1 TECHNICAL DESCRIPTION:

1.1 GENERAL INTRODUCTION:

The HYDRAMARINE HMC 3568 LKO 250-32 (750-20) (1000-15)(1500-10)(100-33) AHC offshore / sub sea knuckle jib deck crane is designed for long time operation and stowing in a tough and corrosive offshore marine environment. The crane is designed with major structural and mechanical over capacity for heavy offshore / sub sea operation on open deck of offshore vessel and for safe stowing on aft deck of such vessel. The crane is designed with a general crane dynamic factor of 1.4 and a pedestal / slew ring / fasteners is designed with dynamic factor of 2.0 according to DNV requirement for offshore crane.

The crane is designed for efficient and accurate offshore/sub sea load handling of general cargo at max. 32 / 33 meter working radius. The jib has a hydraulic knuckle jib with a length of approximately 15 meters giving the crane good operation capabilities under rough operation conditions (low pendulum height under offshore lifting operations).

The crane is equipped with an active heave compensation system on main and auxiliary winches making the crane able to launch and retrieve loads at seabed, with practical no relative heave motion on the load related to seabed. The heave compensation system is an active system based on direct winch compensation.

The crane is delivered as a complete, fully painted, fully pre-assembled and function tested unit, adjusted and ready for installation onboard vessel by Hydramarine, and in accordance with our procedures. The crane is delivered as a complete unit, fitted with pedestal for easy installation at vessel. The crane is a complete, hydraulic operated, independent, self contained unit.

The crane is operated from the fully insulated operator’s cabin on the rotating part of the crane itself. All selected equipment is chosen and installed to ensure the lowest possible emission of sound and for good access for service and repair.

1.2 CONSTRUCTION, MAIN DESIGN:

1.2.1 CRANE PEDESTAL INCL. EQUIPMENT FITTED IN PEDESTAL:

The crane pedestal consist of one deck foundation of circular top and low end, equipped with bolting flange in upper end and welding edge in lower end for hook-up to the vessel. The pedestal has a total height of 5,0 m. The pedestal contains the vertical mounted electric slip ring for transfer of all electric supply to the rotating part of the crane.

Electric interconnection from vessel system to be done at junction box on the slip ring.

The electric main motors with their hydraulic pumps and the oil tank are located in the above located rotating king. The upper part / outside of the pedestal is equipped with a top mounted ring platform, mounted approx. 2 m below the foundation top, ensuring access to crane in all positions. Access to this platform is done by a ladder with safety frame fitted. A hinged access door is fitted in lower part of the pedestal for access inside pedestal. The inside of the pedestal is equipped with access ladder and cable supports for easy termination and inspection/maintenance.

A Slip ring unit:

The electric slip ring transfer all electric power and other communication signals to the rotating part of the crane. The slip ring is enclosed and mounted in suspension inside the crane foundation, in centre, just below the slew bearing. The slip ring is stationary since its rotating part extends into the rotating part of the crane, through the crane centre. Cable tray for power supply cables are fitted inside the crane pedestal. Access ladder and platform for inspection of the slip ring is fitted inside the crane pedestal. A separate control power circuit is fitted to allow motor space heater, heli-light and other cabin functions to be active even when main power supply to crane is switched off (main switchboard). The slip ring assembly is equipped with space heater to avoid humidity during long time standstill.
1.2.2 CRANE KING INCL. EQUIPMENT FITTED IN KING:
The rotating crane king is installed on top of the rotating slew bearing. The king acts as the main structural
element between the pedestal and the jib system. Both luffing cylinders are connected to the lower part of the
king while the inner jib is connected to the top of the king by spherical bearings. The king structure houses the
hydraulic oil reservoir and general machine room where most control valves are fitted. Access to this machine
room is ensured by a hinged door at cabin side. The maneuvering platform structure with the operator’s cabin
is fitted at right hand side of the crane king.
A set of internal fitted, fully integrated slew gears are fitted to the king, with its output pinions in conjunction
with the inner geared slew bearing ring. Each slew gearbox has built in failsafe brakes and each are fitted with
an axial piston motor of variable displacement.

A Electric motors with motor starters:
The electric power is supplied from the slip ring (rotating side) to the electric motor starter cabinets
mounted inside the king engine room. The electric motors are connected to the cabinet. The electric
main motors (four identical main motors and one circulation/cooling motor) are mounted inside the
crane king, outside the oil reservoir. The electric motors are all equipped with a heating element which
reduces its moisture level during long time standstill. Motors are delivered with DNV certificate (part of
the Data Book documentation).

