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Rubber Tyre Gantry Crane

FULLY ELECTRICAL

Employer's Requirements

Technical Specifications

DCT Gdansk S.A.
Deepwater Container Terminal Gdańsk

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Poland

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I. OBLIGATORY SPECIFICATION

1. INTRODUCTION

The specification submits description of the rubber tired gantry crane. The offered crane as well as all its mechanical and electrical components with the control system must fulfil the requirements or preferable exceed them.

Every equipment which is offered must comply with the required expectations in a clear way or must be doubtlessly equivalent to the specified. If the same element is specified in few places of this specification all demands are valid and the more demanding one prevails.

If any equipment or features are indispensable for proper operation or maintenance of the crane or obtaining valid technical certificates and insurance policies and are not mentioned in this specification it is deemed this equipment or elements must be supplied with the crane.

The tenderer must have the experience gained over ten years in the crane design business and done in this time installation of over 50 Rubber Tyred Gantry cranes.

If not specified differently an “experienced manufacturer” means that the specific products of the manufacturer were installed on at least 50 Rubber Tyred Gantry cranes within the last ten years.

2. DESIGN BASIS

2.1. OPERATION

The **RTG** must be able to work continuously in different cycles performing following tasks and also revers processes:

Pick up and lift container of weight not less than 40,6 tonnes from a stack or ground position to a truck chassis, railroad flat car or a ground position. To shorten the duty cycles the crane must be designed and able to do simultaneous moves like hoist and lowering, trolley-travel and “inching” in gantry travel direction.

Gantry travel, at load dependent speeds and trolley travel while carrying loads up to 40,6 tonnes container.

The crane shall be able also to change lanes or working place without load. Gantry travel, at full speed and trolley travel with empty spreader.

There must be possible to turn the wheels through 90° for travelling to other lanes or to other place of destination. The crane can turn wheels to parking position to secure itself in stormy wind conditions. Furthermore a carousel drive must be possible automatically.

Turn and set its wheels able to perform a 180° spin turn about its own vertical axis at a reduced speed.

The crane will be able to operate with I.S.O. Containers of 20ft., 30ft., 40ft. and 45ft. lengths. (45ft. containers are handled at 40ft. connection points).

Handling of break bulk cargo with lashing devices via the four load hooks at the spreader edges.

The working height is five plus one container and working width is for seven containers on the stack plus handling lane

2.2. ENVIRONMENTAL CONDITIONS

The crane must be able to work in the local conditions present in Gdansk on the container terminal DCT Gdansk SA including air humidity, salt content in the air, air pollution, sand flight, snow and must be able to work with typical fuel, oils and liquids needed for normal operation available in this place.

| | | |
|----------------------------|---|---|
| Ambient Temperatures | : | -25 °C up to +40 °C. |
| Atmosphere | : | Salty and Dust-laden, including coal dust |
| Maximum relative humidity | : | Up to 100% |
| Rainfalls /Snowfalls | : | Occasionally Heavy |
| Operation Wind Speed up to | : | 20m/s |
| Max. Out of Service Wind | : | 42m/s |

2.3. DESIGN STANDARDS

The cranes will be designed and built in accordance with:

European Union Directives:

- Declaration of Conformity
- 98/37/EC Directive (health and safety)
- 2006/72/EC directive (machinery)
- 2006/95/EC directive (low voltage)
- 2004/108/EC directive (electromagnetic compatibility)

EN 292-1 and 2 – Safety of Machinery – Basic Concepts, General Principles for Design.

EC harmonised standards, including EN1589 for stairs, ladders and platforms.

In general, design and construction must comply with all EN and Polish standards current at the date of contract

The structural and mechanical design as well as Crane Classifications must comply with F.E.M. 1.001 – 3 Edition 1998.10.01 including ‘Stability and Safety Against Movement by The Wind’.

All crane mechanisms, electrical or electronic equipment as well as the elements of the mechanisms and equipment must be of European origin. Examples- motors, breaks, all electrical and electronic equipment, control equipment, gearboxes and all bearings, ropes, hydraulic with pumps and pipelines, switchgears with cables, switches, sockets, plugs, etc. The origin is understood according to EC definition, which the core part is: *“In effect it means that goods must either (1) be manufactured from raw materials or components which have been grown or produced in the beneficiary country or, should that not be the case, (2) at least undergo a certain amount of working or processing in the beneficiary country. Such goods are considered to be “originating”.* The products can be also manufactured outside EU but by a company of EU origin and the manufacturer must have headquarter in EU for minimum five years. The products must fulfil all EU norms and standards.

The steel quality must fulfil:

- EN 10025
- S235JR
- S355J2+N

Welding required standards:

EN 29692
EN 756
EN 440
ISO 5817

All welders employed during manufacturing of the crane must be qualified and certified what should be confirmed by third party authorities.

Bolt binding standards:

DIN EN ISO 4014
DIN EN ISO 4032
DIN EN ISO 4017

The bolts must be high tension friction grip crack tested and electro plated.

Brakes required standards:

DIN 15431
DIN 15435

The surface preparation and painting

DIN 55928,
BS 5493,
SIS 05 5900

Electrical installations:

V.D.E. - Regulations for the Erection of Power Installations with rated voltages below 1000V.

I.E.E. Regulations for Electrical Installations

C.P. 1014 - Protection against climatic conditions.

Motors and generators:

V.D.E. 0530 - Rating.

BS EN 60034 - Motor Standard.

Cables:

VDE 0281 - P.V.C. Cables in Power Installations

VDE 0113-1 - Safety of Machinery

Switchgear

DIN EN 60947-1 - Low-Voltage Switchgear and Control gear

BS EN 60947-4.1 - Low-Voltage Switchgear and Control gear

Quality management in accordance with ISO 9001

All electrical cables should be suitable for port and marine applications.

In general, design and construction must comply with all EN standards current at the date of contract. For aspects where no EN standard has been issued, appropriate ISO, European or American standards will be used.

The crane must fulfil all obligations needed for obtaining Polish TDT ('Transportowy Dozor Techniczny') approval for usage.

The crane should be designed in a way which eases maintenance. All gearboxes should have easy access for oil replacement.

All descriptions on control panels and maintenance places must be in Polish language.

2.4. CRANE CLASSIFICATIONS

The following are minimal requirements:

| Classification | Single Lift SWL 40,6 tonnes |
|----------------|-----------------------------|
| Structure | U7/Q2/A7 |
| Hoist | T7/L3/M8 |
| Trolley | T7/L2/M8 |
| Gantry | T7/L2/M7 |

Another factor is required design lifetime of 20 years as a minimum.

Fatigue Calculation/Duty Cycle

The fatigue calculation will be based on minimum 2×10^6 hoisting cycles with not less than 25.0 tonnes centrally acting on spreader and trolley.

Load Eccentricity

The following eccentricities must be possible for a 40ft. container, with 35.5 tonnes weight:

- 1.00m. - in longitudinal direction
- 0.23m. - in lateral direction.

Basic Stresses

The basic stresses for the crane will be calculated for the following maximum conditions.
-Max. S.W.L. (40,6 Tonnes), centrally acting on spreader and trolley, all located in the most critical position.
-35,5 Tonnes at full eccentricity acting on spreader and trolley, all located in the most critical position.

2.5. BEARINGS

The used bearings must be of an experienced manufacturer. All bearings must be standardized and have equivalents within a wide range of manufacturers.

The minimum design lifetime:

- Hoist systems: 50 000 hours
- Trolley travel systems: 50 000 hours
- Gantry travel: 15 000 hours

2.6. MAINTENANCE ROUTINES

The maintenance routines for the specific equipment can't be taken more often than 250 mth or 1 month, except visual checks performed by the operator before work.

All greasing points should be in one place, on an overall grease blocks. Centralized lubrication system is acceptable.

3. MAIN TECHNICAL CRANE DATA

3.1. KEY DIMENSIONS AND WHEEL LOADS

MAIN DIMENSIONS

| | |
|-------------------------|-------------|
| Inside portal clearance | 24,35-25,2m |
|-------------------------|-------------|

| | |
|---|---------------------------|
| Minimum lifting height above road surface to underside of spreader | 0 – 18,10m |
| Total Trolley Travel Path min. | 20,85m |
| Overall maximum width of RTG (Ground Level, without cable reel and guide) | 27,84m |
| Overall maximum width of RTG (Top Level) | 28,80m |
| Overall length over wheel guards max | 13,50m |
| Number of Travel Wheels / Tyre size | 16 / 14.00-24 or 16.00-25 |
| Maximum Yard Slope | 2 : 100 |
| Maximum length of cable reel assembly from the tyre centre line | 1,5 m |

SAFE WORKING LOAD - CRANE

Under single lift spreader 40.60 tons
 In addition to this S.W.L., the crane is designed to lift the total weight of the spreader.

