xiii) Lighting Control – Trolley, Floods, Walkways and Cabin

xiv) Other control switches necessary for normal operation and options selected.

Left Hand Console

i) Emergency Stop

ii) Spreader Flipper Controls – Raise/Lower & Enable/Disable

iii) Twin Twenty Memories and Store Positions

iv) Centre Twist-lock Controls – Up/Down, Extend/Retract & Zero/1600

v) Spreader Pump On/Off

vi) Trolley Park

vii) Bypass Switches – Slack Rope, Twist-lock, Landing, Twin Twenty, High Wind

viii) Other control switches necessary for normal operation and options selected.

(4) Emergency stop push buttons and Drive Lock-Out Switches on the console

Emergency stop push buttons shall be positioned so they can be pressed with either hand in an emergency, one on each console shall be provided. The button shall be a mushroom type with raised guard to prevent accidental tripping.

A drive Lock-out switch with facility to padlock in the open position shall be provided on one console and may be incorporated into the E. Stop Pushbutton.

(5) Indicating lamps on the consoles.

i) Control power source 'On' indicator.

ii) Main motion power source 'On' indicator.

iii) Spreader position indicator (20' or 40' or 45').

iv) Spreader 'Zero Trim Zero List Zero Skew' position indicator.

v) Stowage pin 'Clear' indicator.

vi) Wheel brake 'Released' indicator.

vii) Boom position 'Lowered' indicator.

viii) Other indicating lamps as necessary to indicate operable condition with the lamp 'On'.

ix) Overload indicator.

Twin-lift Indicating Lamps

x) Centre twist lock housing at 0mm gap indicator.

xi) Centre twist lock housing at 1600mm gap indicator.

xii) Centre twist lock housing 'retracted' indicator.

xiii) Centre twist lock housing 'extended' indicator.

xiv) Twin 20' containers detected indicator.

(6) Interlock override push buttons

For adjustment and maintenance purposes, interlock override push buttons with cover of approved type shall be installed on the console or near the console apart from normal operational control switch group.

Layout and interlock override type and function shall be approved by the Purchaser.

(7) Labels shall be provided for each push button and indicator in local language. The labels shall beapproved by the Purchaser.

5.4.4. Motion Control Switches in Boom Control Station

(1) The controls shall be located within a cubicle as outlined in 4.6.2 (1) (Boom / Gantry Control Station).The following controls shall be provided as a minimum:

i) Emergency Stop Push Button

ii) Control On Push Button

iii) Control Off Push Button

iv) Fault Reset Push Button

v) Boom Mode Auto/Manual

vi) Latch Up/Down Switch

vii) Latch Floodlights On/Off switch

viii) Lamp Test Switch

The following indicators shall be provided as a minimum:

i) Control On

ii) Emergency Brake Released

iii) Boom Slack Rope

iv) Boom Lowered

v) Boom Latched

vi) Boom Latch Up

vii) Lamp Test

(2) The Control On indication shall inhibit control of any crane function from elsewhere on the crane, except Emergency Stop.

(3) The control station box and all the control switches shall be weatherproof. Automatic acceleration,slowdown and final stop shall be provided for each motion.

(4) An emergency stop push button and indicating lamp shall be installed in the station box in addition tothe control push button switches. These indication lamps shall indicate status of boom and boom latch to ensure safe operation.

(5) A hand free intercom telephone unit which allows simultaneous communication with the operator's cab, machinery house and ground level shall be fitted in the control station box.

(6) Labels shall be provided for each switch and indicator in local language.

5.4.5. Motion Control Switches in Ground Level Station

From this station, the following functions shall be controlled.

(1) Remote control switches of --kV power source for auxiliary systems.

(2) Switch on and off the control power.

(3) Gantry travel each direction at inching speed of 5 m/min maximum.

(4) Wheel brake 'Release' and 'Clamp' operation (Anemometer interlock shall be overridden).

(5) Anchor limit switch overriding for fine adjustment of anchoring position.

(6) Hoist Slow Speed – both directions.

(7) Trolley Slow Speed – both directions

(8) Spreader Pump On & Off

(9) Spreader Extend

(10) Spreader Retract

(11) Twist-lock Lock

(12) Twist-lock Unlock

(13) Flippers Down & Up

(14) All labels for switches and indicators shall be in local language.

5.5. Operational Safety Interlocks

5.5.1. Main Motions Interlocks

The Contractor shall provide hardware/software status and an operational verification on all motion protectiondevices, such as, but not limited to:- limit switches, proximity switches, cam switches, speed sensors, encoders,brakes, couplings, solenoid coils and solenoid valves.

The Contractor shall display the safety interlock verification status on the CCMS. Failure of any safety interlockshall inhibit all motions.

In addition to all the necessary protection of structural, mechanical and electrical system components, the following interlocks are required.

(1) Main hoist operation

i) Main hoist (hoisting or lowering) motion to stop:

a. At upper and lower hoist limits

b. With brake malfunction, or not activated or not in correct position.

c. With overspeed.

d. With motor overheat.

e. Lowering within a certain distance of the landside and waterside sillbeams.

f. Hoisting with an incomplete 'lock' position of twist-lock after the spreader is landedon a load fitted with corner fittings.

g. Hoisting with an incomplete 'lock' position of twist-lock of the

headblock (connectingheadblock to spreader).

h. Hoisting with an incomplete 'unlock' position of spreader twist-locks.

i. Hoisting with an incomplete 'unlock' position of headblock twist-locks.

j. When the actual position of any of the twist locks is different from the twist lockswitch command.

k. With loss of gearbox lube oil pressure if forced lubrication is utilized. (If ForcedLubrication is not installed for any gearbox this clause may be ignored)

l. When the boom is in motion.

m. With overload of cargo (stop hoisting motion, allow only lowering motion after hoistmotion is cut off).

n. With the activation of E-stop.

o. With position check fault.

p. With the spreader interlock incorrect spreader size, unlock & lock signal interlock,twist-lock selector interlock.

q. With the master controller interlock or check fault.

r. PLC / bus transmission error or fault.

s. With Gantry master or in motion.

t. With the wind speed interlock of level 3 or > 24m/s.

u. Drive unit protection on Over-Voltage (OV), Over-Load (OL), Under-Voltage (UV)and Over-Current (OC).

v. Motor side protection on Over-speed (OS), OC, and OV.

w. Speed deviation / control check fault.

ii) Main Hoist (hoisting or lowering) motion to slow down, or in slow speed:

a. Hoisting at near the upper hoist limit, with a safety margin for full decelerationdistance under any load condition before hitting the emergency stop limit.

b. Lowering at near the lower hoist limit, when the head block is at waterside ofwaterside sillbeam.

c. Lowering at the spreader height above quay level is about 4m 6m, when the headblock is at landside of waterside sillbeam. (The height to be adjustable)

d. Hoisting until sag of the wire rope is taken up.

e. With the hoist wire ropes slack.

f. When received the landing signal.

g. Two seconds of hoisting after the landing signal has been switched off.

h. When manual override button is engaged.

(iii) Main hoist hoisting and lowering without load shall be allowed while the boom is in raisedposition. Spreader functions shall also be operable for maintenance work.

(2) Trolley operation

(i) Trolley motion to stop:

a. At travel end limits at max. Out-reach or at max. Back-reach.

b. Where the spreader interferes with sillbeams, with 0.51-meter margin. The marginshall be adjustable.

c. Forwards motion at near the waterside end of the girder if the boom is not in fullylowered position with sufficient slack in Boom Hoist wire ropes.

d. With brake malfunction, not activated or not in correct position.

e. With motor overheat.

f. When the boom is in motion.

g. When any one or all of the high wind stowage pins of the trolley is engaged.

h. Entrance door protection/interlock.

i. PLC / bus transmission error or fault.

j. With the E-stop activated.

k. Drive unit protection on UV, OL, and OC.

l. Motor side protection on OS, OC, and OV.

m. With the master controller interlock or check fault.

n. With position check fault.

o. With the wind speed interlock of level 3 or > 24m/s.

p. Speed deviation / control check fault.

q. No boom horizontal signal. (trolley motion should still be available between legs andin back-reach)

r. Low pressure of rope tensioner (if any).

s. Boom master or in motion.

(ii) Trolley motion to slow down, or in slow speed:

a. Near the travel limits forwards and backwards with a safety margin for full deceleration distance before hitting the end limit, when the boom is in lowered position.

b. For trolley motion while the boom is in raised position (between the normal parkingposition and cab cleaning platform position only).

c. With activation of any override or bypass function.

d. Move to trolley selection.

(3) Boom hoist operation

(i) Boom (hoist or lowering) motion to stop:

a. When the trolley is in motion or positioned on the boom.

b. With overspeed.

c. With wire rope slack during lowering motion at a position other than the boom infully lowered position. (Stop lowering, allow only hoisting motion after stop).

d. Hoisting at upper limit.

e. Lowering at lower limit at boom horizontal position (with ample slack in wire ropes).

f. Lowering at boom latched position.

g. With brake malfunction, not activated or not in correct position.

h. With motor overheat.

i. With the E-stop activated.

j. Drive unit protection on UV, OL, and OC.

k. Motor side protection on OS, OC, and OV.

l. PLC / bus transmission error or fault.

m. Hoist, gantry and trolley master on or in motion.

n. With the interlock of rope tensioner pressure.

o. Speed deviation / control check fault.

p. Interlock of boom latch and hook signal.

q. Boom Drive Lock-Out switch located near to the access gate, or access gate open.

r. With the activation of the boom latch but the engaged signal was missed or failed.

s. When one boom hoist rope fails and the "boom hoist rope broken limit switch" is activated.

(ii) Boom (hoist or lowering) motion to slow down, or in slow speed:

a. Hoisting at near the upper limit before hitting the boom latch or start hoisting fromhorizontal.

b. Lowering at near the boom-lowering limit (boom near horizontal).

c. Lowering to final latching position.

d. Lowering from the upper limit position until boom latches are cleared completely.

e. When manual override button is engaged.

(4) Spreader Functional Interlocks.

i) Twist-lock function

a) Interlock 'permit' on the zero notch of all master controllers.

b) Interlock 'permit' on landing delay 'on' signal.

c) Load cell interlock for unlock function.

d) Signal interlock on unlock and lock sensors.

e) Interlock on twist-lock selector and twist-lock signal.

f) Interlock on holding signal.

ii) The Spreader twist lock movement shall be mechanically and electrically interlocked with the spreader landing detection, so that 'lock' movement is prohibited unless all the twist locks are confirmed as inserted into the container corner fittings. The landing signal shall allow for a one (1) second time lag to indicate the completion of landing to the operator and to activate the interlock

iii) The 'premature unlocking' movement with a suspended load shall be prohibited by means ofan electrical interlock. There shall be no physical movement of the twist locks on the spreader even though the twist-lock switch may be turned to 'Unlock' position. Audible and visual alarms detectable at ground level and at the inside of the operator's cab shall be activated by this premature movement of switches to unlock. Any such premature movementof switches shall deactivate all crane motions. Both audible and visual alarms shall cease when the twist lock switch is returned to its original position. Alarm tone to be approved bythe purchaser.

iv) Telescopic function

a. Interlock on the landing or lock signal.

b. Spreader size selector interlock

v) The twist locks and flippers shall remain in their last position after power interruption i.e. when power is resumed.

vi) Spreader oil pump function.

a. Head-block connect interlock.

(5) Gantry travel operation

i) Gantry motion to stop:

a. When the rail brake is engaged.

b. When the stowage pin is engaged to the quay.

c. When the cable reel limit switch for 'Over Paidout' is activated.

d. With brake malfunction, not activated or not in correct position.

e. With motor overheat.

f. While the main hoist brake is energized.

g. With boom position other than 'fully' lowered' 'stowed' or 'latched' position.

h. When the cable reel limit switch for 'slack cable' is activated.

i. End stopper interlock.

j. PLC / bus transmission error or fault.

k. Drive unit protection on UV, OL, and OC.

l. Motor side protection on OS, OC, and OV.

m. PLC / bus transmission error or fault.

n. With the activate of E-stop

o. With the master controller interlock or check fault.

p. Speed deviation / control check fault.

q. With the wind speed interlock of level 3 or > 24m/s

r. Interlock on gantry collision

s. Boom master or in motion.

t. Over-Tension of trailing cable.

u. Cable reel motor fault.

v. With Buffer switch activated

i) Gantry motion to slow down, or in slow speed:

a. To half speed when the gantry motion is controlled by the control box at the groundlevel or the Boom/Gantry control station, or close to or inside the interfered (common) zone.

b. When the Crane is approaching its traveling limit.

c. When the Crane is approaching the end stopper.

d. When manual override is engaged.

(2) Wind Speed-Wheel Brake Interlock

i) Wheel brakes to be normally in engaged position except when the gantry motion control lever is in 'Right' or 'Left' position and gantry motors are energized. Returning the lever to'Zero notch' shall reapply the rail brake after the gantry brakes are applied.

ii) Operating time for releasing and engaging the brake shall be within 2 seconds. In normaloperational condition at below the wind speed setting as described in 6.5.2(1).i) (Wind SpeedWarning), the brake shall be engaged with a 10 second time delay after each time the Gantrymotion control lever is returned to zero notch position (to achieve better inching response).

iii) This time delay function for engaging the brake shall be eliminated when the wind speed exceeds the lowest wind speed setting as mentioned in 6.5.2(2) (Wind Speed Warning).

iv) The brake must engage immediately when the Gantry motion control circuit is tripped regardless of the Gantry motion control lever position.

5.5.2. Elevator RFID Access/control *(Not Required)*

Access control system/reader shall be added inside elevator cabin by way of RFID tag or equivalent system. Without required coded tag no elevator operation shall be available; all requests for elevator operations shallbe logged with date and time stamp and ID tag number. Access control/operation system and parameters of operation shall be approved by the purchaser.

5.5.3. Cab Access Interlock

Contractor to submit proposal for safe access and egress for the operator's cabin by way of a request and permit locking gate system (industrial) authorized by the crane operator when the trolley and fixed platform are aligned. Control shall be off, during transfer (when one gate is open control shall not be available) once safe passage has been achieved gates are closed and locked and control system receives all clear signal (pushbutton), allowing operator to enable crane control.

5.5.4. Trolley Access Interlock (Mono-box Boom)
Contractor to submit proposal for safe access and egress for the trolley by way of a request and permit locking gate system (industrial) authorized by the crane operator when the trolley and gate (self-closing with latch) are aligned. Control shall be off, during transfer (when one gate is open control shall not be available) once safe passage has been achieved gates are closed and locked and control system receives all clear signal (pushbutton), allowing operator to enable crane control.

5.5.5. E room RFID Access *(Not Required)*
Access control system shall be added to e-room access doors by way of RFID tag or equivalent system. Without required coded tag no access shall be granted, all requests for access shall be logged with date andtime stamp and ID tag number. Access control system and parameters of operation shall be approved by thepurchaser.

***CLARIFICATION: RFID locations, access and functionallty shall be reviewed and approved during design review**

5.6. Communications

5.6.1. Intercom System

(1) A voice communication system which allows simultaneous or selective communication among the machinery house, control panel room, ground level and boom control stations, personnel lift and operator's cab shall be installed.

2 - Handsets in machinery house (1 inside the panel room)

1 - Hand-set in operator's cab

1 - Hand-set in boom control station

2 - Handsets at ground level, one on landside beside the gantry controlstation and one in the checker's cab.

1 - Boom Tip

1 - Top of A-Frame

1 - On back-reach near to TLS hydraulic cylinders

5.6.2. Fibre Optic Cable

(1) The fibre optic communication module shall be rack mounted design and the connecting device (between Crane's optics cable network to the optics cable

network outside the Crane) shall supportthe use of multimode fibre optic cable (62.5-micron core / 125-micron cladding). All optical fibre waveguide shall be terminated with ST-type connectors unless otherwise specified. The plug and socket assembly for the optics fibre cable shall be of IP55 protection.

(2) The fibre optic communication module shall support a fibre communication distance of 10km in a continuous 62.5/125m fibre optic cable.

(3) The fibre optic cable allowable transmission loss in the cable shall be less than the following:
Multi-mode cable: 5.0 dB/km at 850 nm wavelength

(4) Tests to measure and confirm the fibre optic waveguide requirements above shall be conducted during the acceptance, testing and commissioning stage. The Contractor shall provide the test procedures, all instruments, equipment and qualified personnel for carrying out the tests.

(5) The power supply for the fibre optic communication modules shall be back plated supply with LED indications for the active status of the output or receiving channels.

(6) The insulation and sheath material shall be halogen free and low smoke tested in accordance with IEC 754-2 and IEC 1034-3.

