forgings, Carbon and Alloy, General Industrial Use

A992 - Standard Specification for Structural Steel Shapes

A1023/A- Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes

B26 - Standard Specification for Aluminum Alloy Sand Castings

B108 - Standard Specification for Aluminum Alloy Permanent Mold Castings

E543 - Standard Specification for Agencies Performing Nondestructive Testing

F436 - Standard Specification for Hardened Steel Washers

F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

F594 - Standard Specification for Stainless Steel Nuts

AMERICAN WELDING SOCIETY (AWS)

D1.1 - Structural Welding Code Steel

D1.3 - Structural Welding Code – Sheet Steel

D14.3 - Specification for Welding Earthmoving, Construction, and Agricultural Equipment

DEFENSE FEDERAL ACQUISITION REGULATIONS (DFAR)

DFARS 252.211-7003 Item Identification and Valuation

INTERNATIONAL ORGANIZATION FOR STANDIZATION (ISO)

4301-1 - Cranes and Lifting Appliances – Classification – Part 1: General

10816-1 - Mechanical Vibration Evaluation of machine vibration by measurements on non-rotating parts – Part 1: General guidelines

10816-2 - Mechanical Vibration Evaluation of machine vibration by measurements on non-rotating parts – Part 2: Land-based steam turbines and generators in excess of 50MW with normal operating speeds of 1,500 rev/min; 1,800 rev/min; 3,000 rev/min; 3,600 rev/min

10816-3 - Mechanical Vibration Evaluation of machine vibration by measurements on non-rotating parts – Part 3: Industrial machines with nominal power above 15kW and nominal speeds between 120 rev/min and 15,000 rev/min when measured in situ

10816-4 - Mechanical Vibration Evaluation of machine vibration by measurements on non-rotating parts – Part 4: Gas turbine sets with fluid-film bearings

10816-5 - Mechanical Vibration Evaluation of machine vibration by measurements on non-rotating parts – Part 5: Machine sets in hydraulic power generating and pumping plants

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION (NEMA)

ICS 8 - Industrial Control and Systems Crane and Hoist Controllers

MG 1 - Motors and Generators

250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

70 - National Electric Code

70E - Standard for Electrical Safety in the Workplace

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

P-307, Management of Weight Handling Equipment

NAVSEA TECHNICAL PUBLICATION

T9074-AS-GIB-010/271 Change Notice 1 - Requirements for Nondestructive Testing Methods

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

Title 29 CFR Part 1910 Subpart D, Walking –Working Surfaces

Title 29 CFR Part 1910 Subpart E, Means of Egress

Title 29 CFR, Part 1910.66, Appendix C, Personal Fall Arrest System

Title 29 CFR, Part 1917, Maritime Terminals

RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

Specification for Structural Joints Using High-Strength Bolts

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

J429 - Mechanical and Material Requirements for Externally Threaded Fasteners

J995 - Mechanical and Material Requirements for Steel Nuts

1.2 UNIT PRICES

See RFP Section B.

1.3 SYSTEM DESCRIPTION

The intent of this specification is to procure four general purpose service portal cranes. Two of the cranes shall be installed at Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF), Naval Base Kitsap, Bremerton, Washington. The other two cranes will be installed at PSNS & IMF, Naval Base Kitsap, Bangor, Washington. The crane design is intended to be a manufacturer's standard design incorporating the additional features required by the specification.

The crane shall be a portal type (with a rotating superstructure, luffing boom, main hoist and a single line whip hoist) designed to meet the dimensional and functional requirements of this contract. The crane shall be built to the design drawings of a registered professional engineer. The crane shall be designed, fabricated, assembled, shop tested, delivered, installed, inspected, field tested, and made ready for use in accordance with this specification. Basic dimensions related to crane design shall be as follows:

	Bremerton Cranes	Bangor Cranes
Minimum Height of the Boom Heel Pin and Operators Cab Floor	60'	60'
Clearance under Portal Base (minimum)	25'	25'
Tail Swing (maximum, from center of rotation)	30'	30'
Clearance under Travel Truck above Top of Rail both Inboard and Outboard (minimum)	3"	3"
Maximum Allowable Wheel Load (per wheel)	80 kips	90 kips
Closest Wheel Spacing (center to center)	4'	4'
Truck end to end distance (maximum)	60'	60'*

* Bangor cranes shall be designed so that they can be parked on the rail spurs and allow other cranes to pass them without interference (See Appendices).

Existing ground rail conditions are as follows (See Appendices for examples of track features):

	Bremerton Cranes	Bangor Cranes
Rail Size	135 lb (majority) 132 lb (some)	135 lb
Number of Rails	2	2
Track Gauge (center to center of rails) Note that the nominal rail gage "narrows" in curved track areas – see Appendix F	20'	30'
Minimum Rail Curve Radius (inner rail) Note that the nominal rail gage "narrows" in curved track areas – see Appendix F	69'	120'
Maximum Rail to Rail Misalignment	1"	1"

NOTE: Final values shall be verified by the contractor.

1.3 Design Requirements

The design of the crane shall conform to 29 CFR 1917, ASME B30.4, and other requirements specified herein. The crane shall be cab controlled, and designed to operate on an EPA and OSHA compliant onboard diesel engine-power system. The crane shall comply with all applicable requirements ("shall" statements) and recommendations ("should" statements) of ASME B30.4 (all "should" statements shall be considered "shall" statements). The crane shall have minimum ISO 4301 group classifications of A5 for the crane as a whole and M5 for hoists, luff, slew and travel.

A weatherproof machinery house shall enclose all machinery mounted on the superstructure. Travel truck systems shall be designed to enable the crane to operate on straight and curved track with "frogs" and switches at intersections.

The entire crane shall be designed with a minimum 30 year life. The crane shall be capable of simultaneous main hoisting, slewing and luffing with rated load at rated speeds at the operating wind load. The crane shall also be capable of simultaneous traveling and slewing with main hoist rated load at rated speeds at the operating wind load. The crane shall be capable of holding a load without drift for a minimum of 1 hour at a time.

1.3.1 Performance Requirements

Performance requirements of the cranes shall be as follows (all speeds are at rated load in operating wind unless otherwise noted):

Hook Loads and Reaches (from center of rotation)		
Main Hoist Capacity	**Capacity**	**Working Radius (minimum)**
	50,000 lbs	55' to 90'
	30,000 lbs	91' to 140'
Whip Hoist Capacity	17,000 lbs	64' to 165'
Simultaneous Main and Whip Hoist Capacity (used to rotate loads utilizing both hooks)	17,000 lbs	Main: 55' to 140' Whip 64' to 165'
Hook Lifts	**Hook Height (minimum)**	**Radius**
Main Hook Heights (from top of rail)	180'	55'
	120'	140'
Whip Hook Heights (from top of rail)	210'	64
	140'	165'
Reach Below Top of Rail (at all radii)	60'	
Speeds		
Main Hoist High Speeds (at rated load, min)	50 feet per minute	
Main Hoist High Speeds (at no load, min)	100 feet per minute	
Main Hoisting/Lowering Slow Speed (at rated load, max)	1 feet per minute	
Whip Hoist High Speeds (at rated load, min)	150 feet per minute	
Whip Hoist High Speeds (at no load, min)	250 feet per minute	
Whip Hoisting/Lowering Slow Speed (at rated load, max)	2 feet per minute	
Slewing Speed (at rated load, ±10%)	0.75 RPM	

	<= 0.01 RPM minimum speed
Maximum Luffing Hoist Speed (at rated load, time from max to min radius)	5 min
Travel High Speed (at rated load, min)	200 feet per minute
Travel Slow Speed (at rated load, max)	2 feet per minute
Maximum Operating Wind Speed	40 miles per hour
Non-Operating Speed	80 miles per hour
Storm Wind (stowed)	110 miles per hour

* The minimum speeds shall not exceed the values listed above.

1.3.2 Capacity Sign

Provide capacity plates that list the capacity in pounds with permanent lettering, visible from all sides of the crane. All lettering shall be of sufficient size to be easily read from the ground. Beneath the rated capacity the following information shall be included:

Naval Facilities Engineering Command
Contract Number N62470-15-D-3000
Manufacturer's name, address and crane serial number
Crane Number xx

The crane numbers shall be:

PSNS&IMF: 51 and 52
Bangor: 53 and 54

1.3.3 Unique Identifier Tag

In accordance with DFARS 252.211-7003, the contractor shall assign a unique identifier to the crane. The Unique Identification Tag shall be attached to the outside of the main electrical disconnect panel.

1.3.4 Crane Delivery

The contractor shall field verify all crane envelope clearances and other crane interface features, including those identified in Appendices, prior to design of the crane.

For Bremerton, the cranes shall be delivered as complete as possible for final assembly.

For Bangor, the cranes shall be delivered completely assembled.

1.3.5 Crane Removal

The contractor shall remove two existing Westmont 25T portal cranes from the Bangor, Washington location. Crane removal shall be coordinated with the receiving activity to minimize disruption to production efforts and ensure that no more than five (5) portal cranes are on the Delta Pier at any one time. The old cranes shall be removed as a unit to be disassembled in another location. No disassembly is allowed on the pier. The old cranes shall be disassembled so they cannot be used as cranes after removal. Additional information on the Westmont cranes is contained in Appendices.

The existing cranes scheduled for removal are suspected to be coated with lead based paint. If the metal material is to be recycled, the paint is expected to be disposed intact with the metal material. The contractor must provide a specific lead removal program in the Accident Prevention Plan should cutting, grinding, burning or disturbing of the coating be required by the planned work.

The hazardous waste shall be properly packaged and labeled using Department of Transportation (DOT) approved containers. Steel members containing lead paint shall be disposed of by the contractor.

The contractor shall adhere to all local, state, and federal regulations in the handling and disposal of these hazardous materials.

1.4 SUBMITTALS

The contractor shall submit to the contracting officer all items of technical documentation listed hereinafter. The contractor shall ensure that all submittals are in English, in US customary units, and are entirely legible and suitable for reproduction. The content, number of copies, time of submission, and distribution shall be in accordance with Exhibit A of this specification and as specified below. Compliance with the requirements of this specification will be determined by a review of the design and construction submittals by the contracting officer and by field inspection.

For submittals that reference a Navy Crane Center form, the form can be found on NCC website at http://navfac.navy.mil/navfac_worldwide/specialty_centers/ncc.html under the "Downloads" page.

SD-01 Preconstruction Submittals

The Contractor shall submit a schedule which identifies key milestone events in the design, fabrication, and installation of cranes. At a minimum, the schedule shall include the following:

a. Post Award Conference

b. Initial General Arrangement and Design Submittals

c. Government Review of Initial Design

d. Final General Arrangement and Design Submittals

e. Government Review of Final Design

f. Fabrication Initiation

g. Fabrication Complete

h. Pre-Installation Conference

i. Shop Test

j. Crane Delivery

k. New Crane Installation

l. Field Acceptance Test

m. Crane Acceptance

n. Existing Crane Removal

o. Completion of Warranty

SD-02 Drawings

The contractor shall submit for approval the drawings and catalog cuts listed below via ProjNet (www.projnet.org). After Navy Crane Center design approval and prior to shop test, the contractor shall submit a complete set of Final design drawings. Initial design drawings shall include certification

of review by a professional engineer. Final design and "As-built" (hardcopy and PDF) drawings shall bear a complete title block with a permanent drawing number, a registered professional engineer's original seal and dated signature. Drawings within each category (such as structural, mechanical, etc.) shall be numbered consecutively. Each assembly and subassembly drawing shall include an integral Bill of Materials or shall be followed by a consecutively numbered drawing with the applicable Bill of Materials. There shall be no proprietary notes on any drawing. All drawings shall be created for viewing and editing in AutoCAD 2010 with a drawing file format of .dwg or .dxf., and a separate copy viewable in Adobe Acrobat (.pdf). An index for all drawings shall be included.

SD-02.G General Arrangement Drawings

The crane assembly and each major component shall be shown in plan, elevation, and side views. All major features of the crane shall be shown including: overall dimensions, clearances, hook reach and capacity, lifts, wheel spacing, boom hinge and cab floor elevations, tie down arrangements, slewing ring bearing assembly arrangement, speeds, jacking points, maximum wheel loads, electrical power supply, and general locations of components such as: brakes, motors, speed reducers, and control panels (including size). The type of structural bolted connection shall be specified on the drawing. Torque value for structural bolts shall be indicated on the drawing. Fastener installation torque values for base-mounted components shall be indicated on the drawing. In addition, estimated weights shall be shown for the completely assembled crane. Approximate locations of center of gravity and location of lifting points for completely assembled crane and for each major component that could be lifted independently shall be provided on the design drawings.

SD-02.S Structural Drawings

These drawings shall show the arrangement and list of materials. The drawings shall include all items that are not part of the commercially available standard model which were re-designed to match the radius, stability and wheel load requirements. The drawings shall also include the following:

a. Boom

b. Portal Base

c. Gudgeon Pins

d. A-Frame

e. Operator's Cab

f. Machinery House including layout

g. Counterweight

h. Travel Trucks

i. Personnel Access (walkways, ladders, stairs)

j. Diesel Engine Room Layout, including Fuel Tank

k. Crane Load Chart

SD-02.E Electrical Drawings

The drawings shall at a minimum include:

a. Complete schematic diagram with narrative of any special description of operation. All components shown on schematics shall have labels that correspond to the nameplates that will be on the cranes. Wiring type, size, and temperature ratings shall be included on schematic diagrams. All optional equipment not installed on the crane shall be removed from the schematic diagrams. Locations of contacts and coils shall be cross-referenced to

each other within the schematic diagrams. For components with adjustable settings, final settings shall be shown on the schematics.

b. Motor nameplate data (including all information called for in NFPA 70, Section 430.7)

c. Rating and types of over-current protective devices

d. A comprehensive component material list showing all electrical components used on the crane. .

f. Layout diagrams showing component placement in control panel enclosures and for operator's cab

g. List of used symbols and designations

h. Grounding system, earthing system and lightning protection

i. Graphical limit switch diagrams for all limit switches showing the relationship of hoist hooks and boom positions to limit switch trip points. Limit switch contacts shall be clearly marked as either open or closed, as applicable, for all hoist and boom positions.

j. Communication Drawing of all programmable logic control (PLC) Systems and all crane management systems.