Note:

- The hoist overload is set at 10% above normal S.W.L. thus the occasional 44 Tonnes lift may be achieved as requested with driver pre-warning alarm.
- The width with cable reel and guides as well as other dimensions of the crane must allow easy operations on the stacks including but not limited to passing of two RTG cranes, according to the drawings in the point IV. FACILITY CONDITIONS.

WHEEL LOADS

Max. pressure on pavement 172 kN/wheel

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3.2. OPERATING SPEEDS

HOIST

Minimum required speeds:

| No | Load [tones] | Speed [m/min] | Acceleration time [s] |
|----|---------------------|---------------|-----------------------|
| 1 | Empty spreader | 56 | 5,0 |
| 2 | 40,60 with spreader | 28 | 2,5 |

Hoist/lowering speeds will be load dependent and continuously adjusted

TROLLEY TRAVEL

Trolley Travel Speed minimum: 70.0 m/min. with and without load
 Acceleration time: 5 sec

GANTRY TRAVEL UNIT

Gantry Travel Speeds minimum:

| No | Load [tones] | Speed [m/min] | Acceleration time [s] |
|----|---------------------|---------------|-----------------------|
| 1 | Empty spreader | 130 | 12,0-Lcc |
| 2 | 40,60 plus spreader | 70 | 8,0-Lcc |

| | | | |
|---|-----------------------------------|---------------|-------|
| 3 | Stack transfer speed without load | 40 | ----- |
|---|-----------------------------------|---------------|-------|

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Speeds in normal travel direction is hoist load dependent.

WHEEL TURNING

90 degree wheel turning time: max 50 sec

SKEW AND TRIM SYSTEM

5 degree skew maximum time: 15.0 sec
 2.5 degree trim maximum time: 30.0 sec

All required speeds must stay within a tolerance of +5%.

4. THE SPREADER

The telescopic spreader shall be for 40.6 tonnes and capable of handling single ISO 20ft., 30ft., 40ft. and 45ft containers (45ft. containers will handled at 40ft. connection points). On the spreader shall be installed eight lashing eyes, each of 10,15 tonnes capacity.

Spreader Type: all electric with reliable structure and made by experienced manufacturer fully compatible and replaceable with existing on the DCT terminal YSX 40E II type.

The spreader must have ropes attachments or bolt mounted rope attachment bases or reeved-in type and no headblock is needed or allowed.

The spreader must be provided with a heavy duty cable basket for collecting the spreader supply cable.

The spreader cable must be easily replaceable and because of it should have suitable connection points on the spreader and on the trolley.

Four bolt connected fixed side guides fitted for locating the Container Load.

Two sets of LED lights on the spreader will indicate the twistlocks status:

- Yellow – Deposit Pins Made
- Red – Twistlock locked
- Green – Twistlock unlocked

Quantity- one spreader per one crane.

4.1. ANTI-SWAY SYSTEM

The spreader operations must be supported by an anti-sway system. The system must be reliable and effective, electronic or performed by a reeving system of ropes and pulleys arrangement.

The number of ropes can't be larger than eight.

5. STRUCTURAL REQUIREMENTS

5.1. GENERAL

The gantry frame structure shall consist of sections, box or tubular members. The main beams and legs as well as sill beams shall be connected via flange joints and HSFG (High Strength Friction Grip) bolts. The sill beams, legs and girders shall form a continuous rigid frame. A pin joint connects the sill beams to the rocking beams. At each side, a portal tie will pin connected to the upper end of each leg.

5.2. DESCRIPTION OF THE STRUCTURAL COMPONENTS

The structure beams should consists of individual sealed section, box or tubular members made from steel plates with internal diaphragms and stiffeners. Following the welding of each beam will complete with connection flanges, correctly aligned and welded. The different beams should be connected with flanges.

The trolley should be built as a rigid steel frame made of steel sections. The wheel support points have to be machined with suitable accuracy after the whole frame and other structural elements of the trolley are completed. The structure of the trolley unit must guaranty suitable wheel alignment and allows quick and simple readjustment or manufacturing process shall guarantee correct wheel alignment in a fixed position. Beside it the fixing of the wheels shall have a tendency of self-adjusted alignment with trolley track. The trolley must be covered with welded down plates made of steel and the surface of them can't be slippery. All sealed members must be pressure tested and the tightness must be demonstrated by using of suitable check method.

The trolley must have a structural safety protections from falling or jumping out of the rails in case of damage to the wheel(s) or axle.

The trolley rails should be continuously welded to the top of the main girders.

Each surface, where people walk has to be anti-slippery.

5.3. STAIRS, PLATFORMS, LADDERS AND WALKWAYS

The operator's cabin, the E-house, machinery house, and all other components which require routine maintenance or checks must have easy access via staircases and catwalks. Only the access to the top of sill beams, to the trolley or evacuation route can be by ladders. Staircases and catwalks as well as platforms etc. should be provided with non-slippery, hot dipped galvanized open grid gratings. Ladders must be also hot galvanized skid proof. All ladders have to be an integral part of the crane. Each ladder located min. 5m above ground level should be equipped with safety cage. Rungs out of round bars are not acceptable.

5.4. RTG SECURE POSITION

GANTRY

The RTG must be delivered with equipment preventing the gantry from moving in either direction in safe position.

TROLLEY

The trolley should be equipped with devices to secure the trolley in parking position in extreme storm conditions.

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6. EQUIPMENT

Prior to dispatch of the crane from the factory, all mechanical and electrical equipment must be fully assembled to the crane structure, electrically connected and tested. All crane drive systems will undergo test-run under "no load" conditions prior to crane erection on site. A Master-key system should be implemented in each lock with 3 levels and 5 keys for each level.

7. MECHANICAL SYSTEMS

7.1. AUXILIARY DIESEL GENERATOR SET

Drive System Supply should have a maximum 500V and 50 Hz, A.C.

The auxiliary power supply should be installed on the crane in a self-contained weather proof enclosure, diesel driven alternator must include low voltage circuit breaker and voltage regulator.

There must be a possibility to remove the complete power set from the RTG crane as a module. Therefore all electrical cabling connections must be terminated in an electric box or panel located at the enclosure.

The engine and the generator power control unit must be easily accessible from the ground level without climbing on a ladder or staircase or using any other equipment. In another words the panel must be located on the ground level on the height from people chest to head.

The alternator should be a brushless rotating field permanent magnet generator excited type with thermal protection and F/H insulation class as a minimum. The regulation must cover output voltage from unloaded to maximum load within full range.

The output power should be enough for:

- Gantry Travel with speed minimum 40m/min
- Steering and turning wheels
- 40,6t container hoisting with speed limited to not less than 4m/min
- Empty spreader hoisting with speed minimum 10 m/min
- Supply power to working lights
- Power sockets
- Air-conditioning units
- Simultaneous motion of gantry travel and empty spreader hoisting

The auxiliary diesel generator must be installed inside weatherproof enclosure fixed on the height which allows easy access from ground level for maintenance.

The enclosure must have damping insulation to obtain during normal work the sound emission on a level not higher than:

-71 dB inside any point of the operator's cabin

-80 dB at one meter from any corner of diesel generator set when engine is running at maximum speed and full load

Hinged and lockable large doors of robust design provided on both sides for good access to engine, generator set, other equipment like batteries, radiator and cooling system. Auxiliary Diesel have to be equipped with Lockout and Tagout system for cut off power supply from batteries.

The diesel fuel tank should be part of the base frame of the enclosure or should be located in the seal beam. The fuel filler nozzle will be located outside the enclosure at tank level and must allow refuelling with capacity at least 400 liters/min. The refuelling pipe must be equipped with dry disconnect coupling Camlock 2" type SCV 50, ball valve and pipe for taking fuel samples and electronic flowmeter showing amount of fuel delivered from the tanker.

The breathing pipes and or valves must be designed and built in a way which wouldn't allow spillages through it into the generator set chamber

The fuel tank must have an exact fuel level indicator easily visible from ground level staying aside of the crane. The level indicator must have two switch points, one for low fuel warning alarm in the driver's cabin and one for overfill alarm with warning light at the filler nozzle.

Additionally the fuel tank must be equipped with continuous fuel level reading device which shall transmit remotely those data to PC computers located in the offices. The readings must be submitted graphically and digitally via dedicated software delivered with the crane. The software shall record and store at least 3 month history.

The filler nozzle must have a cap with robust lock or fitting to install a padlock.

The exhaust system must include an industrial silencer and extends to about 1m above the trolley rail. The exhaust /fumes cannot reach the operator's cabin independent on the wind conditions.

Diesel generator compartment additional requirements:

The engine should be fitted with functionality which lowers the rotation speed to idle minimum when waiting, to reduce fuel consumption.