(7) The Contractor shall submit the proposed selection of cables and their test certificates to the Purchaser for review prior to ordering of the cables.

5.6.3. Public Address System

(1) Loud-speakers

i) Two loud-speakers pointing down shall be mounted on the trolley or near the operator's cab. An amplifier and a microphone shall be installed in the operator's cab. The volume adjustershall be installed in a lockable box to prevent unauthorized volume adjustment.

ii) Two talkback speakers shall be fitted under waterside and landside sill beams, facing inside toallow communication between operator and ground staff.

5.6.4. Operator Aid Cameras *(Required)*

(1) The crane shall be equipped with HD operator aid cameras on the back-reach pointing towards WSand on the trolley (PTZ auto zoom ± according to spreader height) pointing down enabling clear viewof spreader. The purpose of the system is to provide additional height and depth perception and ultimately improved vision for the operator enabling detection of personnel or obstacles which mayotherwise be positioned out of their field of view.

(2) Boom operation from the operator's cabin utilising a-frame boom latch and forestay camera monitoring system shall be provided. Camera placement and system design shall be discussed during design review.

(3) Two flat screen panels shall be provided, one (1) positioned in the operator's cabin and one (1) positioned in the PLC room. The screen shall be shaded as necessary to ensure clear view in all cabin/room ambient lighting levels. Panel brightness shall be adjustable for day and night-time operation andthe sensitivity of the cameras shall be suitable for operating efficiently during night time operation to provide good definition down to 10lux lighting level.

(4) Monitor display to be auto-switching (with manual selection also available) depending on input, for example when boom operation selected display to switch to boom latch and forestay feed.

(5) The camera signals shall be recorded on a common data storage device. The data storage shall be sized to store at least 120 hours of the camera signals.

(6) Cameras shall be positioned in a convenient location so that maintenance can be performed withoutadditional access equipment. The cameras shall be adjustable for position, enclosed within a weatherproof, security housing and having an automatic thermostatically controlled condensation heater.

(7) The operator aid camera system layout/functionality and manufacture shall be approved by the Purchaser.

***CLARIFICATION: For this project the Contractor shall provide four (4) gantry cameras, one camera at each corner for safe gantry operation, resting display screen (gantry joystick zero position) shall show all four (4) corners, when gantry is selected screen shall automatically display the two (2) camera feeds from direction of travel.**

5.7. Crane Condition Monitoring System (CCMS)

5.7.1. General

The Contractor shall supply, deliver, install and commission a Crane Condition Monitoring System (hereinafter referred to as the CCMS). The design of the CCMS shall facilitate future expansion in terms of capacity and functional features. The CCMS hardware and software shall be modular in design andconstruction to facilitate future expansion. There shall not be major re-configuration of the hardware and software modification and development. System expansion shall not be limited by the capacity of individual On-Board CCMS, RCCMS and PLCs.

The Crane Condition Monitoring System shall be installed in the following locations:

(1) In the electrical room inside the machinery house of each Crane (hereinafter referred to as the On- Board Crane Condition Monitoring System, On-Board CCMS).

(2) In the checkers cabin (CMS client touch-panel)

(3) In the maintenance base at the Engineering office building (hereinafter referred to as the Remote Crane Condition Monitoring System, RCCMS).

5.7.2. CCMS Description

The On-Board CCMS and RCCMS shall incorporate alarm/fault monitoring and graphics display, the conditionstatus monitoring with graphics display, the fault diagnostic functions, Crane operation and shall allowaccess to the programming logic and software. These functions must be able to be downloaded as a softcopy and printed as a hardcopy. The CCMS shall consist of but not be limited to the following elements:

(1) One (1) set of On-Board CCMS on each crane. This shall consist of a personal computer with monitor, keyboards and necessary associated peripherals and software. All hardware and software required for interface to the communication network and peripheral devices shall be included and reviewed by the Purchaser.

(2) Provision shall be provided at the checker's cab to allow engineering personnel to access the On- board CCMS via a notebook computer supplied by the contractor.

(3) One (1) set of RCCMS. This shall consist of a personal computer together with monitor, keyboard and necessary associated peripherals and software. All

hardware and software required for interface to the communication network and peripheral devices shall be included.

(4) A colour laser jet printer to be installed in the Engineering office and its associated peripherals for printing necessary information from the RCCMS.

(5) The Contractor shall provide a cost-free technical training for the engineering staff of the purchaser. The training program shall be submitted in the tender proposal. This training shall be conducted in local language by a competent person representing the Contractor.

(6) The Contractor shall provide 4 sets, cost free, reproducible maintenance manual, operator manual, recommended spare part list and spare part manual to the Purchaser in English and LocalLanguage.

(7) The CCMS shall have proper documentation of circuit diagrams, hardware and software and associated peripheral specifications and network interfaces.

(8) The Contractor shall submit within two (2) months after the date of award of contract, the CCMS system architecture for review by the Purchaser.

5.7.3. Operating Environment and Requirements
The CCMS shall be designed and operated in the following environmental condition:

(1) Environment
The CCMS shall be designed and operated in hot and humid atmospheres where installations are subject to prevailing heavy condensation and light fungi. Equipment shall also be treated to resist attacks and entry of insects. The components shall be suitable for a tropical environment.

(2) Degree of Protection
A minimum IP class (according to IEC 144 and 529) of IP20 is required. Equipment installed inopen atmospheres shall have an IP class of minimum of IP55. Finger protection against touching the electrical potential terminals shall also be required.

(3) Ambient Temperature

The system shall be designed and operated in an ambient temperature between 15 °C to 40 °C.

(4) Relative humidity
The operating and storage humidity shall have a range from 8% to 100% (non-condensing).

(5) Operating Voltage

The system shall be designed and operated under normal supply voltage defined for receptacle outlets and with a supply tolerance of +/-10% and a frequency tolerance of +/-5%.

(6) Duty Cycle

The system shall be designed to operate 24 hours a day for the whole year round with a Mean Time Between Failure (MTBF) at component level of not less than 30,000 hours and a Mean Time To Repair (MTTR) of not more than 1 hour per component replacement. The operational availabilityshall be not less than 99.997% per every continuous duration or period of any 3 months. The operational availability is defined as follows:

Operational Availability, Ao% = ((Toc -Tem) / Toc)

x 100% Toc (hrs): Total occupied time

(system is turned 'ON')Tem (hrs): Total time

for emergency maintenance

5.7.4. On-Board Crane Condition Monitoring System (On-Board CCMS)

(1) General Specification

The On-Board CCMS is located in the electrical room of the Crane. The On-Board CCMS is designed to provide a diagnostic and condition / status real time monitoring of the crane control system. The On-Board CCMS shall consist of the necessary sensors and transducers to be installed on each crane and in conjunction with the PLCs to provide continuous monitoring, diagnostics, datacollection on the Crane's operating systems. The system shall also provide crane operational data that is used to determine crane performance, maintenance scheduling, spare part details and daily/shift reports.

5.7.5. On-Board CCMS Software Requirements

(1) The On-Board CCMS and RCCMS operating system shall be real time, multi-tasking, multi-user operating system. The operating system shall allow the On-Board CCMS and other programs to runsimultaneously and allow the user to access any software without affecting the real time condition monitoring of the crane control system and the communication link between the On-Board CCMS and the RCCMS.

(2) The Contractor shall develop a user interface software to meet the following requirements:

i) The software shall be able to run on Windows operating platform. The operating platform and user interface software shall be approved by the Purchaser. The Contractor shall supply a complete back-up system that shall include the operating system and application software.

The back-up system shall be supplied as follows:

a) Spare SSD containing operating system and application software, with all parametersand settings set as required for the crane.

b) Stored in CD-ROM/DVD-ROM/SSD

The Contractor shall confirm that in the event of a system failure, reloading of the systemshall be completed in an acceptable time frame, approved by the Purchaser. The operating system shall be an English version with loading instructions in English.

The software shall be commercially available, and it shall serve as an interface to display allthe captured data from the On-Board CCMS on a HMI display. The software shall be able to generate but not restricted to historical trend charts/files, trending, alarm management and fault logging, crane maintenance and performance report, planned maintenance information. The Purchaser will release the reporting format and details to the Contractor and the Contractor shall comply with the same as part of the Works. The capacity of the memory shall be able to store not less than 500 fault messages together with the related fault records andat least 3 years of historical productivity data / information. The software shall be able to download or export data files to other commercially available software such as Microsoft Access, Microsoft Excel, Lotus etc. The export data files shall include but not be limited to"txt","csr", "out" format.

ii) The proposed structure of the database system for storing the CCMS data and information hasto be discussed and approved by the Purchaser.

iii) The software shall allow engineers to access (read and write) the PLC ladder diagrams, Boolean logic and other software codes. Forcing-on and forcing-off of switches, contacts and relays on the PLC ladder diagram shall be available on the On-Board CCMS. Key switch and password shall be available to authorized personnel to carry out any modifications as described above. There shall be three (3) levels of security for accessing to different levels of CCMS software. The exact details will be released to the Contractor by the Purchaser and the Contractor shall comply with the same as part of the Works.

iv) The On-Board CCMS shall be able to copy or upload PLC software program to each PLC within 30 minutes. The On-Board CCMS shall be able to download all data files which shall include all real time information of the CCMS and time response graphs. This information shall be able to store in a diskette for printing using Microsoft Excel / Access. Time response graphs displaying different signals simultaneously shall be incorporated in the On-Board CCMS.

v) The software in the On-Board CCMS shall be made accessible for the Purchaser to include additional or new monitoring points and to modify software for presentation, reports for futureenhancements.

vi) Original Licensed software shall be used; these include the operating system application software. One original licensed copy of the software package shall be provided for every computer in the Agreement. All software instructions, including operating systems shall be in English language. All software instructions, including the operating system shall be in English language.

5.7.6. On-Board CCMS Hardware Requirements

(1) The On-Board CCMS shall be mounted in an environmentally controlled, industrial type cabinet thatcan withstand vibration.

(2) The On-Board CCMS shall consist of but not limited to the following items:

i) Computer
The CCMS computer shall consist of the following minimum specification of hardware:

(1) Processor - dual core 3.2 GHz+ (i5 or i7 series Intel processor or equivalent AMD)

(2) RAM - 16 GB DDR4

(3) Minimum 1TB SSD SATA

(4) Graphics Card - any with DisplayPort/HDMI or DVI support

(5) Monitor - 23" widescreen LCD with DisplayPort/HDMI or DVI support

(6) Gigabit Ethernet, 802.11n Wi-Fi

(7) Minimum 4 USB ports

(8) DVD+/-RW Drive

(9) Portable storage 500GB SSD

It is the intention of the Purchaser to standardize the make and model of the On-BoardCCMS computer.

5.7.7. Condition Monitoring

(1) The status and condition for the electrical systems, sub-systems and all the essential components,Electrical, Mechanical and Hydraulic which are critical to the proper functioning of the crane shall

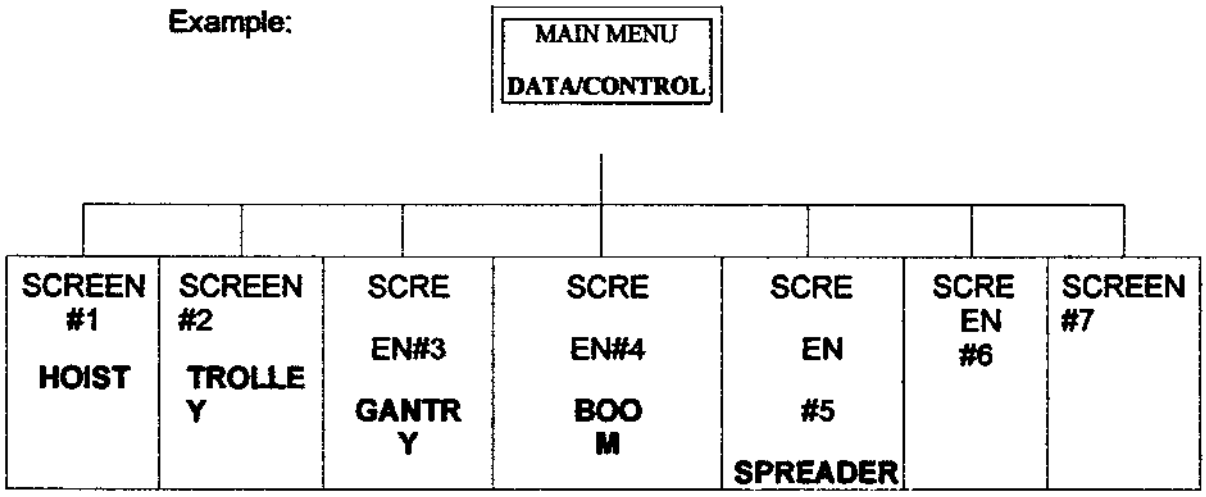
be monitored, during all modes of operation and status of power supplies.

The Contractor shall provide a UPS, suitably rated for 30 minutes, to afford access to allinformation in the event of power failure, either relating to the main generator or shore power.

(1) The CCMS shall present all information, status, graphics and data in easy-to-read window display formats. The Purchasers preferred format for real time data, being graphical displays rather than numerical presentation of the relevant data.

(2) The main screen shall lead the user to separate screens, divided into the following major application screens.

Example:



(3) Principle functions and components, associated with each application shall be displayed, in realtime mode, on individual screens, such as, but not limited to:

Motor Feedback Signals, i.e., Speed, Current, Voltage, Frequency, Torque Revolutions, Directions and Temperature

Reference signals of Controller, Ramp Generator and Acceleration/ Deceleration Ramps, Encoders, Pulse Generators.

Performance, Operation, Positioning, Current, Voltage and Speeds of Converters, Inverters, Brake Chopper Units, Brakes, Contactors, Relays and other devices, applicable to the application.

Hardware status of Limit Switches, Interlocks, Cam Switches, Sensors, Encoders, Fuses and other Protection devices shall be monitored and displayed in an approved format.

Data relating to Loads, Component Operational Time and Operational hours of major devices, i.e. Motors, Converters, Inverters, Brakes shall be displayed in an approved format.

Provision shall be made for Status Warning, Alarm Trips and Faults to be displayed at all times on all screens.

The system shall provide sub-windows, where operational performance of sub-assemblies can be monitored, such as, but not limited to:

Shore Supply, Hydraulic Motors and Pumps, Elevator, Cable reel and Spreader Functions.

(4) The Contractor shall provide easy to access data of Systems, Parameter Settings of PLC and/or Drives and Components in easy-to-read formats. These systems and components shall include, but not limited to the following:

Performance of the Drives (Inverters and Converters) which includes the AC Supply, AC Motor Control, DC Motor Control (if any), Operator Control, Motion Interlocks, Safety Interlocks, Sequence Interlocks.

The temperature for all AC Motors, for the Main Hoist, Boom Hoist, Gantry Travel, Trolley Travel.

The operating voltages and currents for all the Converters,

Invertors, Braking Chopper Units, Brakes and Motors The status

of the high voltage switches, low voltage switches, protection

relays.A real time update of all Positioning / Distance sensors.

Threshold values for warning and shutdown shall be incorporated in the CCMS. Adjustment of thethreshold values shall be made accessible to the Purchaser.

Any abnormality in the Crane's system and components shall be prompted and immediatelydisplayed on the screen of the On-Board CCMS.

A real time update of all speeds, motions and

operations.All Ramps

Actual Loads

(5) The following, as a minimum, data associated with the Hoist operation shall be displayed:

i) Controller Position of Forward, Reverse, Hoist, Lower, Left, Right and Zero, shall be displayed. Actual proportional position of Controller reference shall be displayed in an approved graphical format and indicates to the user actual percentage (%).

ii) Hoist motion interlocks, Spreader interlocks, Slack Rope, Load Cell measuring.

iii) Hoist Inverter status, interlocks, performance and protection devices.

iv) Hoist Brake Function, Operation and Brake Proving shall be displayed

v) Function and Operation of Limit Switches, Cam Switches, Encoders, Tacho-Generators andPulse Encoders.

vi) Hoist Speed, Slowdown, Speed Check, Stop and Positioning.

(6) The following, as a minimum, data associated with the Trolley operation shall be displayed:

i) Controller Position of Forward, Reverse, Hoist, Lower, Left, Right and Zero, shall be displayed. Actual proportional position of Controller reference shall be displayed in an approved graphical format and indicates to the user actual percentage (%).

ii) Trolley motion interlocks, Spreader interlocks,

iii) Trolley Inverter status, interlocks, performance and protection devices.

iv) Trolley Brake Function, Operation and Brake Proving shall be displayed

v) Function and Operation of Limit Switches, Cam Switches, Encoders, Tacho-Generators andPulse Encoders.

vi) Trolley Speed, Slowdown, Speed Check, Stop and Positioning.