SD-02M Mechanical Drawings

a. Drive arrangements (including assembled components)

b. Reeving Diagram

c. Base mounted component bolt torque values shall be provided for installed fasteners with consideration for any lubrication and/or washer types used; generic bolt torque tables shall not suffice.

d. Coupling installation drawings including: locations, applicable shaft engagement allowable misalignment, and bore and key details.

e. Brake installation drawings including: locations, applicable shaft engagement, and bore and key details.

f. Lubrication drawings showing all lubrication points, the type of lubrication used and the recommended lubrication frequency.

g. Hydraulic Systems Circuit Diagram and Schematic (if applicable) – This shall include the hydraulic power and control circuits for each drive and show the layout of hydraulic equipment on the crane, including motors and brakes. All components shown on schematics shall have labels that correspond to the nameplates that will be on the cranes. Hydraulic hosing/piping/tubing type, size, and pressure ratings shall be included on schematic diagrams

h. Wheels

SD-03 Product Data

Manufacturer's catalog data shall be provided for all major components of the crane. The catalog cuts shall be marked-up or supplemented with additional sheets to clearly identify the model or size, selected options, features, and/or modifications to demonstrate compliance with specification requirements. Catalog cuts which show modifications beyond the standard options and all supplemental pages shall bear original signatures and dates of the equipment manufacturer's authorized representative. Each catalog cut and each supplemental sheet shall clearly identify the item to which it applies. All catalog cuts shall be submitted in one file viewable in Adobe Acrobat and bookmarked as to the location of each catalog cut. In accordance with Exhibit A, the contractor shall submit for approval the catalog cuts listed below:

SD-03.M Mechanical Product Data

SD-03.M1	Speed Reducers including gear ratio
SD-03.M2	Brakes (including electrical information)
SD-03.M3	Diesel Engine
SD-03.M4	Diesel Engine Control System
SD-03.M5	Bearings and Bearing Housings
SD-03.M6	Couplings
SD-03.M7	Load Blocks
SD-03.M8	Control Valves
SD-03.M9	Filters
SD-03.M10	Hydraulic Motors, Pumps and Cylinders

SD-03.E Electrical Product Data

SD-03.E1	Variable Frequency Drives
SD-03.E2	Motors
SD-03.E3	Electrical Enclosures
SD-03.E4	Hotel Power Components
SD-03.E5	Limit Switches
SD-03.E6	Encoders
SD-03.E7	Operator Controls
SD-03.E8	Warning and Pilot Devices
SD-03.E9	Disconnect Switches & Power Distribution Switchgear
SD-03.E10	Fuses and Circuit breakers
SD-03.E11	Generator
SD-03.E12	PLCs
SD-03.E13	Lighting
SD-03.E14	Slip Rings
SD-03.E15	Transformers
SD-03.E16	Capacity Overload Protection

SD-03.S Structural Product Data

SD-03.S1	Travel Trucks (including Drive Units)
SD-03.S2	Painting System
SD-03.S3	Bumpers

SD-04 Samples

Not applicable to this specification.

SD-05 Design Data

These calculations shall demonstrate compliance with all design requirements of this specification. Calculations will not be approved if their evaluation/review is dependent on data or information not previously approved. Drawings/Calculations shall include complete information so that they may be approved without reference to detail (shop) drawings.

SD-05.S Structural Calculations

SD-05.S1 Stability calculations in accordance with section 2.3.1 of this specification.

SD-05.S2 Wheel loads at 100%, 130%, and no load (without impact)

SD-05.S3 Buckling calculations for main structural members

SD-05.S4 Fatigue calculations in accordance with section 2.3of this specification.

SD-05.S5 Structural response of cranes during shipping in accordance with section 1.6 of this specification.

SD-05.S6 Stresses in cranes and pier due to loading and unloading of the cranes in accordance with section 2.3.1.1 of this specification.

SD-05.S7 Sea fastening calculations in accordance with section 2.3.1.1 of this specification.

SD-05.M Mechanical Calculations

SD-05.M1 Mechanical drive calculations including motor sizing, rope calculations and sheave bearings

SD-05.M2 Calculations verifying brake selections

SD-05.M3 Calculations verifying coupling selections

SD-05.M4 Gearbox calculations including classification, gear strength and durability, shaft size and fatigue and bearing life

SD-05.M5 Wheel load and shaft calculations, including fatigue and bearing life

SD-05.M6 Calculations verifying bumper selection

SD-05.E Electrical Calculations

SD-05.E1 Motor sizing

SD-05.E2 Overcurrent protection

SD-05.E3 Conduit fill calculations (using tables from NFPA 70, Chapter 9 or manufacturer's data sheets)

SD-05.E4 Protective device coordination study showing proper coordination between the overcurrent devices installed.

SD-05.E5 Diesel Engine and Generator Sizing

SD-05.E6 Arc flash energy calculations for each electrical control panel showing proper data necessary for appropriate arc flash labels per NFPA 70E Flash Calculations

SD-06 Test Reports

The following reports, outlines, and plans shall be submitted in accordance with Exhibit A.

SD-06.1 Status

The contractor shall submit monthly status reports with updated project schedules.

SD-06.2 Hook Non-Destructive Test (NDT) Report

SD-06.2.1 The contractor shall provide a certification that the NDT vendor meets the requirements of ASTM E543. The certification shall be current, within one year of the date the NDT was performed.

SD-06.2.2 The contractor shall submit for review the NDT vendor's procedures, including technique sheets specific to the types, shapes, and size of the parts being examined (e.g., shank hook, eye hook, duplex hook, eye pin, swivel eye bar). For the magnetic particle method, the procedures shall adequately describe the orientation of the hooks, swivel eye bar, or eye pins with the magnetizing equipment. Procedures must be reviewed and bear the signature of an SNT-TC-1A qualified Level III examiner stating they are independent of the vendor.

SD-06.2.3 Prior to performing any operational testing of the crane, the hook and eye pin or swivel eye bar (as applicable) shall be inspected by the magnetic particle method over their entire surface area in accordance with NAVSEA Technical Publication T9074-AS-GIB-010/271. ASTM A275 may be used with the following restrictions: DC yokes (including switchable AC/DC yokes used in the DC mode) and permanent magnet yokes shall not be used; automatic powder blowers or any other form of forced air other than from a handheld bulb shall not be used for the application or removal of dry magnetic particles; arc strikes shall be removed; and equipment ammeters shall have an accuracy of ± 5 percent of full scale (equipment ammeter accuracy other than that stated is acceptable provided the magnetic particle method procedure states that a magnetic field indicator is used to establish and verify adequate field strength for all aspects of the inspection). If NDT cannot be performed on surfaces inside holes, those surfaces shall be visually inspected to the maximum extent practical. Acceptance criterion shall be no linear indications greater than 1/16 inch. The NDT report shall be provided to the Government and shall be traceable to the unique ID number of the hook and eye pin or swivel eye bar (as applicable).

SD-07 Certificates

All certifications shall be dated and shall bear the original signature (above the printed name) of the authorized representative of the contractor or the manufacturer of the items or equipment being certified. Each certification shall clearly identify the crane, hoist, the drives, components, and location (as applicable) to which it applies:

SD-07.1 Wire Rope

The contractor shall provide the wire rope manufacturer's certification that the rope meets the published breaking strength of samples taken from reels and tested. Certification shall be traceable to the hoist, crane and reel.

SD-07.2 Periodic Overload Testing

The contractor shall certify the crane is capable of being load tested (statically and dynamically) semi-annually up to 131.25% of the rated capacity without any detrimental effects.

SD-07.3 EPA Emission Certification

The contractor shall submit certification that the provided diesel engine meets the applicable EPA Tier Level.

SD-07.4 Hazardous Material

The contractor shall certify that the crane contain no asbestos, lead paint, Polychlorinated Biphenyl's (PCB's), elemental mercury, or chromates.

SD-07.5 Loss of Power Test

The contractor shall certify that when lowering a test load a loss of power test can be performed without any detrimental affects to the electronic control system.

SD-07.6 Coupling Alignments

Contractor shall submit coupling alignment data records with certification that the alignment of all shafting connected by means of flexible couplings are within manufacturer's installation tolerances. The coupling alignments shall be made using laser alignment equipment, except for the barrel coupling which may use the manufacturer's recommended alignment method. The data records shall be taken after the coupling's final installation and after installation of shear bars or dowel pins in all base-mounted components. Coupling alignments shall be verified by the contractor after crane installation. The coupling alignment data record shall be submitted on the official form, which can be found on the NCC website. The contractor shall also provide the manufacturers' documentation (installation manual or other documents as necessary) that indicates the tolerances associated with each coupling installed on the crane.

SD-07.7 Hook and Hook Nut Proof Test

Contractor shall submit certification for the hook material type and that the hooks and hook nuts have been proof tested and satisfy the acceptance criteria of ANSI B30.10.

SD-07.7a Hook Material Type

Contractor shall submit certification documenting the hook material type.

SD-07.8 Welding Certifications

The contractor shall provide a certificate stating that all welders, welding operators, weld inspector(s) and welding procedure (qualification) meet the requirements of AWS D1.1 or AWS D14.3 for all work performed in manufacturing the crane.

SD-07.9 Design Review by Professional Engineer

The contractor shall provide a certificate stating that the design has been reviewed by a professional engineer. The certificate shall indicate the name, state of licensure and license number of the professional engineer.

SD-07.10 Contractor's Self Test

The contractor shall provide a certificate stating that the contractor's self test has been completed in accordance with section 2.8.1 of this specification.

SD-07.11 Ductile Material

The contractor shall provide a certificate stating that all non-redundant components directly supporting the load are ductile materials according to the requirements of Section 2.1.1.

SD-07.12 Transport Manual

The contractor shall submit a transport manual detailing the work involved in the transport and delivery of the crane. The plan must be submitted prior to the pre-delivery meeting, and shall contain the following:

a. Final stowage plan
b. Final dunnage plan showing proposed blocking and sea-fastenings
c. Final loading/unloading sequence and schedule
d. Loading and unloading locations and support arrangements
e. Final stability calculations for intact stability during voyage reviewed by third party. under conditions of a "beam wind" as defined below.

f. Computer sea-keeping analysis to predict motion responses for the intended route and time of year. Analysis should include the inertial and gravity forces acting on the cargo center of gravity for the six degrees of freedom (i.e. roll, pitch, yaw, heave, surge, and sway).

g. Design forces on sea-fastenings (derived from the sea-keeping analysis plus an assumed "beam wind" as defined below.

h. Cribbing/blocking pressures (based on sea-keeping analysis)

i. Analysis showing maximum sustained sea state which the loaded vessel and cargo can withstand.

j. A description of the method used to perform a check of the sea-fastenings at least once each day (24 hour period) while in transit.

beam wind = the greater of the maximum wind by weather routing multiplied by a 1.21 wind gust factor, or, if no weather routing is specified, assuming a standard 86.8 knot wind.

SD-8 Manufacturer's Instructions

SD-08.1 Shop Test Procedure

The contractor shall develop and submit a shop test procedure that will demonstrate operation, performance, and safety of the crane. The testing shall include brake torque verification. The test procedures shall be submitted and approved prior to conducting the shop test.

SD-08.2 Crane Removal/Installation Plan

The contractor shall submit a plan detailing the logistics involved in the installation of the new cranes and removal of the existing cranes. The contractor shall coordinate delivery and removal such that there is never more than five (5) portal cranes on the delta pier at one time. The plan shall include, as a minimum, detailed sequence of lifts, rigging sketch(s) with details of rigging equipments and methods of attachment to the component being lifted for installation. The plan shall be submitted by the contractor, for review by the Contracting Officer and the supported command. Any crane and rigging gear shall comply with OSHA requirements and any local requirements. Lifts of all major components for crane removal and installation are considered to be critical lifts and include any lifts performed by equipment such as forklifts and jacks. Actual locations of center of gravity and location of points for completely assembled crane and for each major component shall be provided with the crane installation plan.

NOTE: On site changes of the plan are not allowed without Government review.

SD-08.3 Accident Prevention Plan (APP)

The APP shall be prepared in accordance with Appendices (Safety), and Exhibit A and B and shall be submitted for review and comment by the Contracting Officer. Installation or removal of the cranes cannot proceed prior to the review and acceptance of the APP by the Contracting Officer.

SD-08.4 Training Course Outline

The Contractor shall prepare and submit to the Contracting Officer for approval, a training course outline. The outline shall contain enough detail for the Government to determine that all topics are adequately covered as prescribed in section 3.8 of this specification.

SD-09 Manufacturer's Field Reports

SD-09.1 Brake Adjustment Records

The Contractor shall provide a brake adjustment record and installation/maintenance manuals for each brake on the crane. The brake adjustment record shall be submitted on the official NAVCRANECEN form titled "Brake Adjustment Record Form" located on the NAVCRANECEN website. Each brake measurement shall have a tolerance traceable to the associated brake manual or documentation

provided by the brake manufacturer, location of measurements, and the actual brake setting. Changes made to settings of the brake, at any time, will void the record.

SD-09.2 Shop Test Deficient Items List

Upon completion of the government witnessed shop test and inspection of the crane, a list of deficient items will be compiled and attached to NCC Form 08-002 and signed by the contractor, Navy Crane Center Representative, and activity representative (if applicable) and forwarded to the Contracting Officer.

SD-09.3 Shop Test Record

Upon completion of the shop test for the crane(s), the contractor shall submit records of all test data.

SD-09.4 Field Test Record

The contractor shall develop and submit a field test procedure that will demonstrate operation, performance and safety of the cranes. The test shall be based on a pre-work inspection report and shall prove the functionality of the crane matches or exceeds the requirements within this specification. This test shall include all demonstrations including tests with no load, 50% load, 100% load and 125% load. This test shall include inspections necessary to verify safety of the crane (including verification of brake settings) that much be performed prior to beginning of load testing.

SD-10 Operation and Maintenance Data

The contractor shall submit one hard copy and an electronic copy of the crane's operation and maintenance manual to the Government for review. The operation and maintenance manuals shall be the contractor's standard format and include: a table of contents for operation instruction, preventive maintenance, parts information, drawing list, supply list, catalog cuts, photographs, and calculations. The body of the technical manuals shall include the following: contractors detailed written procedures, operation instructions, preventive maintenance information, drawings, parts information, supplies needed, catalog cuts, photographs, and calculations. Maintenance information shall include recommended maintenance procedures and manufacturer's installation and maintenance manuals (for purchased components) and lubrication instructions. Operation information shall include detailed crane operating and safety instructions. Parts information shall include all information on all contractor-designed parts, all purchased sub-assemblies and components including the manufacturers part number. The information shall be broken-out to the smallest replacement part. Within these sections the following information shall also be included:

a. Maintenance and programming instructions for the drives and PLCs.

b. Maintenance instructions including maintenance, alignment, adjustment, and calibration instructions for commercial components and parts lists.

c. Operating instructions and special precautions for starting/stopping, operation, and safety.

d. Preventive maintenance instructions including location of lubrication points, type of lubricant to be used, and the frequency of lubrication, which shall agree with the lubrication drawing provided.

e. Recommended spare parts list.

f. The contractor shall provide a complete listing of all control system parameters with an explanation of their functions.