A light switch operated from the engine battery with cut out timer shall be provided inside the compartment to assist in maintenance checks on lubricant levels, maintenance works etc.

| | |
|-----------------------------------|--|
| Generator Set classification: | 100kVA-130 kVA at ab. 1500-1800 rpm |
| Functioning Voltage/Frequency: | max 500V/50Hz |
| Diesel Fuel Tank Capacity | : Minimum 48 hour operation but minimum 200 liters |
| Control Type: | Electronic |
| Control Panel: | 110V AC/24V DC |
| Starting: | Remote/Local |
| Engine Make and Type: | Industrial Diesel Engine with turbocharger, thermostatically controlled cooling system and electronically controlled fuel management (EMS). |
| Low idle, rpm: | 750-1000 |
| Injection: | direct |
| Input signals from Engine to EMS: | Generator voltage, Generator current, Generator Frequency, Speedometer for engine, Engine temperature value, Engine oil pressure value, Voltmeter for batteries, Digital engine hour meter, Engine emergency stop push button, Fuel level in the tank, Coolant level, Indication for following warnings, alarms and shut downs |

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(8pcs): Fuel Level, Common Alarm, Generator status, Battery Fail, Over Speed, Oil Pressure, Coolant Temperature & Generator Voltage.

7.2. GANTRY TRAVEL

The gantry drive and brake system shall provide sufficient thermal capacity, torque and traction for all operating conditions. The Gantry Travel System must have min. four driven axle units. The Drive Units must be accessible from ground level. The driven axle unit will consist of an electric motor with a break. There must be possible to tow the RTG along gantry travel direction and cross travel. All axles must have proper jacking points and safety guards.

7.2.1. TYRES AND WHEEL RIMS

The long travel wheels must have heavy duty welded rims on which are installed tubeless tyres used of the industrial, suitable for RTG operations. Tyre inflation pressure shall be about 10bar. The inflation pressure should be continuously read in each tire and must be transmitted remotely to PC computers located in the offices of the Technical Department. The readings must be submitted graphically and digitally via dedicated software delivered with the crane. The software shall record and store at least 1 month history. If pressure is below acceptable an alarm should be displayed also on operator's panel, informing about the value of the pressure and precise location of the tire.

7.2.2. GANTRY TRAVEL BRAKES

The travel brakes must have a possibility of smooth adjustment of the breaking force and acceleration as well as possibility to hand release. There should be additional switch for opening of electro thruster when the gantry travel is stopped and lockout is implemented, for safe adjustment of the drum brake by the technicians.

7.2.3. STEERING AND WHEEL TURNING

The steering and turning should be made on each gantry travel drive which allows of turning the wheel unit up to 90 degrees.

The system must have a possibility for easy adjustment of the wheel fixed position for straight gantry drive.

There must be at least four locking position of wheels, controlled from driver's cabin:

- All wheels fixed in gantry travel direction used during normal RTG operation
- All wheels fixed at 90 degree for gantry cross travel to other stacks
- All wheels fixed at 45° or two of wheel at 90 ° with two at 0° for parking position and the crane can't gantry travel
- All wheels fixed in such position that drive system can make spin turn around crane vertical axle

RTG must have an option of gantry steering by different speed on each side of the crane. The equipment which turns the wheels and locks in fixed positions must be easy accessible from the ground and located in place safe for the equipment.

7.3. TROLLEY TRAVEL

The trolley travel drive must be installed directly on the trolley. One, two or four electric motors with AC Speed Control drive are provided. Each motor must be equipped with a fail-safe brake. Motors must be duly protected from water ingress.

7.3.1. TROLLEY TRAVEL GEARBOXES

The gearbox must have gear teeth case-hardened and finish-ground, assuring a high degree of accuracy and silent running.

7.3.2. TROLLEY TRAVEL BRAKES

The trolley travel system must have the number of brakes equal to the number of trolley travel motors. Each break should be fail-safe electromagnetic released and mounted on the rear of the motor. An equipment for manual release must be also installed.

7.3.3. TROLLEY TRAVEL BUFFERS

Four trolley travel buffers must be provided on the main beam at the trolley travel end stops for each corner of the trolley.

7.4. HOISTING SYSTEM

The hoist unit shall be positioned on the trolley and shall be driven by one or two electric motors and one reduction gear per motor. The connection between the motor and gear must be via flexible and fail-safe input coupling.

The gearbox input drive shaft extension shall be fitted with a decently brake. The location and features of the break must damper the vibrations.

The load will be handled by system of maximum eight ropes.

7.4.1. HOIST ROPE DRUM

The hoist rope drum must have spiral grooves sufficient for total length of hoist rope in a single layer and shall also have suitable margin. The drum shall be made of steel and must be supported in secure and self-aligning way.

7.4.2. HOIST ROPES

The hoist ropes should have **safety factor** at least of **6:1** based on the minimum breaking strength of the rope in centric load case.

The rope must be of a standard type easy available on the local market.

The lifetime should have a theoretical minimum life of 80.000 moves, except damage such as cut etc.

7.4.3. HOIST ROPE PULLEYS

The hoist pulleys shall be of the same type and design made as steel construction. The rim will have groove suitable for the rope according to the standards.

7.4.4. HOIST GEARBOX

The hoist gearbox shall have maximum three stages, the shafts must be parallel or input to output shaft located at 90 degrees. The gearbox will be fully enclosed with oil bath

lubrication. It must have a tight fit dip plug and a breather. To allow for a quick oil change, the unit must be equipped with a drainage tap, magnetic plug and extension pipe to the main beam walkway with a ball valve. The unit will be completely accessible for service. The housing must be of rigid structure and have all needed lifting points on covers.

7.4.5. HOIST PRIMARY BRAKE

The brake will be fail safe operated A limit switch must indicate the status and control the braking system.

Brake safety factor: 2:1 as a minimum (Ratio between actual braking force moment and minimum braking force / moment required for stoppage.) Covers and guards are necessary for safe operation.

The whole brake have to be equipped with the LockOut system.

Deleted: additional hand release lever and the

7.5. TRIM AND SKEW

RTG must have system allowing skew of container in a minimum range plus minus 5 degree and trim of container with a minimum range plus minus 2,5 degree. Both functionalities must work simultaneously and separately.

8. ELECTRICAL SYSTEMS

8.1. GENERAL REQUIREMENTS

- The Contractor shall be responsible for the safe and reliable operation of the equipment in accordance with the requirements of these specifications. The Contractor shall demonstrate with its drawings and specifications and with the required tests that the equipment is capable of performing the specified functions with a minimum of downtimes.
- The electrical installation shall provide reliable power for the rapid precise handling of containers in continuous loading and unloading operations.
- The main drive of the hoist, trolley, gantry travel should be in AC technology.
- The auxiliary drives shall be also in AC technology.
- The AC frequency converter of the hoist and gantry travel should be independent.
- The main switchgear shall be installed in the Transformer room or in the Electric House.
- The main switchgear shall control and deliver power to all drives and their equipment and also to other minor installations like lighting, heating and so on.
- The main switch gear should be equipped with a power analyser, which provide min. following factors: Voltage, current, kvar, kWh, power factor, Hz, harmonics.
- Power compensation and suitable filter systems must be included to obtain correct power factor and low level of noises acc. to EU standard EN 61000-3-2; EN 61000 3 4. The system should dynamically regulate a factor with min. **0,94** power factor in every operation.
- All electrical and electronic equipment should be protected against power surge.
- The power supply electrical circuit of the crane should be properly designed to minimize crane recovery time in case of power supply failure in a form of short duration voltage dip or complete loss of LV power supply.
- Electrical machines, equipment, cables, schematics and drawings shall comply with suitable EU standards and directives and be suitable for port and marine industry.

- All electrical switchgears must consist of components delivered by an experienced and reputable international manufacturer and all of them must be readily available for the customer.
- All electrical installations should be ready for immediate implementation of Lockout and Tagout system without any modifications.
- All electrical components like circuit breakers, DIN power supply's etc. should be unified and delivered by up to five different manufacturers. Apart from that each specific and particular element should be made by the same manufacturer for all cranes delivered.

8.2. MAIN POWER SUPPLY

8.2.1. GENERAL

| | |
|------------------------------------|---|
| Voltage: | 1kV with minimum tolerance of +/-10% |
| Frequency: | 50Hz |
| Phase: | 3 |
| Cable length: | 350m plus margin for 350m gantry travel |
| Maximum continuous power demand: | 400 kVA |
| Maximum available power per crane: | 0,400 MVA |
| Power Circuits: | ab. 400V 50Hz |
| Control Circuits: | 115V/230V A.C. 50Hz, 24V D.C. |
| Working Lighting Circuits: | 230V A.C. 50Hz, 24V D.C. |
| Repair Lighting Circuits: | 12V |

All transformers and sensitive equipment should be located indoors and should have anti-condensation heating.

