Huisman

Worldwide Lifting, Drilling and Subsea Solutions

Technical Specification

Customer	CIMC Raffles
Product	Offshore Mast Crane
Model	1800mt OMC
Project no.	A08-10400
Revision	U
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1 INTRODUCTION

This Technical Specification describes the 1800mt Offshore Mast Crane (OMC) that is offered for to be new-build Semi-submersible for Marine Subsea. Typical characteristics of the 1800mt OMC are:

- Two identical cranes
- Both cranes are prepared for future upgrading with a deepwater auxiliary hoist
- The crane is outfitted with four (4x) 25mt load tuggers
- The crane is outfitted with two (2x) 15mt sling hoists (25mt in block tugger mode)
- The crane is fully electrical driven.
- The crane pedestal footprint is a rectangle of 11.25m x 9.75m.
- Where possible, equal parts are used in drive components, e.g. same inverter drives on main hoist, auxiliary (optional), whip hoist and boom hoist, reducing the amount of required spare parts.
- Crane power supply is redundant (2 feeders). Each feeder provides 50% of the required power. In case one feeder fails, the crane still can operate with full load capacity, at half maximum speed. This redundancy gives higher safety, during subsea installation or construction work.
- Boom can be parked in transverse direction within limited conditions with a boom angle of approximate 78^{o} (lower blocks will be connected to a putting on the A-deck).
- The crane consists out of a static and rotating part. The pedestal and mast are static. Around the mast a slew platform is mounted. The boom is connected to the slew platform. The boom is supported by luffing wire ropes which are running from the boomhead to the masthead to the boom hoist winches. The masthead on top of the mast is placed on a bearing. The slew platform, masthead and boom are rotating around the mast. A slip-ring is placed in between the mast and the slew platform.

2 TECHNICAL SPECIFICATION

Dimensions according to General Arrangement drawing A08-10400-10-01 Rev. T.

Note:
- Specifications can be subject to very little changes as the design progresses.
- Stated weights and loads are in metric tonnes [mt]

2.1 Main Hoist

Capacity Revolving (in air)			
Safe Working Load at approx. 27m radius	32 falls	1800	[mt]
Capacities given for the following conditions:			
Dynamic factor		1.1	[-]
Offlead		1	[°]
Sidelead		3	[°]

Hoisting Speed (at outer layer drum)			
Full load	Approx.	3.8	[m/min]
Reduced load	Approx.	9.5	[m/min]

Working range			
Minimum radius	Approx.	14	[m]
Maximum radius	Approx.	62	[m]
Hook travel	32 falls	105	[m]

2.2 Auxiliary Hoist

The crane is prepared for future upgrade with a deep water auxiliary hoist. The deepwater auxiliary hoist is optional. The delivery and installation of deep water preparations are included:

- Foundations for traction winch on crane pedestal structure
- Reinforcements of crane pedestal
- Sheave boxes for high tension sheaves:
  - below winch floor
  - on mast head
  - on slew platform
  - on jib.
- High tension sheave (109mm) below winch floor
- High tension sheave (109mm) on mast head
- Reinforcements of winchfloor
- Reinforcements of mast head
- Additional space in E-room for future installation of drive cabinets, power and electrical cabinets for traction and storage winch
- Preparations for future installation of controls of traction and storage winch.

The following scope of supply is optional and can be quoted upon request:

- 300mt Traction Winch
- Storage winch for 3000m wire rope (dia. 109mm)
- Drive system, power and electrical cabinets for traction and storage winch
- Controls for traction and storage winch
- 600mt lower block including sheavebox
- Wire rope (approx. 3300m - dia. 109mm)
- Three sheaves (109mm) including shafts and loadpin in the boom and slew platform.

Items not specifically mentioned in above option however necessary to complete the deepwater system shall be included.

The scope not covered by Huisman includes:

- Supporting steel in the vessel for storage winch
- Cable trays and interconnecting cabling between E-room and traction + storage winch.

The traction winch is mounted onto the pedestal of the crane where the storage winch must be positioned on deck. The auxiliary hoist reeving is 2 falls (600mt SWL) or 1 fall (300mt) with a 109mm steel wire rope.

Capacity 2 falls (in air)			
Safe Working Load at approx. 29m radius	2 falls	600	[mt]
Safe Working Load at approx. 58m radius	1 fall	300	[mt]
Capacities given for the following conditions			
Dynamic factor		1.2	[-]
Offlead		2	[°]
Sidelead		5	[°]

SWL Reduction for Water Depth			
Safe working Load Reduction	1 fall	5.25	[mt/100m]
Safe working Load Reduction	2 falls	10.5	[mt/100m]

Hoisting Speed			
Full load (2 falls)	Approx.	8.5	[m/min]
Reduced load (2 falls)	Approx.	17	[m/min]
Full load (1 fall)	Approx.	17	[m/min]
Reduced load (1 fall)	Approx.	34	[m/min]

Working range			
Minimum radius (2 falls)	Approx.	16	[m]
Maximum radius (2 falls)	Approx.	72	[m]
Minimum radius (1 falls)	Approx.	15	[m]
Maximum radius (1 falls)	Approx.	71	[m]
Hook travel (2 falls)*		1500	[m]
Hook travel (1 fall)		3000	[m]

* When working with 2 falls measurements might be required to prevent twisting of the lower block

2.3 Whip Hoist

The whip hoist reeving is 1 or 2 falls (100mt SWL) with a 50mm steel wire rope.