SD-11 Closeout Submittals

SD-11.1 Drawings on CD

The contractor shall provide as-built drawings on CDs viewable and editable in AutoCAD 2010. The file shall be in .dwg or .dxf format and a separate copy in Portable Document Format (.pdf). The as-

built drawings shall be submitted to the Government following final Government acceptance of the crane. The CDs shall include an index of the drawings.

SD-11.2 Operation and Maintenance Manuals

The contactor shall provide the operation and maintenance manuals on CDs and three hard copies following final Government acceptance of the manuals. The manuals shall be in Portable Document Format (.pdf). The manuals shall be indexed using bookmarks in Adobe Acrobat.

SD-11.3 Control System Parameter Record

After the crane has passed the final field test, the contractor shall complete a control system parameter record for the crane and provide the crane parameter file downloaded from the crane at time of acceptance, if applicable. The record shall include the contract number, contractor's name and address, date, all control system parameters and their final settings. Each control system parameter shall be designated as either used or unused. A copy of the parameter file records shall be provided to the Government on CD.

SD-11.4 Product Data

Electronic submission of catalog cuts shall be submitted as one unit with a cover sheet containing a title block and index sheet identifying individual catalog cuts. Ensure each page is numbered and identified to allow proper filing if separated or if provided in .PDF format linked book marking is acceptable vice page numbering. The minimum sections for indexing shall be the sections noted in paragraph SD-03.

SD-11.6 Property Transfer Verification

After the crane has passed the final field test, the contractor shall transfer possession of all small items associated with the operation and maintenance of the crane, including but not limited to: keys, control software, computer cabling, etc. The property shall be given to the point of contact of the supported command. The contractor shall provide an itemized invoice showing the quantity and description of items transferred; obtain the signature of the recipient and date on the invoice. Submit a copy of the signed invoice.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

Crane design shall be accomplished by, or directly supervised by, a registered professional engineer (PE). PE licensing shall be by a board or agency authorized to license and register professional engineers in the U.S. or Canada. The PE may be a contractor's regular employee or a consultant. The PE's review and attestation of specification compliance and professional responsibility shall be signified by his or her PE original seal, and dated signature on the final design (PDF) and "as-built" (hardcopy and PDFs) drawings.

1.5.2 Regulatory Requirements

The diesel engine shall conform to the U.S. EPA emission standards specified in 40 CFR 89 or 40 CFR 1039, as applicable for the manufacture or importation of non-road compression ignition engines. All crane functions and components shall comply with all OSHA requirements and other listed references in this specification. Anchorages to which personnel fall arrest equipment is attached shall be capable of supporting at least 5,000 pounds per person attached, or it must be designed, installed, and used as part of a complete personal fall arrest system which maintains a design factor of at least 2.0 under the supervision of a qualified person as required by 29 CFR 1910.66.

Attach a permanent label at each anchorage point identifying it as a "Fall Protection Anchorage Point" listing its capacity (e.g. one person capacity).

Open gearing and couplings with exposed bolts or nuts (non-safety type) shall be provided with guards. The guards shall be removable type and allow for a visual inspection of the covered component when installed. The guards shall be securely fastened and shall be capable of supporting, without permanent deformation, the weight of a 200-pound person, unless the guard is located where it is impossible for a person to step on it.

Any part of the crane above 200 feet shall meet Federal Aviation (FAA) requirements. This includes but is not limited to crane markings (i.e. striped boom tip), lighting at the highest point and any required FAA approvals necessary.

1.5.3 Post-Award Conference

The contractor shall attend a post-award conference that will be held at the Bremerton site. This conference will cover design submissions, shop testing, shipping, site mobilization, erection dates, Exhibit A submissions, Accident Prevention Plan, crane installation plan, roles and responsibilities of the entities involved and the schedule. Meeting minutes shall be prepared by the Contractor and reviewed by the Government.

1.5.4 Pre-Installation Conference

The contractor shall attend a pre-installation conference that will be held at each installation site. This conference will allow the contractor and any sub-contractors, the Navy Crane Center and the supported command the ability to review any necessary precautions to insure a safe and accurate installation. A draft of the Crane Installation Plan should be available at the pre-installation conference. Meeting minutes will be prepared by the contractor and submitted for review and approval by the Government in accordance with Exhibit A.

1.6 DELIVERY, STORAGE, AND HANDLING

The cranes are to be fully erected in the Contractor's facility and tested prior to shipment. The cranes may be partially disassembled to achieve transportation height. Partial disassembly shall minimize impact of the tested status of the cranes.

The Contractor shall suitably restrain the cranes and crane components during shipment so as to avoid damage to the cranes and crane components. The Contractor shall protect components to minimize damage and corrosion during loading, shipping and unloading operations.

The Contractor shall prepare calculations and detailed plans for crane partial disassembly, on-loading onto the transportation, restraining the cranes and crane components, protecting the cranes and crane components, off-loading the cranes on to the pier. These procedures shall be submitted to the Contracting Officer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Environmental Requirements

The crane shall be designed to operate in an outdoor heavy industrial marine environment with an ambient temperature of 30° to 110° F and 100% relative humidity.

1.7.2 Existing Conditions

Prior to mobilization, the site shall be inspected by the crane contractor, a facility representative, and a NCC representative to document the condition of all existing construction and record any existing damage. A Pre/Post Installation Site Inspection Checklist form shall be initiated at that time, NCC Form 11-001. Upon completion of the work, the crane contractor, a facility representative, and a NCC representative shall determine the extent of any damage that may have occurred as a result of work performed under this contract. During this final inspection the NCC Form 11-001 shall be completed. Any damage as a result of the crane installation and/or testing shall be the responsibility of the crane contractor under this contract.

1.7.3 Government Furnished Equipment

The Government shall provide certified test weights and associated rigging at the facility for acceptance testing of the crane.

1.8 SEQUENCING AND SCHEDULING

The contractor's on-site work may impact the on-going operations at the installation site and installation shall be planned to minimize the duration and scope of disruption. The contractor shall provide an onsite work schedule with durations and desired start/stop dates. The Contractor shall provide notice a minimum of thirty days prior to the desired mobilization date at the supported command.

1.9 CONTRACTOR REQUESTED ENGINEERING CHANGES

All contractor-requested engineering changes must be submitted to the Navy Crane Center on the "Contractor Change Request Form" (NCC Form 07-001). The "Price Worksheet" (NCC Form 07-001A) shall be attached to any engineering changes when a price increase/decrease is proposed by the contractor. The worksheet shall compare the price of equipment as specified in the contract with the price of the proposed change. CCRFs shall be disapproved if submitted without Price Worksheet. The forms are available at https://portal.navfac.navy.mil/ncc under the "downloads" page.

1.10 WARRANTY

See section I for warranty information.

1.11 MAINTENANCE

Not applicable for this specification.

PART 2 PRODUCTS

2.1 MATERIALS

Material shall be free from defects and imperfections that might affect the serviceability and appearance of the finished product. All material shall be new and unused.

2.1.1 Ductile Materials

All ~~non-redundant~~ components directly supporting the load shall be of ductile materials. These components include, but are not limited to all hoist drive gear reducer housings, motor frames and end bells (except for end bells of the C-face mounted motors), flanged adapters, and brake wheels and discs. For the purposes of this specification, ductile is defined as having a minimum elongation of 5% in 2 inches. Furthermore, all shafts, keys, gears, torque carrying coupling components, and wire rope drum shall be steel.

2.1.2 Structural Steel

Structural steel shall conform to ASTM A36, A572 or A992.

2.1.3 Cast Steel

Cast steel shall conform to ASTM A27 or ASTM A148.

2.1.4 Ductile Cast Iron

Ductile Cast Iron shall conform to ASTM A536.

2.1.5 Forged Steel

Forged steel shall conform to ASTM A668 or ASTM A521, grade as applicable.

2.1.6 Steel Shafts

Steel shafts shall conform to ASTM A434 - Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered

2.1.7 Aluminum Castings

Aluminum castings shall conform to ASTM B26 or ASTM B108.

2.1.8 Welding Materials for Crane

Welding materials for cranes shall conform to AWS D1.1

2.1.9 Structural Tubing

Structural tubing shall conform to ASTM A500

2.1.10 Structural Pipe

Structural pipe shall conform to ASTM A53

2.2 MANUFACTURED UNITS

Not applicable for this specification.

2.3 EQUIPMENT

2.3.1 Structural Design

The structural design of the crane shall conform to ASME B30.4, AISC 360, OSHA 29 CFR, Part 1917.45, and other requirements specified herein. The structure shall be capable of following occasional rail-track deviations which exceed the specified maximum rail-track deviation as given in FEM 1.001. The structural design shall assume a design life of 30 years.

Pockets where water or dirt may collect shall be avoided. Where unavoidable pockets are formed, drains shall be provided so that water will drain in all positions.

2.3.1.1 Design Loads

The crane shall be designed taking into account the prescribed load cases which are comprised of various design loads. Loads due to temperature effects, erection stresses, and other loads based on the Contractor's experience shall be included in the analysis if they cause significant stresses. If analysis indicates loads larger than what is specified herein, the larger loads shall be used. Crane upper works is defined as the boom, A-frame, strut and machinery deck. The travel truck system is defined as equalizers, gudgeons, gudgeon pins, float pins and travel trucks. The design loads shall be defined as follows:

Dead Load (DL). A load of constant magnitude which acts permanently on the structure including the weight of the crane's structure and all permanently attached equipment

Lifted Load (LL). The load which hangs from the hook, including hook block, wire ropes, sheaves, and the lifted load. The lifted load shall be taken as the rated capacity and shall be applied concentric to the geometric center of the head block.

Skewing Forces (SK). Horizontal loads produced by acceleration and decelerations of the travel drives and rotate drives. Rate of acceleration from a standstill to related speed in 8 seconds.

Extraordinary Breaking Load (EBL). Horizontal loads produced by decelerations of the travel drives and rotate drives by loss of power or emergency stop. Forces are based on rated speed and are considered to act one at a time.

Impact Forces due to Vertical Acceleration of Load (IML). Static increase in lifted load due to vertical dynamic force on the lifted load due to handling. 0.3 for upper works, 0.15 for portal base/tower . 0.25 travel system (applied to total vertical load).

Spreading and Squeezing Forces (SSF). Friction forces due to travel into a curve, outward and inward movement applied perpendicular to rail axis. Force shall be considered to be 12% of maximum wheel load caused by the DL + LL.

Collision Forces (COLL). Forces resulting, while traveling at 100 percent of rated speed but with the power off, from the collision of gantry bumpers with their end stops or another crane. Deceleration due to collision bumpers may be considered. Assume no braking and omit the live load.

Operating Wind Load (WLO)*. The load imposed on the crane due to a wind speed of 40 miles per hour using the methods of ASCE 7-10

Non-Operating Wind Load (WLN)*. The load imposed on the crane due to a wind speed of 80 miles per hour using the methods of ASCE 7-10

Storm Wind Load (SWL)*. The load imposed on the crane due to a wind speed of 110 miles per hour. The resulting dynamic pressure shall be applied in the most adverse horizontal direction using the methods of ASCE 7-10

Earthquake Load (EQ). The crane structure shall be designed as a non-building structure with an ordinary moment resisting steel frame according to ASCE 7 or from another widely recognized code. The earthquake loads shall be applied parallel and perpendicular to the gantry rails.

Snow Load (SL). The snow load on either the machinery deck or operator's cab.

Roof Load (RL). Concentrated downward load of 250 pounds at any location on roof.

NOTE: *The wind loadings listed above include an allowance for wind gusts, but does not account for shape factors.

2.3.1.2 Load Combinations

The design loads defined above shall be combined in the following combinations with simultaneous operations occurring in the most adverse directions. For the crane upper works, the forces on the components should be determined in 5 to 10 foot increments, for the full range of main hoist operating radii and the corresponding rate load. For the portal base should be analyzed for three orientations of the boom axis: parallel to the rails, perpendicular to the rails and at the orientation that produces the maximum corner load. Each of these three orientations shall be analyzed for two boom radii: the radius that produced maximum overturning moment on the portal base and the radius that produces maximum axial load on the portal base.

2.3.1.2.1 Basic Operating Conditions

NOTE: All of the load cases listed below shall be analyzed for elastic limit and buckling considerations.

The allowable design stresses for the following cases shall be 85 percent of AISC allowable stresses:

(a) DL + LL(1+IML) + SK +WLO (Upper Works)

(b) DL + LL(1+IML) + SK +WLO + SSF (Portal Base)

(c) DL + LL(1.25) + SK + WLO + SSF (Travel Truck System)

The allowable design stresses for the following cases shall be 100 percent of AISC allowable stresses:

(a) DL +WLO + SL (Machinery House and Operator's Cab)

(b) RL (Machinery House and Operator's Cab)

The allowable design stresses for the following cases shall be 133 percent of AISC allowable stresses:

(a) DL + LL+ EBL (Upper Works and Portal Base)

2.3.1.2.2 Non-Operating Conditions

All of the load cases listed below shall be analyzed for elastic limit and buckling considerations.

The allowable design stresses for the following cases shall be 133 percent of AISC allowable stresses:

(a) DL + WLN (Upper Works, Portal Base and Travel Truck System)

(b) DL + SL + WLN (Machinery House and Operator's Cab)

2.3.1.2.3 Test Conditions

All of the load cases listed below shall be analyzed for elastic limit and buckling considerations.

The allowable design stresses shall be 135 percent of AISC allowable stresses

(a) DL + LL(1.3+IML) + SK +WLO (Upper Works)

(b) DL + LL(1.3+IML) + SK +WLO + SSF (Portal Base)

(c) DL + LL(1.55) + SK + WLO + SSF (Travel Truck System)

2.3.1.2.4 Stowed Condition (boom is raised up)

All of the load cases listed below shall be analyzed for elastic limit and buckling considerations.

The allowable design stresses shall be 126 percent of AISC allowable stresses.

(a) DL + SWL (Upper Works, Portal Base and Travel Truck System)

(b) DL + EQ

2.3.1.3 Fatigue Design

Stress-carrying structural elements shall be designed for fatigue in accordance with the AISC 360 or FEM 1.001. The crane shall be designed for a loading condition of 100,000-500,000 cycles. This loading condition shall be applied to all components of the crane.