On the crane should be an installation forcing automatic shutdown from over-tension. The power supply cable should be connected to power supply point via easy and fast disconnection plug. When the plug is not connected to the power supply point on the yard, it has to be stowed on an easy accessible plug holder on the crane. The plug holder shall be equipped with a limit switch with alarm, to indicate if the plug is placed correctly in the plug holder. The plug should have protection against falling off from transporting holder, when the crane operates on the auxiliary diesel. The power supply system should be installed on the crane through LV cable reel system. The system should permit the normal cargo operation. Suitable transformer should be installed to convert the Primary voltage to Secondary voltage. ~~The cable reel drive and slip ring components should be protected by safety barriers with easy and safety access for maintenance staff.~~

Deleted: The LV cable should be connected to the special junction box via cable clamp drum. The parts shall be supplied with crane.¶

LV cable

The LV cable should be 1kV flexible reeling cable for high to extreme mechanical stresses, high travel speed, dynamic tensile loads, multiple changes of direction into different planes, churning or running. LV cable shall be equipped with fibre optic cables for possible future needs. The fibre optic cable should include at least 14 fibre optic links capable of transmitting single-mode at wavelength $\lambda=1310\text{nm}$ and $\lambda=1550\text{nm}$.

LV plug

The LV plug type should be Cavotec bent Push & Pull PC5-SX04-0950 or other fitting to Cavotec PC5-TX04-0950 socked existing on the DCT yard.

Cable reel

The cable reel should be the single drum of mono-spiral type, installed on the opposite side of the operator's cabin. The drum will be driven by a motor directly connected to a gearbox. The drive shall provide adequate torque and speed to lift the cable from the ground, preventing slack under any operating condition and the motor can't be overheated. A means shall be provided to prevent the cable from spooling off the reel when the drive is de-energized. The cable will run vertically down to the roller guide which will divert the cable into the cable channel or on the cable trays. The drive system should be supplied with tension control system to allow to keep proper tension of LV cable.

The slip rings system should be proof to weather condition (IP min. 65). The suitable anti condensation heater should be installed.

The cable roller guide should be direct fitted below the cable reel drum and shall directs the cable into the cable channel or on the cable racks, along the cable track. Diverting unit shall be double sided, symmetric, mounted on crane structure

There are required limit switches which stops the crane gantry travel drive at maximum length of given out cable. The slip ring system shall be equipped with a provision for a fibre optic rotary accumulator.

Transformer

LV transformer should be suitable for this application, hermetically sealed, equipped with suitable electrical protections. The transformer should be installed in a weather proof and ventilated Transformer Room.

LV switchgear

The LV switchgear should be equipped with a LV cubicles, which is a „Load Break” switch fuse combination for transformer protection. Tripping of the switch may be performed either manually, automatically on failure of one of the fuse links, or remotely by means of a shunt trip coil. An over-temperature in the LV transformer should cause Automatic disconnection of this switch. Each switch of LV switchgear should be ready for immediate implementation of Lockout and Tagout system without the need of any modifications.

8.2.2. MOTORS

The AC variable frequency motors must be equipped with anti-condensation heaters. The motors of same rating shall be identical and interchangeable.

All motors must have overload protection which isolates phases with adjustable thermal/magnetic devices.

The breakers and overload devices should send via auxiliary contacts signals about their status and faults to the safety logic and to the fault indication PC.

Gantry Travel Motors

Four motors as a minimum, with max. power of **45 kW** each.

Winding Insulation min. "Class F".

Protection min. IP 56.

Type of work S3 – 60%.

Trolley Drive Motors

Motors with max. total power of **40 kW**

Winding insulation min. "Class F"

Protection min. IP55.

Type of work S3 – 60%.

Hoist Motor

Motors with max. power of **200 kW**.
Winding Insulation min. "Class F"
Protection min. IP56.
Type of work S3 – 60%.

8.3. CONTROL SYSTEM

The control system shall be dedicated to the specific needs represented by customer requirements and crane manufacturer's knowledge. The system shall be designed and built by crane manufacturer's or by a manufacturer who has at least 15 years' experience in building such systems for RTG cranes and their systems was installed on minimum 30 RTG cranes. The Contractor should demonstrate reliable and successful operational within its all applications. The communication shall be via profibus or interbus I/O system.

All equipment must allow simultaneous operation of all motions. Thus the crane operator must have a possibility to hoist, trolley travel and gantry travel at the same time.

The electrical control system should consist with:

8.3.1. COMPUTER

The electrical house of each crane should be equipped with industrial range PC for interface communication with PLC, Crane Management System, Drives, Engine Set controller.

8.3.2. PLC

For the control will be used a fully digital, based on microprocessor and programmable logic controller. The controlled units must be connected via Profibus. The Programme may be presented as block, ladder, statement or function format.

8.3.3. SPEED CONTROL SYSTEM

The gantry travel, trolley drive and hoist must be controlled by master switches. The speed is fluently increased or decreased or the direction is changed by the operator who moves the switches in suitable direction. The acceleration and deceleration is automatically limited within already adjusted values. The drives can't move jerking thanks to suitable protections and characteristics. The speeds on all drives must be controlled fluently from zero to maximum by operator's moves. The system must control speeds to optimise the performance of the crane and also the accuracy of the moves especially during positioning the container on stack or spreader on container already located on stack or on a vehicle.

The crane should be equipped with function "Inching". This option allows very small moves of gantry travel while simultaneous trolley travel with hoist moves are also possible. It must allow easy location of container or spreader on a container.

8.3.4. LOGIC CONTROL

The crane should be equipped with a serial bus or field bus system which transmits data between control systems and distributed I/O modules that are connected to sensors and actuators. The transmission speed should be sufficient for fast and reliable data transmission.

8.3.5. OVERLOAD SYSTEM

The overload system should be equipped with a tension load cell, which must measure the total load. The system should be consist of:

- A fail-safe monitor which prevents hoisting motion when the load cell supply or connection cables are broken.
- Tare adjustment, to compensate weight of the spreader.
- Slack rope monitoring
- Snag load protection
- Warning Overload - gives a visual warning when the load approaches the maximum Safe Working Load of the crane.
- Overload stops – gives an audible and visual warning when the load exceeds the Safe Working Load. The load can be lowered only.

The values of the load shall be used by control system for automatic optimising the hoisting speed. The overload system shall be equipped with bypass protected from unauthorized use. The bypass shall allow hoist 110% and 125% of SWL during tests which are required also by Polish authorities TDT.

Deleted: controlled by a key

Deleted: with key

8.3.6. DGPS AUTOMATIC STEERING

The crane should be equipped with DGPS Gantry Steering. The system should be compatible with already installed in DCT Goetting, AutoSteering or Smartrail base station and system. It should ensure smooth reeling of the power supply cable.

8.3.7. CONTAINER LOCATION

The crane should be equipped with DGPS Container Location and Identification System. It should be compatible with existing Goetting, Autosteering or Smartrail base station and system.

8.3.8. TRAVEL DRIVE, STEERING AND WHEEL TURNING IN AUXILIARY DIESEL MODE

The crane should be equipped with system that allows drive of travel, steering and turning wheel if the crane is supplied from auxiliary diesel generator.

8.3.9. CONTROL PANELS

CONTROL PANEL IN ELECTRIC HOUSE

A control panel should be provided in the E-house with the following functions as a minimum:

- Crane ON/OFF
- Emergency Stop
- Engine Emergency Stop
- Reset
- 2 Spare switches

OPERATOR'S CONTROL PANEL IN THE CABIN

The control panel must be operable from the operator's seat. The adjustable seat should be located centrally. On both sides of the seat should be located two consoles with two industrial and heavy duty joysticks with self-return motion performed by a spring. The right hand joysticks should work as controller of hoisting and twistlocks. The left hand joystick

controls trolley drive and gantry travel. Both joysticks shall work as digital encoders with infinitive variability.

The ergonomic installation of the joysticks shall be at about 20 degree angle.

CONTROL PANEL OF TRIM/SKEW SYSTEM

An adjustment of trim and skew system must be possible by buttons on the left joystick.

ENGINE CONTROL PANEL

At least the following instruments and controls will be installed in the panel doors:

- Starting switch
- Generator voltage, current, frequency meter
- Speedometer for engine
- Engine temperature value
- Engine oil pressure value
- Indication lights for all warnings and shut downs
- Voltmeter for batteries
- Ammeter for battery charging
- Digital engine hour meter
- Fuel consumption meter
- Engine ignition switch
- Engine idle speed, full speed and stop push buttons
- Engine emergency stop push button
- Engine alarms
- Alternator alarms
- Fuel level in the tank

8.4. SAFETY STOPS AND GATES

General

All gates between moving and fixed platform shall be of automatic gravity closing, latching and ergonomic type with high quality industrial and weatherproof switches. The opening of either gate shall immediately disable trolley motion. The opening must be impossible when one of the platforms is not opposite the gate or is not aligned correctly.

Standard E-stops

The emergency stops when pressed must isolate power supply to the crane drives and stop all motions. The energy supplies are de-energised and brakes are applied. Diesel engine shall remain running if was in use and all auxiliary power circuits are still energised. However lighting switches can't be tripped by emergency stops.