Capacity			
Safe Working Load at all radii	2 falls	100	[mt]
Safe Working Load at all radii	1 fall	50	[mt]

(The whip hoist is suitable for man-riding in single line at 3mt)

Capacities given for the following conditions			
Dynamic factor		1.3	[-]
Offlead		3	[°]
Sidelead		6	[°]

Hoisting Speed (at outer layer drum)			
Full load – 2 falls	Approx.	36	[m/min]
Reduced load – 2 falls	Approx.	90	[m/min]
Full load – 1 fall	Approx.	72	[m/min]
Reduced load – 1 fall	Approx.	180	[m/min]

Working range

Minimum radius	Approx.	21	[m]
Maximum radius	Approx.	82	[m]
Hook travel	2 falls	700	[m]
Hook travel	1 fall	1400	[m]

2.4 Boom hoist

Working range

Minimum boom angle, operational		15	[°]
Minimum boom angle, storage		-5	[°]
Maximum boom angle		81	[°]

Boom hoist time

Full load 15° to 75° boom angle	Approx.	18	[min]
Reduced load 15° to 75° boom angle	Approx.	7	[min]

2.5 Slew system

Slewing Speed

Slewing speed at full load	Approx.	0.25	[rpm]
Slewing speed at reduced load	Approx.	0.5	[rpm]

Working range

Slewing range		450	[°]

2.6 Load Tuggers (4 off)

Capacity

Safe Working Load		25	[mt]

Hoisting speed (at outer layer of the drum)

Full load	Approx.	12	[m/min]
Reduced load	Approx.	32	[m/min]

Working range tugger winches

Hook travel	Approx.	100	[m]

The tugger winches can be operated in speed mode and constant tension (CT) mode.

2.7 Sling Hoist / Block Tugger (2 off)

Capacity

Safe Working Load in block tugger mode		25	[mt]
Safe Working Load in sling hoist mode		15	[mt]

Hoisting speed (at outer layer of the drum)

Full load	Approx.	12	[m/min]
Sling Hoist Mode	Approx.	20	[m/min]

Working range tugger winches

Hook travel	Approx.	105	[m]

The tugger winches can be operated in speed mode and constant tension (CT) mode.

2.8 Interface data

Weight

Total weight crane from demarcation level, including transformers and brake resistors		1660	[mt]
Maximum allowed tolerance		+/- 3%	
Weight deepwater system auxiliary hoist:			
Traction Winch	Approx.	90	[mt]
Storage Winch	Approx.	80	[mt]
Wire rope (approx. 3300m - dia. 109mm)	Approx.	198	[mt]
300/600mt lower block	Approx.	24	[mt]
Sheaves in boom and slew platform	Approx.	8	[mt]
Total weight deepwater system		400	[mt]
Maximum allowed tolerance on total weight		+/- 3%	

Dimensions

Pedestal Footprint	11.25 x 9.75	[m]

2.9 Design considerations

Design Code

Lloyd's Register of Shipping, Code for Lifting Appliances in a Marine Environment, 2009

Environmental Conditions

Min. operating temperature	-10	[˚C]
Max. operating temperature	45	[˚C]
Max. ambient temperature brake resistors and 12-pulse transformers (located inside vessel)	55	[˚C]
Max. operating wind speed	20	[m/s]
Survival wind speed (with boom in boom rest)	63	[m/s]
Permissible tilting angle of vessel:		
Heel – crane in operation	1	[°]
Trim – crane in operation	1	[°]
Area classification	Safe zone	

The boom has to be placed in a boom rest when the crane is not in operation.

Environmental conditions while boom in parking position

Max. longitudinal acceleration (perpendicular to boom)	Approx.	0.1	[G]
Max. transverse acceleration (longitudinal with boom)	Approx.	0.2	[G]
Boom angle (above horizontal)		78	[°]

Boom parking position is in transverse direction (from SB towards PS)
No load is suspended in the hoists; main, auxiliary and whip hoist lower blocks will be connected to a putting on the A-deck to pretension the boom.
Accelerations on COG of the boom; accelerations include static inclination and dynamic acceleration.