(7) The following, as a minimum, data associated with the Gantry operation shall be displayed:

i) Controller Position of Forward, Reverse, Hoist, Lower, Left, Right and Zero shall be displayed. Actual proportional position of Controller reference shall be displayed in an approved graphical format and indicates to the user actual percentage (%).

ii) Gantry motion interlocks, Wheel Turning interlocks,

iii) Gantry Inverter status, interlocks, performance and protection devices.

iv) Gantry Brake Function, Operation and Brake Proving shall be displayed.

v) Function and Operation of Limit Switches, Cam Switches, Encoders, Tacho-Generators andPulse Encoders.

vi) Gantry Speed, Slowdown, Stop and Positioning.

(8) The following, as a minimum, data associated with the Boom Hoist operation shall be displayed:

i) Actual Command Switch Position.

ii) Boom Hoist motion interlocks.

iii) Boom Hoist Inverter status, interlocks, performance and protection devices.

iv) Boom Hoist Brake Function, Operation and Brake Proving shall be displayed

v) Function and Operation of Limit Switches, Cam Switches, Encoders, Tacho-Generators andPulse Encoders.

vi) Boom Hoist Speed, Slowdown, Speed Check, Stop and Positioning.

(9) The following, as a minimum, data associated with the Spreader operation shall be displayed:

i) Controller Position of Forward, Reverse, Hoist, Lower, Left, Right and Zero shall be displayed. Actual proportional position of Controller reference shall be displayed in an approved graphical format and indicates to the user actual percentage (%).

ii) Spreader motion interlocks, Spreader Retract and Expand interlocks,

iii) Spreader Motor status, interlocks, performance and protection devices.

iv) Spreader Electrical Function, Operation and Proving shall be displayed.

v) Function and Operation of Limit Switches, Cam Switches, Encoders, Tacho-Generators andPulse Encoders.

vi) Spreader Stop and Positioning.

vii) Spreader Twist-locks, Lock and Unlock, including indication and By-Pass status.

viii) Function clock shall display actual operation time of Expand/Retract, Twist-

lock Operation and Flipper Operation.

(10) The following, as a minimum, data associated with the General Crane Control System shall bedisplayed.

i) Emergency Stop operation where the status of individual stations shall be displayed.

ii) Main Generated Power Supply, Auxiliary Power Supply, Shore Power Supply and UPSfunction, status and performance.

iii) Function Operation and Status of Circuit Breakers, Fuses, Contactors, Relays andProtection devices, shall be displayed.

iv) Operator Mode Selection, Function and Status

5.7.2. Fault Diagnosis

(1) The faults and status data including historical data shall be stored in the On-Board CCMS database.All the data in the database shall be translated and stored in a suitable text file for a standard editor. All data shall be easily downloaded to removable storage (SSD). A zip function shall be available in the software for file compression.

(2) The objective of the fault diagnosis is to assist Purchaser's engineers to remedy the fault or confirmthe exact nature of a fault within a very short time. All faults shall be coded with a suitable numerical code and the first fault causing an alarm, trip or crane stoppage shall be highlighted as first fault. Provision shall be provided that as a minimum the system shall display twenty (20) faultsthat may occur at any one time.

This first fault shall be displayed clearly to assist the Purchasers engineers on the CCMS and remote display units. Faults interrupting crane operation shall be highlighted, either by flashing or appearing in a "Pop-up" window, regardless of screen selected and fault indication shall be only when crane motion or operation is selected.

The fault diagnosis shall be able to narrow down the faults to the exact components, safety interlocks failures, drive faults, PLC controller failures.

There shall be details and information on faulty component locations and possible remedy actions to be taken. There shall be intermediate fault tracing and measurements checkpoints and these functions shall be made available to Purchaser's qualified personnel to input new parameters for troubleshooting purposes. The resolution and duration of these measurements are 10ms to 100ms and 5s to 50s respectively.

(3) Drawings on electrical circuit, PCB layout, schematic drawing, software ladder and software device listing of crane control, Drives and PLC shall be made available in the fault diagnostic mode. Accessto the information shall be easily obtainable on any CCMS screen.

The CCMS shall store all faults in appropriate historic files in daily, weekly, monthly and yearly log folders, easily accessible and selection of data shall be by selecting a daily, weekly, monthly or yearly option.

5.7.3. Remote Crane Condition Monitoring System (RCCMS)

(1) General Specification

The RCCMS shall allow engineering personnel to perform diagnostic, condition monitoring of the CCMS in the engineering office remote to the Cranes and web-

based facility for offsite monitoring. The RCCMS shall be able to perform all the functions of the On-Board CCMS as stated in clause

5.7.4 (On-Board CCMS) and the following additional requirements:

(i) All the information and functions on the Cranes' On-Board CCMS specified in this Specification shall be available for the RCCMS.

(ii) All the alarm and fault messages on the Crane which requires the attention of engineeringpersonnel shall interrupt the RCCMS. The response time for the alarm and fault messages shall be less than 5 seconds. After the interrupt has been acknowledged, the present task shall be able to continue. The fault messages shall include but not limited to thefollowing:

(a) Crane ID

(b) Location

(c) Fault code / messages

(d) Part code

(e) Date/time reported

(iii) There shall be a server for the CCMS by each drive supplier. The RCCMS computers shall be able to access to the On-Board CCMS of any Crane via the respective server and CCMSsoftware.

5.7.4. RCCMS Software Requirements

(1) The RCCMS software shall be able to perform all the On-Board CCMS functions as defined in clause5-7.5.

5.7.5. RCCMS Hardware Requirements

(1) The RCCMS shall consist of but not limited to the following items:

(i) Computer
The RCCMS computer shall consist of the following hardware:

(1) Processor - dual core 3.2 GHz+ (i5 or i7 series Intel processor or equivalent AMD)

(2) RAM - 16 GB DDR4

(3) Minimum 1TB SSD SATA

(4) Graphics Card - any with DisplayPort/HDMI or DVI support

(5) Monitor - 23" widescreen LCD with DisplayPort/HDMI or DVI support

(6) Gigabit Ethernet, 802.11n Wi-Fi

(7) Minimum 4 USB ports

(8) DVD+/-RW Drive

(9) Portable storage 500GB SSD

It is the intention of the Purchaser to standardize the make and model of the RCCMScomputer.

(ii) One unit of UPS with a minimum of 60 minutes

(iii) One unit of colour laser jet printer.

(iv) One unit of server. The function of the server is to allow RCCMS to access to all the information on On-Board CCMS on the cranes specified in this tender. It shall also enable the On-Board CCMS to send real time information, status and alarms by means of interrupts to the RCCMS.

(v) One unit of standby server. The function of the standby server is to automatically resume the server's function when the server is not functioning.

***CLARIFICATION: For this project cold standby functionality shall be acceptable.**

5.7.6. CCMS Reporting Format
The CCMS reporting format will be released to the Contractor.

5.7.7. CCMS Data Communication

(1) The RCCMS shall allow data to be accessed remotely (outside the terminal). The Contractor shall submit the communication protocol for sending data to these computers and for communication between On-Board CCMS and RCCMS. The communication protocol shall be submitted for the Purchaser for approval.

(2) The data communication between the On-Board CCMS, Server(s) and RCCMS shall be through an optical fibre link data communication media.

(3) The Contractor shall provide and install the following hardware and cables on the Crane for communication among the above servers and computers.

a) Terminating boxes with ST connectors for fibre-optic cables inside the Operator's Cabin and Checker's Cabin.

b) Two sets of six cores multi-mode fibre-optic cable from the fibre-optic termination box in the Electrical House to the terminating boxes inside the Operator's and Checker's Cabins. Size of each core of the fibre-optic cables shall be 62.5/125 microns.

***CLARIFICATION: Landside switch/media converter from FiO to Ethernet shall be provided by the Contractor**

5.8. Intelligent Status Monitoring System *(Required)*
The crane(s) shall be fitted with an Leewell intelligent status monitoring system to monitor (as a minimum) main drives (motor, reducer, brakes, couplings) for temperature, speed and vibration and be able to predict premature failures of major components. The monitoring system shall include a propriety interface and management system to view and interrogate the system status of components, readings and warnings/ alarms, both locally and remotely. Push notifications to prescribed users regarding warnings and alarms shall be included along with comprehensive system training onsite at the Purchaser's location (refer appendix12).

***5.9.* Trailer Positioning System** *(Required)*
The crane shall be fitted with an indication system to signal to terminal tractor operators that the trailer is correctly parked under the crane during normal operation. The system shall be capable of detecting trailers in following conditions:

(1) Empty trailer.

(2) Trailer loaded with one (1) 20-foot container.

(3) Trailer loaded with two (2) 20-foot containers.

(4) Trailer loaded with one (1) 40-foot container.

(5) Trailer trains (multiple trailer system)
The system shall be based upon Sick technology described in their website: Trailer

Positioning System" The system can detect the trucks entered into the lanes

between WS and LS rails in both directions."

5.10. OCR System *(Not Required)*
The Crane is equipped with an integrated OCR-system that automatically reads and records the container ISO code numbers as it is handled by the crane. The system links with the Terminal Operating System for triggering and data processing purposes. The OCR system includes all hardware and software components for direct installation on container-handling equipment. The final location of the OCR system will be determined according to the Purchaser's requirements.

The system shall include but not be limited to the following features:

(1) Handle all standard size containers (20', 20'/20', 40', 45')
(2) Read ISO 6346 formats including check digit verifications.
(3) Container Seal present *(Not required for this project)*
(4) Real-time tracking of containers handled by the crane
(5) Read container numbers from both sides
(6) Operation uninterrupted by traffic into loading area
(7) Simple configuration
(8) Minimal equipment
(9) Low maintenance
(10) Superior reading accuracy
(11) Seamless performance guarantee

The locations and positions of OCR cameras shall be according the supplier requirements, but it's envisioned that cameras shall be located at the waterside leg position. The locations shall be fitted with supports, maintenance platforms and ladder for easy access.

5.11. Vessel profiling & Container Soft-Landing (SPS) *(Required)*

The crane shall be equipped with a laser scanner mounted on the main trolley which continuously scans the vessel toupdate the crane control system of the actual profile of the stacked containers on the ship.

By measuring the stack height on the ship and logging the load position at every twist-lock operation above the ship,the SPS creates a profile of the ship. The ship profile is used in three ways:

1. COMMON ITEMS

1.1. Walkways, Stairs, Ladders and Platforms

6.1.1. Applicable Code/ Standard

(1) Walkways, stairways and platforms shall be designed to avoid tripping, skidding, ducking or crawling.Clear headroom of 2.1 meters shall be maintained throughout the walkways, stairways and platforms. Special non-skidding treatment shall be applied for flat structural surface if used as walkways.

(2) The design of walkways, stairs and ladders shall comply with the requirements of OSHA.

(3) Special attention shall be paid to all areas that potentially allow personnel to pass through unsafely andunrestricted, for example gantry bogies, all locations must be closed off using permanent guard rails orgates to restrict access, the use of chains shall not be acceptable.

6.1.2. Stairway Requirements

(1) Landings shall be provided for ladders or stairs at intervals of between 4 meters and 6 meters.

(2) Stairway treads shall be open grid metal construction, hot dip galvanized. Stairway treads shall be bolted and not welded to the stairway structure.

6.1.3. Ladder Requirements.

(1) Special ladders shall be installed inside all four crane legs for their entire length for inspection of structure, wiring or fittings. Man-holes at the top and the bottom of the legs with hinged doors withseal shall be provided as access ways. The sealing flange of all manholes shall be at least 20mm above the surrounding steelwork to avoid water ingress when the covers are opened.

(2) Vertical or near vertical ladders of over 2-meter length shall be attached with safety hoops. The spacewithin the hoop shall be sufficient for a man with tools to climb up or down the ladder and shall not besmaller than 650mm depth x 600mm width. Vertical straps for the hoops shall be spaced adequatelyto prevent a human body to fall through.

(3) Access to all ladders in main walkway areas or platforms shall be accessed via hinged self-closing gates; chains across opening are not acceptable.

6.1.4. Walkway Handrail Requirements

(1) For a level walkway the height of the top handrails shall be 1100m with an intermediate rail height of685mm. The height shall be increased as necessary at the stairway etc., to ensure safety of passage.The handrail shall be constructed with steel tube, all welded joints finished smooth to same diameteras the tube, and continuous along walkways, platforms and stairways. Adequate safety straps or barsshall be installed between the lowest safety hoop of a vertical ladder and handrail for landing wherever there is a wide clearance which may allow a person to fall.

(2) The height of kick plate from the walkway tread level shall be 200mm. The kick plate shall be continuous along walkways and platforms and constructed of minimum 200mm wide steel strip of minimum thickness 4.0mm.

(3) Walkway handrail stanchions shall be bolted to platform structure.

6.1.5. Platforms Requirements

(1) Permanent and safe access platforms shall be provided in all areas requiring inspection and maintenance as outlined in Section 6.1.6 below.

(2) Platform walkways shall be open grid steel construction, hot dip galvanized these shall include but notbe limited to the following platforms:

i) At the top end of legs at each connection point of gantry structure and boom/girderconnection point.

ii) On each side of the cable carrier system at the back-reach of the Crane.

iii) Around all four sides of the machinery house.

6.1.6. Maintenance Platforms

(1) Stairs, platforms and walkways shall be provided to allow ample and safe access to all sheaves, pins,wheels, MV cable reel, power feeder system, carriers, ropes, machineries, switches and control equipment, etc., where preventive maintenance is necessary. At least 600mm clear passage around any machinery shall be provided. Application of vertical or near vertical ladders shall be limited to places where frequency of usage is less than twice a year.

(2) The Contractor shall provide permanent access ladders and platforms at all inspection locations, withstructural maintenance inspection intervals of 12 years or less. Access shall meet applicable safety laws and regulations.

6.1.7. Cab Access Platforms

(1) Walkway shall be provided from the landside leg to enable the operator to enter the cabin from theside through a hinged self-closing gate. The cab access platforms shall be equipped with tubular frameconstruction, inward opening and self-closing (by gravity) interlocked hinged gates on trolley side and gantry structure side. Opening of the door shall prohibit the trolley motion.

6.1.8. Cab Window Cleaning Platform

(1) A cab window-cleaning platform shall be fitted near the back-reach end of the girder to permit the operator to clean the lower front, bottom and lower window safely. Interlocked self-closing gate accessto the cleaning platform shall only be permitted from the operator's cab.

1.2. Illumination and Lighting

As an overriding requirement, preference will be given to those Contractors who are able to offer energy efficientlighting systems for all applications.

6.2.1. Walkways, Stairs, Ladder, Cab Access

(1) The supply voltage for lighting sources shall be as specified in 5.3.2 (Power Supply Specifications).

(2) LED lighting system shall provide adequate illumination for all ladders, platforms, walkways, machineryhouse and operator's cab.

***CLARIFICATION: LED lighting for walkways, stairs, ladder and cab access, shall be provided.**

6.2.2. LED Work Area Floodlights

(1) A floodlighting system shall provide adequate lighting to all work areas of the crane including penetration into the ship's cell. An average illumination of 300 lux at quay level measured within 10.0m either side of the centreline of the Crane along the entire trolley travel range shall be achieved.The maximum to minimum level of illumination shall be a minimum of 0.7 to one.

(2) To assist the berth operators when working beneath the crane, fixed LED floodlights shall be mountedto the topside of the portal beams of the Crane to achieve the required level of illumination. At least 4nos. LED lamps with equivalent power of 1000 watt (Philips crane master or equivalent) shall be fittedon top of the portal beam to provide sufficient lighting for landside face of container in each lane.

***CLARIFICATION: LED lighting for work area floodlights shall be provided.**

6.2.3. LED Floodlights on Trolley

(1) Powerful spotlights minimum four (4) of LED lamps with equivalent power of 1000

watt (Philips cranemaster or equivalent) each shall be mounted near the cab at or below the cab bottom level to provideexcellent viewing of the ship's cell or a slot at night when the crane trolley is working over a vessel.

(2) The positioning of all floodlights shall not cause glare for the berth operators or in the Crane operatorscab nor shadows which make it difficult for the operator to safely operate the crane.

***CLARIFICATION: LED floodlighting for trolley floodlights shall be provided.**

6.2.4. LED Emergency Lighting for Escape Routes

Emergency LED flashlights operated by rechargeable batteries shall be provided in the operator's cabin, electrical and machinery house. Battery chargers to maintain the batteries in continuously charged conditionshall also be provided. Access stairways shall be illuminated by emergency fluorescent fittings.