The allowable design stresses shall be 100 percent of AISC allowable stresses.

2.3.1.3.1 Upper Works

The stress range shall be defined as the algebraic difference between the stresses due to cases a and b below with the hook at 75% of its maximum operating radius:

(a) DL + 0.5(LL)

(b) DL

2.3.1.3.2 Portal Base

(a) The stress range shall be defined as the algebraic difference between the stresses due to cases i. and ii. below:

(i) Boom directly over section

(ii) Counterweight directly over section

(b) The stress range shall be defined as the algebraic difference between the stresses due to cases a and b in Upper Works above.

2.3.1.3.3 Travel Truck System

The larger of the following two stress ranges shall be used:

(a) The stress range shall be defined as the algebraic difference between the stresses due to cases i. and ii. below:

(i) Counterweight positioned to produce the maximum corner load

(ii) Boom positioned to produce the minimum corner load

(b) The stress range shall be defined as the algebraic difference between the stresses due to cases a and b in Upper Works above.

2.3.1.4 Stability

In addition to the stability requirements of ASME B30.4, the entire crane shall maintain stability in the following load cases. The resultant of all forces is translated to the plane of the tipping axis – either on the rails or through the main gudgeon pins. When the tipping axis is the rail, the maximum detrimental combination of travel truck float and wheel flange clearance on the railhead must be included in the analysis. Several hook/radius combinations at 5 to 10 foot increments are to be used in the stability cases defined below:

(a) 150 percent of maximum load moment on the crane (maximum product of load multiplied by radius). Rotate positions with the boom in line and perpendicular to the rails must be considered. The resultant of all forces must be within the rails (track gauge) or between the main gudgeon pin axes, as applicable.

(b) Maximum load moment on the crane, and 40 mph operating wind from the rear of the upper works. Rotate positions with the boom in line and perpendicular to the rails must be considered. The overturning moment must not exceed 77 percent of the stabilizing moment.

(c) No load on the hooks and the boom at its minimum operating radius. Rotate positions with the boom in line and perpendicular to the rails must be considered. The resultant of all forces must be within 60 percent of the distance from the crane's center of rotation to either rail or either main gudgeon pin axis, as applicable.

(d) No load on the hooks, the boom at its minimum operating radius, and 80 mph non-operating wind from the front of the upper works. Rotate positions with the boom in line and perpendicular to the rails must be considered. The overturning moment must not exceed 80 percent of the stabilizing moment.

(e) With the crane positioned in its storm wind stowed configuration, the overturning moment must not exceed 80% of the stabilizing moment with a wind speed based on the maximum local operating wind velocity at the geographic location in accordance with ASCE 7.

2.3.1.5 Welding

All welding procedures and qualifications shall be in accordance with the requirements of AWS D1.1 as required by SD-07.8.

2.3.1.6 Structural Bolted Connections

Major structural bolted connections shall be designed and installed in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.

2.3.1.7 Boom

A method to remove the load from the boom hoist shall be provided. OSHA compliant maintenance walkway access shall be provided to all locations on the boom requiring maintenance.

2.3.1.8 Portal Base

The portal base shall be a primarily welded steel structure composed of closed sections with interiors accessible for inspection. Sealed hatches equipped with latches and provisions for opening them from either side, shall be provided to permit inspection of the portal base internal sections. The four corners of the portal base shall rest on equalized travel truck systems and shall have provisions for jacking up one corner or one side to permit the removal of any equalizer beam or travel truck.

2.3.1.9 Storm Secure Method

Provision for securing the crane against storm winds shall be incorporated into the design of the portal base and travel drive system. The crane shall be designed to not move during storm wind. The primary method of resisting wind shall be the travel system brakes. If the travel brakes are not sufficient, storm locks shall be designed and sized to withstand the storm wind. Storm locks shall lock onto the existing rail head. Special tie downs which require specific location and or modifications to the existing rail system are not allowed.

2.3.1.10 Access Structures

All access structures shall be in accordance with OSHA and ASME B30.4. The crane shall be equipped with the necessary stairways, walkways, platforms, and ladders to provide safe access to all areas necessary for crane operation, lubrication, adjustment, servicing, and inspection. Stairs shall be used whenever possible and ladders only when stairs are not feasible. Two means of access be provided to the upper works. Stairways shall be provided at two diagonal corners of the portal base for access to the crane upper-works from the ground. Continuous circular walkways (or equal) shall be provided around the interior and exterior of the rotate bearing with direct access from the interior of the rotate bearing to portal base and machinery house. Access to all machinery house exit doors shall be available with the upper works in the any position. The arrangement shall preclude the possibility of a person being crushed between rotating and fixed parts of the crane or being pushed off by the rotating parts.

2.3.1.11 Travel Truck System

The travel truck system shall be designed to allow crane travel with rated load through all track corners including starting and stopping mid curve. The truck system shall also equalize all wheel loads at each corner and permit articulation and float of all travel trucks. The arrangement shall permit the removal of any wheel, travel truck, or combination of equalizer girders and travel trucks by jacking a portal leg or side without affecting stability. The arrangement shall also permit open access to all drive motors, gear reducers, and brakes.

2.3.1.12 Travel Trucks

Wheel axles shall be of the rotating type, with each end supported by an antifriction bearing. Rail sweeps shall be provided on outboard ends of travel trucks at each corner of the crane to remove obstructions from their path. Means shall be provided to limit the drop of truck frames in case of wheel or axle breakage to a distance that will not cause the crane to overturn.

2.3.1.13 Lateral Float

Each truck assembly shall be designed to accommodate truck float to either side of the portal leg centerline. The magnitude of truck float both outward and inward, and resulting side to side crane float shall be as required to allow satisfactory operation on the existing ground track system (including straight and curved track). Truck gudgeon pins shall be covered to keep out dust, dirt, and moisture.

All truck assemblies shall provide smooth and free lateral float when the crane negotiates curves with any combination of hook load, boom radius, or machinery deck orientation. The travel truck system

shall not violate the outboard clearance envelope, as specified in this contract in its extreme float position and the inner flange of the wheels against the rail head.

2.3.1.14 Counterweight and Ballast

Counterweight and ballast shall be plain concrete, cast iron or steel plate. Earthen material and liquids shall be prohibited. Counterweight and ballast shall be enclosed in a weatherproof steel box and seal welded. Counterweight and ballast shall be completely sand blasted, primed and painted in the same manner as other structural components. Counterweight shall be designed in accordance with ASME B30.4, to preclude shifting and adequately protected to withstand the operation environment.

2.3.1.15 Machinery House

The machinery house shall be designed and constructed in accordance with the manufacturer's standard practice, except as modified herein. The assembly shall be steel framed, weatherproof, and ventilated. The machinery house shall be of sufficient size to accommodate, with ample working space, all hoist machinery, rotate drive machinery, electric control panels, diesel engine-generator set and all other equipment required for the operation and control of the crane.

The machinery house shall have a minimum of two exit doors. In addition, air flow patterns and location of louvers in the machinery house shall ensure adequate cooling of electrical equipment. Openings for diesel engine combustion and cooling air shall be fitted with louvers and filters. Filters shall effectively preclude the infiltration of dust and abrasives associated with abrasive blast operations carried on in the vicinity of the crane and shall be of the replaceable type.

The roof of the assembly shall be built with sufficient slope to prevent water pocketing, but flat enough to allow people to walk on the roof. The roof shall be insulated with an asbestos-free, fire-retardant, insulating material.

Welding of sheet steel shall be in accordance with AWS D1.3.

Openings in the roofs for the ropes shall be hooded and guttered to prevent entrance of rain and shall have ultra high molecular weight polymer rubbing blocks to minimize rope wear.

Provisions shall be made in the roof and in the walls for the removal of major components, including hoist and rotate drive motors, gear reducers, and brakes as specified herein. The floors shall have steel skid-resistant surfaces.

2.3.1.16 Operator's Cab

The operator's cab shall be fully enclosed and shall have a full view of the crane operations envelope (including the entire jib boom) from a seated position. The cab shall limit noise and vibration. The minimum cab size shall accommodate both the operator's chair and a chair for an observer. Cab design shall meet the minimum requirements of ASME B30.4 and OSHA safety standards. A capacity plate and radius indicator shall be installed inside the operator's cab such that they are visible to the operator when operating the crane. The capacity plate shall be sized to contain the following information:

Rated capacity of the crane at each operating radius
Naval Facilities Engineering Command
Contract Number 62471-13-4008
Manufacturer's name and crane serial number
Government Crane Number XX

The cab structure shall be thermally and acoustically insulated. The cab shall be constructed of fire-resistant materials. The sound level inside the cab shall not exceed 68 dB(A) at any point when all devices are operating normally, excluding the PA system and any audible alarms.

All cab and machinery house glazing shall be safety-glazing material, as defined in SAE Z26.1 with the exception that wired glass and plastic is prohibited for the cab glazing material. Operator's cab front and lower panels shall be clear glass, and installed in a manner that can withstand a load of 200 pounds applied to the glass unless other loading conditions increase the loading on the glass. This applies for both the glazing and the mounting method. Glazing shall meet the projectile requirements contained in ASCE/SEI 7. Glazing on the cab roof shall offer protection from falling objects and by being able to support a 50 psf static load. Windshield wipers should be installed on the front glazing. Window framing shall not interfere with the operator's normal lines of vision.

All glass shall be installed in accordance with the manufacturer's recommendations and shall permit easy replacement. A method to allow cleaning of all windows without the use of a man-lift shall be provided.

Drip rails shall be provided over the windows and doors. All vertical and sloping glass shall be tinted safety glass.

All windows shall be provided with tinted industrial grade window shades to allow the operator to block sunshine.

A suitable coat rack and book shelf shall be provided.

2.3.1.17 Fire Protection System

A ten pound (10-lb) ABC dry chemical portable fire extinguisher shall be provided for the operators cab. The fire extinguisher shall comply with NFPA 10 and the fire extinguishing agents shall be approved by the Environmental Protection Agency.

Two (2) ten pound (10-lb) ABC dry chemical portable fire extinguisher shall be provided for the machinery house. One shall be located near the primary entrance and the second shall be centrally located to the electrical drive control equipment. The fire extinguishers shall comply with NFPA 10 and the fire extinguishing agents shall be approved by the Environmental Protection Agency.

A fixed fire extinguishing system shall be provided for crane compartments that contain diesel engines. The fire extinguishing system shall be automatically actuated with back-up manual actuation. The system shall comply with NFPA 12 or NFPA 2001. Fire extinguishing system piping shall be suitably marked to indicate "FIRE EXTINGUISHING SYSTEM", the compartment(s) it protects and normal direction of flow. System piping shall be painted a bright red color.

The extinguishing agent discharge pipe shall include a shut-off valve that is to be locked in the open position, except when the diesel engine, electric generator, or the extinguishing system is undergoing maintenance. It shall be lockable in the shut position to allow securing the system during maintenance. The extinguishing agent containers shall be mounted outside the protected compartments in safe, readily accessible locations. The containers shall be marked with normal weight or volume of agent and provided with reliable means of checking the quantity of agent in them.

A manual actuation station shall be located outside each protected compartment adjacent to the primary entrance/exit. Manual actuation controls shall be guarded, double-action type. Each station shall be clearly labeled as to its function and which protected compartment(s) it will flood.

An automatically actuated audible alarm system shall be provided for the fire alarm system. The system shall comply with NFPA 72 to the maximum extent practicable. The ambient design temperature for the entire system shall be taken as 104 degrees Fahrenheit. The alarm system shall annunciate audibly and visually in the operator's cab upon fire detection. Warning signs shall be provided at each entrance to each protected compartment indicating that the compartment is protected by a total-flooding fire extinguishing system and shall be promptly evacuated when the alarm sounds. Upon actuation of the extinguishing system (either automatic or manual), but prior to agent discharge into the protected space, the alarm system shall:

1. provide a minimum 20 second warning of the impending release of the fire extinguishing agent,

2. shut down all ventilation fans, and

3. close all openings which admit air into, or would allow the extinguishing agent to escape out of the protected compartment.

The diesel engine shall not be shut down by the alarm system.

2.3.2 Mechanical Design

The mechanical design of the crane shall conform to ASME B30.4, and other requirements specified herein. Drive train components shall be of ductile material. All rotating machinery shall meet ISO 10816 Parts 1-5 Zone A (new equipment) mechanical vibration criteria.

2.3.2.1 Design Factors

Unless otherwise specified, all mechanical components, including fasteners, shall be designed for a factor of safety of no less than 5.0 based on material ultimate strengths respectively. Shafts and axles subjected to reversed or fluctuating loads shall be designed to provide a fatigue factor of safety of not less than 1.5. Impact, shock, vibration, or acceleration need not be considered in the stress/safety factor computations.

2.3.2.2 Alignment

All base-mounted motors, gear reducers, brakes, and pillow blocks shall be locked in proper alignment, both longitudinally and laterally, after adjustment, shimming, and fastening, with appropriately sized dowel pins or shear bars. Dowel pins or shear bars shall be installed after final field verification of coupling alignments

2.3.2.3 Threaded Fasteners

All base-mounted and flange-mounted components and all mechanical connections subjected to calculable loads shall be fastened with SAE J429, Grade 5 or Grade 8 fasteners, ASTM F436 washers, and SAE J995 Grade 5 or Grade 8 nuts. Mounting fasteners from flange-mounted components, including keeper bars, may be installed into tapped holes provided that adequate thread engagement is provided to develop the full tensile strength of the fastener. All nuts shall have a minimum of one thread pitch of the bolt protruding above the nut top surface. Fastener connections shall be sized neglecting any benefit to be derived from shear bars or dowel pins.

2.3.2.4 Load Blocks

Load blocks shall be entirely of steel construction. The designs shall preclude the wire rope from being cut, pinched, crushed, or chafed in case of two-blocking or unloading of the wire rope. The load blocks shall be constructed so that the hooks and hook nuts can be removed without disassembly of the blocks. The hook shall be mounted in a separate trunion. The hook shall rotate freely with 131.25% of rated load. The thrust bearing shall have a static capacity of no less than 150% of rated load. The hoist capacity in pounds shall be clearly marked on both sides of the load blocks.

2.3.2.4.1 Whip Hoist Load Block/Overhauling Weight additional requirements

The whip hoist shall have a block of sufficient weight to overhaul the hoist ensuring wire rope tautness under no-load conditions. The maximum diameter of the whip hoist overhauling weight shall be 22 inches in diameter.