FEM Classes and Groups

Crane Design Life Time	20 years
Design Guide	FEM 1.001, Rules for the design of Hoisting Appliances, 1998/10/01

	Duty Class	Lifetime Class	Mechanism Class
Main Hoist	L2	T2	M2
Auxiliary Hoist	L3	T4	M5
Whip Hoist	L3	T3	M4
Boom Hoist	L1	T4	M3
Tugger Winches	L2	T5	M5
Slewing	L2	T4	M4
Total Crane	Q1	U1	A1

3 CRANE DESCRIPTION

3.1 Hoists and Rigging

3.1.1 Lower blocks

The following lower blocks will be delivered with the crane:

Main hoist:	One SWL 1800mt lower block with two ramshorn hooks
Auxiliary hoist (Optional)	One SWL 600mt lower block with ramshorn hook
Whip hoist:	One SWL 100mt lower block with ramshorn hook
Sling hoist:	Two SWL 25mt lower blocks with a single hook

The lower blocks are fitted with a swivel for free rotation of the load and ball weights for proper spooling of the wire on the drum. The 100mt whip hoist lower block and optional auxiliary hoist lower block will be delivered with a detachable sheave box and can also be used in single line.

3.1.2 Wire ropes

The crane is outfitted with the following tackles:

Hoist	Wire dia.	No. of falls
Main hoist	50 mm	32
Auxiliary hoist (optional)	109 mm	2 or 1
Whip hoist	50 mm	2 or 1
Boom hoist	50 mm	22
Load tugger (4x)	30 mm	1
Sling hoist (2x)	30 mm	1

The auxiliary and whip hoist wire rope is of non rotating type, while the main and boom hoists wire rope have a regular construction.

3.1.3 Winches

All winches are driven by planetary built-in gearboxes and electrical variable frequency motors. The reeving arrangement is designed for natural wire spooling, i.e. without spooling devices. Lebus grooves will be applied on the main, whip and boom hoist winches and optional storage winch of the auxiliary hoist.

For normal braking of the winches the electro-motors are used. Furthermore all winches are equipped with fail safe (spring set) parking brakes acting directly on the motor shaft. All brakes are fitted with brake release sensors, constantly monitored by the control system. The drive system (when operational) will try to keep the motor speed at zero, even when a brake is failing. If a brake is failing the control system will issue an alarm.

Main, whip and boom hoist winches are installed inside the pedestal, being protected from the harsh marine environment. The optional deepwater auxiliary hoist storage winch is placed on deck where the traction winch is mounted on the crane its pedestal.

3.1.4 Sheaves

Sheaves for main, boom, auxiliary (optional) and whip hoist have a minimum diameter of 20 times the wire diameter to ensure proper lifetime of the wires. The sheaves are fitted with roller bearings. Where necessary the sheaves are fitted with wire retaining bars which ensure that the wire will not jump out of the groove.

Figure 1: Head crane house with retaining bars (typical)

Figure 2: Winches inside crane house (typical)

3.2 Drive System

The crane is completely electric driven. The main advantages of an electrical driven crane compared to a hydraulic driven crane are:

- Limited maintenance
- Less components
- High reliability
- No oil leakage
- Lower noise level.

The following electro motors are used on the crane:

Drive	Motor	No.	IP-class
Main hoist	400 kW	2x2	IP 23
Traction Winch Aux. Hoist (Optional)	145 kW	2x4	IP 56
Storage Winch Aux. Hoist (Optional)	45 kW	2	IP 56
Whip hoist	400 kW	2	IP 23
Boom hoist	400 kW	2	IP 23
Load tugger (4x)	60 kW	4x1	IP 56
Sling hoist (2x)	60 kW	2x1	IP 56
Slewing	100 kW	8	IP 56

Minimum protection class of the E-motors are:

- Indoor electro motors:
  - Electro-motors < 55kW: IP44
  - Electro-motors >= 55kW: IP23
- Outdoor electro motors: IP56

Cooling of the IP23 class electro motors is performed via a separate driven fan.
Cooling of the IP56 class electro motors is performed by natural convection.
The above mentioned motors are equipped with stand-still heating.

Motors shall be of squirrel cage induction type of IEC standard frame designed for 690 V, 3 phases, 60 Hz, except for the small motors (less than 10kW) may be AC 440 or 230 V single phase or 3 phase type.

3.2.1 Power consumption

The maximum simultaneously power consumption of the crane is approx. 2400kW.

3.2.2 Power regeneration

Electrical power which is generated by the electro motors during lowering of a load is absorbed by water cooled ballast resistors which will be installed inside the crane.

3.2.3 Electronic cabinets

The electronic cabinets are installed in an electrical room inside the crane. The E-room is kept at a maximum room temperature of approx. 30 [˚C]. It is provided with:

- Insulation
- Rubber mats on floors
- Air conditioning / heating
- Lighting
- Fire extinguisher.