* Access stairways including operator's Emergency route including route from boom station will be illuminated during power failure by 30% of the LED fittings which shall be equipped with batteries

6.2.5. Lighting Control Switches

(1) Light switches shall be consolidated in several convenient locations to permit centralized control. Threeonoff control switches to control all the operational lights including walkway lights shall be located atground level, machinery house and operator's cab to allow switching from any of these three locations.

(2) A photocell shall be installed to switch off floodlights automatically during daylight hours and an override feature shall be installed to bypass the photocell in the event it fails to the open condition.

(3) The Boom floodlights shall switch to the off condition whenever the boom leaves the horizontal position

6.2.6. Work Area and Trolley Floodlights

(1) All work area lamps and flood lights shall be securely fixed to structures, protected against vibrationand fitted with safety ropes to arrest the fall of the lamp should the main fixings fail.

6.2.7. Walkway and Access Lamps

(1) Exterior lighting fixtures shall be specially designed for outdoor conditions and be braced to handrail.Externally mounted lighting fixtures shall have a minimum of IP55 class of protection.

6.2.8. LED Boom Latch Area Illumination

(1) Minimum number of two (2) LED floodlights with equivalent power of 400w each lamp.

(2) The boom latch shall be clearly illuminated from beneath for viewing from the boom control station.

(3) All the light fixtures shall have safe access for replacement of fitting or components.

6.2.9. Aviation Warning Lights

Aviation warning lights shall be installed at the following locations: -

(1) At the Boom end:

Two (2) FAA approved 100-watt equivalent LED type strobe lights mounted such that the lights are vertical when the Boom is in the fully raised position.

(2) At the top of the Superstructure (or 'A' Frame):

These Warning Lights shall be energized continuously. To provide continuity when the main supply to these lights is interrupted for any reason a back-up system shall be switched in automatically, it shall be possible to replace bulbs from the normal platforms.

6.2.10. Access for Lights Maintenance
All lights must be safely accessible for maintenance.

1.3. Painting and Protective Coating

6.3.1. Paint System General*Painting of electrical motors and control panels will be according to manufacturer'sstandard.

(1) The Contractor shall submit his proposed specification for the preparation, cleaning, painting and corrosion protection of the crane.

(2) Surfaces not required to be painted, but which are adjacent to steel work which is to be cleaned and painted, shall be protected by appropriate masking during cleaning and painting of the adjacent work.

(3) Special care shall be taken during manufacture to ensure that foreign matter is excluded from all working parts of the Crane.

(4) All parts of the Crane shall be surface treated during manufacture to ensure their protection from the effects of moisture during storage, transport and erection.

All bright surface and machined parts, including gear teeth, screws threads, etc., shall be protectedby an approved rust preventive compound. Particular care shall be taken with the protection of anti-friction bearings and enclosed gears and shafts.

(5) All metal surfaces shall be thoroughly cleaned to bare metal, removing rust, loose scale, dirt, grease, oil, dust and other foreign materials in accordance with 6.3.2 and 6.3.3 hereof. Particular care shall be used at joints and all other places to which access for cleaning is difficult.

(6) Faying surfaces of structural members intended to be clamped together by bolts shall be shot blastcleaned as specified in Clause 6.3.3(3) hereof and shall be given one coat of Epoxy zinc rich- primer, 25 microns thick.

(7) Machined mating surfaces of all ferrous components (other than structural members) which are to be clamped together by bolts, in final assembly, shall be protected, as specified in 6.3.1(4) above, after fabrication and just prior to final assembly shall thoroughly cleaned and smoothly coated witha suitable protective compound approved by the Purchaser.

(8) All structural steel plates and sections which shall form sealed internal surfaces shall be blast cleaned and prime coated using "whole of plate" blasting and painting with a suitable weld-throughprimer. Angle or flat sections used for plate stiffening shall be similarly treated by mechanized treatment methods.

Providing damage to such prime coating during fabrication is minimal, in the opinion of the Purchaser, power brush and cleaning of such pre-primed surfaces with a suitable approved solvent may be accepted in lieu of a second blast cleaning.

(9) For the purposes of this Specification 6.3, the term "External Surface" shall include the following areas:

(i) The exterior surfaces of all structural members.

(ii) The whole of the surface of any object such as an equalizing beam or bogie.

(iii) The whole surface of any component part such as a lug or cheek plate.

(iv) The outside surface of any gearbox, motor, brake, bearing spacer, collar, track wheel (excluding the actual tread), rope drum (excluding the rope groove) or other similar mechanical or electrical part which is not protected from the weather by being enclosed ina cabin or housing.

(v) The outside surface of any guard, cabin or housing.

6.3.2. Surface Preparation

(1) All castings shall be properly fettled and cleaned. All runners, veins, pins, etc., shall be carefully chipped off so that no lumps or rough areas are left.

(2) All welding slag and spatter shall be carefully cleaned off by chipping and power brush and,where necessary, grinding.

(3) All sharp edges shall be smoothly ground to a radius of not less than 1.6 mm.

(4) Any areas of surfaces which are to be blast cleaned as specified in 6.3.3 hereof, and which show any traces of oil or grease, shall be thoroughly degreased prior to such blast cleaning, using an approved solvent.

(1) The outside surface of sheet metal components, such as electrical cubicles, shall be dressed by means of a finishing machine or orbital sander to produce a smooth finish, free from weld protrusions, spatter, surface blemishes, etc. All sheet metal components and thin-walled section (below 3 mm in wall thickness) shall be degreased by an approved process in accordance with BS5493 and shall then be pickled, to remove all mill scale, mill bloom, accordance with BS5493.After appropriate neutralization and rinsing, such components, with the exception of those which are to be galvanized, shall be given an approved chemical or electro chemical surfacepassivation and anti-corrosion treatments.

(2) Particular care shall be taken to ensure that surfaces which have been prepared and cleaned for painting, other protective coating or treatment, are not re-contaminated by handling with bare hands or by exposure to any contaminating environment.

6.3.2. Abrasive Blast Cleaning

(1) All un-machined steel and cast-iron surfaces, apart from sheet metal components and thin-walled sections (below 3 mm wall thickness) shall be abrasive blast cleaned, as specified hereunder, afterall fabrication and hot work has been completed.

(2) The use of pre-blast pre-painted workshop primed steel plate may be accepted, subject to all mechanical and heat affected areas being suitably re-prepared to the equivalent of the Sa2.5 by either abrasive blast cleaning or other mechanical methods prior to the application of subsequent coatings. The welding on of lugs, brackets etc. after the application of undercoats or topcoats is considered to be poor construction practice, comprises the paint system and must therefore be

avoided. Only when it can be shown to be physically impossible to carry out blasting after fabrication will blasting and prime coating prior to fabrication be permitted.

(3) Contractor shall submit details of the blast cleaning proposed to be used, including type of equipment, type and grade of abrasive and profile height expected from use of such abrasive.

(4) External surfaces as defined in 6.3.1(9) shall be dry abrasive blast cleaned to a white metal finish in accordance with SIS005900 Sa2.5.

Internal surfaces to be abrasive blast cleaned shall be dry abrasive blast cleaned to a finish in accordance withSIS005900Sa2.

(5) After blast cleaning, surfaces shall be fibre brushed or blown with clean dry air (providedadequate driers and oil mist filters are used in air lines) or vacuum cleaned to remove all blast products and abrasives from the entire surface, including pockets and corners.

(6) Blast cleaning shall not be performed on surfaces that may in the opinion of the Purchaser's Representative, become wetted after blasting and before painting, or other protective coating, norshall blasting operations be performed on surfaces the temperature of which is less than 3°C above the dew point of the surrounding air, or when the wet bulb temperature in the immediate neighbourhood, as measured by a standard wet and dry bulb thermometer, differs from the dry bulb temperature by less than seven and one half (7.5) percent of the dry bulb temperature, nor shall blasting operations be performed when the temperature of the metal is higher than 38°C or lower than 10°C. Contractor shall ensure that all measuring equipment is available and tested to record the above conditions. Adequate precautions shall be taken to ensure that no damage to or contamination of partially or entirely completed portions of the work, or to machinery, occurs fromblast cleaning.

(7) All free oil and moisture shall be effectively removed from the air supply lines of all blasting equipment, using adequate and approved filters and driers.

(8) Blast cleaned surfaces shall be kept free of all contamination before painting, etc., as required by 6.3.2(5) above

(9) Operators shall wear fabric gloves of an approved type during cleaning operations and any area inadvertently touched by bare parts of the body, shall be immediately solvent cleaned byapproved methods.

(10) All items of metal work to be painted shall be so treated not more than four hours after surface preparation of each item has been completed.

(11) Any unpainted surfaces which have been subjected to conditions which might induce condensation of water thereon, or which have been left longer than the above-specified two hours after blast cleaning, shall be again blast cleaned before being painted.

(12) All paint application shall be in accordance with paint manufacturers' recommendations with paint manufacturers' representative present on site during preparation and painting and verified by Third Party Inspection Company.

6.3.3. Painting General

(1) All painting and coating operations shall be performed in a neat, thorough workmanlike manner.All paint and coating materials shall be in a thoroughly mixed condition at the time of application and shall be thinned only in accordance with the manufacturer's instructions.

(2) Paint or coating material shall not be applied unless the temperature of the metal surface and the atmospheric conditions satisfy the requirements specified in 6.3.3(6) above. The mixing, preparation and application of all painting materials shall be in full accordance with the paint manufacturers written instructions which shall be presented for approval of the Purchaser.
The first coating shall be applied as soon as possible after cleaning the surface, but in any case,not longer than 2 hours after cleaning.

(3) All surfaces to be coated shall be completely free of moisture, foreign surface matter and abrasive dust at the time of application of each coat.

(4) Each coat shall be uniform and free from runs, sags and other imperfections. Limitations on minimum and maximum inter-coat drying periods recommended by the paintmanufacturer shall be strictly observed.

(5) All paints shall be of approved colours which will be provided to the Contractor during the design phase.

The colour of each coat shall differ from that of the previous coat to a sufficient extent to enable missed areas and uneven or inadequate covering to be clearly observed. The final coat shall be thespecified colour.

(6) All paint shall be applied to the thickness as specified, and such paint thickness shall be gauged by a certified thickness gauge supplied by the Contractor.

Paint shall be applied by approved spray equipment corresponding to the equipment recommendedby the paint manufacturer for the particular type of paint.

It is preferred that as far as practicable, semi-hollow components such as switchboard cubicles andconsoles and any other smaller items where difficulty could be encountered in obtaining even coverage, be painted by means of electrostatic spray equipment.

All welds and edges shall be double passed with each coat.

(7) The Contractor shall, at his own expense, take all precautions and provide all equipment, including ventilation plant, which may be necessary to obviate health hazards arising from the use of specified paints and coating materials in confined spaces or elsewhere.

(8) All joints, including bolt heads, bolt ends, nuts, washers and attachments, shall be painted, after the connection has been made, to complete the protection in the same system as that specified forthe adjacent steel work.

(9) The Contractor shall submit full technical, application and service details from the manufacturer of the paints they propose to use.

(10) Proprietary Equipment
The external surfaces of all mechanical and electrical equipment shall be protected by paintsystems having durability comparable with that of the systems specified herein for other steel workin similar environment.

Wherever possible special paint treatment of approved quality shall be specified in the ordering of proprietary items.

Any equipment having external surfaces of materials which are subject to corrosion and which shall be exposed to the weather shall be protected by an approved paint system equivalent in durability to that used on the main structures.

(1) Alternative Paint Systems

Contractor may offer alternative paint systems to those specified, but such will only be consideredif evidence is submitted to support claims that the systems offered are of at least equivalent durability to that of the system specified.

6.3.2. Paint Systems

(1) External Steel Work

After preparation and cleaning in accordance with 6.3.2 and 6.3.3 above, all external steel surfaces with the exception of (a) galvanized surface and (b) machined surfaces referred to in Clauses 6.3.1(4) and 6.3.1(8) shall be given the following protective treatment:

First Coat:

Apply one (1) coat of a zinc rich primer, to a minimum dry film thickness of 75 microns.

Second Coat:

Apply one (1) coat of epoxy micaceous iron oxide primer / under coat, to a minimum dry filmthickness of 100 microns.

Third Coat:

Apply one (1) coat of a high performance anti-corrosive barrier coating based on polyurethane enamel, to a minimum dry film thickness of 50 microns.

The topcoat colours shall meet ICTSI Terminal Equipment Colour Specification. The Contractor shall submit a crane livery schedule drawing and colour samples for the Purchaser's approval

Total Dry Film Thickness of system shall not be less than 225 microns.

***CLARIFICATION: For this project Polysiloxane paints shall be considered by the Purchaser if they offer equal to orgreater than polyurethane coating performance/characteristics**.

(2) Internal Unsealed Surfaces

After preparation and cleaning in accordance with 6.3.2 and 6.3.3 above, all internal surfaces with the exception of (a) galvanized and non-ferrous surfaces (b) machined surfaces referred to in 6.3.1(4) and 6.3.1(8) hereof shall be given the following protective treatment:

First Coat:

Apply one (1) coat of epoxy zinc rich primer, to a minimum dry film thickness of 50 microns.Second

Coat:

Apply one coat of epoxy micaceous iron oxide primer / undercoat to a dry film thickness of 100microns minimum.

N.B. Total Dry Film Thickness of system to be not less than 150 microns.

(3) Galvanized and Non-Ferrous Surface, both Internal and External

Galvanized and non-ferrous components shall, after appropriate cleaning by an approved method, be given the following protective treatment:

Galvanized and Non-Ferrous Surfaces, both Internal and External

Surface Preparation:

Ensure that all surfaces are free from all grease, oil or other contaminants by application of a degreasing solution formulated from a blend of solvent and emulsifier. Apply Degreaser liberally ensuring that material does not spill on existing paintwork, working well into the surface to be degreased. Allow 5-10 minutes for the solvent to take place. Flush with clean fresh water and allowto dry thoroughly prior to application of the primer coating.

First Coat:

Apply one (1) coat of micaceous iron oxide primer / undercoat to a minimum dry film thickness of 50microns.

Top Coat:

Apply one (1) coat of a high performance anti-corrosive barrier coating based on polyurethane enamel, to a minimum dry film thickness of 50 microns.

N.B. Total Dry Film Thickness of system to be not less than 150 microns.

(4) Motor, Gearboxes, etc.

The external surfaces of all machinery such as motors, rope drums, gearboxes, couplings in exposedlocations shall be given protective treatment as specified for external steel work, galvanized and non-ferrous surfaces in 6.3.5(1) and 6.3.5(3) above. Motors/Gearboxes in outdoor locations shall be painted the same colour as structure.

The external surface of such machinery enclosed in housings or enclosures shall be given the protective treatment specified for internal steel work, galvanized and non-ferrous surfaces in 6.3.5(2)and 6.3.5(3) above.

After preparation and cleaning in accordance with 6.3.2 and 6.3.3 above, all external surfaces of such machinery shall receive the following protective treatment:

First Coat:

Apply one (1) coat of an epoxy zinc rich primer, to a dry film thickness of

75 microns.Second Coat (Top Coat):

Apply one (1) coat of epoxy-based enamel, to a dry film thickness of 50 microns.

Where it is shown that proprietary items such as electric motors have received preparation and appropriate surface protection, the Contractor may, with the approval of the Purchaser's Representative on submission of technical details, omit any further surface treatment.

The contractor shall remain responsible for ensuring paint system compatibility.

(5) Horizontal Surfaces of Access Ways, etc.
Area: Horizontal Surfaces of Access Ways

All horizontal surfaces used for pedestrian or traffic surfaces for access to any part of the crane for normal operation or maintenance procedures, including such surfaces on structural members, shall be given an approved special paint treatment.

Such special treatment shall provide improved abrasion resistance and non-slip characteristics whileproviding protection and having durability not less than that of the top coating specified for each relevant environment, i.e. external or internal.

Non-Skid Powder shall be applied to second last coat while still tacky and allowed to set prior to application of final coating.

6.3.3. Galvanizing

(1) General

Components or surfaces required to be galvanized shall be prepared generally as specified in 6-3.2 (Surface Preparation) and shall than be either acid pickled in accordance with BS5493:1997 (Protective coating against corrosion) or abrasive blast cleaned in accordance with Clause 6.3.3. Abrasive blast cleaning shall only be permitted on components or surfaces where there is no likelihood of distortion due to such cleaning method.

After such cleaning, all components or surfaces required by this specification shall be given a hot dipped galvanized coating conforming to the requirements of BS5493.