2.3.2.5 Hooks and Hook Nuts

The main hoist hooks shall be duplex swivel with lower bail attachment hole. The whip hoist hooks shall be a single barbed hook. The hooks shall be forged carbon steel conforming to ASTM A668 or ASTM A521 with a longitudinal elongation of not less than 18%. The hook nuts shall be secured to the hooks by a bolt and lock nut. The hooks shall be provided with safety latches. The hooks and

hook nuts shall be uncoated. The hooks shall be uniquely marked in a permanent fashion that is traceable to the NDT certification. The nut shall be marked to match with the hook. The markings shall be visible when the hook and hook nut are assembled on the hook block.

2.3.2.6 Main Hoist Wire Rope

The drum line pull shall not be more than 20% of the nominal breaking strength of the wire rope to obtain a minimum wire rope design factor of 5 to 1. For single layer wire rope drums, the hoisting rope shall be 6 x 36 class construction, extra improved plow steel or extra-extra improved plow steel, regular lay, uncoated, with an independent wire rope core, and in accordance with all requirements of ASTM A1023/A. For multi-layer drum, the wire rope selected shall be recommended by the wire rope manufacturer for use on a multi-layer drum and shall have compacted strands or compacted (swaged) rope construction. Hoisting rope dead end connections to equalizer bar (if used) shall be by means of poured socket connections or swaged fittings installed in a manner that develops the full breaking strength of the hoisting rope; wedge sockets shall be prohibited. The sockets shall be forged steel. Hoisting rope ends on the drum shall be anchored by means of swaged fittings or by clamping. Clamped hoisting rope ends shall be neatly and securely seized with wire.

2.3.2.6.1 Whip Hoist Wire Rope

The whip hoist wire rope shall use ASTM A1023 Category 1 rotation resistant wire rope. For multi-layer drum, the wire rope shall be recommended by the wire rope manufacturer for use on a multi-layer drum, be ASTM A1023 Category 1 rotation resistant wire rope and shall have compacted strands or compacted (swaged) rope construction. The drum line pull shall not be more than 12.5% of the nominal breaking strength of the wire rope to obtain a minimum wire rope design factor of 8 to 1 and be equipped with a roller or ball bearing swivel. The whip hoist wire rope shall have swaged or poured end fittings. Swaged fittings shall conform to EN 13411 Part 8 and have Navy Crane Center approval. Swage fittings shall be selected in accordance with the swage fitting and wire rope manufacturer's recommendations. Poured fittings may be made with molten zinc or resin socketing material approved by Naval Ships Technical Manual Chapter 613. The sockets shall be forged steel. Hoisting rope ends on the drum shall be anchored by means of swaged fittings or by clamping. Clamped hoisting rope ends shall be neatly and securely seized with wire.

2.3.2.7 Sheaves

Sheaves shall be steel. The grooves shall be machined or ground to contour and rim toughened to not less than 320 BHN.

All rotating sheaves shall be installed with bearings. For 6x36 class wire rope, the pitch diameters of the upper and lower load block sheaves and the boom hoist sheaves shall not be less than 30 times the nominal diameter of the rope used. For rotation resistant wire rope the pitch diameters of the upper and lower load block sheaves and the boom hoist sheaves shall not be less than 40 times.

2.3.2.8 Drums

The drum shall be a one-piece steel weldment, finish-machined after all welding and stress relieving has been completed. The hoist drum shall be grounded.

~~Drum~~ Hoist drive train shafting shall not be mounted in a three bearing configuration.

The drum shall be designed such that not less than two dead wraps of hoisting rope will remain on each end of the drum when the hook is in its extreme low position. For single layer wire rope drums the drum grooves shall be helical and machined right and left hand.

The pitch diameter of the single layer hoisting drums shall not be less than 30 times the nominal diameter of the wire rope.

The single layer wire rope drum groove pitch shall be a minimum of 1.125 times and a depth of 0.375 times the nominal wire rope diameter.

The single layer wire rope drum shall have end flanges that extend a minimum of one rope diameter above the top layer of wire rope. Multi-layer wire rope drums shall employ Lebus lagging.

For multi-layer wire rope drums the pitch diameter of the single layer hoisting drums shall not be less than 40 times the nominal diameter of the wire rope.

The multi layer wire rope drum shall have end flanges that extend a minimum of two rope diameter above the top layer of wire rope.

2.3.2.8.1 Boom Hoist Ratchet and Pawl

The boom hoist drum shall be equipped with a drum ratchet and pawl assembly. The ratchet shall be securely mounted on the drum's middle section. The pawl shall be controlled from the operator's cab, shall be positively guided into the drum ratchet, and shall be designed to maintain both engaged and disengaged positions, wherever positioned last, without reliance on electrical power. The luffing pawl actuator shall prevent pawl actuation while the boom is moving.

The ratchet, its fasteners, the pawl, and the pivot joint shall be designed for 150% of the rated hook load drum line pull.

2.3.2.9 Gearing

Reducers and gearmotors shall be sized per the manufacturer's recommendation, except as noted in this specification. All gearing shall meet applicable AGMA standards or the international equivalent with a comparison to the US equivalent. All gearing shall be of the enclosed (gear reducer) type, except final drive. Shafts with three or more bearing supports shall not be permitted. Gear reducers shall be standard commercial products. Enclosed reducers shall have a convenient means of lubricant level indication and draining. All reducers shall have a ball valve to facilitate draining.

2.3.2.10 Brakes

Each brake shall be capable of stopping its respective drive under all operating and emergency conditions from maximum speed to zero unaided by motor regeneration, and independently hold the test load. Each brake shall be provided with a release mechanism that is self-return to ON so that it may be partially and completely released by hand. Maintained OFF, release mechanisms are not permitted.

Main hoist, whip hoist and boom hoist brakes shall release only after motor torque has been proven by their respective hoist drive systems. Automatic regenerative braking shall be provided for all drives when reducing speed before spring-set brake setting. Hoist secondary brakes shall have a setting time delay between 1 and 3 seconds in any stopping condition, including loss of power. Time delay shall not be accomplished via an uninterruptable power supply. All brakes shall have means for easy adjustment.

Brakes, pads, linings, and/or friction discs shall not contain any asbestos and shall not contact the brake wheels, rotors or discs except when the brakes are applied.

2.3.2.10.1 Main Hoist, Whip Hoist and Boom Hoist Brakes

Each hoist shall have a minimum of two spring-set type brakes. Each brake shall be rated at 130 percent of rated load hoisting torque at the point where the brake is applied as a minimum. Each brake shall independently stop and hold the 131.25% test load. Each brake shall be provided with a means to manually verify the holding torque in a deenergized state.

2.3.2.10.2 Travel Brakes

Each travel drive shall be provided with an electro-mechanical brake.

Each brake shall be motor end-mounted and spring applied, electrically released. Each brake shall have a minimum torque rating equal to 100% of the drive motor rated torque, not greater than 200%

of drive motor rated torque. The brakes shall be designed to permit easy access for adjustment and inspection for wear and/or setting of the friction discs.

2.2.2.10.3 Slewing Brakes

Each slewing drive shall be provided with an electro-mechanical brake.

Each brake shall be spring applied, electrically released. Each brake shall have a minimum torque rating equal to 100% of the drive motor rated torque. The rotate brake(s) shall be capable of stopping and holding rated load at rated speed in 40 mph wind.

2.3.2.~~12~~11 Travel Drives

Travel drives shall be electrically driven. The travel drive(s) shall provide adequate traction and power under normal operating conditions to include acceleration and deceleration with and against the specified operating wind and through track curves. The drive system shall provide speed control at all times (i.e. it shall not allow the crane to be "overhauled" by the specified operating wind at start or stop). At least half of the travel wheels per travel truck shall be driven. The travel drives shall be capable of traveling through the curved track at rated load at rated speed. The travel drives shall be capable of starting from a stop in the middle of the curved track with rated load. The travel drives shall be capable of operating on a 1% inclined grade.

2.3.2.~~13~~ 12 Slewing Drive

The drive shall provide adequate power under normal operating conditions to include acceleration and deceleration with and against the specified operating wind at rated load and speed. The drive system shall provide speed control at all times (i.e. it shall not allow the crane to be "overhauled" by the specified operating wind or load swing at start or stop). The slewing drive system shall have capability to continue to operate (at reduced speed) if a portion of the drive system malfunctions.

2.3.2.~~14~~ 13 Slewing Lock

A slewing lock (spud lock) device shall be provided for locking the crane upper-works to the portal base with the boom pointing in a minimum of two locations (jib aligned forward and aft with rails). Additional locations will be required for Bangor cranes (Government number 53 and 54) if the profile of the crane does not allow cranes to pass when the crane is parked in the spurs. An interlock (electrically) shall prevent the spud from being engaged when the rotate function is operating and prevent rotation unless the slewing lock is fully released.

2.3.2.~~13~~ 14 Shafts, Axles, and Pins

All shafts, axles, and pins shall be steel.

2.3.2.~~14~~15 Couplings

Chain and continuous sleeve type couplings shall not be permitted. Gear couplings shall be bolted flange type. Brake wheel couplings (if used) shall have the brake wheel mounted on the driven hub. Spline couplings are acceptable as installed on c, d, or p-face assemblies. Barrel type couplings shall be used in connection between the hoist reducer output shaft and drum flange. Conventional couplings shall not be loaded in the radial direction. Semi-flexible couplings shall be used on floating shafts and shaft arrangements where one shaft has sufficient length such that shaft deflection easily compensates for misalignment and the other shaft does not.

Full-flexible couplings shall be used on connecting shafts and axles with adjacent bearing supports.

Rigid couplings are permitted only on long shafts (with distant bearing supports) where shaft deflection easily compensates for any misalignment.

Flexible couplings shall not be relied upon to compensate for inaccurate alignment.

There shall be adequate clearance between couplings and adjacent components to allow removal of the cover for inspection, adjustment and alignment. Ends of coupled shafts shall be aligned within the recommended installation criteria of the coupling manufacturer or ¼ degrees per gear mesh, whichever is smaller. Coupling alignments shall be measured, and verified during the shop test. Hoist couplings shall be measured by the contractor and witnessed by the Government after field installation.

2.3.2.~~15~~16 Wheels

The wheels shall be sized for the maximum wheel load. See Appendices for required wheel flange dimensions. Travel wheels shall be double flanged and manufactured from wrought (forged) steel. Wheels shall be heat treated and case hardened including tread, flange faces and flange outside diameters, to a minimum Rc 48. Case hardened wheels shall be manufactured from fine grain, full killed, vacuum degassed forged or alloy steel. The steel forgings shall conform to ASTM A668. The hydrogen content of the forged steel material shall be tested in the ingot mold and shall not exceed 2.0 PPM. The forgings shall be fully normalized prior to hardening to ensure a grain size of ASTM number 5 or finer throughout the forging. A hardness gradient shall be specified to provide smooth transition without a drastic or abrupt change in hardness from the specified surface hardness (at the tread and flange surfaces) to the core material properties to sustain sub-surface shear stresses at maximum wheel load. Material in the web and hub area of the wheels shall be core material hardness.

All wheels shall be interference fitted and driving wheels shall be keyed to axles. The wheels shall be designed to withstand all forces during crane operation on existing ground rail including cornering and operate with full rated vertical load on the flanges when the crane moves through "frogs" and switches.

2.3.2.~~16~~17 Bumpers

Hydraulic bumpers shall be provided on the four corners of the portal base of the Bangor cranes (Government number 53 and 54) mating with the existing endstops (see Appendices). Strike plates shall be provided on the four corners of the Bremerton (Government number 51 and 52) portal cranes. The strike plate area shall be a 12" x 12" square (centered on the rail) and 24" to 36" above the rail. Bumpers shall be provided on the boom and stops shall be provided on the A-frame. Boom bumpers shall fully mate with the A-frame stops and mounted to provide proper clearance when bumpers are fully compressed.

2.3.2.~~17~~18 Keys and Keyseats

Key/keyseat assemblies shall be of the parallel type and machined. The manner of key installation shall preclude any possibility of a key shifting out of its intended position.

2.3.2.~~18~~19 Bearings

All bearings shall be of the antifriction type except where specifically permitted or required otherwise. Permanently lubricated sealed bearings shall be used wherever practical. Provide easily accessible fittings for lubrication of the grease-lubricated bearings. All antifriction bearings shall be supplied with inner races. If a pedestal bearing is used to support a drum, the housing shall be steel.

2.3.2.~~18~~19.1 Slewing Ring Bearing

The rotate bearing shall be the product of a manufacturer regularly engaged in the manufacture of such bearings to commercial precision limits. The bearing shall be of the roller type with three independent rows of rollers and specifically designed for thrust loads, overturning moments, and radial loads.

The L-10 life shall be not less than 10,000 hours based on continuous rotation at 100 percent rated speed. The rotate bearing shall meet the 10,000 hour minimum L-10 life criteria based on each of the following conditions:

a. 85% of the rated main hook load/operating radius combination resulting in the greatest forward moment.

b. Dead load with boom at minimum operating radius.

The bearing L-10 life shall be calculated without inclusion of such life extending factors as lubrication, cleanliness, or geometry. The slewing ring bearing shall be selected and installed in accordance with the slewing ring bearing manufacturer's recommendations.

2.3.2.~~19~~20 Bushings and Thrust Washers

All connections, including equalizer sheaves or bars, subject only to small rocking motion shall be fitted with bushings and/or thrust washers, as applicable.

2.3.2.~~20~~21 Shims

Shims shall be pre-cut, slotted, stainless steel, with the thickness stamped on an insert tab. The shape of the shims shall resemble a U and the slot widths shall approximate the mounting bolt diameters. The shim tabs shall be visible, legible and unpainted after installation.

2.3.2.~~21~~22 Lubrication

The crane lubricants shall be compatible with the standard lubricants listed in the Appendices.

The crane shall be designed to minimize both the number of lubrication points and the required frequency of lubrication. All points on the crane requiring lubrication shall be easily accessible from the structure, service platforms, or walkways, or shall have extensions (shortest possible) with approved pipe and fittings to accessible locations. Only one size and type of grease lubricating fitting shall be used throughout the crane.

2.3.2.~~22~~ 23 Hydraulic Systems (For cranes with hydraulic drives)

All hydraulic components and assemblies shall be standard commercial products. All hydraulic fittings and reservoirs shall be stainless steel. The luffing system shall be able to maintain a fixed position for a minimum of three hours. Each crane motion (hoist, luff and rotate) shall be driven by an independent pump.