The electronic cabinets of the crane contain three sections. All electrical systems are powered from these cabinets.

3.2.4 Drive system cabinets

This section contains the main switches and contactors, rectifier units, DC-bus, inverters for all crane movements and the reverse power handling.

The rectifiers inside the crane transform the AC power into DC power and feed it to the DC-bus. All crane movements are inverter controlled allowing step less speed variation from 0 to maximum speed. These inverters are powered by the DC-bus.

3.2.5 Power cabinets

The power cabinets (POCA) contain for example the brake lift circuits, stand-still heating and cooling fans of the E-motors, the power supply to HVAC-units, floodlights and general lighting.

3.2.6 Electrical cabinets

This section (ELCA) contains the PLC and the load monitoring system.

3.3 Power supply

To obtain a high level of redundancy the crane will be connected to the following power supplies (other configurations can be discussed):

3.3.1 Main power supply

To establish redundancy in the crane power system, the crane is connected to two redundant power supplies: each supply providing 50% of the power needs. In case one feeder or rectifier is down, the crane can still operate at half speed and full load. 12p transformers might be required to reduce the amount of harmonic distortions in the vessel switchboard. Harmonic distortions are due to the relative large power consumption of such cranes. The crane power supply is 6.6 kVAC / 60 Hz.

3.3.2 Auxiliary power supply

Auxiliary power supply feeds the crane auxiliary like ventilation fans and A/C units. One auxiliary 100% redundant power supply of 3 phase 440 VAC / 60 Hz is required. This power supply must be redundant for crane redundancy.

3.3.3 Emergency power supply

The crane shall be connected to an emergency generator for safe evacuation of the crane in case of a total black-out: 3ph 230 VAC / 60 Hz feeding the Crane Monitoring System and (evacuation) lighting.

3.3.4 Uninterrupted Power Supply

A UPS is provided to maintain power on the control system in case of a power failure during a limited time.

3.4 Control system

3.4.1 Control cabin

The crane is equipped with a control cabin mounted on the side of the slew platform.

Figure 3: Operators cabin (typical)

The control cabin is outfitted with the following items:

- Control panel
- Swivelling operator chair with crane controls integrated in the arm rests
- An additional chair for supervisor or instruction purposes
- Crane capacity monitoring screen
- Repeater monitor (read-out only) of capacity monitoring screen other crane
- Dedicated CAT-6 Ethernet connection with outlet box in the crane cabin. The inlet box for this connection will be at demarcation level
- CCTV: camera-display system with 5 camera's (+ 1 optional camera):
  - 2 camera's with view on main, boom and whip hoist winches
  - 1 camera with view on sling hoist winches
  - 1 swivelling camera in boom head with zoom function
  - 1 camera on the slew platform with pan and zoom function
  - 1 camera with view on deepwater system auxiliary hoist (optional)
- Heating, ventilation and AC-system
- Smoked safety glass windows
- Sunscreens
- Window wipers on top and front shield
- Protective cage
- Walkways around for window cleaning
- Fire extinguisher
- Deck horn
- Wind speed meter
- 1 x Fixed VHF/FM, UHF/FM Marine radio (with foot switch operated)
- 2 x VOIP telephone or analogue telephone
- 1 x RJ-45 or equivalent wall outlets (with anti dust hatch)
- 6 x PAGA loudspeaker (2x inside cabin, 2x inside winch room, 2x inside E-room)
- 3 x Fire detector and 3x manual call point
- 1 x UHF, VHF antenna
- Display load master information from control system.

3.4.2 Safety features

The in house developed control system of the crane is based on a Siemens PLC. Sensors are mounted throughout the crane provide information to the PLC regarding crane loading condition and crane status. The control system prevents unintentional overloading of the crane and other situations which may cause damage to the crane and/or the load in the crane. For example the following safety features are included in the system:

- Overall overload protection (combination of loads in main hoist and whip hoist tackles and the radius at which the crane operates)

- Overload protection of hoists
- Over speed detection on each hoist
- Slack rope detection on hoist winches (not on load tuggers)
- Geared cam limit switches on all winches. The geared cam limit switch is preset on the pre-highest position of the hook. As soon as the hook passes this pre-limit switch the hook speed is reduced until the hook reaches the limit switch. Also the lowest position of the hook is preset in the geared cam limit switch.
- Highest position limit switch
- Brake release sensors
- Slipping brake detection
- Electro-motor over-temperature protection.
- A boom hoist limiter or shutoff is provided to automatically stop the boom hoist when reaches a pre-determined high and low angle
- Boom stops are provided to resist the boom from falling backwards
- Emergency buttons are available on several locations.

All sensors are failsafe. This means if an electrical failure occurs in a sensor, the control system will notice there is no signal and issue a warning. The crane operator is prevented to operate the associated function and the crane will go to a safe state.