Galvanizing of any component or surface shall only be carried out after completion of all fabrication work on such component or surface. No welding on any pre-galvanized component or surface will be tolerated unless the component or surface is to be subsequently re-galvanized.

6.3.1. Reinstatement of Protective Coatings at Site

(1) Care shall be taken at all times to ensure that the protective coatings and treatment shall not sufferany damage during handling, transport and erection.

(2) After the components have been transported to the Site, assembled and welded where necessary, allprotective coatings shall be carefully inspected and any areas where protective coatings have been damaged or found defective shall be clearly marked with orange coloured spray paint or paint stick or chalk, for ready identification and remedial treatment.

All weld slag and spatter or heat affected coatings on surfaces that have not been adequately protected during field welding, shall be completely removed and any high points on field welds shall be ground completely smooth.

All such areas together with field welds, weld margins and burn marks shall be abrasive blast cleaned as specified in 6.3.3 (Abrasive Blast Cleaning) hereof, with due care of other areas of the coating to avoid further damage.

(3) All site abrasive blast cleaning shall be effected with approval closed cycle vacuum blasting equipment. Within two hours of cleaning as specified in 6.3.7(2) above, and before any contamination or discoloration can take place, the blast cleaned areas shall be recoated with the priming coat and to the thickness specified in 6.3.5 (Paint Systems) hereof for the relevant type of surface and location.

Undercoats and topcoats of the type and thickness, as specified in Clause 6-3.5 hereof, for the relevant type of surface and location shall subsequently be applied, with suitable feathering of coatsto avoid ledging. Manufacturer's recommendations regarding application and drying or inter-coat intervals shall be strictly observed.

(4) Damage to paint coatings such as scratches or abrasions which, in the opinion of the Purchaser's Representative, do not penetrate the total paint system may, at the discretion of the Purchaser's Representative, be reinstated by cleaning with a suitable solvent and then touch up painting with therelevant primer(s), intermediate and top coats as directed by the Purchaser's Representative.

(5) For all repair painting, the final coating shall comprise paint from the same batch as that originally used on the particular surface.

(6) Cleaning and repair painting of the crane or its equipment shall be carried out only when the conditions specified for the original cleaning and painting in 6.3.3(6) and 6.3.4(2) hereof, are satisfied.

Painting shall not be permitted if there is dust being deposited on the surface to be painted or conditions are not in accordance with Clause 6.3.3(6).

6.3.2. Inspection and Sample Panels

(1) Attention is drawn to Inspection Control Sheets. Inspection shall take place before and after preparation and coating and also on site.

(2) Before any surface treatment is carried out and within 3 months of issue of the Letter of Acceptance,the Contractor shall supply to the Engineer, free of charge;

a) Samples of each type and color of paint approved for use on the crane for testing. The Engineer reserves the right to call for further random samples during the entire painting operation. Should the tests prove unsatisfactory, the entire batch shall be rejected, and theContractor shall take corrective action to re-blast and re-paint all sections painted using therejected batch to the satisfaction of the Engineer.

b) Two sample blast cleaned panels one panel cleaned in accordance with 6.3.3(3) and the other cleaned in accordance with 6.3.3(4) hereof, each panel measuring not less than 150mm x 150mm x 6mm, and adequately protected after cleaning by sealed clean polythene wrapping.
If approved, the sample shall then be retained by the Engineer for comparison with theprepared steel work.

c) Two steel panels for each painting system, at the commencement of painting operations, cleaned and painted in accordance with the relevant requirements of this specification withthe exception of any site coat.

One of each pair of panels is to be "stepped" to show the successive build-up of the painttreatment and will be used as a standard of acceptance throughout the painting operations.

1.4. Crane Livery, Purchaser's Logo, Asset Numbers, Signs

6.4.1. Crane Livery

(1) Details of the crane livery are provided in Appendix 2.

(2) The paint colour scheme, which shall be used for the final finish coat, is based on the RALstandard. For comparison, the original register cards issued by RAL (www.RAL-Farben.de) shall be the controlling reference.

(3) Contractor shall supply for review and approval, full colour drawings of all crane livery and signage.

6.4.2. Purchaser's Logo

(1) Details of the Purchaser's logo are provided in Appendix 2.

(2) The logo shall be painted on three sides of the machinery house. Minimum size is 6.4m x 3.5m.

(3) Detailed design and final size to be confirmed during design review.

6.4.3. Language of Signs

(1) The language of all signs shown in this Specification is English, but the actual signs, name plates, labels and caution plates shall be provided in local language

(2) The Contractor shall submit all translations of the crane, spreader, hook beam and test weight signs forapproval by the Purchaser prior to manufacture.

6.4.4. Crane Signs

(1) The following signs shall be fitted to the crane(s), spreader(s) and - if to be provided under this Contract - to the Hook Beam, the Container Tope Safety Frame and the Test Weight in the positionsdefined below using a font of Arial Bold in black colour. Loads and asset numbers in the below tablesare for illustrating purpose only. Correct loads and asset numbers are specified in Clause 1.4.3 and Appendix 2.

(2) Crane Signs

Sign	Description / Location	Height
SWL 41 MT SINGLE LIFT	To be applied each outside of the portal beam.	min. 300 mm
SWL 2 x 27.5 MT TWIN-LIFT	To be applied each outside of the portal beambeneath the "SWL Single Lift" sign.	min. 300 mm
SWL 75 MT HOOK BEAM	To be applied each outside of the portal beambeneath the "SWL Twin-Lift" sign.	min. 300 mm
QCXX – QCXX	This is the asset number for the crane. To be applied both inboard faces of the sill beams.	min. 800 mm

(3) Spreader Signs:

Sign	Description / Location	Height
SWL 55 MT SINGLE LIFT	To be applied each side of spreader centresection.	150 mm
SWL 2 x 27.5 MT TWIN-LIFT	To be applied each side of spreader centresection beneath the "SWL Single Lift" sign.	150 mm
SWL 12.5 MT	This is the Safe Working Load of each pad eye. To be applied adjacent to each pad eye.	50 mm
SP-P 3 & 4	This is the asset number for the spreader. To be applied both sides of the centre section towards bottom RH corner.	80 mm
LAND SIDE	To be applied on the cabin side only and directly beneath the SWL signs.	80 mm
WATER SIDE	To be applied on the non-cabin side only and directly beneath the SWL sign.	80 mm

(4) Hook Beam Signs:

Sign	Description / Location	Height
SWL 75 MT	To be applied each side of the hook beam near to the central rams' horn hook to indicate its lifting capacity.	150 mm

SWL 40 MT	To be applied each side and each end of the hook beam near to the smaller hooks to indicatetheir lifting capacities.	150 mm
SWL 15 MT	To be applied in four positions, one adjacent toeach lifting lug to indicate their lifting capacity.	100 mm
HB7	This is the asset number for the hook beam. Tobe applied both sides of the hook beam towardstop RH corner.	80 mm

(1) Container Top Safety Frame / Lashing Cage Signs:

Sign	Description / Location	Height
CONTAINER TOP SAFETYFRAME	To be applied each side of the CTSF in aprominent position.	150 mm
MAX LOAD XX MT	To be applied each side of the CTFS.	150 mm
TARE WEIGHT XX MT	This is the tare weight of the CTFS with no load.To be applied each side of the CTFS beneath theMAX LOAD sign.	80 mm
MAX XX PAX	This is the maximum number of personnel whichcan be transported with the CTSF.	80 mm
LC1	This is the asset number for the CTFS. To be applied both sides of the CTSF towards top RHcorner.	80 mm

(2) Test Weight Signs:

Sign	Description / Location	Height
TEST WEIGHT	To be applied each side of the test weight in aprominent position.	150 mm
MAX LOAD 125 MT	To be applied each side of the test weight.	150 mm
TARE WEIGHT XX MT	This is the tare weight of the test weight with no load. To be applied each side of the test weight beneath the MAX LOAD sign.	80 mm
XX MT	This is the self-weight of each individual weightof the test weight. To be applied to each individual weight.	50 mm
TW1	This is the asset number for the test weight. Tobe applied both sides of the test weight towardsbottom RH corner.	80 mm

(3) All above signs are additional to the manufacturer's serial number plate, safety and maintenance signs.

(4) The Contractor shall submit a drawing showing locations, specification and dimension of all crane, spreader, hook beam and test weight signs for approval by the Purchaser prior to manufacture.

6.4.2. Manufacturer's Logo and Name Plates

(1) Manufacturer's logo and name plate may be placed on the outside of the portal beams only. The Contractor's or any 3rd party logo font size shall not exceed that of the Purchasers logo. The size and location must be approved by the Purchaser.

(2) Stainless steel plates showing year and place of manufacturing, manufacturing number, principal dimensions, speeds and capacity of the Crane shall be fitted below the sill-beam, clearly visiblefrom the first main access stairway, and in the operator's cab.

(3) Each item of machinery shall be properly labelled for its direction of motion or operation and forany precautions to be taken before operation or maintenance.

(4) The components manufacturer's name plate shall be fitted on each major mechanical system or component showing type, capacity, serial number, manufacturing number, manufacturing date, etc., for future reference.

6.4.3. Hazard Signs

(1) Hazards which may result in injury to personnel shall be clearly marked with signs identifying the nature of the hazard, the consequence of not avoiding the hazard, and how to avoid the hazard. Signs shall be permanently secured in a conspicuous location and shall comply with appropriate legislation or, if such legislation does not exist, with ANSI Z535 or ISO 3864.

(2) Equipment which may start automatically shall be marked as a hazard. Hydraulic power units are examples of this type of equipment.

(3) High Voltage warning signs shall be provided for each position where medium voltage connection ismade, on each piece of MV equipment and on the MV cable runway at the crane (at every3 metres).

(4) Standard pictorial symbols indicating the nature of the hazard shall be used. Text shall clearly identify the hazard, the consequences of not avoiding the hazard, and what steps personnel are to take to avoid the hazard.

(5) Where lengthy instructions or procedures for avoidance of hazards are required, the signs shall refer to the appropriate section of the maintenance manuals or operating instructions.

(6) The Contractor shall provide written procedures in the maintenance instructions for the maintenance and replacement of all hazard signs in accordance with the recommendations of ANSIZ535.4 or ISO 3864.

(7) The format, language, graphics, and placement of all hazard signs shall conform to the recommendations of ANSI Z535 or ISO 3864 and shall be approved by the Purchaser. Exceptions are allowed for buyout components.

1.5. Alarms, Warning, Signals & P.A. System

6.5.1. Gantry Travel Warning and Shutdown

(1) Four (4) Red flashing electronic type strobe warning lights shall be installed at four corners of the crane. These lights shall be automatically activated by gantry motion. The Purchaser shall approvethe type.

(2) These lights shall be mounted in a position where they can be clearly seen by both pedestrians and bythe operators of Terminal Tractors.

(3) The gantry travel warning sound shall be automatically activated by gantry motion. The siren soundshall be activated by the operator pressing down the foot switch on the floor of operator's cab, andwhen pressed during gantry motion shall override the travel warning sound. The type of sounds to beapproved by the Purchaser.

(4) Alarm speakers shall be located at a maximum height of 2.5m above ground level. The alarm speakers shall generate signal level of not less than 95dB at 1 kHz at a point 1m forward (relative tothe direction of motion of the Crane) of each of the speaker measured at a height of 1.5m above ground level. In order to minimize disturbance to communities around the terminal, the signal mustnot exceed the above limit by more than 3dB. The alarm tone shall consist of an intermittent signal, sounding at 1/sec for duration of 0.5 sec.

(5) A collision avoidance system shall be installed to warn of crane to crane, crane to obstacle and crane toend of travel collisions. The system shall interface with the control system to automatically warn theoperator of an imminent collision and slow down the gantry drive system in the collision direction. Upon pre-set condition the crane gantry motion shall automatically stop.

* Photoelectric switches such as SICK shall be used for crane to crane anti-collision.

A collision avoidance system shall be installed to warn of the crane boom approaching a vessel such asa bridge or ship mounted crane. The system shall interface with the control system to automatically warn the operator of an imminent collision and slow down the gantry drive system in the collision direction. Upon pre-set condition the crane gantry motion shall automatically stop.

* Boom to ship collision protection shall be achieved by photoelectric switches such as sick or Banner which activate upon a set proximity causing Gantry motion to Emergency stop.

***CLARIFICATION: For this project, in addition to the boom collision avoidance system the boom anti-collision shall also incorporate a wire rope and proximity switch system which shall emergency stop gantry in the event the crane boom (wire) comes into contact with the vessel.**

6.5.2. Wind Speed Warning

(1) The anemometer shall have analogue output to the crane PLC which will provide three independentlyadjustable outputs to:

i) Activate intermittent audio warning and amber warning lamp in the operator's cab when thewind speed exceeds the lowest setting of the wind speed (setting shall be adjustable).

ii) Activate continuous audio warning and red warning lamp when the wind speed exceeds the middle setting of the wind speed (setting shall be adjustable).

iii) Deactivate motion control while keeping status of (ii) when the wind speed exceeds thehighest setting. (Setting shall be adjustable).

(2) Once the above preset value (i) is exceeded, the anemometer shall only be

capable of being reset manually when wind speed falls below the preset alarm value (i).

***CLARIFICATION: The display for the wind speed shall be by analogue meter provided in the trolley cabin, boom cabin and RCS. The anemometer manufacturer shall be Vaisala and shall be submitted to the Purchaser for review.**

6.5.3. Main Hoist Overload Warning

(1) An audible alarm in the operator's cab to be activated and a red warning light for indicating 'Hoist Overload' shall be illuminated when overload is detected on the main hoist system. With 10% overload over 3 seconds the hoisting motion shall be inhibited automatically. After hoisting motion isinhibited, only lowering motion shall be allowed.

6.5.4. Premature Twist-lock Operation Warning

(1) The 'premature LOCKING' movement before the spreader is landed on the container or hatch covershall be prohibited by means of electrical interlock on the logic control circuitry. There shall be no physical movement of the twist locks on the spreader even though the switch is turned to the 'LOCK'position. Audible and visual alarms discernible at ground level and at inside the operator's cab shall be activated by this premature turning of the lever type twist lock limit switch and all motions of the craneshall be deactivated. Both audible and visual alarms shall cease when the twist lock switch is returnedto its original position.

(2) The 'premature UNLOCKING' movement while suspending the load with twist locks shall be prohibitedby means of electrical interlock on the logic control circuitry. There shall be no physical movement ofthe twist locks on the spreader even though the switch is turned to 'UNLOCK' position. Audible and visual alarms discernible at ground level and inside the operator's cab shall be activated by this premature turning of the lever type twist lock limit switch and all motions of the crane shall be deactivated. Both audible and visual alarms shall cease when the twist lock switch is returned to itsoriginal position.

6.5.5. By-pass Switch Abuse Warning

(1) Twist lock interlock bypass push button
When the Twist-lock Interlock Bypass push button is depressed to overcome a difficult situation to carry out hoisting or lowering function, an alarm sound shall be broadcast through an independent amplifier through a speaker located outside the operator's cab and facing downward. The hoisting speed and the trolley speed shall be slow-down mode.

(2) Landing bypass push button

When the Landing Bypass push button is depressed to permit the twistlocks to rotate without a landed signal, an alarm sound shall be broadcast through an independent amplifier (same as the one for twist lock interlock bypass push button) through a speaker located outside the operator's cab and facing downward. The hoisting speed and trolley speed shall be at slow down mode since it is a difficult condition and safety is required.

(3) Labels shall be provided for each switch and indicator in local language to be approved by the Purchaser.

6.5.6. Electrical Control House Air Conditioning and Humidity Warning.

(1) Visual and audible warning shall be provided if the temperature of the control panel

room exceeds 30degrees C. The air conditioning system failure shall be indicated by a warning lamp in a location outside of the panel room in the machinery house, and as an alarm condition in the CMS.

(2) Visual and audible warning shall be provided if the humidity of the control panel room exceeds 85%.The air de-humidifier failure or high humidity shall be indicated by a warning lamp in a location outsideof the panel room in the machinery house, and as an alarm condition in the CMS.

6.5.7. Fire Warning

(1) Visual and audible warning shall be provided if the smoke detectors in the Electrical rooms or Machinery House are triggered.

(2) Smoke detection shall be indicated by a warning lamp in a location outside of the Machinery Houseand as an alarm condition at the Operator's panel and in the CMS and RCMS.