Main emergency stops shall be of key release type.

The E- stops should be located at least at:

- Electrical House x 1.
- Auxiliary switchgear on Trolley x 1.
- Cabin Console x 1.
- Ground Level Corner 1 and 2 .
- Ground Level Corner 3 and 4.
- Main Beam Corner 1 – 4 x 1.
- Trolley Entry from Main Beam x 1.

E-stop mounted near to ladder should be key release type, with protection cover allowing a fast activation by hand.

Separate E- stops must be located on the diesel-generator control panel to cut off the engine control power to stop the engine, in E-house and at main entry on the crane. Also the spreader shall have a separate emergency stop preventing all spreader motions. Emergency stops are required of mushroom head and self-lock type in red colour. The stops must be released by turning the head counter clockwise.

Wireless fast stop

The wireless fast stop will be used by technicians doing maintenance, repair or test works on particular crane.

The fast stop shall be located on wireless transmitter which remotely stops the crane when pushed. The particular transmitter is dedicated to one crane only.

The receiver is located on the crane inside the E-house.

As long as the transmitter is active but the fast stop button is not pressed the crane shall be operational and ready to work. If the transmitter will be out of range or turned off the receiver also should be active and can't switch the crane off.

When the fast stop on the transmitter will be pressed within the range of transmitter, the crane and all of its drives shall be immediately stopped, because the receiver will disconnect the emergency circuit(s) like standard E-stop. After the wireless fast stop was used the receiver must be activated manually in E-house by a technician. The receiver must keep the emergency stop circuit disconnected until the manual activation.

The transmitter:

| | |
|--|--|
| Number: | three pieces per crane with three 230V /50 Hz charging units or one charger with three ports |
| Type: | industrial version |
| Frequency: | 868 MHz |
| Range: | min. 300m on open space and min. 200m on container stacks |
| Antenna: | integrated |
| Battery life: | min 140 hours |
| Battery durability: | min 3 years |
| Power consumption on standby: | up to 60 micro Amps |
| Power consumption during transmission: | up to 7 milli- Amps |
| Battery monitoring: | low level LED indication |
| Impact resistance: | up to 2 meters |
| Water and dust resistance: | min IP65 |
| Weight: | min 130, max. 195 grams |
| Dimension: | min 100 x 50 x 25 mmm, max. 130 x 70 x 40 mm |

The industrial receiver:

| | |
|----------------------------|---|
| Number: | one per crane |
| Water and dust resistance: | min IP68 |
| Indication: | status of the receiver and connections with transmitters. The statuses must be available in Crane Management System (CMS), on the operators panel and on PC in E-house. Each change must be recorded with time logs for at least 30 days and available on the crane computer and CMS. |

8.5. ELECTRICAL SWITCHGEARS

8.5.1. GENERAL INFORMATION

Electrical switchgear shall be of reliable industrial type and must consist of standard and serial electrical elements. The components must be easily available upon standard purchase procedures.

On low voltage control circuits, no more than three devices shall be assigned to one circuit breaker. Where available, electronic cards shall be coated.

The electrical switchgear should be fully assembled, all wires connected. Before the dispatch it must undergo in the manufacturer facility all tests confirming correct wiring, functionality and lack of logic errors.

8.5.2. MAIN SWITCHGEAR

The main switchgear shall be an integrated part of the Electric House or the Transformer Room. In front of switch gear should be located a shelf or table for convenient service works or review electrical drawings. The main switchgear shall control and deliver power to all drives and their equipment and also to other minor installations like lighting, heating and so on.

8.5.3. DRIVE INVERTERS

The drives of hoisting, trolley, travel should be supplied by AC variable frequency, step less regulated drives, specifically developed for RTG crane. The deceleration shall be arranged through power regeneration. The holding brakes can be applied only when the drive is almost stopped. The hoisting and lowering speed is achieved by load dependant adapting of the motors field strength.

8.5.4. POWER REGENERATION

The equipment must allow return of power to the grid.

8.5.5. RESISTANCE BOX

The resistance box must contain resistors for drive regeneration when supplied from auxiliary generator set. They must be made of rust proof materials,

Deleted: located inside weatherproof box

8.5.6. TROLLEY SWITCHGEAR

It must be located on the trolley and should supply power and contain control elements for trolley, spreader and I/O elements.

8.6. SERVICE SYSTEM

8.6.1. CRAWLING MOVES

There should be one push button located in the Electric House with key allowing switching from position "standard operations" to "crawling moves" for maintenance and service purposes. In the "crawling moves" position all maximum speeds will be reduced to 1-10% of standard maximum speeds. In the Electric House should be duly described possibility to adjust fluently the speed of each crawling move separately within the range 1-10%.

8.6.2. TAGOUT

At the access ladder of the crane and nearby the power generator should be located frame for TAGOUT warning signs. The frames should have width of 145mm, height 210mm and thickness 3mm.

8.6.3. REMOTE CONTROL FOR SERVICE WORKS

The crane should be equipped with remote control functionality where all moves must be available via remote radio controlled pilot. Only one move should be available at the same time.

The following moves shall be controlled as a minimum:

- Gantry
- Hoist
- Trolley
- Trim/ Skew
- Spreader moves

The delivery should include one pilot per crane. The pilots can't be interchangeable between cranes without mechanical setting deep switches or changing password on the pilot. The functionality must be activated in Electric House by key lock button and the pilot can work in crawling moves mode only.

8.7. ELECTRICAL CHECK AND FAULT FINDING SYSTEMS

ELECTRICAL CHECK

The system must allow testing of all electrical and electronic circuits, simulate the start sequences and check current of motors field supplies. During the tests motors and brakes must be isolated to avoid any risks related to the procedure.

Fault finding system

The founding of the faults and monitoring of conditions will be performed via PLC. The PLC will monitor continuously status of all switchgears and electrical elements. In case of any abnormality the information shall be detected and send to the computer /display unit via bus connection.

The information about an fault must be showed on a display unit and the history about the faults must be stored with possibility to copy on a CD or USB flash drive as well as to be printed on a printer.

The faults must be submitted in a certain order, first of all showing a sequence in which they occurred and their priority.

This system can't be dependent on the crane's control system and can't shut down if the crane's control system went under a self-fault.

Crane operating parameters recorder (black box)

Description: log box, where all operator's signals and commands are stored for at least 30 days of operations 24 hours per day. It shall include all spreaders signals, weights, counter with lockable swivel, hour meter, start timer of the crane, power winch on time, drive on time, drive trolley on time, , etc. All data should be available also remotely via CMS.

8.8. CRANE MANAGEMENT SYSTEM

The Crane Management System shall monitor and record faults and conditions of work which are critical for crane operations.

As a minimum should be remotely available: working hours of hoisting, trolley, gantry travel, diesel generator plus number of moves, electrical energy consumption, fuel level in the tank, tire pressure, position /location of the crane on the stacks from DGPS, alarms and warnings from control systems, events.

The system should also record and deliver remotely readings of Voltage, current, kvar, kWh, power factor, Hz, harmonics.

At the end of each month the system should automatically create and record report showing total power consumption for the month.

For chosen period system should create report with working hours of all drives and idle time, when the seat was loaded or the crane was switched on but the drives didn't work for time longer than set up in the system (adjustable).

All of those data should be stored in a memory of the crane as records with date, time.

The system must work with high speed allowing to monitor all critical tasks. The system shall be arranged in a way which is clear and logical and easily understandable even to non-technical staff.

The Crane Management System should be installed and operated on board PC. All fault and monitoring data should be performed and kept on this PC. The system shall also present data in graphic way including oscillograph recordings allowing selection and tracing.

Crane Management System must be available through an RF Link / WLAN on indicated terminal PC computers for viewing on demand and shall include availability of all data including warnings alarms and current statuses. The Supplier should provide communication channel which allows collect live data from central unit as well as remote access to system settings and access to API communication with API specification.

8.9. ELECTRICAL INSTALLATIONS

All cable tray brackets should be installed before painting if are welded.

Terminal boxes, located outdoors, should be made of stainless steel, protection IP55 , fitted with hinged covers and anti-condensation heaters.

Cabinets, bus bars, legs, cabin, drive motors etc. are to be sufficiently earthed through mounting.

All cables transferring digital or control signals must be screened and terminated using glands and clamps which shall duly protect against electromagnetic interferences.

8.10. LIGHTING

All lighting circuits are to be separated into branches. Each branch shall be protected by its own circuit breaker with ground fault protection in the electrical room. A failure of a single branch shall not cause the loss of power for more than 50% of all lights belonging to the same group. Lamp within the fixtures shall be supported to withstand the crane's vibrations. Fixtures shall be installed on vibration damping mountings. The floodlights should be installed to minimize reflections into the operator's cab. Mounting shall permit easy repair or replacement from normal walkways.