3.4.3 Anti-collision system

An anti-collision system for the booms of both cranes will be provided. This system prevents slewing into area's where a collision can occur between both booms. The system will use the data of the boom angle and the slew angle of both cranes. The position of the lower blocks will not be taken into account.

3.4.4 Crane monitoring system

The used crane capacity is displayed on a monitor in the crane cabin as shown in figure 3. This will show the relevant capacity curve for the main hoist, auxiliary hoist and whip hoist. The actual loading condition of the crane is shown in relation to the crane capacity curves, e.g. load in the relevant hoist and radius at which it is lifted.

Figure 4: Operator's main display (typical)

3.4.5 Remote access system

The crane will be equipped with a remote access system. This system allows Huisman engineers to monitor the crane operation in real time and to trouble shoot if necessary from our office, by using the vessel's communication system to connect to the main office in the Netherlands.

3.4.6 Data logging

A data logging system which stores the sensor measurements with a date-time stamp is installed. This system is useful for later reference and for failure analyses.

3.4.7 Uninterrupted Power Supply

An UPS is provided to maintain power on the control system in case of a power failure during a limited time.

3.4.8 Motion Sensor

To determine the motions of the boom top / tip a Motion Reference Unit (MRU) will be installed inside the crane pedestal of each crane. On basis of this the control system of the crane will determine the boom tip motions. These motions will be displayed in the control cabin.

3.4.9 Boom angle indicator

A mechanical boom angle indicator will be installed on the boom base section. The indicator will be readable from the control cabin.

3.4.10 Interface with vessel

The crane and the vessel will exchange information via the Vessel Control System (VCS). An Ethernet, profibus or modbus connection between the crane and VCS will be available inside the E-room of the crane. Information provided by the vessel to the crane will be displayed in the crane cabin, for example the load master (ballast system). Information provided by the crane such as revolving angle, revolving speed, load radii, boom angle, power consumption, temperatures of main transformers, etc. will be send as an output to the VCS.

3.5 Steel structure

The steel structure of the crane house is an all welded plate construction. Material will be certified. Welding and NDT is done by certified welders and NDT operators. Shafts are made of high alloy steels. All shafts are secured in position by locking plates.

Proper corrosion protection is provided by coating all steel except inside completely closed structures. Coating according the below paint system.

3.5.1 Corrosion protection

Corrosion protection of all steel components is provided, except for the inside of completely closed structures, according the following paint system:

Pre-treatment	Dry film thickness
Blasting Sa 2.5	
Shop primer	15 micron

Exterior Paint Type	Dry film thickness
1 coat Jotacote Universal	150 um
1 coat Jotacote Universal	150 um
1 coat Hardtop AS	50 um
Total Dry Film Thickness	350 microns

Interior Paint Type	Dry film thickness
1 coat Jotacote Universal	125 um
1 coat Jotacote Universal	125 um
1 coat Hardtop AS	50 um
Total Dry Film Thickness	300 microns

The colour of the topcoat is to be determined. Huisman recommends a light colour; yellow or white.

3.5.2 Lighting

General lighting using 230V, 2 x 36W FL lights is provided:
- Along the access on and to the slew platform
- Internal spaces in machinery rooms
- At the control cabin.

Flood lights of 400/1000/2000W will be installed on the crane for better visibility during the night. Three aircraft warning lights will be installed near the top of the mast (pitch 3 x 120°) and one on top of the fly-jib. The flood lights on the boom are mounted on a swivelling construction to keep them self-leveling.

3.5.3 Maintenance

The required maintenance will be specified in the manual that is delivered with the crane. Grease lines are centralized as far as practical. A drawing showing all locations where greasing is required will be provided in the manual.

Above the machinery inside the slewing base lifting points are provided. With chain tackles equipment, such as E-motors and gearboxes, can be replaced. Gearboxes and E-motors can be removed through a single door (e.g. winch drums cannot be removed).

The slew system can be cut-off from the cabin during maintenance.

3.5.4 Spare parts

The delivery of two years operational spare parts and special tools according to attached lists are included in the scope of supply.

Seller takes charge of commissioning work and will provide a commissioning spare part list, based on Seller's experience, for review to Buyer within 3 months before start of commissioning.

3.5.5 Access

Access is provided as indicated on the drawing. It consists of either painted or galvanized carbon steel cage ladders, stairs and walkways. Access is provided to all locations that require regular inspection or maintenance, except for the upper blocks. Proper access from the boomrest is a requirement to fully inspect and maintain the crane's upper blocks.

In case of fire inside the crane the operator can leave the control cabin and return to vessels deck without entering the crane.

3.5.6 Mechanical ventilation

The cranes are equipped with a mechanical ventilation system suitable for a minimum refreshment rate of six (6) times the internal crane volume per hour. Fresh air for the mechanical ventilation is to be provided via the hull (yard supply approx. 60,000 m^3/hr/crane).