6.5.8. Public Address/ Warning

(1) One loudspeaker pointing down shall be mounted on the trolley or near the operator's cab to broadcast the following warning sound:

a. Twist lock interlock bypass push button.

b. Landing interlock bypass push button.

c. Premature 'Locking' switching

d. Premature 'unlocking' switching

1.6. Emergency Stop Push Buttons

6.6.1. Location

A total 23 nos. of emergency stop push buttons shall be installed on the Crane in the following locations:-

2 in Operator's Cab	One on each console
5 in Machinery House	(1-Near Main Hoist motor)
	(1-Near Trolley motor)
	(1-Near Boom Hoist motor)
	(1-Near Front door)
	(1-Near Rear door)
1 Boom Control Station	On Console
1 Gantry control Station	On console
1 Headlock Man Cage	
1 Control Panel Room	On Electrical panel near to CCMS
1 Electrical Panel room	On Electrical Panel in central location

2Boom	Boom mid position and boom tip
1 A-Frame	At top of A-Frame
1 TLS	Near tot the TLS Hydraulic cylinders
1 TrolleY	On trolley platform

6 Ground Positions

4 – One at each corner of crane, neargantry buffer

2 - One each at centre of landside and waterside sill beam, at ground level inboard of the Crane to be reachedby ground operation personnel

All emergency stop buttons shall be hardwired, connected to individual I/O's and the status shall bedisplayed on the CCMS and fault display.

Safety PLC's and I/O may be used for safety circuit.

A total of 6 Drive Lock-Out switches shall be installed on the crane in the following locations:

When the drive lockout switch is activated (same circuit and function as e-stop) it enables maintenanceengineers to disable and lock out all crane functions during maintenance or inspections. When the switch is activated (switched in the off position) there shall be a facility to attach a padlock and lockthe switch in the off position.

1 in Operator's Cab	On Rear panel
1 in Machinery House	Near Main Hoist motor
1 Boom access gate	Boom hoist permit (prevents boomUp when locked off)
1 in E-house	Lockable mushroom head e-stop ortraditional rotary type

2 Ground Positions 1 – Waterside
1 – Landside

to be reached by ground operationpersonnel.

1 Control Panel Room On Electrical Panel near to CCMS

All Drive Lock-Out switches shall be hardwired connected to individual I/O's and the status shall bedisplayed on the CCMS and fault display.

Safety PLC's and I/O may be used for safety circuit

6.6.2. Type

Mushroom head emergency stop pushbutton (self-latch) switches shall be provided. All emergency stop buttonsshall be recessed to prevent from being actuated accidentally.

6.6.3. Emergency Stop Signs
Adequate signs shall be provided in local language and English language "EMERGENCY STOP" to clearly identifytheir locations to ground floor personnel. The size of the signboard shall be 300mm x 300mm minimum.

1.7. Fire Extinguishers

6.7.1. Locations
Each crane shall be provided with fire extinguishers in the following locations as a minimum:

(1) As a main hoist slowdown height for ship cells below and above the deck.

(2) As a smart slowdown in trolley drive for deck cargo, higher than the spreader load.

(3) As a safe path to be used by semi-automated hoist and trolley movements *(Not Required)*

(1) Machinery House - two (2) of 7kg capacity.

(2) Electrical Room - one (1) of 7kg capacity.

(3) Operators Cabin - one (1) of 3 kg capacity.

(4) Checkers Cabin – one (1) of 3 kg capacity

(5) Quay level near the access ladder – one (1) of 7kg capacity.

6.7.2. Type - Model

All the portable fire extinguishers shall be CO_2 type compliant with appropriate laws in the country of operationand shall be locally refillable by approved contractor.

1.8. Maintenance Tools and Equipment

6.8.1. Maintenance Tools

(1) Maintenance tools as listed in Appendix 3 (Tools List) shall be provided with the crane(s). The Maintenance Tools shall be made available to the Purchaser before Taking-over of the firstcrane(s).

6.8.2. Spreader Test Panel *(Required)*

(1) If required under this contract (refer to Clause 1.4.1 Crane Details and Accessories), a control panel foroperating and testing spreaders in the workshop shall be provided with the crane(s).

(2) The Spreader Test Panel shall incorporate push button switches, selector

switches, indicator lamps, PLC, input / output devices, spreader multi-pin connector, cables and all parts and software necessary for operating and confirming all the functions and safety features of the spreader.

(3) A 15 metres power supply cable with plug shall be provided with the Spreader Test Panel.

6.8.3. Drive Simulator *(Not Required)*

(1) If required under this contract (refer to Clause 1.4.1 Crane Details and Accessories), a Drive Simulator shall be provided with the crane(s) for the purpose of a training aid to electrical technicians to avoid occupying a crane during training sessions.

(2) The Drive Simulator shall include the following items of identical type to those actually installed on thecrane:

- Main Drive rectifiers/inverters – smaller rating than installed on the crane is acceptable
- PLC
- Master Controller
- AC Motor – smallest type installed on the crane, such as spreader cable reel motor
- Switches, terminals, contactors and other components required to operate and test theequipment in a typical crane environment.

(3) Software of the Drive Simulator shall be modified according to the hardware configuration requiredfor training.

(4) A 15 metres power supply cable with plug shall be provided with the Drive Simulator.

(5) All equipment shall be mounted on a panel and mobile stand with castors and dust cover.

2. PROJECT ADMINISTRATIVE REQUIREMENTS

2.1. Document Submission (Project)

7.1.1. Submission Schedule

(1) The Contractor shall submit project management and technical information as outlined in this Section 7 and in Appendix 4 (Documentation Status Control Sheets).

(2) The Appendix 4 (Documentation Status Control Sheets) shall be updated from time to time by the Engineer or his representative.

7.1.2. Project Organization Chart (Shop & Site)

(1) The Contractor shall submit to the Purchaser a project organization chart within two (2) weeksafter the date of the Agreement.

(2) The Organization Chart shall show the organization of the Contractor's resources, which he intendsto employ in the total project from shop manufacturing through to the site commissioning phases. This will clearly identify the departments involved, the people responsible for each element and thenumber of personnel directly involved in administering the project.

7.1.3. Project Schedule / Programme (Shop & Site)

(1) The Contractor shall submit to the Purchaser a project schedule (program) within two (2) weeks after the date of the Agreement.

(2) The Programme (and any revisions thereof) shall be presented in the form of a logic linked timed schedule covering all activities appertaining to the manufacture of the Crane(s). The contents shall include but not be limited to the following: -

i) Commencement date.

ii) Engineering Design Period.

iii) Submission of Drawing/Design Calculations and operating and maintenance instructionsand for the approval thereof by the Engineer.

iv) Procurement of Materials and Components.

v) Manufacturing Periods for the main Structural Sections.

vi) Erection in the Contractors Facility.

vii) Shop Test and Commissioning.

viii) Transportation Period.

ix) Site Commissioning.

x) Completion Date(s)

xi) Contractual Payment Milestones (estimated time of invoice issuance)

xii) Dates when Purchaser supplied information or permits are required

(3) Further the Programme shall include the times by which the Contractor requires the Purchaser:

xiii) to furnish any drawings or information,

xiv) to provide access to Site,

xv) to have completed any necessary civil engineering or building work (including foundationsfor the Plant),

xvi) to have obtained any import permits or licences, consents, wayleaves and approvalsnecessary for the purposes of the Works,

xvii) to provide electricity, water, gas, air and other services on the Site or any equipment,materials or services which are to be provided by the Purchaser.

(4) The Programme shall be provided in "MS Project" and PDF format and shall be presented in a way that clearly shows each activity connected in a logical program sequence. Each activity shall show the duration, early start and early finish and shall identify the critical path of the project.

7.1.4. Project Progress Report

(1) The Programme shall subsequently be updated and submitted to the Purchaser at intervals of no more than one (1) month throughout the course of the project until the Taking-over Certificate for the last crane has been issued.

(2) The monthly update will show actual progress against the original baseline so that effect of any slipor improvement in progress can be easily identified.

7.1.5. Crane Delivery Method Statement

(1) No later than three (3) months before the arrival of the first Crane(s), the Contractor shall submit amethod statement for the Purchasers approval for the roll-off or lift-off or discharge of the crane(s) to the Purchasers quay deck. The method statement shall include:

(i) The total area required for the roll-off or discharge operation.

(ii) Full details of the transportation vessel and the stowage of the crane(s).

(iii) Orientation of the vessel when offloading.

(iv) Number and position of bollards and moor lines.

(v) Length and position of sea anchors (if applicable).

(vi) System of transferring the crane to the quay deck.

(vii) All skid beams and skid beam centers (if applicable).

(viii) All positions and magnitude of loadings applied to the quay deck during the offloadingoperation.

(2) The proposal shall also show a period of occupancy and the length of the Purchaser's berth required for roll-off or discharge operation.

7.1.6. Site Work Method Statement

(1) No later than three (3) months before the arrival of the first Crane(s), The Contractor shall submit to the Purchaser a site work method statement for the Purchasers approval showing all activities from arrival of the crane(s) through to taking-over.

The method statement shall include:

i) The total area required to complete the crane(s) and to store the loose items and spareparts. (This will be strictly subject to the Purchasers approval.)

ii) Roll-off, Lift-off or discharge scheme and date of performance.

iii) Key activities of the commissioning / completion and duration.

iv) Number of days required from the date the crane is ready for starting up and load testing.

v) Date the Crane(s) will be Test Commissioned and handed over to the Purchaser.

vi) Date the Crane(s) will be finally handed over to the Purchaser.

vii) Other key dates of significance.

7.1.7. Daily Plan and Report (Site)

(1) For the duration of the period of site work at the Purchaser's Site, the Contractor shall submit, at daily intervals in a form approved by the Purchaser, his progress of activities and tests carried out. This daily plan shall also indicate weather conditions, number of Contractors personnel and sub- contractors engaged at site together with the activities planned for the next day.

7.1.8. Ordered Spare Parts List

(1) No later than three (3) months after the issue date of the Letter of Acceptance, the Contractorshall provide to the Purchaser a list of recommended Priced Spare Parts. The recommended parts shall be capable of supporting the operation of the Crane(s) for a period of two (2) years.

(2) No later than two (2) months after the receipt of the list of recommended Priced Spare Parts, the Purchaser shall select from that list items that he intends to purchase. Those items selected by the Purchaser for purchase will be incorporated into the Ordered Spare Parts list defined in the Agreement.

7.1.9. Training Program

(1) No later than three (3) months before the arrival of the crane(s), the Contractor shall provide a comprehensive training program to cover the theoretical and practical training requirements for thePurchaser's crane operators, electrical and mechanical tradesmen and electronic technicians. The program shall be aimed at all aspects of the crane(s) in the respective disciplines in order toprovide the trainees with a sound basic knowledge of the crane systems

(2) The scope of training to be conducted for the disciplines shall be generally as outlined in Section
7.9 (Training and Familiarization)

(3) The training program is subject to approval by the Engineer.

2.2. Design Drawings and Calculations

7.2.1. Drawing Management System

(1) With the submittal of the Conceptual Design, the Contractor shall submit to the Engineer fulldetails of the Contractors system of drawing management, which shall be maintained throughout the project.

(2) The Contractor shall demonstrate that a logical system of drawing administration exists and shall clearly establish to the Engineer, the procedures and current practices in place which deal with alterations, modifications and re-issue of drawings from the design stage through to the as built drawings.

(3) The Contractor shall provide and maintain a drawing register for all submitted, reviewed and re- submitted design documents, including the document numbers, version number and dates.

722. Design Review

(1) The Contractor's design documents shall be reviewed by the Purchaser's appointed review engineer as outlined in Appendix 4 (Documentation Status Control Sheets).

(2) Design review meeting(s) to further clarify design details and review comments shall take place as outlined in Appendix 4 (Documentation Status Control Sheets). All costs incurred to the Purchaser or his representatives in connection with the design review meeting(s) shall be borne by the Purchaser.

(3) The review engineer's comments on the drawings or submittals shall not waive the Contractor's duties or obligations to achieve satisfactory performance of the crane as set out in the Contract.

(4) The Purchaser undertakes no duty to the Contractor to neither identify nor notify to the Contractor any errors or omissions in the Contractor's design.

723. Conceptual Design

(1) The Contractor shall submit to the Purchaser a conceptual design, which outlines his proposal for the Crane(s) for his review. The conceptual design shall show clearly by drawings, calculations anddescriptions the major design details.

724. Detailed Design

(1) Following review and acceptance of the conceptual design, prior to the fabrication or ordering of components, the Contractor shall submit detailed drawings and calculations.

(2) General arrangement drawings, calculations and data other than listed in Appendix 4 which clarifiesfurther details, shall be submitted from time to time at the request of the Purchaser for review.

725. Final Design

(1) Following the review and acceptance of the detailed design, the Contractor shall submit to the Purchaser all documents reviewed and if necessary revised according to the Purchaser commentsor for other agreed reasons.

(2) No alterations to the final design shall be allowed unless specifically approved by the Engineer (=Design Freeze).

726. As-Built Drawings

(1) The Contractor shall submit to the Purchaser three (3) sets full-size hard copies (in the original drawing size) and two (2) sets in CD ROM (PDF format) the following asbuilt drawings within 30 days after the date of issue of the Taking-over Certificate for the first Crane(s):

(2) All drawings that were previously submitted for the Purchaser's review and

revised as built as atthe shipment date.

(3) Detailed drawings for wearing parts showing machining tolerances, wherever applicable, and wear limits:

i) Brake drums (or discs)

ii) Brake shoes

iii) Wheels

iv) Drive Couplings

v) Sheaves

vi) Antifriction bearings

vii) Bushes

viii) Bearing plates

ix) Oil seals and Orings

x) Table for consumable parts of electrical machineries

xi) All other wearing parts.

(4) Detailed electrical control circuit drawings, control logic programs, and wiring diagrams.

(5) Full details of all boughtin equipment, drawings instructions, etc.

(6) List and specification of structural connection bolts and machinery fitting bolts with tightening torque value for each location/size.

(7) The Contractor shall revise and resubmit drawings for replacement in case any modification or revision is made on the Works (as defined in the Agreement) after the initial submission.

2.3. Quality Assurance Inspection and Test Protocols

7.3.1. Quality Assurance Program / Manuals

(1) Contractor shall submit to the Purchaser a quality assurance program for review within one (1) month after the date of the Agreement.

(2) The program shall consist of a General Quality Assurance Program, which states Contractor's general practice and organization to control the quality standard during design, procurement, fabrication and erection periods, and a Specific Quality Assurance Program.

(3) The Specific Quality Assurance Program shall relate particularly to the Cranes and Equipment to be supplied in this Contract and shall include key inspection and test items during fabrication and delivery through to hand over of the Crane to the Purchaser with proposed timing and locations of conducting such inspection and test.

(4) This Quality Assurance Program shall cover all the inspection and review items as set out in Inspection / Test Control Sheets.

(5) Test certificates confirming the material mechanical property of steel plate and

forging bars or steelbars shall be submitted.

(6) Mechanical property testing shall be conducted on all critical mechanical fastener systems. These tests shall be conducted in accordance with the mechanical property test requirements. The Engineer shall require records of this testing for review.

(7) An organization chart with names of the quality assurance team personnel for this Contract foreach major stage of fabrication, delivery, commissioning and Defects Liability Period shall be included in this Program.

7.3.2. Mechanical Property Testing of Critical Structural and Mechanical Fasteners

(1) The Contractor is to submit all manufacturer's fastener certificates to the Engineer. As a double check, the Contractor shall be required to randomly test the fastener system to verify mechanical properties. This testing shall be performed by an independent testing firm, acceptable to the Owner, commissioned by the Contractor. The sample fastener system shall be tested for proof load, tensile strength (wedge test), and hardness. Samples are to be selected at random from each shipping lot. These samples shall include the entire fastener system. Included in the system are the bolt, nut, and washer. The quantity of samples to be tested per shipping lot are to be determined as follows:

Number of Pieces in Shipping Lot	Number of Specimens
150 or less	1
151 to 280	2
281 to 500	3
501 to 1,200	5
1,201 to 3,200	8
3,201 to 10,000	13
10,001 or more	20

(2) If any fastener in a shipping lot is found to be defective, the entire lot is to be rejected. Records ofthese tests shall be required by the Engineer for review.

(3) Supplemental Hardness Testing of Critical Structural and Mechanical Fastener Systems

(4) In addition to the test specified by item (1) of this Section, the hardness of one random fastenerper connection shall be checked. If the hardness is below tolerance for size and grade, hardness

tests on the other fastener in the connection shall be performed. If any others are found to be below tolerance, the entire lot of fasteners shall be rejected, and all fasteners replaced.

7.3.3. Pre-Shipment Inspection and Test on Completion Protocol

(1) No later than four (4) months before the Shipping date of the first Crane(s), the Contractor shall submit to the Engineer for his approval a Pre-Shipment Test and Test on Completion Protocol.