All drive system components shall be sized or selected so that all crane motions will start from dead-stop (neutral position) with 130 percent of the rated load on the hook and have continuously variable speed in each direction.

Hoist and rotate hydraulic drives shall be closed loop systems. Closed loop systems shall consist of a dedicated pump(s) and motor(s) for each function. Appropriate pump drive, relief valves and controls shall be provided. Hoist drives shall consist of variable displacement hydraulic motor(s), planetary gear reduction, and drum as specified in paragraph 2.3.2.8.

The hoist hydraulic drives shall have a failsafe feature to prevent over speeding of the motor or lowering of the load or boom in the event of hydraulic pressure loss, malfunction, or power loss. The rotate hydraulic drive shall have the ability to prevent drift when in neutral or in the event of hydraulic pressure loss.

Each hoist and luff drive shall be equipped with a minimum two brakes, of either drum band or disc type (spring set, hydraulically released). Each brake shall be rated at a minimum of 130 percent of rated load hoisting torque at point of at the point where the brake is applied.

The entire assembly of motor, speed reducer, and disc type brake should be provided as a single unit. The rotate system shall be equipped with a disc type (spring set, hydraulically released) brake rated at a minimum of 100 percent of motor torque.

The hoist and boom shall have a means for controlled lowering at rated load in the event of power loss.

Provide provisions for hydraulic circuit sampling and pressure test ports.

Provide hydraulic fluid coolers and heaters to maintain proper fluid temperature with the crane operating at any load and speed within its operating capability and in ambient temperatures of 0 to 110 degrees.

Fluid filtration system shall be capable of filtering to a cleanliness level of 18/17/14 (ISO 4406:1999) or as determined by component requirements.

2.3.3 Electrical Design

The electrical design of the crane shall conform to NFPA 70, ASME B30.4, NEMA ICS 8, and other requirements specified herein. The electrical system shall be 480VAC and utilize 60 Hertz 3 phase. The electrical system shall be designed to allow simultaneous motions of the main hoist, luffing hoist, slewing and ancillary loads; or slewing, and travel drive mechanisms and ancillary loads. Control voltage shall be 115 VAC 60-Hertz or low-voltage DC generated by the crane via a built in transformer.

The main line disconnect switch shall be a lever arm type switch (rotary type switches are not acceptable) located in a separate enclosure from the control panel. A permanent placard shall be installed on the face of the main line disconnect that states "WARNING – THIS DOES NOT ISOLATE POWER TO LIGHTING, RECEPTACLES, AND ANCILLARY EQUIPMENT". Additionally, a lighting (ancillary equipment) disconnect shall be provided, with lockout feature, as the isolation means for the lighting transformer and lighting circuit breaker panel, which shall power the crane's ancillary equipment. Provide individual disconnects, with lockout feature, capable of being locked in the open position for crane lights and receptacles.

All control circuits shall be fed from a single phase, air cooled, double-wound transformer. The contractor shall furnish and install all electric drive equipment on the crane, including motors, brakes, switches, controllers, panels, wiring system, cables, and electrification. All contactors and relays shall have appropriate MOVs or R-C surge absorbers installed across the respective device's coil. As much as possible, power and control cables shall not be mixed in the same conduit in order to prevent interference. Shielded control cables (encoders, load indicating devices, etc.) shall not be run in conduit with any other control or power conductors.

Enclosures for control panels and auxiliary devices shall be UL or CSA listed metallic NEMA type 12 as defined by NEMA Standards Publication Number 250. Components in all panels shall be selected and installed such that the control system enclosures are NFPA 70E arc flash hazard/risk category 0. Individual components shall be designed and installed to meet ingress protection rating 20 (IP20) (Finger Safe) per ANSI/IEC 60529 standard. Appropriate shields shall be placed over components that cannot meet category 0 or IP20 standards and allow the panel doors to be open with the drives in operation. The enclosures shall be designed with appropriate heating and/or cooling accessories to maintain a climate within the panel that provides an appropriate internal temperature environment for proper operation of the drives. There shall not be any condensation inside the control panels. All control panels shall have an interior light for each 3ft of enclosure width with a door switch to turn lights off when doors are closed. The control panel lighting shall have no exposed contact points within the panels. All electrical components shall be industrial grade and located so they are easily accessible for inspection and maintenance.

2.3.3.1 Wiring System

Unless otherwise specified, interconnecting wiring shall be of copper stranded construction complying with Table 310.104(A) of NFPA 70. Aluminum conductors shall not be used. Aluminum connectors are allowed if they are rated for use with copper conductors (marked "AL/CU"). All conductors connected to or routed above resistors shall have insulation shown in NEC Table 610.14(a) for 125°C maximum temperature. Motor branch circuit conductors shall be sized as to have an ampacity not less than 150% of the motor full load current rating and to be no smaller than 12 AWG. Conductors shall be selected and de-rated based on maximum ambient temperature. Continuous loads such as utility, heating, lighting, and air conditioning shall be multiplied by 2.25 to determine ampacity in order to permit application of NEC 610.14 (A) for crane supply conductors.

To the greatest extent possible, wiring shall be run on ladders or in cable trays. Use of conduit shall be kept to a minimum. The crane structure shall not be used as a raceway. Flexible conduit shall be synthetic jacketed, spirally wound galvanized steel. The use of flexible conduit shall be minimized. Flexible conduit shall only be used to accommodate relative motion between machine components and the structure. If approved, flexible conduit may be used at structural field joints where it can be shown that prior fit-up is not practical. Each use of flex shall not exceed 3 feet in length.

Bulkhead type fittings shall be used for penetrations of sealed and pressure tested members. External cable trays shall be stainless steel with cabling shielded from direct sunlight and rain. External raceways shall be stainless steel. Internal cable trays and raceways shall be hot-dip galvanized after fabrication or stainless steel. Cable ladders shall be stainless steel or hot dip galvanized after fabrication.

Excluding conduit directly connected to dynamic breaking resistors, raceways shall maintain a 12-inch clearance between the raceway and surfaces with temperatures exceeding 104°F. A separate grounding wire, sized in accordance with Section 250-122 of NFPA 70, shall be routed with all ungrounded conductors. All wiring shall be numbered or tagged at all connection points. Power conductors which are shielded such that their wire size cannot be easily determined shall be labeled as to the conductor size. All unused conduit openings shall be plugged. All conductors shall terminate on terminal blocks; there shall be no splices, with the following exceptions:

a. Encoder conductors shall have a continuous run from the encoder to the drive. If the length of cable required between a drive and its respective encoder is longer than 300 feet, fiber optic cable shall be used.

b. Motor and brake connections may be made using split-bolts or lugged and connected with nuts, bolts, flat washers and lock washers in lieu of installing a terminal block in the motor connection box. No wire-nuts shall be permitted.

c. Connections for lighting ballasts may be made using wire nuts.

d. Conductors shall be continuous between the load cell, and the load indicating device (if applicable).

2.3.3.2 Drive Mechanism Motors

The drive mechanism motors shall conform to NEMA MG 1. The ~~hoist~~ hoists (60 min rated min), slewing (continuous rated), and luffing (60 min rated min) motors shall be AC vector duty, totally enclosed non ventilated (TENV) or totally enclosed fan cooled (TEFC), squirrel cage induction type with encoder. The travel drive motors shall be AC inverter duty, totally enclosed non-ventilated (TENV) or totally enclosed fan cooled (TEFC), squirrel cage induction type and designed for rated speed at the operating wind load in any direction. Motor insulation shall be a minimum of Class F. Motors located outdoors shall be furnished with anti-condensation heaters that remain energized when the mainline contactor is deenergized. The form of protection for the electric motors shall be IP54, for the electric motors for any oil coolers it shall be IP56.

Motors shall be equipped with thermal trip type over-temperature protection. The temperature sensors shall be of the automatic resetting type and installed integral to the motor windings. Activation of any integral motor over-temperature device shall energize a red indicating FAULT light mounted in the operator's cab and shall de-energize the individual function as follows:

~~Hoist~~ Hoists and Luffing: The raising direction only

Travel and Slew: Travel motion in either direction.

The red indicating fault light shall remain energized until the over-temperature device resets.

2.3.3.3 Electric Controls

All motions of the cranes shall be controlled using the manufacturer's standard electrical control system. All electrical controls shall be variable frequency. Hoists shall have encoder feedback. The controls shall monitor for fault conditions and shall safely set the brakes and stop crane motion in the event of fault conditions. The control system shall record the fault and provide troubleshooting information. Each variable frequency drive is required to include as a minimum; electronic instantaneous over current protection, under voltage protection, DC bus over voltage protection (where used), and the ability to withstand output line-to-line shorts without component failure.

All hoist drives shall be equipped with a motor overtorque limit to lock out the hoist and prevent gross overload of the associated hoist. The overtorque limit should be set such that a 130% dynamic overload test can be performed without tripping the overtorque fault. All controllers shall be provided from the same manufacturer. Dynamic braking shall be provided for each electric drive. Dynamic braking shall be sized to support lowering (at rated speed and slow speed) of rated load from high hook height to ground rail height.

Speed control shall be infinitely variable type for each function. Controls shall be designed such that the maximum speed of each function shall be limited to 25% of rated speed when a slow speed switch is actuated in the operator's cab. A yellow/amber light mounted in the operator's cab shall be energized while in slow speed mode.

The hoist, luffing, slewing, and travel brakes shall set after the associated controller decelerates the drive motor to a controlled stop. The hoist, luffing, slewing, and travel controllers shall be sized to provide sufficient starting torque to initiate motion of that crane drive mechanism from standstill with 0 to 131.25% of rated load on the hook. Hoist functions shall not produce any rollback and shall produce no more than 1/8" of roll-up. Rollback is defined as "an inherent condition due to insufficient motor torque, which allows the hoisted hook load to lower when the hoist controller is moved initially into the hoisting position or as the controller is returned to neutral." Roll-up is defined as "on solid state controlled hoists, the distance a hoisting drive block rises when the controller is placed in the lowering direction. This roll up is due to torque proving circuits in the hoist direction that ensure the drive is capable of restraining a load before releasing the holding brakes." The hoist controller shall enable the drive motor to develop full torque continuously at zero speed. Motors shall operate smoothly at all speeds without torque pulsations, and shall only be energized within the frequency range of 50-60 Hz at rated speed. The control system may utilize overspeed up to 120hz unloaded only if the drivetrain equipment has all been balanced and is rated for the resulting speed. With respect to AC control wiring, no neutral wire shall pass through the contacts of a control relay or contactor, i.e., a device shall not be shut off or disengaged by breaking the device's neutral conductor.

Hoist drives are required to be selected such that the continuous rating of the controller is not less than 130% of the calculated motor full load current based on NEC Table 430.250 and the following equation:

$$Mechanical\ HP\ = \frac{WxV}{33000\ x\ E}$$

where:

W = total weight in pounds lifted by the hoist drive system. This includes complete hook block and rated load.

V = specified speed in feet per minute when lifting weight W

E = $(E_g)^n\ x\ (E_s)^m$

E_g = efficiency per gear reduction, (E_g) = 0.97 for anti-friction bearings and (E_g) = 0.93 for sleeve bearings

n = number of gear reductions

E_s = rope system efficiency per rotating sheave, (E_s) = 0.99 for anti-friction bearings and (E_s) = 0.98 for sleeve bearings

m = the number of rotating sheaves between drum and equalizer passed over by each part of the moving rope attached to the drum

2.3.3.4 Transients and Harmonic Protection

Varistors for transient protection shall be provided internal to the controller.

Minimum harmonics protection shall consist of an isolation transformer connected in series with each controller's line (input) terminal. All isolation transformers shall be rated for continuous duty operation based upon motor nameplate amperes and shall be designed for 60 Hertz operation.

For a drive motor branch circuit that exceeds 100 feet in length, a reactor shall also be connected in series with the controller load (output) terminals to provide standing wave protection.

2.3.3.5 Data Recorder and Drive Faults

Control parameter adjustment and fault monitoring shall be capable via user interface mounted in a location that does not require opening any electrical cabinet with exposed conductors.

A ruggedized laptop computer complete with all compatible software (including software licenses) and all necessary cables and special connectors to allow crane software to be troubleshot, checked and upgraded, and for the data recorder to be accessed and information retrieved, shall be provided.

Drive faults shall energize a red indicating FAULT light mounted in the operator's cab.

2.3.3.6 Brakes

Each drive mechanism's spring-set brake(s) shall release upon movement of the electric drive's controller from the OFF position and verification of motor torque and shall set after the electric drive's controller is returned to the OFF position and motors have regeneratively slowed to a controlled stop. Hoist secondary brakes shall be controlled separate from the primary brakes and connected to a different output (within the drive or independent of the drive) from the primary brakes.

A three positioned spring returned brake release keyswitch, for each hoist, shall be installed on the outside of the control panel. The keyswitch shall allow for testing each brake independently. The right position shall be labeled "PRIMARY BRAKE TEST " allows for testing the primary brake, and the left position shall be labeled "SECONDARY BRAKE TEST " allows for testing the secondary brake. The center position of the keyswitch shall be labeled "NORMAL" allows both brakes working in their normal operating configuration.

2.3.3.7 Main Line Contactor

A main line contactor shall be provided. Energization of the main line contactor shall be controlled by the POWER-OFF/POWER-ON toggle switch in the operator's cab.

2.3.3.8 Electrical Overload Protection

Protection shall be not less than required by NEMA ICS 8 and NFPA 70. All protection shall be by circuit breakers or fuses. Motor branch circuits shall be individually protected by circuit breakers capable of being locked in the open position without use of a portable lockout device.

2.3.3.9 Operator Controls

There shall be five joysticks integrated into adjustable enclosures on both sides of the operators chair. The joysticks shall be arranged in the following sequence (starting at the operators rear-left and progressing to the right-rear): luffing, slewing (rotate) (left operator's control console); whip hoist,

main hoist and travel (right operator's control console). ~~There shall be five joysticks integrated into the chair and shall be arranged in the following sequence (starting at the operators left): luffing, slewing (rotate) (left operator's control console); main hoist, whip hoist and travel (right operator's control console).~~ Controls shall be designed such that all master switches shall be in the OFF position before any initial crane function can begin. Master switches shall provide infinitely variable speed control to the particular function. Directional contacts shall also be utilized to ensure proper motions are executed. All master switches shall be non-spring-returned and have a detent neutral position and a trigger type dead-man switch. There shall also be an inadvertent motion foot switch. At least one dead-man switch or the foot switch shall be continually activated in order to operate any crane function. All joysticks shall be labeled for proper function and direction. Operation of any individual dead-man switches shall allow for operation of any of the crane functions. Resetting a drive fault on a crane function shall not allow the crane to operate until all master switches are returned to neutral. Motion indicators shall also be supplied to provide tactile feedback of hoist drum movement.