3.5.7 FAT testing

The various functions of the crane will be tested (as far as practical) at our facility, prior to delivery. During this Factory Acceptance Test (FAT) the following items are tested as a minimum:

- Function tests of frequency drives
- Function tests of winches and slew drives
- Testing under load of slew drives
- Load testing of winch drives (only for winches with multiple drive motors)
- Testing of brake systems (as far as practical)
- Control system components.

The load test has to be done after the crane has been installed on board of the vessel.

3.6 Parts

The crane will be delivered in one major piece. The 12-pulse transformers will be delivered as a loose item.

3.7 Certificates

Class certificates as per Class requirements shall be provided. Factory acceptance test report (including punch list) shall be provided.

3.8 Dynamic factor according EN and API

Below tables are given illustrating the dynamic factor as function of the SWL and Hsig according EN and API. These calculations are based on a main hoist radius of 27m with the hook 25m below pivot level. Assured must that the Sidelead and Offlead are kept within the limits defined according the technical specification, namely 3° Sidelead and 1° Offlead (incl. 1° heel/trim).

SWL [mt]	1000	1200	1500	1800
Hsig [m]				
0.3	1.13	1.12	1.10	1.10
0.5	1.20	1.18	1.16	
1.0	1.36	1.33	1.29	
1.5	1.50	1.46		
2.0	1.63	1.58		
2.5	1.76			

Dynamic factors according EN-13852 (simplified calculation method Annex B1)
Crane mounted on semi-submersible according EN
SWL lifted from barge according EN
Lifting speed Vc = 3.8 m/min
Crane stiffness = 35000 kN/m.

SWL [mt]	1000	1200	1500	1800
Hsig [m]				
0.3	1.13	1.12	1.10	1.09
0.5	1.20	1.18	1.16	
1.0	1.38	1.35	1.31	
1.5	1.57	1.52		
2.0	1.76			
2.5	1.97			

Dynamic factors according API-2C
Crane mounted on semi-submersible according API
SWL lifted from moving vessel according API
Lifting speed Vc = 3.8 m/min
Crane stiffness = 35000 kN/m.

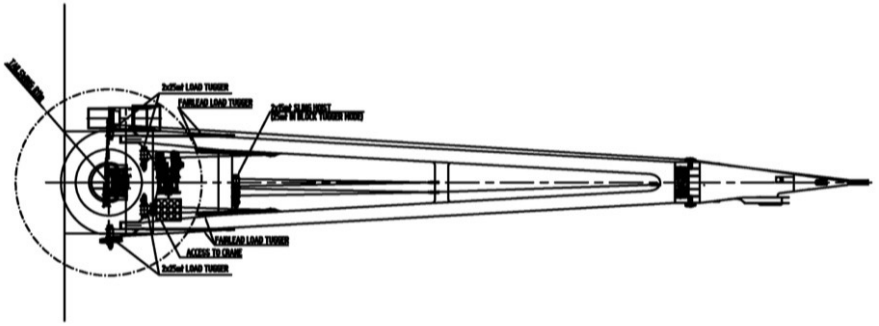
SWL [mt]	1000	1200	1500	1800
Hsig [m]				
0.3	1.06	1.06	1.05	1.05
0.5	1.09	1.09	1.08	1.07
1.0	1.17	1.16	1.14	
1.5	1.25	1.22	1.20	
2.0	1.32	1.29	1.26	
2.5	1.40	1.36	1.32	

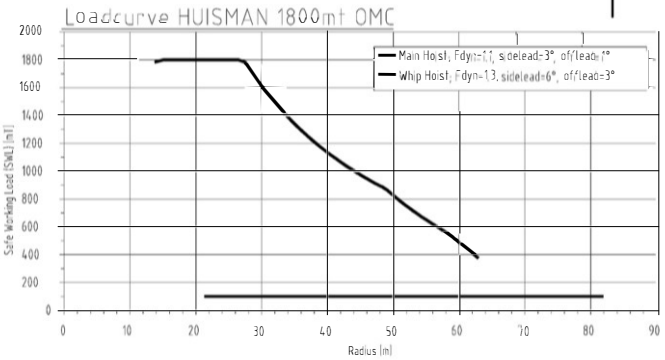
Dynamic factors according EN-13852 (simplified calculation method Annex B1)
Crane mounted on semi-submersible according EN
SWL on fixed platform according EN
Lifting speed Vc = 3.8 m/min
Crane stiffness = 35000 kN/m.