(2) The Testing Procedures shall be in the form of the Pre-Shipment Inspection and Test on Completion Protocol as provided with the Contract Agreement and shall contain detailed field and function check procedure to fully demonstrate the specified requirements and the suitability of the crane for container handling operations. The procedure shall describe the tests to be performed, the indications to be measured and the method by which they are measured. It shall contain the design or acceptable values of each measurement along with blanks in which the tester can enter the measured values.

(3) Provision shall be made within the procedure for the tester and the Engineer's Representative to initial and date each separate test.

(4) The Testing Procedures shall be duly completed by the Contractor following each individual test or each series of tests conducted at the Contractor's facility and at site. Where necessary the Engineer's Representative shall verify the results.

(5) The Contractor shall submit the completed Pre-Shipment Inspection section of the protocol before loading of the respective crane on to the vessel.

(6) The Contractor shall submit the completed Pre-Shipment Inspection and Tests on Completion Procedure no later than one (1) month after the notification of successful completion of the Test onCompletion.

2.4. Operation and Maintenance Instructions

7.4.1. Operation Manuals

(1) The Operation Manual shall clearly state the start-up procedure of every device on the Crane including all bought-in equipment, and all the points to be observed or checked during the start up.

(2) The Operation Manual shall be provided in English and local language.

(3) The Contractor shall provide three (3) sets of each of the required languages of the Operation Manuals to the Purchaser three (3) months before arrival of the first crane(s) at the Site. Receipt ofthese Operation Manuals is one of the preconditions for the issuance of the Pre-Shipment Certificate.

(4) Corrections shall be made for any changes made in the instructions during the commissioning period, and five (5) sets of each of the required languages of the

revised Operation Manuals shall be submitted one (1) month after the notification of successful completion of the Tests onCompletion of the first Crane(s)

(5) Two sets of above instructions shall be submitted on SSD.

7.4.2. Maintenance Manuals

(1) The Maintenance Manual shall include maintenance intervals and procedures for all the boughtin equipment, and also calibration instructions and standards for meters, gauges and any components, which require periodical calibration to allow calibration by the Purchaser's maintenance staff.

(2) The Maintenance Manual shall include a complete list of wearing parts showing the allowable limit of wear for each part.

(3) The maintenance instructions shall be based on a scheme which utilizes runtime hours rather than calendar intervals for defining the preventive maintenance tasks wherever possible, Runtime hours shall be those measured by the runtime meters such as Hoist, Trolley, Gantry, Boom and Control- On Hours.

(4) The Maintenance Manual shall be provided in English and local language.

(5) The Contractor shall provide three (3) sets of each of the required languages of the Maintenance Manual to the Purchaser one (1) month before the date of the first crane departure from the Contractor's manufacturing site. Receipt of the Maintenance Manuals is one of the preconditions forthe issuance of the Pre-Shipment Certificate.

(6) Corrections shall be made for any changes made in the instructions during the commissioning period, and the five (5) sets of each of the required languages of the revised Maintenance Manual shall be submitted one (1) month after the notification of successful completion of the Tests on Completion of the first Crane(s)

(7) Two sets of manuals on SSD shall be submitted.

7.4.3. Lubricant List

(1) The Contractor shall supply a complete list of oil and lubricants to be used on the Crane three (3) months after the date of the Agreement for the Purchaser's approval.

(2) All the oil and lubricants used for the crane shall be selected from those available locally in the country of operation and used by the Purchaser.

7.4.4. Structural Maintenance Program

(1) The fatigue criteria in this specification are based on producing a damage tolerant design. Becauseof the variation of fatigue performance and that usage may exceed the design conditions, there isa risk that a structure or component may fail in service. When fatigue cracks develop, theremaining structure should sustain the maximum working load until the cracks are discovered. Satisfactory performance of the damage tolerant design, therefore, depends on adequate methods of fatigue crack detection and the ability to repair or replace the damaged component. The intentof this section is to define a method of routinely inspecting for fatigue cracks to significantly improve the structural reliability.

(2) Periodic structural inspections are required to detect cracks that have developed

during d the life ofthe crane. The inspection intervals defined below are based on fracture mechanics calculations, reliability analysis, and the fact that fatigue cracks can be classified as infant and aging failures.The Delivery Inspection and Warranty Inspection should detect infant failures and subsequent periodic Maintenance inspections should detect aging failures. Infant failures are primarily due to deficient fabrication; underestimation of fatigue damage, which may be due to deficient design or excessive loading; or a combination of these. Aging failures are primarily due to cumulative damage from normal operations and properly designed and manufactured components.

(3) Since the integrity of the structure depends on inspections, interpretation of the results, and the choice of repair, it is important for the Contractor and the Engineer to review all reports.

(4) No later than three (3) months before the arrival of the crane(s) the Contractor shall submit a Structural Maintenance Program for review. The program shall be based on the principles of fracture mechanics and shall include the following information for both infant and aging failures:

- Inspection intervals
- Locations to be inspected
- NDT procedures to be used
- Reporting procedures
- Repair procedures
- Documentation showing the parameters used to determine the inspectionintervals in accordance with the criteria specified below

i) Inspection methods shall be selected to detect fatigue cracks. Only critical locations need to be inspected by NDT methods such as MT, DPT, RT, and UT. Critical locations on all members are those locations where fatigue cracks, if any, would be expected to initiate. The inspected region shall extend a reasonable distance beyond critical points. MT shall beused at critical locations of fillet welds and UT shall be used at critical locations of butt welds. VT shall be used at all locations of potential fatigue cracks.

ii) Inspection intervals shall be determined according to Table 71. Locations where thecumulative damage ratios are less than those for 24 years need not be included in the Structural Maintenance Program.

iii) The Structural Maintenance Program shall be reviewed by the Contractor's responsible Structural Engineer and he shall certify in writing that he has reviewed the program and is satisfied with it. The program shall be included in the maintenance and inspection manual.

(5) If a sea state rougher than the design sea state is encountered during the delivery voyage, the Contractor shall inform the Purchaser and Engineer and a Delivery Inspection will be performed. The extent of the Delivery Inspection will be determined by the Engineer. The Delivery Inspection will occur prior to commissioning. Within 30 days after the inspection, the Contractor shall submita plan to repair any defects found. Upon the Purchaser's approval of the Contractor's plan, the Contractor shall repair the defects at his expense. The Purchaser's independent agency will inspectthe repaired defects. If any of the repairs are not acceptable the Contractor shall make additional repairs as necessary. The costs of the inspection and additional repairs shall be borne by the Contractor.

(6) The Contractor's responsible Structural Engineer or other qualified engineer shall perform a walkthrough visual inspection of the crane after delivery and after removal of all sea-fastening and other temporary attachments and certify in writing that he reviewed the crane and is satisfied with it.

(7) Unless agreed otherwise, Structural Maintenance Program inspections will be performed by an independent agency retained by the Purchaser and in accordance with the Structural Maintenance Program.

i) The Warranty Inspection will be made prior to the end of the warranty period, but no later than 200,000 moves. All FCM details and all details that are scheduled to be inspected at an interval of 24 years or less shall be inspected. The inspection procedures used for the Warranty Inspection shall be the same as those used for subsequent Periodic Maintenance Inspections.

ii) Subsequent Periodic Maintenance Inspections will be made according to the recommended inspection intervals from the Structural Maintenance Program. The first Periodic Maintenance Inspection period will begin after completion of the Warranty Inspection.

iii) Within 30 days after the Warranty Inspection or any Periodic Maintenance Inspection(s) occurring during the structural warranty period, the Contractor shall submit a plan to repair any defects found. Upon the Purchaser's approval of the Contractor's plan, the Contractor shall repair the defects that are not the result of the Purchaser's misuse of the crane, at the Contractor's expense. The Purchaser's independent agency will inspect the repaired defects. If any of the repairs are not acceptable, the Contractor shall make additional repairs as necessary. The costs of the additional inspection and repairs shall be borne by the Contractor.

(8) The Contractor shall provide permanent access ladders and platforms at all inspection locations, with inspection intervals of 12 years or less. Access shall meet applicable safety laws and regulations.

INSPECTION INTERVAL vs. CUMULATIVE DAMAGE RATIO D = L/K1 OR L/K2

DETAIL	24 YEARS		12 YEARS		6 YEARS	
	NFCM	FCM	NFCM	FCM	NFCM	FCM
B	0.21-0.41	0.19-0.38	0.42-0.69	0.39-0.64	0.70-1.00	0.65-1.00
C	0.18-0.36	0.17-0.33	0.37-0.62	0.34-0.57	0.63-1.00	0.58-1.00
D	0.18-0.35	0.16-0.33	0.36-0.61	0.34-0.56	0.62-1.00	0.57-1.00
E	0.15-0.29	0.13-0.26	0.30-0.50	0.27-0.45	0.51-1.00	0.46-1.00

F	0.17-0.34	0.16-0.31	0.35-0.58	0.32-0.53	0.59-1.00	0.54-1.00
F2	0.16-0.32	0.15-0.29	0.33-0.56	0.30-0.51	0.57-1.00	0.52-1.00
G	0.21-0.41	Not allowed	0.42-0.70	Not allowed	0.71-1.00	Not allowed
W	0.20-0.40	0.19-0.37	0.41-0.69	0.38-0.64	0.70-1.00	0.65-1.00
TUBULAR	0.20-0.35	0.15-0.30	0.36-0.64	0.31-0.50	0.65-1.00	0.51-1.00

Table 7.1 Inspection Interval Criteria

2.5. Shop Inspection & Tests

7.5.1. Shop Inspection and Verification

(1) Inspection and testing of the Crane shall be performed to verify or demonstrate the Crane's conformance to this Specification and the Purchaser's Requirement as set out in the other Contract documents, following the approved Specific Quality Assurance Program as stated in 7.3.1(3) above.

(2) Without limitation to the Purchaser's rights under the Agreement, the Contractor and the Purchasershall agree to the content, nature and extent of the review, inspection and tests to be carried outto any of the Works at each of the following stages:

i) Design.

ii) Fabrication and assembly;

iii) Pre-shipment;

iv) Upon Delivery;

v) Tests pursuant to the Conditions of Contract, which, if successful will lead to the issue of aTaking-over Certificate.

vi) Such further tests as otherwise may be required that in the opinion of the Purchaser ispursuant to the Conditions of Contract.

(3) The Purchaser reserves the right for itself or any party authorized by the Purchaser to inspect the Crane at any time during fabrication and delivery.

(4) The Contractor shall notify the Purchaser, or any party authorized by the Purchaser of the date andplace of each key inspection or test, at least three (3) weeks prior to the date when the key inspection or test is to be made.

(5) Inspection and test items shall generally include (but not limited to) the following fundamental items.

i) Materials and components sources and identification of standards applied.

ii) Workmanship overall.

iii) Inspection of Operational and Maintenance Safety, Test of all safety equipment and safetydevices.

iv) Inspection of Operational Efficiency, Functional Test of all components equipped foroperation.

v) Inspection of Maintenance Efficiency, Functional Test and inspection of all equipment formaintainability.

vi) Rated Load Tests, 1/2 Loads Tests and No-Load Tests including Test and Measurement ofSpeeds and accelerations.

vii) Overload (Proof Load) Tests including Stability Test and Measurement of StructuralDeflection.

viii) Accessories and Spare Parts Inventory.

ix) Operating Instruction and Maintenance Manual Review.

x) Weight verification as necessary.

xi) Statutory inspection and tests.

(6) Static wheel load verification. Any inspection or test results verified by the Purchaser shall notwaive Contractor's duties or obligations to achieve satisfactory performance of the Crane in actual operation as set out in the Conditions of Contract.

(7) The Contractor shall submit to the Purchaser a list of designed weights of the moving loads, namely, the trolley, head block and spreader, and any other moving loads, when the design of these components are completed.

(8) At the same time, Contractor shall submit a list of calculated maximum structural stresses at criticalpoints of the Crane structure.

(9) The Contractor shall verify the calculated stress level by actually weighing these moving weights after the fabrication and assembly are completed.

(10) The weight of trolley assembly, head block assembly and spreader assembly shall be weighed by the Contractor and witnessed by the Purchaser's Representative. A Certificate shall be submitted to the Purchaser.

(11) The Contractor shall be responsible for maintaining the calculated stress level within allowable limits. If there are differences between the designed weights and the actual measured weights, theContractor shall re-submit calculations of all stress levels based on the true weights to show that the levels are maintained within requirements. Any stress levels over the allowable limit will require a redesign to be carried out by the Contractor.

(12) The recalculation and if necessary, the redesign plan shall be submitted to the Purchaser for reviewno later than commencement of the pre-shipment Crane assembly load test.

7.5.2. Pre-Shipment Inspection and Test

(1) Cranes, which according to the Agreement, shall be fully erected in the Contractor's facility, shall be tested prior to shipment. Component and sub-assembly testing will be permitted if the cranes areto be delivered in knock down form to an acceptable erection site.

(2) The Contractor shall prepare a shop assembly and Crane erection program including all tests and dimensions to verify the proper installation and assembly of the crane's components. The drawings shall include assembly procedures, drawings, dimensional acceptance criteria, structural member dimensional checks, structural frame alignment dimensions, structural pin and bore fits, structural bolt torques and machinery alignments.

(3) The Contractor shall inspect the assembly of components and Crane erection throughout the process to verify and to be satisfied that the requirements of the Specification are being fully complied with in all respects.

(4) The Crane shall be fully lubricated in accordance with the manufacturer's recommendation prior to any shop testing. A lubrication checklist shall be included in the test documentation.

(5) The assembled crane shall be inspected and tested at the Contractor's assembly facility. All installations and functions shall be verified for compliance to the Specification. The Crane testing shall follow the Pre-Shipment Inspection and Test on Completion Protocol as stated in 7.3.3 above and as a minimum include the following:

(i) Verify trolley speed, acceleration according to Specification with Rated Load.

(ii) Verify hoist speeds, accelerations according to Specification with Rated Load.

(iii) Verify gantry motor rotation direction and other gantry and gantry cable reel functions to the extent possible (typically limited due to space limitations at the Contractor's erection location).

(iv) Boom travel sufficient to verify the hinge geometry. Boom hoist under crane power from operating to the stowage position and from stowage position back to operating position using automatic controls for slowdowns and stops. The boom shall hang on the disc brake at highest load position as a verification of disc brake operation.

(v) The sway control and anti-sway system shall be set up and tuned under a range of load conditions. Verify the sway control and the effectiveness of the electronic anti-sway. (If applicable)

(vi) Snag system release under reduced load. Snag load trip of hoist utilizing a lower than normal snag setting.

(vii) Trim, list and skew motions.

(viii) All interlocks and limit switch settings, and software logic.

(ix) Safety and protection systems

(x) Function tests of all systems.

(xi) Rated load and proof load tests

(xii) Function test of jib cranes and all service cranes

(xiii) Brake dynamic torque values shall be verified for each drive by driving through each brakeand calculating the braking torque from the current draw. Thermal capacity of the brakesshall be verified in the same manner with torque, time and brake revolutions recorded.All brakes shall have their linings properly burnished or seated to the manufacturer's

recommendations prior to conducting these tests.

(xiv) Check structural alignment and integrity.

(xv) Inspect and demonstrate that all electrical wiring and wiring components are installed andproperly marked.

(xvi) 24-hours heat run test of all systems using rated load. The heat run test is not required incase the Endurance Test is performed at the Contractor's site.

(6) The Crane's static wheel loads shall not exceed the wheel loads referred to in this Specification. Should any Crane's static wheel load exceed any such wheel load this shall constitute a Defect and the Contractor shall not be entitled to dispute this on any grounds or in any circumstances. The Contractor shall be required to carry out appropriate and accurate tests in order to identify the static wheel loads of the completely assembled Crane complete with the rated load at the maximum outreach, in between the legs and at maximum back-reach. A procedure for performing the tests shall be submitted to the Engineer for his approval prior to the tests being performed. These tests shall verify that the static wheel loads do not exceed the declared wheel loads shownin the Form of Tender. These tests shall be carried out in the presence of the Purchaser or his representative.

7.5.3. Purchaser Representatives (Shop)

(1) Purchaser representatives shall attend the Contractor's works from start of fabrication until shipment of the last crane(s).

(2) The Contractor shall provide for the Purchaser representatives at the Contractor's site(s) appropriately sized and air-conditioned office(s) with working desks & chairs, and access to the siteoffice communication, electricity and water supply, as well as the staff's canteen and restroom facilities.

(3) The Contractor shall provide transportation for the Purchaser representatives between their accommodation and the Contractor's site(s).

(4) The Purchaser representatives shall adhere to the Contractor's site safety and health regulations.