FLOODLIGHTS

Main beam Floodlighting

Type: HPS (high pressure sodium) 400 Watt or LED equivalent

These provide illumination of approx. 100 LUX, at ground level, for hoist/trolley operation under the girder.

Trolley

Type: Metal Halide (400 Watt) or LED equivalent

At least two floodlights should be fitted to the underside of the trolley to illuminate the spreader and container in the working area.

Gantry Travel

Type: Halogen - (4 x 500 Watt) or LED equivalent

At least on each crane corner minimum one floodlight should be installed and illuminate the gantry travel path. Additional floodlights should be installed on lower level to illuminate the 20ft and 40ft pins on a trailer of the external trucks

ACCESS LIGHTING

Each ladder, staircase, platform and walkway should have suitable illumination by halogen floodlights or LED equivalent giving as a minimum 50Lux illumination. All lighting should be controlled automatically by a photocell.

LIGHTING OF CABIN

Inside the cabin the illumination level can't be less than 200 Lux and must assure suitable lighting without shadows installed overhead.

8.11. POWER GENERATOR AND E- HOUSE LIGHTING

Inside the power generator house should be located overhead and at least two non-fluorescent 100W (or LED equivalents) lights giving light fully sufficient for maintenance works.

Inside E-house shall be installed overhead a florescent light providing illumination of the working area on the level not less than 150 LUX

8.12. WARNING SAFETY LIGHTING

As a minimum at each corner of the crane should be installed a reliable and weather proof flashing orange beacon with separated siren announcing the travel of the crane. The beacons and sirens should be connected with power supply to the motors of gantry travel and work continuously when the crane travels. The sirens must have an option of wide range adjustment of the sound frequency and level.

8.13. EMERGENCY LIGHTING

The self - contained unit should be installed at least in the driver's cabin and E-house.

8.14. POWER SUPPLY TO TROLLEY

Electrical power shall be delivered to trolley ONLY via flexible Energy Chain. It means all electrical cables including power and control cables are connecting the crane cabling with trolley through the Energy Chain. The flexible cables shall be laid within a reinforced plastic chain and shall be insulated with an UV-light, ozone, oil and cold weather resistant jacket. The chain should be located in rust protected guide fixed to the crane structure.

The power supply system should be suitable for trolley maximum speed described in this specification and built by an "experienced manufacturer".

Energy Chain

Electrical power shall be delivered to trolley via flexible Energy Chain. The Energy chain system must be installed inside roofed space. The noise generated by the work of it can't exceed 54dB(A). The range of required working temperatures of Energy chain are -40C to +40C and the system shall be ultraviolet proof.

The cables in the Energy Chain

The system must allow fast replacement of the cables. The cables should be fixed and conducted in a way which eliminates stretching tensions and shall have radius cross-section. The cables used inside the Energy chain must be dedicated to work inside Energy chains and be delivered by the manufacturer of the Energy chain as one set. The allowable bending radius of the cables shall comply with the Energy chain system. The range of work of copper cables should be -35C to +90C and -35C to +60C for fibre optic..

8.15. ELECTRICAL CABLES

Cables will be labelled on both ends and appropriately marked in the electrical diagrams. The control cables located in Energy chain shall have 20% spares. Spare wire labels shall determine the location of the other end of the wire. Power to variable frequency AC motor drives shall be supply via dedicated special motor cables.

The cabling shall have an insulation rating of 1000 VAC as a minimum and must be screened from inverter to motor and also segregated from control and data cables as far as realistically possible.

The spreader cable should be a PVC shielded cable with lead bead weights. It must have strength suitable for dynamic loads existing during all type of handling works. The core must bear central load. The cable must be terminated by plug allowing rapid disconnection.

All cables should be laid on cable ladders and cable channels and kept in place by UV resistant double lock plastic ties. The ties must be installed at regular and suitable intervals guarantying correct strength. The cable entries shall be made from the bottom of cabinets or if impossible and entries are from a side than suitable cable loops must be made to dispose of the water from the cable surface.

8.16. CCTV SYSTEM

The cameras should be located on outer legs to assure live view visibility for operator during gantry travel, and for safe truck positioning and monitoring during container handling. CCTV monitor shouldn't limit the visibility from operator's seat.

All newly installed CCTV systems should be based on IP cameras of at least 1,3Mpix resolution and IP digital recorders. Recorders should be installed in secure cabinets with limited access and proper environmental control. The communication between recorders and cameras should be transferred through IP data network. Recorders should be accessible from the port data network via existing 802.11g/n standard wireless infrastructure.

RECORDERS SPECIFICATION:

1. IP based camera connectivity
2. H.264 video compression
3. Internal, solid-state storage easily replaceable for recording acquisition or storage device maintenance
4. Capable of storing at least 30 days of recordings for all cameras with full resolution
5. IP based wireless 802.11g/n standard communication
6. Capable of sending email alerts and notifications via SMTP on a custom port

7. NTP protocol compatible
8. Capable of exporting recordings via IP and high speed physical data storage connection
9. Capable of handling power outages with automatic power-up after power loss
10. Capable of handling environmental conditions that can be found in the installation location

It is also acceptable to use analogue CCTV. CCTV cameras should be located on the RTG crane in a way that will not interfere with any normal operations or maintenance. Cameras installation point, viewing angle, lens focal length and other parameters should be chosen properly to ensure full visibility of areas around the RTG at ground level on both sides of the container stack. Additional camera should provide an overhead view of the RTG operations from the operator cabin perspective. System should allow live view from the operators cabin. Cameras should be able to record clear video during both day and night. Cameras should be capable of handling environmental conditions that can be found in the installation location.

Additional CCTV cameras should be located in the inner legs (from operator cabin side) dedicated for:

- Safe container handling, clear view of handled container and truck cabin (1 camera)
- Container positioning onto trailer pins (3 cameras)

The Contractor shall provide all activities involved in the testing and certification of the systems to demonstrate fitness for purpose.

Equipment and cabling shall comply with the requirements of the EMC Regulations and suitable protection shall be afforded against the local conditions with regard to both the IP rating of the equipment (min. IP65 as IEC 529).

9. HEATING AND AIR-CONDITIONING

9.1. DRIVER'S CABIN

The driver's cabin should be equipped with complete set of air conditioning unit, electrical heaters, fans and windows defrosting and demister system. The air conditioning and heating shall be provided to maintain conditions of 20° C and 50 percentage relative humidity as well as suitable air replacement and circulation. The windows defrosting and demister system allows defrosting and demist of all windows in all conditions.

The air conditioning and heating vents should be located at the lowest possible height above the floor level.

9.2. ELECTRIC HOUSE

The electrical house should be equipped with complete set of air conditioning unit and electrical heaters and fans. The air conditioning and heating shall be provided to maintain conditions of 20° C and 50 percentage relative humidity as well as suitable air replacement and circulation.

10. COMMUNICATION SYSTEMS

10.1. LOUDSPEAKER SYSTEM

The system shall allow communication from operator's cabin to people staying on the ground in location closely to the crane and should consist of the microphone, amplifier and speaker.

The Loudspeakers should be located at least in those places:

- 1x loudspeaker on the operator's cabin
- 2x loudspeakers onto the inner legs – one loudspeaker per leg.

10.2. TELEPHONE SYSTEM

On the crane should be installed telephone system with own and independent power supply. The system shall cover at least following places:

- Handset with socket and line in Electric house and operator's cabin
- Socket and line for connection a handset at ground level at main entry and on trolley in switchgear

Each place must be able to connect with any other place. The handsets, plugs and other equipment must have suitable weather protection.

11. LIMIT SWITCHES

All limit switches should be delivered in a dust-tight version and IP65 protection class suitable for all climate conditions met in place of installation of the crane. Everywhere where it is possible, should be implemented proximity switches.

Every limit switch should be part of monitored circuit checked by PLC for correctness of the sequences and recording of the fault data.

12. AUXILIARY EQUIPMENT

12.1. HOIST OVERSPEED AND END STOP

The over speed should be control by a unit which is installed on the hoist drum and shall stop the drive and break at 110% of maximum speed without load. The unit should be used also for calculation of the spreader position by PLC and to stop the spreader at end top and end bottom position.

Additionally the over speed must be controlled by the crane control system.

12.2. ANTI-COLLISION SYSTEM

The crane shall be fitted with two anti-collision system:

Cat whiskers

The system shall stop the crane in case of interferences. The gantry travel must be stopped at the moment when one of the 'whiskers' touched an object. They must be installed on each direction of gantry travel.

Anti-collision system

A reliable laser devices shall be installed on each of four corners and prevent collision with another crane, container, vehicles and other objects. The system must be able to work without interruptions in all weather conditions (heavy rain or snow falls, darkness, fog, etc.).

13. OPERATOR'S CABIN

13.1. GENERAL

The operator's cabin must assure safety, comfort and effectiveness of works. For safety reason the cabin should be equipped with safety hooks preventing cabin from falling as additional protection.