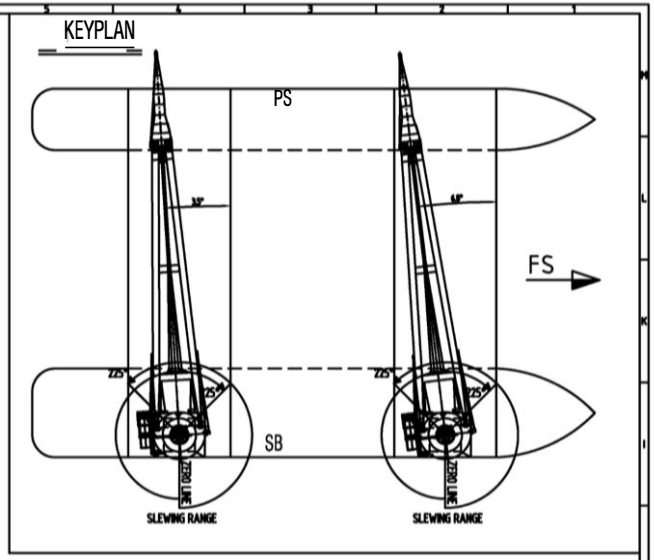
SWL [mt]	1000	1200	1500	1800
Hsig [m]				
0.3	1.02	1.02	1.02	1.02
0.5	1.03	1.03	1.03	1.02
1.0	1.07	1.06	1.06	1.05
1.5	1.13	1.12	1.11	1.10
2.0	1.22	1.20	1.18	
2.5	1.33	1.30	1.27	

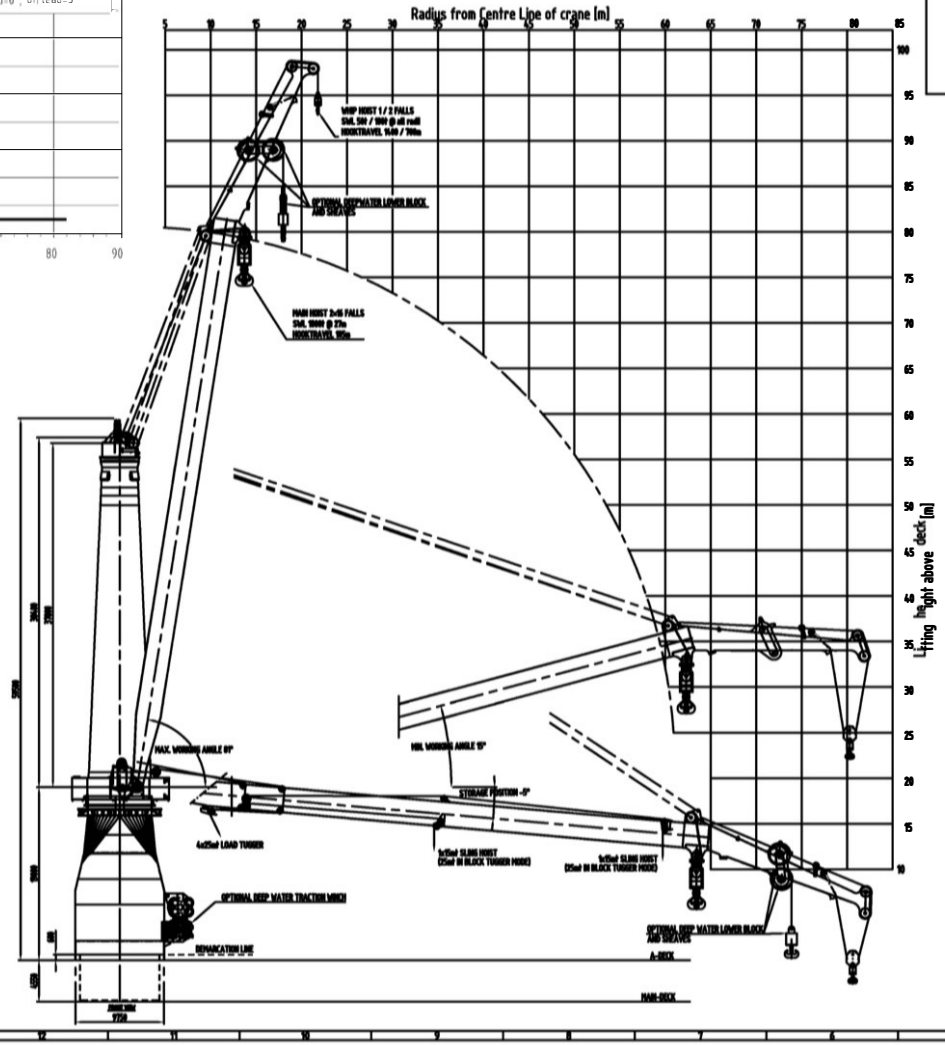
Dynamic factors according API-2C
Crane mounted on semi-submersible according API
SWL on fixed platform according API
Lifting speed Vc = 3.8 m/min
Crane stiffness = 35000 kN/m.