Electrically operated windshield wipers shall be provided on windows as necessary to afford the operator unimpaired vision. Windshield wiper shall have an automatic park position out of the operators' direct vision. Windshield wiper drive shall be heavy duty and durable. Windows shall be equipped with electrical heat strips or means for defogging that shall not interfere with the operator's vision.

Automatic and thermostatically controlled air conditioning and heating shall be provided to maintain conditions of 68 degrees F (20 degrees C) and 50 percent relative humidity.

A color display console shall be provided and conveniently located for use by the operator during operations. Selection of display factors shall allow an operator with corrected 20/20 vision to read the display with his head in the normal operating position in both bright sunlight and at night. The display shall provide load lifted in pounds, radius in feet, wind speed in miles per hour, diesel engine indicators and other pertinent operating parameters.

There shall be a single emergency stop push button, within reach of the operator, in the operator's cab for all crane motions/drives.

A method for the operator to feel actual drive operation (i.e. drum motion for the hoist) shall be provided in the cab.

A visual method for the operator to correlate master-switch movement direction with actual gantry motion shall be provided.

An operator warning horn (audible at ground level and all hook locations) shall be provided with both a momentary pushbutton switch and a foot operated switch.

Within the operator's cab an upholstered, nonfabric, three-directional adjustable chair shall be provided. The operator's seat shall be adjustable forward and aft to vary the relationship between the operator and his controls. The height of the seat shall be adjustable as well as the weight control of the seat suspension. The seat back shall have multiple tilt positions and adjustable lumbar support.

An additional chair shall be provided in the operator's cab for an observer.

The cab shall provide adequate sight lines for the operator to see operations at all rated operating configurations.

2.3.3.9.1 Indicator Lights and Warning Devices

Indicator lights and beacons shall be installed with LED type lights sized to be visible inside the operator's cab during any time of the day. There shall be a white light to indicate that power is available on the load side of the crane disconnect, a blue light to indicate that the main line contactor is energized, an yellow/amber slow speed light, an yellow flashing reduced capacity light and a red fault warning light to indicate a motor over-temperature or drive fault as required in paragraph 2.3.3.2 and

2.3.3.5. The voltage of the lights shall be 115 VAC or 24 VDC or lower. The nameplate shall be provided for each light and shall be legible from the operator's chair inside the cab. The nameplates shall read "POWER ON', "POWER AVAILABLE", "FAULT", "SLOW SPEED", "BOOM PAWL POSITION" and "REDUCED CAPACITY". A lamp test pushbutton shall be installed inside the operator's cab to allow for simultaneously energizing of all lights in this section for testing purposes.

a) Boom Actuated Limit Switch

A boom actuated limit switch shall provide an upper limit as emergency back-up of the geared upper limit switch by causing power interruption to the hoist drive mechanism motor and brakes by opening the a hoist line contactor. A key controlled bypass switch shall permit the operator to restore power and lower (not lift) the boom with the emergency back-up switch tripped.

b) Luffing Hoist Drum Pawl Position Indicators

Limit switches shall be used with boom pawl mechanisms. Limit switches shall be used to determine the position of the pawl so that its full engagement and full disengagement can be:

1.) Indicated to the operator.

2.) Its engagement is prevented while lowering the boom.

3.) Boom lowering is prevented unless the pawl is released.

Circuitry shall be used to prevent engagement of the pawl during the time the boom is commanded to stop from a lowering motion until it has actually ceased movement.

c) Wind speed indication in accordance with ASME B30.4.

Wind speed indicating devices shall give a visible and audible alarm to the crane operator at when the wind speed reaches the maximum operating wind speed.

2.3.3.11 Limit Switches

Provide primary (adjustable) lower and upper limit switches of the control circuit for all hoists. Software activated limits based on encoder feedback are acceptable as primary limits. Primary upper limit switches shall be designed such that activation shall allow movement only in the lowering direction. Lowering of the block (or boom) shall automatically reset the primary limit switch. Primary lower limit switches shall be designed such that activation shall allow movement only in the raising direction. Raising of the block (or boom) shall automatically reset the primary limit switch.

A boom (or block)-actuated upper limit switch wired independent of the directional contactors and of the primary limit switch shall be provided as an emergency back-up of the primary upper limit switch, by causing power interruption to the hoist motor and brakes through a means different from that used by the primary limit switch (for example, by opening a line contactor).

A three-position spring-returned keyed bypass/reset switch shall be included for each limit. The keyswitch shall allow for bypassing of each primary upper limit switch to allow for testing of the secondary limit switch and shall allow resetting of the secondary upper limit switch prior to resuming operation. During resetting of the secondary limit, the hoist shall operate in the lowering direction only.

Runout distances shall be computed with no load on the hook.

The lower limit switches shall be set such that there are a minimum of two wraps of rope on each hoist drum (three wraps for ungrooved drums) upon limit switch actuation.

a. Main and Whip Hoist Limit Switches

Main and whip hoist limit switching shall be provided to:

1.) Prevent raising of the hooks beyond ~~its~~ the associated maximum elevation with the boom at the angle which puts the ~~main and whip~~ hoist hooks at the associated~~its~~ maximum operating radius

2.) Prevent raising of the hooks beyond ~~it~~ the associated maximum elevation with a horizontal boom unless automatically bypassed whenever the boom is at or above the angle which puts the ~~main~~ hoist hooks at ~~its~~ the associated maximum operating radius

3.) Prevent the lowering of the hooks beyond ~~it~~ the associated minimum elevation with the boom at the angle which puts the ~~main~~ hoist hooks at ~~its~~ the associated minimum operating radius

b. Hoist Limit Switch Settings

Each primary upper limit switch shall be set at the maximum practical hook height but not lower than high hook position. Each secondary upper limit switch shall be set not lower than the hook height of the primary upper limit switch setting plus the primary run out distance, but not less than the secondary run out distance below the lowest contact point (two-block condition). (The run out distances are defined as the load block maximum drift, after switch activation, in the hoisting direction at maximum speed with no load on the hook. Primary and secondary run out distances are associated with the primary and secondary upper limit switches, respectively.)

c. Luffing Hoist Limit Switches

Luffing hoist limit switches shall be provided to:

1.) Prevent the raising of the boom above the angle which puts the main or whip hoist hook at its minimum operating radius.

2.) Prevent the lowering of the boom below an angle which puts the main or whip hoist hook at its maximum operating radius.

3.) Prevent the lowering of the boom beyond horizontal.

4.) Bypass the main or whip hoist upper limits (with a horizontal boom) whenever the boom is at or above the angle which puts the main or whip hoist hook at its maximum operating radius.

d. Boom Actuated Limit Switch

A boom actuated limit switch shall provide an upper limit as emergency back-up of the geared upper limit switch by causing power interruption to the hoist drive mechanism motor and brakes by opening the a hoist line contactor. A key controlled bypass switch shall permit the operator to restore power and lower (not lift) the boom with the emergency back-up switch tripped.

e. Travel Limit Switches

An interlock shall be provided to preclude travel if the rail lock is engaged.

f. Slewing Limit Switches

An interlock shall be provided to preclude slewing when the slewing lock is engaged. Limit switches shall be used with the slewing (spud) lock to:

1.) Limit the upward and downward movement of the spud.

2.) Energize and de-energize lights indicating the engagement or disengagement of the spud

3.) Indicate to the operator the position of the spud, relative to the socket, when they are within close proximity while the upper works rotates.

2.3.3.12 Portal Travel Warning

One electrically operated automatic warning buzzer or multi-tone siren shall be mounted at each portal leg and shall sound automatically whenever the travel motors are energized. The warning shall be adjustable in volume and tone and capable of achieving a level of 80-90 dB.

2.3.3.13 Collector Ring Assembly

Current shall be carried between the crane upper structure and the portal base by means of collector rings and brushes.

Spare rings of each size of collector ring shall be provided, three for 3-phase AC circuit and two for single phase AC circuit and DC circuit applications.

The collector rings shall be fabricated from a copper alloy and shall permit unlimited 360° rotation. Collector ring assemblies shall be selected based upon their non-rotating, continuous duty current rating. A minimum of 10% spare capacity shall be provided in the slip rings.

2.3.3.14 Hotel Power Reel and Associated Cables

The crane shall be capable of being parked for a minimum of 8 hours without being started or operated without loss of any computer or electronic functionality. For maintenance lighting and longer periods of inactivity, a hotel electrical connection is required. The connector shall be accessible on both sides of the crane from the ground level when the crane needs electrical power while in the parked condition. Cabling shall be sized appropriately for all ancillary equipment on the crane. A cable reel (or equal) shall be provided which allows connection to a hotel electrical connection 75' from either side of the crane The reel end connector shall match the existing connectors at the respective locations (see Appendices). Provide all required transfer switches at the ground level that ensure the crane cannot be powered simultaneously from the diesel generator and hotel power.

2.3.3.15 Nameplates

Nameplates shall be provided for all electrical control equipment such as contactors, relays, transformers, etc., and all electrical panels. As a minimum, each nameplate shall identify the associated function and system designation. Each electrical component shall retain all nameplates, markings, etc. provided by the original manufacturer. Electrical enclosures shall be posted with their arc flash ratings per NFPA 70. The Contractor shall supply arc flash hazard assessment calculations in accordance with NFPA 70E.

2.3.3.16 Electrical Outlets

There shall be 120 VAC duplex outlets provided on the crane. The circuit(s) supplying receptacles shall incorporate ground-fault circuit-interrupter protection for personnel and shall be protected by a circuit breaker with a minimum rating of 15 amps.

a. Two in the Operator's Cab
b. One at the Collector Ring Assembly
c. One at each Corner of each Level in the Machinery House
d. Two in the Electric Room
e. One Every 20' of Portal Base Structure

2.3.3.17 Lighting

Compact fluorescent or LED lamps shall be used to illuminate crane passageways and spaces. Exterior footwalks, ladders and stairs shall be illuminated to 5 foot-candles. For stairways and ladders where illumination is required, switches shall be provided at both the top and bottom of the ladder or stairway. Machinery houses shall be illuminated to 40 foot-candles at a work plane 3 feet above the

floor with a switch located at each entrance. The operator's cab shall be provided with two lighting systems, one providing white light and the red light for "night vision". Access lighting shall be provided when the crane's electrical system is not energized. This system should be supplied from the diesel engine starting batteries or other source of power available when the crane is not energized. When batteries are used to provide access lighting, timer type switches shall be used to limit the length of time current is being drawn from the batteries.

Metal halide or tungsten halogen (quartz) lamps (or equal) shall be used in floodlights and spotlights. Floodlights shall be mounted along the boom to illuminate the work area beneath it. Mounting brackets for the floodlights shall be designed to permit the floodlights to hang plumb at any boom angle. Floodlights shall be mounted around the portal base or rotate tube to illuminate the area about the crane. Floodlights for the work area shall be switched from the operator's cab. Spotlights, trainable from within the operator's cab, shall be provided. Floodlights shall be designed to be serviceable from walkways on the crane. Floodlights shall be equipped with safety cables to prevent the fixture from falling if dropped while being serviced.

2.3.3.18 Emergency Illumination

An emergency lighting system is required in each machinery house module and individual diesel compartment. The system shall be so arranged that the failure of any individual lighting element, such as the burning out of a light bulb, cannot leave any space in total darkness. Emergency lighting facilities for means of egress shall be provided for passageways, platforms, ladders and stairs leading to an exit. Adequate and reliable illumination shall be provided at all exit facilities.

2.3.3.19 Obstruction Lights, if applicable

The crane shall be equipped with obstruction lights, of the number, wattage, type, and configuration required by the FAA. As a minimum, they shall be located at points on the crane that are over 200' high. The obstruction lights shall meet the requirements of FAA Advisor Circular, AC 70/7460-1K - Obstruction Marking and Lighting.. Four-hour battery backup shall be provided. All obstruction lights shall be within easy and safe reach for re-lamping.

2.3.3.20 Capacity Overload Protection

A commercially available product complying with SAE J159 shall be provided to provide capacity overload protection for the main and whip hoist. The system shall be of the Load Moment Indicating (LMI) type and shall consist of devices which monitor the crane load and boom angle. The overload limit for each hoist shall be initially set at 100% of rated load (based on load chart) and shall, at a minimum, be adjustable from 80% to 131.25% of rated capacity. When an overload is detected the affected hoist function shall be limited to the lowering direction only and the luffing hoist shall be limited to raising direction only. Each hoist shall have a maintained keyed override located on the outside of the control panel, which can be used to deactivate the capacity overload device during overload testing. Resetting of the overload shall only be accomplished by moving the hoist in the down direction or by cycling power.

Measurement of the load shall be performed at the hook block and wirelessly transmitted. The measurement device shall not be via indirect method (measurement of the lateral deflection force of wire rope between three sheaves in a rigid frame). Information, audible warnings, and visual warning from the LMI system shall be displayed in the cab as required in para. 2.3.3.9.

Minimum accuracy criteria for the LMI system shall be as defined by SAE J159 and shall maintain the load accuracy requirement to a minimum of 50% of rated capacity. Minimum testing for the capacity overload systems shall be as prescribed in SAE J159 and shall be performed with 50% and 100% weight.

The system shall be capable of being calibrated while installed. The minimum design factors for steel and aluminum load bearing components for the LMI system are required to be 5.0 and 7.0 based on

the material ultimate tensile strength respectively. The hardness of steel load bearing components may not exceed 40 HRC. Precipitation hardened stainless steel (e.g. PH17-4) load bearing elements shall be age hardened at a minimum temperature of 1025 degrees Fahrenheit.

2.3.3.21 Hour Meter

Provide a non-resettable hour meter, connected across the main line contactor, readable from the exterior of the main control panel, to indicate the elapsed number of hours the crane is energized. Additionally, provide non-resettable hour meters for each function, readable from the exterior of the main control panel to indicate the running time of each individual function.

2.3.3.22 Communication System

Provide a suitable Public Address system for the operator to communicate to the ground level.

Provide a communication system with communication between the following locations, operators cab, ground level at each crane access and machinery house.

2.3.3.23 Diesel Engine and Generator

The crane shall be provided with a self-contained diesel engine and generator capable of adequately supplying electrical/hydraulic power for the crane. The diesel engine shall conform to the U.S. EPA emission standards specified in 40 CFR 89 or 40 CFR 1039, as applicable for the manufacture or importation of non-road compression ignition engines. The diesel shall be designed to allow maintenance to be performed up to and including engine swap-out.