The cabin shall be installed below trolley and assure for operator perfect visibility of the handling area. The Contractor must deliver a diagram showing operator's visibility to demonstrate correctness of the location of the cabin and also the size and shape of the windows.

The cabin shall be welded rigid steel construction with correct and effective sound, vibration and heat insulation between the double walls including floor and ceiling.

The cabin should be extensively glazed using single glazed toughened safety glass, tinted on the sides, front and back, and clear on the floor panels.

Foot grids should be installed above the bottom window for the driver's feet.

The cabin should be provided with top opening windows on the front and at the two sides what should allow good air circulation and window cleaning from inside.

Opening of operator's cabin door should be collision-free and safe.

13.2. OPERATOR'S SEAT AND CONSOLE

The seat should be ergonomically designed and adjustable forward and backward, up and downwards. It should have also possibility to rotate. The seat back shall have various tilt positions and adjustable lumbar support. The seat shall be provided with a safety two-points seat belt of Br4 type.

. The console with seat shall be also adjustable forward and aft.

13.3. EQUIPMENT INSIDE CABIN

Additionally the cabin should be equipped with the following units:

- Security system against unauthorized crane usage. Inside the cabin should be access point system which allows to start and operate the crane only after the operator swapped the magnetic card over the reader. The system should record the card number and recognise the name of operator assigned to the specific card number. System should be equipped with CCTV camera integrated with crane CCTV system for checking who is operating the crane. Additionally it should remember for at least 90 days the date, hour, minute and second when the operator swapped the card on the start and when the operator switched off the crane what should finish the authorisation time. Those data, including history and current situation as well as suitable reports should be available ONLINE remotely on existing computers located in the Administration Building of the terminal. System should work with magnetic cards existing on the terminal.
- spare fold up seat.
- 2 sets of seat covers (easily replaceable)
- a telephone link to other crane areas.
- microphone and loud speaker system
- warning signal horn
- an overhead light
- an emergency light
- air conditioning and heating equipment

- the windows defrosting and demisters system
- roll up blinds
- locker
- three socket outlets (UE type). 230V/16A on separate electric circuits
- the installation for a 2-way radio
- the installation for data transfer and power supply for RDT unit according to the instruction issued by IT department.
- CCTV system -control and display
- A windscreen wiper with washer for the front, rear and roof window

13.4. OPERATOR'S DIGITAL PANEL WITH DISPLAY

In the cabin should be ergonomically located operator's digital display having good visibility in all light conditions and showing as a minimum data as follows: fault displays, spreader height, load, trim angle, skew angle, etc. It must allow the driver to see all recent faults in a clear and easily understandable format.

14. SYSTEM PREVENTING EXTERNAL TRUCK TRAILER LIFTING

The system should prevent lifting of the external truck trailer when crane is lifting the container and the locks on the trailer are not open. System can work in two way:

- Make impossible to continue lifting when trailer is hoisted with container, by turning off the hoisting system
- There shall be fixed a sound and light alarm in operator's cabin informing about lifting truck trailer. In that case, the type of alarm has to be different then each other alarms used on the crane.

15. TRAFFIC LIGHTS FOR POSITIONING TRUCK UNDER THE CRANE

The crane should be equipped with traffic lights on the side where is the truck lane. The lights should inform the truck driver about the need to move it forward or backward, to position the container on the truck trailer directly under the spreader position.

16. DIAGNOSTIC TOOLS

The crane should be equipped with diagnostic tools and PC(USB) interfaces including software for easy access to the devices which are installed on the crane

As a minimum:

- Diesel engine
- Generator control panel
- DGPS system
- Digital displays
- Drives
- Communication network parts.

The software allows to:

- Check all parameters
- Calibration
- Maintenance of the device

The manual and maintenance instruction should be attached with all access codes.

All the software should be installed on PC which is installed in Electrical house and installation version with all licence should be delivered on CD or DVD.

There should be delivered one full set of diagnostic tools per five cranes.

17. ADDITIONAL FITTINGS

17.1. WARNING SIGNS AND NOTICES

The warning signs must be located by manufacturer according to already mentioned rules as well as all EU requirements and Polish TDT. The warning notices must be in Polish language.

S.W.L. SIGNS: Two signs are provided, one on either sill beam.
Wording: Safe Working Load 40.60 Tonnes
Letter Colour: BLACK on WHITE background

CUSTOMER LOGO SIGNS

Three customer signs are provided, one on each side of the main beam and one on the outside of the electrical house. Each RTG shall also have a local I.D. number on all legs and the main beams as well as sill beams.

17.2. FIRE EXTINGUISHERS

CO2 type fire extinguishers will be provided acc. to EU and local authorities requirements but at least in the following locations:

- At ground level, main entry site
- Outside diesel generator set enclosure
- Outside Switchgear Enclosure
- Trolley
- In driver's cabin

18. PAINTING AND SURFACE PROTECTION

SURFACE PREPARTION

The surface preparation of all raw steel materials shall be carried out in an automatic blasting machine or in specialised manual blasting hall.

The cleaned surface quality should be minimum as per Swedish Standard SA 2.5 with a surface profile. All fabricated box sections must be completely blast-cleaned in order to return the surface quality to SA 2.5, prior to application of the paint system.

PAINTING

The painting system shall consider at least three coats: primer, middle coat and finishing coat. The painting should be started immediately after the above shot-blasting process.

The total dry film thickness of the paint system is minimum **250 microns**.

Main Structure Final Top Coat Colour shall be RAL 5005.

PLATFORMS, STAIRS AND LADDERS

All bolted-on platforms, stairs and ladders in the main entry system are "hot-dip-galvanised." The zinc coating is typically in excess of 70 microns thick. All the bindings used in these areas, up to a size M16, are of stainless steel – Grade A2-70.

19. CRANE COMPLIANCE

- a. RTG shall be fitted with pedestrian stoppers in between RTG wheels / legs- if crane will be equipped with 16-wheels that requirement does not apply.
- b. RTG shall have a positioning guides installed to assist the operator with aligning containers, preventing damage to container stacks and reefer racks. - Appropriate centre markings to be clearly marked in container yard stacks to a line RTG.
- c. RTG flippers spreaders / guide shall be fitted with a secondary attachment chain.
- d. RTG shall be fitted with hands free two-way radio communication device operated by a foot pedal and or button positioned on the operators joy stick.
- e. RTG operator cabins shall have an aiding mirror fitted.
- f. RTG shall be fitted with a training seat with a two (2) point lap seat belt.
- g. RTG shall be fitted with electronic anti-collision devices on each corner for long travelling.
- h. RTG shall be fitted with people pusher on each corner located at the outer end of each leg.
- i. RTG shall be fitted with a stack profiling system.
- j. RTG shall be fitted with a fire detection and automated fire suppression system installed.
- k. RTG operator's cabin shall be fitted with a 2 (two) point adjustable seatbelt and be worn while operating.

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20. TECHNICAL DOCUMENTATION

The documentation must comply with requirements of local Polish authorities TDT (Transportowy Dozór Techniczny).

The set of following documentation should be delivered:

- RTG Instruction Manual for operation
- RTG Crane Passport
- RTG Maintenance Instruction Manual including instruction on calibration of sensors and calibration of other equipment which should be adjusted on the crane
- CE certificate of RTG
- CE certificate of spreader
- RTG Spare parts catalogue, list - all parts used on the crane, including diesel engine spare parts
- Technical main data sheets and machinery cards, including trolley rail tracks and trolley wheels with nominal dimensions, tolerances, acceptable wear of rails, wheel flanges and other needed data
- Spreader Instruction Manual for operation
- Spreader Maintenance Instruction Manual
- Spreader Spare Parts List
- Assembly drawings
- Main components drawings
- Static calculations and drawings of the steel construction
- Electrical Diagrams
- Electrical Instruction Manual
- PLC documentation with FBD (Function Block Diagram), LD (Ladder Diagram), IL (Instruction List), SFC (Sequential Function Chart),
- All passwords for PLC and other electronic devices
- After-assembly Protocol with measurements of electrical installation, effectiveness of electrical protections and lightning protection
- Cyber security certificate

When the assembly works are finished the Contractor will deliver written conformity that assembly was done according to standards and his technical knowledge and confirmation

that all tests were done. Conformity must be signed by authorised person that was coordinating or supervising assembly works.

Additionally suitable parts of documentation must include:

- technical description
- general drawing
- wiring diagrams, hydraulic and pneumatic diagrams if were implemented
- diagrams of rope drive systems and other existing drive systems

Both documentation and Equipment must fulfil requirements of Polish rules regarding handling equipment with regard to amount and quality. Execution of the rules is supervised by TDT.

Drawings and diagrams should be provided in format readable in PDF and general crane assembly drawings in format readable in PDF and also in format readable in **AutoCAD**.