7.5.4. Defects List / Punch List / NCR

(1) The Purchaser or his representatives shall be allowed to gain access to any part of the Crane(s) during their assembly at the Contractors facility and during the site-commissioning period for the purposes of inspecting part or completed works. If in their opinion certain parts of the Works does not meet with the requirements of the Agreement, or is deemed as bad practice or poor workmanship, then these shall be noted as a defect and informed to the Contractor in a list.

(2) The compilation and provision of this list by the Purchaser or his representative will in no way relieve the Contractor from his obligation to provide defect free crane(s).

(3) The Contractor shall be obliged to correct these defects and any other defects according to the set milestones below, prior to performing Tests on Completion, heat run (manufacturing site endurance test) and crane loading.

i. Tests on completion (65% punch-list completion)

ii. 24 hr heat run test, also referred to as manufacturing site endurance test

(85% punchlistcompletion)

iii. Loading (98% punch-list completion)

In exceptional circumstances an alternative appropriate punch-list completion rate may be approved by the Purchaser.

(4) The rectification of defects in the defects list shall be carried out in a thorough and workmanlike manner. The Contractor shall prepare and submit to the Purchaser a rectification report that confirms defect completion together with a description of the action taken.

2.6. Shipment and Delivery

7.6.1. Clearance for Shipment

(1) Each crane shall be tested for functions of all the devices and systems in the Contractor's yard before shipment in accordance with the approved Pre-Shipment Inspection and Test on CompletionProtocol as set out in 7.3.3.

(2) The Engineer (and/or Engineer's Representative) shall work with the Contractor to witness pre- shipment tests. The Engineer will issue a "Pre-Shipment Certificate" to the Contractor when tests and punch-list have been completed to his satisfaction.

(3) Pre-shipment tests which are not completed because of late performance by the Contractor may beconducted at the Site. In such case, no Pre-Shipment Certificate shall be issued by the Engineer and the Contractor shall bear all costs for the Purchaser's representative and third-party inspectors to attend the Site until the last crane has been taken over.

7.6.2. Notification of ETA Site.

(1) The Contractor shall notify the Purchaser of the estimated time of arrival of the marine transport vessel ("ETA"), which is carrying the Goods (or any part of the Goods) at least six (6) weeks prior to such ETA. Upon receiving such notice, the Purchaser shall tentatively allocate a berth at Site fordelivery and unloading of the Goods. The Purchaser shall inform the Contractor of any restricted berthing periods which may exist one (1) week before and after the notified ETA.

(2) The Contractor shall confirm to the Purchaser the date of actual departure of the vessel from the loading port and thereafter without fail the daily Noon position of the vessel together with an updated ETA by daily Email transmission to the Purchaser to include but not limited to thefollowing information:

(a) Call Sign/Vessel Name

(b) Condition of sea fastenings

(c) Speed in Knots

(d) Latitude

(e) Longitude

(f) Weather including wind-speed

(g) Sea conditions and swell including wave height (Beaufort scale)

(h) Time: LT/UTC

(i) ETA (LT):

(3) The exact berthing time and berthing position for the vessel shall be agreed and fixed at least one day prior to the ETA between the Purchaser and the Contractor based on the Contractor's daily position and ETA report

7.6.3. Navigation Requirement

(1) The Contractor shall be responsible for following all necessary procedures to ensure the safe passages of vessels whilst navigating in the Port. The Contractor shall maintain close contacts with the relevant Maritime Authority in the country of operation.

(2) The Cranes aviation warning lights shall be kept illuminated continually from the time the vessel carrying the crane approaches the Harbour. The temporary power source for the warning lights shall be provided by the Contractor.

7.6.4. Berthing and Roll-off Requirements

(1) The Crane shall be rolled off or lifted off from a vessel onto the designated position of the quay, then shifted to a designated test position by the Contractor. Such operations shall in no way overstress any part of the piled quay deck and the yard. Specifically, any loads on the quay apron, waterside of the waterside crane rail beam (overhung slab) are prohibited.

(2) The time allowed for the vessel to stay at the Purchaser's berth for the delivery and unloading of the Goods shall be as defined in the Conditions of Contract from the agreed time of berthing as setout in 7.6.2 notwithstanding the actual time of the berthing of the vessel.

(3) The vessel must leave the berth as soon as practicable after completion of the unloading regardless of the above time limit. The Contractor shall inform to the Purchaser the estimated timeof departure ("ETD") of the vessel at least four (4) hours before such ETD.

(4) All the necessary calculations, design, engineering, preparation works and clean up works for the rolloff and shifting the Crane to a designated test position and testing at the site shall be the responsibility of the Contractor. The preparation works shall include obtaining necessary technical information of the quay from outside consulting engineers and obtaining necessary clearance or permit for the works from government offices concerned.

(5) The Contractor shall have obtained all necessary approval, clearance, permits, etc. required for thesite works prior to the vessel departing from the Contractors facility.

7.6.5. Customs Clearance
Refer to the Conditions of Contract.

2.7. Site Work

7.7.1. Work Permits

(1) All engineer/supervisors dispatched for start-up, testing and training shall obtain proper working visas for the country of operation, which must be valid for entire estimated period of stay.

7.7.2. Site Safety and Security

(1) The Contractor shall comply with the Purchaser's security requirements for making

entry or exit to and from the Terminal, and inside the Terminal.

(1) The Contractor and its subcontractors shall be responsible for protecting their own plants, tools, temporary site offices and other belongings from weather, fire or theft. The Contractor shall be responsible for sufficient fencing, guarding, lighting and watching of all the Works on the Site until taken over. The Contractor shall not use any naked light on the Site without the specific consent ofthe Engineer or the Engineer's Representative.

(2) The Crane(s) shall be protected by the Contractor from typhoon, fire, collision and any other possible risks until the Crane or other Works are Taken-over by the Purchaser.

(3) Erection All Risk insurance, Third Party Liability insurance, Workmen's Compensation insurance andother necessary insurances shall be secured and maintained by the Contractor in accordance with the Conditions of Contract.

7.7.2. Site Erection area and Facilities, Access

(1) The Purchaser shall make available to the Contractor the agreed area required to complete the crane(s), and for the Contractor's office and storage containers.

(2) The Contractor shall at his own cost provide for the installation of office and storage containers.

(3) For access requirements: Refer to the Conditions of Contract.

7.7.3. Site Office Communication, Electricity and Water Supply (Utilities)

(1) The Contractor shall at his own cost provide for the installation of a telephone line for outside call, internet and facsimile purposes.

(2) The Purchaser shall make available on the Site for use by the Contractor for the purposes of the Works the supply of electricity and (if available) water. The supply points shall be located in the vicinity of the Contractor's site office. The supply of electricity (and water) to the Contractor for thesaid purpose shall be free of charge.

(3) The Contractor shall provide any apparatus necessary for the use of such supplies of electricity(and water). At the end of the site works, the Contractor shall remove any apparatus installed by the Contractor and safely close the supply points.

7.7.4. Power for tests on site

(1) For cranes with electrical power supply: Electrical power supplied from the MV cable connection point to the crane(s) for conducting the final commissioning and Tests on Completion of the crane(s) shall be made available from the Purchaser to the Contractor free of charge.

(2) For cranes with diesel-electrical power supply: Diesel Fuel (including the required re-fuelling equipment) for purpose of conducting the final commissioning and Tests on Completion of the crane(s) shall be provided by the Contractor. Neither diesel fuel nor the required re-fuelling equipment may be stored at the Purchaser's Site without the written consent of the Purchaser.

7.7.5. Clearance of site

(1) From time to time during the progress of the Works the Contractor shall clear away and remove from the Site all surplus materials and rubbish and, on completion, all

Contractor's Equipment. The Contractor shall at all times leave the Site and the Works clean and in a safe and workmanlike condition to the Purchaser's reasonable satisfaction.

(2) Upon completion of the site works, the Contractor shall remove any office and storage spaces, equipment, apparatus, etc. from the Site and clean the area occupied by the Contractor during the site works to the reasonable satisfaction of the Purchaser.

7.7.6. Contractor's Representatives

(1) One English speaking principal site engineer shall be dispatched prior to arrival of the Crane(s) to the Site to plan and coordinate the work and to communicate with and report to the Purchaser. Heshall stay in the Purchasers locality for the entire period from delivery to Taking-over of the Crane(s) to the Purchaser.

(2) A sufficient number of qualified startup engineers and training engineers shall be dispatched to thePurchaser's Terminal to handover the Cranes in an expeditious manner.

(3) The Contactor shall provide a qualified and competent Electro/Mechanical Service Engineer to remain on Site for a period of twelve (12) months after issue of the Taking-over Certificate for the final crane. The Contactors Service Engineer will be required to provide support to the Purchaser's maintenance engineers, assist with fault diagnosis and identification and to liaise with the Contractor's office.

7.7.7. Purchaser Representatives (Site)

(1) One ICTSI representative shall attend the Purchaser's site two days prior to vessel arrival and will remain onsite until the issue of the Taking-over Certificate of the last crane(s).

(2) The Contractor shall provide for the ICTSI representative at the Contractor's site office an air- conditioned workspace with a working desk & chair, and access to the site office communication, electricity and water supply.

(3) The Contractor shall provide a pick-up truck from a local car hire company for the duration of stay until last crane has been taken over.

7.7.8. Purchaser's lifting equipment

(1) Any lifting equipment, as it may be required by the Contractor in connection with the Works, shall be provided by the Contractor. No lifting equipment belonging to the Purchaser will be provided by the Purchaser and none may be used by the Contractor in connection with the Works.

7.7.9. Test Weight (Not Required)

(1) Certificated load test weights shall be provided by the Contractor for the load testing andadjustment of the Crane.

(2) If a Test Weight as set out in 4.13 is included in the Contractor's scope of supply, such Test Weightshall be used for the load testing and adjustment of the crane(s) and shall become the property of the Purchaser after Taking-over of the last crane which is to be supplied under the Agreement.

2.8. Site Inspection and Tests, Certification

7.8.1. Tests on Completion

(1) The Crane(s) and other Works shall be verified at Site as operational and safe under any load conditions prior to the Tests on Completion. Only minor items pertaining to maintainability which do not affect the safety of operations or maintenance work may be allowed by the Purchaser as a pending item for correction at the time of the Taking-over Certificate. These items shall form part of the Defects List (=Punch List / NCR).

(2) The Tests on Completion will be as defined in the approved Pre-Shipment Inspection and Test on Completion Protocol as set out in 7.3.3. The Contractor shall show the Purchaser by documentationor by physical demonstration (in either case as determined by the Purchaser) that all functions of the Crane(s) or other Works are safe and conform to the Agreement. The Contractor shall correct or modify whatever aspect is found unsafe. The Crane(s) and other Works shall pass the statutory tests, which will be carried out and witnessed by the Purchaser's Representative.

7.8.2. Proof Load Test

(1) The Proof Load Test forms part of the Tests on Completion. The Crane(s) shall be required to undergo a test to demonstrate the stability of the Crane(s). The proof load shall comply with Country Law and shall be at least 100% of maximum lifted load for the dynamic test and 125% of maximum lifted load for the static test. Details of the Proof Load Test will be as defined in the approved Pre-Shipment Inspection and Test on Completion Protocol as set out in 7.3.3.

(2) If required by Country law, the Contractor shall be responsible for the issuance of a Proof Load Certificate from an inspection authority acceptable to the local authorities in the country ofoperation

(3) The test load for the Proof Load Test shall be provided by the Contractor.

7.8.3. Endurance Test

(1) The Endurance Test forms part of the Tests on Completion. The Crane(s) shall be required to undergo a test to demonstrate the combined operation of all Crane systems and the reliability of the components. The endurance test shall consist of repetitive cycling as follows whilst handlingthe Crane's rated load.

i) Pick up the container at the halfway point of the full back-reach of the crane.

ii) Hoist up above half of the crane maximum lifting height.

iii) Trolley forward to the centre between the crane rails.

iv) Lower to approximately 1-meter height above quay level.

v) Wait 30 seconds.

vi) Hoist up above half of the crane maximum lifting height.

vii) Trolley forward to halfway position of the crane full outreach.

viii) Lower to approximately 1-meter height above quay level.

ix) Wait 30 seconds.

x) Hoist up above half of the crane maximum lifting height.

xi) Trolley back to the centre between the crane rails.

xii) Lower container to ground.

xiii) Unlatch the container.

xiv) Hoist up to approximately 5 metres below the crane maximum lifting height.

xv) Trolley back to the halfway point of full back-reach.

xvi) Lower to approximately 3 metres above quay level.

xvii) Repeat cycle in reverse order.

xviii) After each 30-minute operation the crane(s) shall gantry for a minimum of 30 metres to anew position and the cycle repeated. The crane shall then gantry back to the original test position.

(2) This cycle is a preliminary proposal, and the final test cycle shall be determined by the crane configuration and in agreement with the Purchaser.

(3) The endurance test shall be continued for a period of 24 hours. During the initial 16 hours, faults eliminated within 15 minutes shall not result in the failure of the endurance test, with the provisionthe total amount of downtime in the first 16 hours does not exceed 30 minutes. In the event of a malfunction in the final 8 hours of the endurance test, the endurance test shall be continued until 8hours of trouble-free operation have been logged.

(4) Throughout the period of testing the current, voltage, speed, main drive mechanism temperature, noise and vibration shall be recorded at intervals of 1 hour. Any malfunctions or problems and any remedial action taken during the test shall be recorded.

(5) The crane operators for the Endurance Test shall be provided by the Contractor.

7.8.4. Oil Sample Test

(1) Oil samples shall be taken from each gearbox and hydraulic unit after the completion of the endurance test for verification of proper lubricant, freedom from contamination, and absence of deterioration of the lubricated device.

(2) Samples shall be analysed by a local qualified independent laboratory at the cost of the Contractor.As a minimum, tests shall include:

i) Kinematic Viscosity @ 40°C

ii) Particle Count

iii) Water by Karl Fisher

iv) Metals by Spectroscopic

(3) Test results demonstrating the proper lubricant / hydraulic oil, lack of contamination, and absence of deterioration shall be provided to the Engineer with the Pre-Shipment Inspection and Test on Completion Protocol.

7.8.5. Taking-over Certificate

(1) The Taking-over Certificate will be issued on successful completion of the Tests on Completion (including the Endurance Test and Proof Load Test), and training as defined in 7.9. The Taking-overCertificate shall include the Punch List as defined in 7.8.1(1).

***CLARIFICATION: Any outstanding training at the time of taking over shall be completed within two (2) months ofthe date specified in the taking over certificate. A detailed training schedule for shall be provided prior to taking over.**

7.8.6. Remedial Work

(1) Outstanding items (also called "punch list items") shall be rectified by the Contractor after the Taking-Over within eight (8) weeks or a period as agreed by the Purchaser and the Contractor. ThePurchaser shall give the Contractor access to the Works as necessary to resolve the punch list items.

2.9. Design Review, Training and Familiarization

7.9.1. Design Review

(1) The Contractor shall provide the following for the Purchaser's engineering personnel, as defined below, to attend two (2) one (1) week STS crane design review meetings, at the Contractor's manufacturing facility or an alternative mutually agreeable location. All associated costs shall be at the Contractor's account, including Business Class airfare, local transportation, daily subsistence, and accommodation at an International 4-Star rated hotel.
For clarity each design review meeting shall allow for a seven (7) day hotel stay.

a. Three (3) attendees from Visayas Container Terminal, Iloilo, Philippines

b. One (1) attendee from ICTSI, Manila

7.9.2. Training and Familiarization Off-Site

(2) The Contractor shall conduct off-site training and familiarization for the Purchaser's maintenance personnel as defined below. This training shall be at the Contractor's account, including Premium Economy class airfare, local transportation and boarding at an International 4-Star rated hotel.The Overseas Training shall be conducted in English language.

(3) Training off-site is dedicated to crane PLC (one week) and drive application training (one week). Training shall be conducted by drive system supplier at dedicated regional (Purchaser's location) training centre.

For this project, PLC and drives application training shall be provided for 4 attendants.

(4) During crane manufacturing, the Contractor shall facilitate familiarization and inspections at his works.

For this project, familiarization during manufacturing shall be provided for 4 attendants for 6 weeksper attendant.

(5) During crane commissioning and testing, the Contractor shall facilitate familiarization and inspections at his works.

For this project, familiarization during manufacturing shall be provided for 4 attendants for 6 weeksper attendant.

7.9.3. Training On-Site (Maintenance)

(1) The Contractor shall carry out the maintenance training of the Purchaser's staff during thecommissioning period and following the Tests on Completion of the Crane. The training shall be conducted by suitable Contractor and Crane