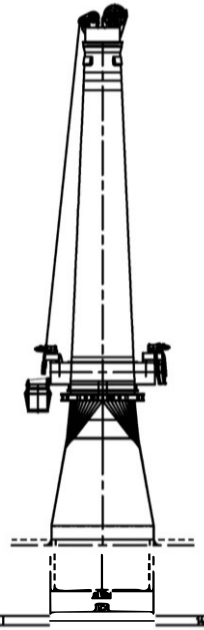
Appendix 2 General Arrangement-1800t crane




Loadcurve HUISMAN 1800mt OMC
Main Hoist, Fdyn=1.1, sidelead=3°, offlead=1°
Whip Hoist, Fdyn=1.3, sidelead=6°, offlead=3°
Safe Working Load (SWL) [mt]
Radius [m]


KEYPLAN
PS
FS
SB
SLEWING RANGE
SLEWING RANGE


Radius from Centre Line of crane [m]
Lifting height above deck [m]
WHIP HOIST 1 / 2 FALLS
MAIN HOIST 2x4t FALLS
4x25ton LOAD TUGGER
OPTIONAL DEEP WATER TRACTION WINCH
OPTIONAL DEEP WATER LOWER BLOCK AND SHEAVES
REPARCATION LINE
A-DECK
MAIN DECK



Appendix 3 Deviation list to the specification

DEVIATION LIST TO THE SPECIFICATION

Project: DP3 SSCV

No.	Specificat	Specification requirement	Contractor's comment/proposal	Yard/owner comment	Remark
1	Chapter 1.2 (1.2.1,1.2.2,1.2.3,1.2.4), page 3～6/82	NATIONALITY, CLASS, FLAG & NATIONALITY, REGULATIONS	Cranes designed and certified according: "Lloyd's Register of Shipping, Code for Lifting Appliances in a Marine Environment, 2009". Other rules not applicable for the crane.	Follow crane sepc	Technical specification A08-10400-S1 Rev T
2	Chapter 2.1, page 8/82	Two (2) Main Cranes shall be built and installed. Each crane (structure, fittings and rigging), and corresponding Vessel supporting hull structure, must be designed to lifting 1,800 MT revolving single and in tandem under minimum sea state corresponding to significant wave height 2,5 m. The motion effect (as mentioned in Motion Analysis Report from YCRO) of the vessel under the wave height of 2.5m should be considered in crane design.	First of all is not very realistic that the operator will lift 1800mt or 2x1800mt with a Hsig of 2.5. When considering loads with such SWL they will in general be quite expensive limiting the risk of damaging such expensive items, they will in general be lifted only during very mild conditions. Also constructing a crane that will be able to lift 1800mt with a Hsig of 2.5 will make it very heavy and expensive where in reality this is not required. During the detailed design of the crane HE will make supply boat curves which are depending on the type of lift, Hsig and RAO's. The SWL will be downgraded for these curves.	As advised by both side CEO, Crane SPEC. REV T will be followed, but Huisman will calculate and reply the max. wave height the crane can operate to Yard and charter for confirmation. Yard will reply to charter to confirm this in the vessel SPEC.	Max. wave heights, according to simplified calculation methode EN-13852-2 and API, are indicated in article 3.8 of Technical Spec. Rev. T
3	Chapter 2.1, page 8/82	Motors shall be of squirrel cage induction type of IEC standard frame designed for 440 V, 3 phases, 60 Hz, except for the small motors (less than 10kW) may be AC 230V single phase or 3 phase type	Motors shall be of squirrel cage induction type of IEC standard frame designed for 690 V, 3 phases, 60 Hz, except for the small motors (less than 10kW) may be AC 440 or 230 V single phase or 3 phase type.	Follow Huisman	

4	Chapter 2.1, page 8/82	The coil design of the electric motors shall be suitable for direct starting on the board net.	Not possible. Used drives are Variable Frequency Drives (VFD).	Follow Huisman	
5	Chapter 2.1, page 8/82	Motors shall be rated for continuous full load duty	The main, boom, auxiliary and whip hoist motors are S1 class. The tuggers motor are S3 class.	Follow Huisman	
6	Chapter 2.1, page 8/82	Maximum significant wave height for Parking position using a 250 MT padeye is governed by the longitudinal acceleration, which restrains Parking in max. significant wave height of 6.2 meters. Using a 150 MT padeye the maximum significant wave height is governed by the transverse acceleration, which restrains Parking in max. significant wave height of 5.7 meters.	Max. longitudinal acceleration (perpendicular to boom) Approx. 0.1 [G] Max. transverse acceleration (longitudinal with boom) Approx. 0.2 [G] Boom angle (above horizontal) 78 [°] Boom parking position is in transverse direction (from SB towards PS) No load is suspended in the hoists; main, auxiliary and whip hoist lower blocks will be connected to a putting on the A-deck to pretension the boom. Accelerations on COG of the boom; accelerations include static inclination and dynamic acceleration.	Follow Huisman	