The documentation should be delivered in one **English**, tree **Polish** hard copies and two CDs or two USB memory sticks.

21. TRAINING

A training for maintenance staff shall be arranged in DCT Gdansk location and should be performed in Polish language.

A/ Before the commissioning of the first section of the cranes there must be finished training sessions in how to repair and maintain:

The crane:

- minimum twenty days training for electricians, five days for one of the four groups
 - minimum twelve days for mechanics, three days for one of four group of mechanics
- The training shall be provided by the manufacturer of the crane and should include the special procedures for crane additional tests/checks if the wind force was above the design limits or if there was an accident with the crane participation etc.

The spreader:

- minimum four days training, one day for one of four groups. The training shall be provided by the manufacturer of the spreader.

The hoist ropes:

- minimum four days training, one day for one of four groups of mechanics. It should be performed by the rope manufacturer and shall include all the necessary procedures for rope maintenance rules, test, acceptance procedures, storage, certificates, etc.

The dates of training sessions should not coincide.

B/ Within one week after the TDT approval is obtained, on the terminal shall be arranged minimum ten working days training session in how to operate the cranes for the crane operators.

The training day should last for eight hours including one 30 minute break.
The trainings should be carried Monday – Saturday.

A training for operations staff shall be arranged in DCT Gdansk location and should be performed in Polish language.

The Supplier of the equipment should provide trainings dedicated for the crane operators.

- A. Date of the training should be set with Operations Training Coordinator minimum 14 days before each training session
- B. Trainings should be carried Monday - Friday
- C. Trainings should be conducted before the commissioning of the cranes
- D. Trainings should be carried by person who is fluent in crane operations
- E. After training all participants should know how to:
 - a. Self-service the crane and all the devices on it, required for everyday operation of the operator's position
 - b. Be able to interpret the most common error messages / faults on the device
 - c. Be able to handle all crane systems supporting the operator's operation
- F. There should be minimum 1 theoretical and 3 practical (driving course) training sessions conducted, for 2 operating instructors on each practical session. Theoretical session should last minimum 2 hours, practical minimum 5 hours.
- G. Supplier should deliver minimum 6 sets of operating instructions, written in Polish language.

II. ADDITIONAL EQUIPMENT

A. AUTOMATED POSITIONING SYSTEM

The system shall allow positioning of the container. In result of it the position of container on the chassis will match the position of the crane spreader. All four flippers on the spreader shall be placed on the corners of the container without any extra moves either the chassis nor the long gantry of the crane and the twistlocks shall lock on the container.

The crane shall be ready to further semi automation of operations. It means that modification to semi automation operations must be possible and relatively easy to implement. The Automated Positioning System should allow integration with existing Terminal Operating System, allowing hands-free container positioning and update in Terminal Operating System.

B. AUTOMATED SYSTEM PREVENTING SPREADER COLLISION

The system should continuously scan the profile of containers and all other objects below the spreader. The arrangement should slowdown the trolley and hoist to prevent collision of the spreader with or without container with other objects, mainly the containers or chassis. The system shall be equipped with functionality of automatic slowdown of the spreader or spreader with container over the container on the stack or over the chasses.

C. SEMI AUTOMATION OF OPERATIONS

1. The system should continuously scan the profile of containers and all other objects below the spreader. The system should slowdown the trolley and hoist to prevent collision of the spreader with or without container with other objects, mainly the containers or chassis. The system shall be equipped with functionality of automatic slowdown of the spreader or spreader with container over the container on the stack or over the chasses.

2. The way of spreader travelling system should be optimised and system should allow of semi-automation of operations. The operator controls only picking up container up to 1-2 meters above the stack and unloading the container on the chassis until 1-2 meters above the tractor and by analogy opposite. The PLC of the crane controls the rest of the move by taking over from the operator when the container is on certain height above the stack or chassis until position above the container on stacks or chassis. The PLC scans the stacking profiles of containers by external laser scanners and calculates the shortest, fastest and the most economical and safe route. The operator indicates the crane's system the position of the trolley above the stack with containers. The PLC remembers the position until the operator decides to change it.

D. UPGRADE OF OPERATOR'S CABIN

GENERAL

Construction double skinned, roof mounted. At least 50mm wool insulation.

OPERATOR'S SEAT

The seat should be roof mounted. Fully adjustable forward and backward, designed for male and female of weight up to 150 kg. The seat height should accommodate within 20 cm. Adjustable electrically up and down with pneumatic suspension and own small electrical compressor. The upholstery shall be made of leather.

Cushion:

Forward - backward adjustment
Heating
Pressure switch integrated
V-cut in cushion
Head rest

Backrest:

Height adjustment
Inclination adjustment
Heating

Tilt:

Tilt adjustment seat min 3° forward
Weight / suspension adjustment pneumatic - electric
Armrests- after adjust armrest should be stiff, heavy duty

Console:

Consoles forward – backward, moved up – down, revolving, tilt adjustable
Joysticks and seat should have adjustable shock absorption.
Swivelling panel RH side
Swivelling panel LH side
Revolving table
Console width 200 mm - 250mm
Text plates
Complete wiring of consoles & panel
Control components

E. EVACUATION

The system should allow fast evacuation of the operator in every position of the trolley.

F. AUTOMATIC GREASING OF HOIST ROPES

The system should eliminate completely the need of greasing the ropes or significantly reduce the frequency of the greasing, what should be clearly declared in the description of the option. The equipment should also optimise the consumption of the grease or oil and do not allow contamination by grease the adjacent area of the crane or the yard.

G. AUTOMATIC CONTAINER WEIGHING SYSTEM WITH TOS INTEGRATION

The principle of the system is to communicate an information on the container weight from the container handling equipment to the terminal operating system automatically, without human interaction. The System is expected to be mounted on the spreader, load sensors on each of the twistlock pins, which capture the weighing information upon each lift. The data from the weighing system should be sent via the crane cable to the crane's PLC. The measured values should be sent wirelessly through server software to the TOS.

III. SPARE PARTS LIST

SPREADER

- each type of sensors – 5 pcs
- programmed spreader PLC - 1 unit – if applicable
- each type of electric/electronic I/O unit – 2 units
- flipper arms – 2 units
- each type of contactors – 2pcs
- each type of electric motors – 1pc
- each type of relays – 10pcs

GANTRY TRAVEL

- each type of sensors – 5 pcs
- each type of electric/electronic I/O unit – 2 units
- encoder – 2 units – if applicable
- encoder coupling – 2 units – if applicable
- beacon lamp – 4 units
- beacon siren – 4 units
- gearbox oil filter– set for each crane
- each type of solenoid for hydraulic valves- 2pcs - if applicable
- motor for travel brakes – 1pc
- gantry travel motor – 1pc

TROLLEY

- each type of sensors – 5 pcs
- each type of electric/electronic I/O unit – 2 units
- encoder – 2 units
- encoder coupling – 2 units
- beacons (light + sound) – 4 units
- gearbox oil filter– set for each crane

HOIST

- each type of sensors – 5 pcs
- each type of electric/electronic I/O unit – 2 units
- encoder – 2 units – if applicable
- encoder coupling – 2 units – if applicable
- overspeed device – 1 unit
- gearbox oil filter– set for each crane
- load sensor – 1 set
- hoist ropes- full set for five cranes

TLS

- each type of sensors – 5 pcs
- each type of electric/electronic I/O unit – 2 units
- electric motor – 1 unit – if applicable
- hydraulic oil filter– set for each crane

OPERATOR'S CABIN

- each type of sensors – 5 pcs
- each type of electric/electronic I/O unit – 2 units
- each type of pushbuttons with mounting and contactors – 2 sets
- each type of operator's joystick– 1 full set

- each type of operator's display – 1 unit

CABEL REEL

- each type of sensors/ transducers – 5 pcs
- cable reel motor – 1 pc

ELECTRIC HOUSE/ELECTRICS

- each type of sensors/ transducers – 5 pcs
- each type of electric/electronic I/O unit – 2 units
- each type of pushbuttons with mounting and contactors – 2 sets
- each type of PLC – 1 unit, others if applicable
- each drive: hoist, trolley, travel, derrick – each unit [1piece of each unit]
- each type off contactors – 1 unit power > 50kW, 2 units <50kW

GENSET

- each type of sensors for diesel – 5 pcs
- radiator for cooling system - 1 pc
- a set of injectors for two engines.
- water pump for cooling system - 3 pcs
- belts and tensioners - full set for five cranes

V. FACILITY READINESS

Electric Power:

The power for the assembly works will be available for the Contractor in the place where it is. The Contractor will be charged for the consumed power. The Contractor should install suitable counters, if needed.

The Contractor will be charged for the power delivered to the connection boxes of the cranes until the successful Tests on Completion. Cost of the successful Test will take the Employer.

Water

The water will be available for the Contractor where it is and free of charge but in reasonable amount, needed for the assembly works.