Diesel engine(s) shall be sized so that the crane drive with the largest motor(s) can be accelerated at maximum (test) load to its rated speed while the other drives are operating at that same maximum load and 25% of rated speed, plus ancillary power requirements. Generators shall be selected based upon the power required to simultaneously accelerate the three largest drives operating at rated load plus ancillary power requirements. The generator control system and function drives shall work in tandem to identify high load conditions on the generator and then automatically prevent high speed or high power operations of the drives in order to prevent the diesel engine from being overloaded. The generator shall be sized large enough that the effects of multiple drives operating in any quadrant will not adversely impact voltage control.

The diesel engine and generator set shall have electronic speed and fuel controls. Diesel instrumentation shall include but not limited to the following: engine speed (RPM) tachometer, coolant temperature gauge, and the lubricating oil pressure gauge. The tachometer and gauges shall be installed in the operator's cab and in the diesel engine operations space. Audible and visual alarms for engine overspeed, high coolant temperature, and low lubricating oil pressure are required in the operator's cab. For electronic engine controls where overspeed alarm and shutdown are not required by the engine manufacturer, the audible and visual alarm indication may be omitted from the operator's cab. When any of the audible and visual alarms settings are exceeded beyond the engine manufacturer's limits, the engine control system shall automatically shut it down.

There shall be an emergency stop push button for the diesel engine and generator inside the diesel engine room. The diesel engine shall be equipped with an hour meter.

The diesel fuel tank shall be fillable from ground level and shall be supplied with the required end fitting for the location (see Appendices). The capacity of the tank shall allow for a minimum of six eight hour shifts of operation at the rated service classification prior to refueling. The diesel engine shall be located and designed to limit noise both in the cab (<60dB(A)) and at ground level during operations (<70dB(A)).

2.4 COMPONENTS

Standard commercial product/assembly is defined as an item that is advertised for sale in current commercial literature and is being sold in substantial quantities on the open market in the course of

normal business operations. Nominal quantities, as normally associated with models, samples, prototypes, or experimental units are not acceptable under this definition. The contractor may utilize standard commercial products/assemblies, including major components such as complete end trucks, in the design of the crane, provided such components meet the requirements of this specification. The component selection must be substantiated by means of the manufacturer's published ratings, selection method, or pro-rating. Standard commercial gearboxes are acceptable as rated.

2.5 ACCESSORIES

Not applicable for this specification.

2.6 MIXES

Not applicable for this specification.

2.7 FABRICATION

2.7.1 Shop Assembly

2.7.1.1 Structural Assembly

Structural steel shall conform to the AISC Steel Construction Manual. Structural steel shall be free from kinks and sharp bends. Shearing and chipping shall be done neatly and accurately. Corners shall be square and true. Straightening shall be done by methods that will not change material properties or cause fabrication scars. Flame/quench straightening is prohibited on high strength steel.

Post-weld heat treatment (stress relieving) of high strength steel parts, if used, shall be in accordance with AWS Dl.l and shall be part of the welding procedure and its qualifications.

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 Contracting Officer. All weld repairs shall be items of permanent record.

2.7.1.2 Mechanical Assembly

All mechanical components shall be accurately aligned and positively secured to maintain alignment. Parts shall not be forced into position to obtain apparent alignment.

Fasteners or parts which might become loosened by vibration, shock, or crane operation shall be secured by suitable locking devices. Friction shall not be relied upon for retention of parts.

2.7.1.3 Rotate Bearing Assembly

Rotate bearing mounting fasteners shall comply with the rotate bearing manufactures recommendations and API 2C requirements. The rotate bearing rings shall bear directly on accurately machined (turned or machined) flat seats of the bearing supports, without the use of any pads or filler materials. The flatness of the bearing supports shall be in accordance with the bearing manufacturer's criteria.

2.7.1.4 Base-Mounted Components

Component's feet shall be shimmed as necessary to not exceed 0.001 inches of soft foot.

All based mounted components shall have a minimum of 0.100 inches of shims under each foot. The number of shims of any thickness shall be limited to four (4) under any mounting bolt. Shoe brake bases shall be shimmed to align the brake shoes with the brake wheel. Pillow blocks with hollow feet shall be mounted with fasteners and washers that overlap two or more solid vertical sections of the base.

Fine thread, lockable jacking bolts shall be installed on the foundation at each foot of the base-mounted motors for fine movement of alignments.

2.7.1.5 Electrical Assembly

Installation of all electrical wiring, conduit, and components shall be performed in accordance with the requirements of NFPA 70. As a minimum, items a. through k. below shall be followed:

a. All electrical connections shall be installed in accordance with NFPA 70 sections 110.14 or 430.9, as applicable, or as recommended by the device manufacturer. Connections shall capture 100% of the wire strands in the conductor.

b. Crimped terminal lugs, if used, shall be properly sized for the wire and installed using the device(s) – e.g., crimping tool and indenter – recommended by the terminal lug manufacturer.

c. All spare conductors shall be identified as spare conductors, and shall have their ends insulated to preclude accidental contact with energized equipment.

d. Adhesive-backed wiring tie wraps and cable-clamping devices shall not be used unless they are secured with fasteners, in addition to the adhesive.

e. All panels shall have their doors, back sheets, and panel boards bonded together with flexible bonding straps.

f. Bonding straps and equipment grounding conductors shall have all paint removed from their termination points, or shall have toothed (star) lock washers installed, to insure proper grounding of the equipment.

g. Wiring around sharp edges, such as panel doors, shall be wrapped in protective sleeves (e.g., "spiral wrap") to prevent wiring insulation damage from chaffing, cutting, or abrasion.

h. Control panels shall not be used as raceways for conductors not terminating within the panel.

i. Bushings or chafing protection gear shall be used on all panel conduit entries.

j. Only equipment that needs to be viewed or accessed from the panel door (i.e. dataloggers, key switches, pilot lights, etc.) shall be mounted on the panel door.

k. Bonding conductors are required to be provided across all gudgeons and the boom and strut hinge pins; the minimum size of these conductors is to be 2/0 AWG. The upper works shall be electrically bonded to the portal base utilizing 2/0 AWG conductors and a collector ring having a minimum cross-sectional area meeting NEC grounding requirements.

2.7.1.6 Mechanical Fastener Tightening

All fasteners used in securing mechanical or spring set (i.e., brakes) components to their foundations shall be tightened to accepted torque values from standard tables based on the lubricant used. The fasteners must be lubricated and shall not be installed "dry". The prevailing torque of the locking element shall be accounted for where self-locking nuts are used. All mechanical fasteners shall be nominally tightened to 70% of the fastener yield strength, except in applications where component manufacturers prescribe specific fastener torquing requirements. The requirements of this paragraph also apply to the fasteners use for mounting wheel assemblies, all pillow block bearing fasteners (unless bearing manufacturer specifies otherwise), and gear case assembly bolts (in the case that gear case is disassembled after receipt from the gear manufacturer).

2.7.1.7 Structural Fastener Tightening

All fasteners and any other fasteners critical to the structural integrity of the crane shall be installed and tightened in accordance with one of the methods in the RCSC Specification for Structural Joints using High-Strength bolts.

2.7.2 Shop and Factory Finishing

2.7.2.1 Corrosion Protection and Paint

All parts of the crane shall be protected against corrosion. Pockets where water can collect shall be avoided or drains shall be installed to prevent standing water. Corrosion resistant stainless steel fasteners shall conform to ASTM F593 and F594. All surfaces normally painted shall be cleaned, primed, and finish painted at the contractor's plant as specified hereinafter. All externally installed hydraulic fittings shall be stainless steel or rust protected after final painting. The crane shall be protected by a two-component zinc-rich epoxy primer coat, two-component epoxy intermediate coat and finished by a heavy metal free polyurethane finishing coat, and applied in accordance with the paint manufacturer's recommendations. Primer and paint shall not contain any lead, copper or chromates.

2.7.2.2 Surface Preparation

Exterior steel surfaces including welds shall be cleaned in accordance with requirements stated by the coating manufacturer. All grease, oil, and surface debris shall be removed by solvent wiping and/or detergent/water scrubbing prior to cleaning. All weld spatter shall be mechanically removed prior to cleaning. All exposed edges of exterior steel shall be rounded to ensure proper paint adhesion and proper paint dry film thickness.

2.7.2.3 Additional Painting Requirements

Faying surfaces of slip-critical structural bolted connections be prepared as specified in RCSC Specification for Structural Joints using High-Strength bolts. All structural bolts shall be painted once installation has been completed.

The crane gantry shall be safety yellow from the ground up to approximately 10-feet and blue from there-on to the top of the crane machinery house and A-frame. The crane jib boom shall be safety yellow.

The government crane number shall be painted in approximately 6-feet high numbers on all four sides of the machinery house, in approximately 4-feet high numbers on all four sides of the gantry beam and in ~1' high numbers at each access point at eye level.

The crane capacity sign shall be placed on all four sides of the gantry beam (readable from the ground level).

2.7.2.4 Non-Painted Items

The following items shall not be painted: machined surfaces that are bearing surfaces, hooks, hook nuts, lubrication fittings, hoisting ropes, wheel treads, sheave and drum grooves, corrosion resistant steel, bronze, anodized aluminum, name plates, flange mounting faces, flexible metal conduit, and other items not normally painted.

2.7.3 Tolerances

Tolerances shall be in accordance with this specification and all references specified herein.

2.8 TESTS, INSPECTIONS, AND VERIFICATIONS

2.8.1 Contractor's Self Test

The contractor, at the contractor's facility prior to Government witnessed shop test, shall test each operating or major component of the assembled crane at "NO LOAD". Testing and inspection shall include brakes, lights, motor controls, speeds, limit switches, interlocks, wiring, and paint. The manufacturer shall inspect the entire crane for form, fit, and function, and shall operationally test all drives. Once the manufacturer successfully completes this test, the contractor shall notify the Contracting Officer to schedule the Government representative witnessed shop test and inspection.

2.8.2 Government Witnessed Shop Test and Inspection

The contractor will make the crane available for Government witnessing of the shop test procedure (SD-08.1) and inspection. The contractor shall advise the Government of the anticipated test dates prior to the beginning of the government witnessed shop test. The crane shall not be considered ready for testing until all documentation is approved by the government such as final drawings, wire rope certifications, and hook and nut proof test and NDT certifications. Upon completion of the government witnessed shop test and inspection, a list of deficient items will be compiled and signed by the Government representative and the contractor and forwarded to the Contracting Officer.

PART 3 EXECUTION

3.1 EXAMINATION

All shop test identified deficient items shall be resolved prior to shipment of the crane, unless authorized by the Contracting Officer.

3.2 PREPARATION

All items intended for permanent installation on the crane shall be cleaned of any dirt, grime, debris, etc. prior to installation.

3.3 ERECTION

Not applicable for this specification.

3.4 INSTALLATION/REMOVAL

3.4.1 The crane contractor shall provide an onsite representative during erection. Contractor personnel shall refer to Section H (Bremerton) and/or I (Bangor) (as applicable) of the solicitation for site specific requirements.

3.4.2 The contractor shall erect the crane in accordance with Crane Installation Plan (SD-08.2). The crane contractor shall secure the crane, while not directly in control of the work area, during installation.

3.4.3 Lifting of any major components (assembled crane, girder(s), and end trucks) shall be considered critical, and lift plans shall comply with the requirements of paragraph 1.7.2. of the NAVFAC P-307 and 29 CFR 1926 subpart CC. When the installation plan requires lifting or handling of major components, rigging by choking or sweeping using synthetic products, wire rope or chain is not allowed unless specific approval is obtained. Rigging gear shall only be attached to major components using designed attachment points. "Lifting" is not exclusive to crane lifts and can include use of any mechanized lifting device.

3.5 APPLICATION

Not applicable for this specification.

3.6 FIELD QUALITY CONTROL

3.6.1 Field Inspection and Test

a. Contractor Preliminary Inspection and Test

Prior to scheduling the Government inspection, the contractor shall perform an inspection, and complete no load operational tests on each system to be tested. The contractor shall ensure the crane meets this specification and systems are properly adjusted, lubricated, operational, and can be safely load tested.

b. Government Inspection

After the contractor's preliminary inspection and test is complete, the contractor shall notify the Government. Within the next fifteen days, a site inspection will be conducted by the Government along with the contractor (contractor shall provide operator to support

Government inspections). Failure of the crane to pass any of the inspections shall be cause for rejection. The crane may again be offered for Government inspection provided the contractor has corrected all defects and retested the crane. The government shall have five day for re-inspection.

c. Field Acceptance Test

Following completion of government inspection, a performance test shall be satisfactorily performed. One copy of all final crane drawings and a preliminary operation and maintenance manual shall be made available at the test site. The government will provide certified test weights and rigging gear. Failure of a crane to accomplish any of the prescribed operations shall be cause for rejection of the crane. A completed report shall be submitted to the Contracting Officer. The Government, at its option, may also conduct additional tests to determine compliance with the specification requirements.

d. Final Government Inspection

The government shall have one day for final inspection after field acceptance test.

3.6.2 Acceptance

Final Government acceptance of the crane shall take place only after the following conditions are met:

a. Contractor receives Government Approval for reports, tests, inspections and release of all data items.

b. The crane meets all contract requirements.

c. The crane passes a final inspection by the Government.

d. All deficient items have been corrected or method of resolution has been determined. Deficient items not corrected prior to the Government's acceptance shall be carried as warranty items, which will be corrected by the Contractor.

e. Navy Crane Center form 93-005R shall be completed and signed by a contractor representative, an activity representative, and a Navy Crane Center representative.

3.7 ADJUSTING AND CLEANING

Not applicable for this specification.

3.8 DEMONSTRATION

3.8.1 Training

After successful field testing of the first crane delivered at each location, provide the following training at the installation (once at Bremerton and once at Bangor) sites. Provide one day (8 hours) basic on-site crane operational training to an audience of up to 20 people. The operational training session shall include a general review of the entire crane capabilities, limitations, pre-operational checks and safety. In addition, provide three (3) days (24 hours) basic on-site crane electrical/mechanical/structural maintenance training to an audience up to 20 people. The crane maintenance training session shall be provided for mechanics likely to perform troubleshooting/repairs and routine preventative maintenance on the crane. Each attendee shall be provided with a copy of the course materials.

3.9 PROTECTION

Not applicable for this specification.

3.10 SCHEDULES

Schedules and their submittals are defined in section SD-01. Updates to the schedule shall be submitted should events changing the schedule occur.