B Hydraulic oil tank/hydraulic pumps:
The hydraulic oil tank of required capacity is integrated as part of the rotating crane king structure.
The hydraulic main pumps is of high pressure, low noise variable displacement type and is mounted
on flexible dampeners outside the oil tank, to reduce the noise level to an absolute minimum. The tank
is equipped with visual oil level indication glass, (visual from the outside of the king) breather filter, oil
filling filter, and a drain valve for use when changing oil and cleaning of the oil tank.

Both oil level and oil temperature sensors are measuring the hydraulic oil status continuously and will
give information to the crane operation if any abnormal value is registered. Access to tank is possible
through inspection hatch in side of crane king.

Total oil volume in reservoir is approx 6000 liters (plus oil in system loops, ~1500 liters)

C Hydraulic Filter system:
A well dimensioned oil return filter system is installed in the system to remove any impurities from the
hydraulic oil returning from the system to the tank. A well dimensioned separate oil filter is installed in
a separate circulation system to remove any contamination in hydraulic oil, continuously, when the
crane is running. Large oil/air coolers are fitted in the circulation loop to ensure low oil temperature,
even with continuously crane operation under warm conditions. The filters are equipped with visual
contamination indicators and electric switch which is connected to the control system in the crane
cabin, informing the crane operator if any abnormal value is registered. The filtration level is 5 micron
nominal and system contamination level is set to NAS class 8.

A separate offline filter type CJC are fitted in system to maintain the hydraulic oil and keep the
contamination level low, even when crane is not in use.

D Slewing gears / slew bearing:
The slew bearing is a heavy duty offshore/marine slew ring equipped with internal gearing for transfer
of the slew torque from the output pinion of the slew gearbox. The slew gear system consists of
several hydraulic driven planetary gears with built in fail-safe dynamic multidisc brakes. The brakes
are dimensioned to take the full load at the maximum list, plus any additional dynamic force acting on
the slew gears. In the case of hose or pipe failure, the brake blocks the slewing immediately. A heavy
duty hydraulic motor is flanged onto each gearbox. The slew motor, which is controlled by the main
control valve, and the counter balance valve in the loop, gives smooth and accurate slewing of the
crane.
E  Operator cabin:

The crane is equipped with a well dimensioned operator cabin representing a comfortable work place for the crane operator. The cabin is equipped with one main seat and one foldable co-pilot seat for crane instructor etc. The cabin is located on right side of the crane king. The cabin is bolted to a stable steel foundation, bolted to the crane king structure. A protective steel structure is surrounding the cabin to protect this against damage if other elements hit the cabin area. The operator cabin is equipped with an ergonomic and dampened operator chair with all main operation handles of joy stick type located in armrests at side of the operators chair. Main handles are of spring centered type, winch on right hand side, jib operation (both main and knuckle jib) and slew at left hand side. The cabin is equipped with windows wipers, signal horn, internal light, air condition / heating system and houses the main cabinet for the crane control system.

A LCD screen based control system gives the crane operator all required information for both crane system status and operation. The main control system for the crane is electronic and if a crane motion shall be stopped due to action from the crane control system, the control signal is cut-off, and the actual crane motion is stopped softly. The cabin is equipped with a catwalk outside to give access for cleaning of the windows. A stereo radio/CD player is fitted. A separate LCD screen for camera monitoring of winch drums is fitted near operator.

All cabin windows are equipped with roll screens, fitted to window mounted rails, to protect the crane operator against direct sunlight. The screens are adjustable. Several of the windows are equipped with opening systems. The operator cabin is fitted with an effective fire extinguisher according to regulations. The operator cabin fulfills noise and working environment requirements set by the authorities.

F  Communication system /ROV monitor signals:

The crane cabin is equipped with a VHF/UHF radio. The crane slip ring has available 6 extra slip rings for connection of vessels intercom system or ROV monitor transfer. Available signal lines are terminated from cabin to junction box in pedestal.

G  Extra Information panel for vessel installation:

The crane is delivered with a separate LCD panel for remote monitoring of crane status and selected data. This panel may be installed in suitable vessel location according to diagram delivered by Hydramarine.

1.2.3  WINCH SYSTEMS:

The crane is equipped with two separate winch systems, one main winch fitted on aft part of crane king, and one auxiliary winch fitted on the crane boom. The main winch skid is mounted in the upper/aft part of the king structure. The winch skid houses the main winch and all associated equipment including accumulators etc for the Active Heave compensation system.

Both winches are monitored from the crane cabin, on a separate LCD screen, with respect to wire spooling etc.

A  Main Winch System:

The main winch consists of a steel drum with a flanged on gear-ring, one on each side of the winch drum. Drive gears on each side, each driven by a variable displacement hydraulic motor, are fitted. The gear boxes are all fitted with a fail-safe multidisc brake. The brakes are dimensioned to take the full load plus any additional dynamic forces acting on the winch. In the case of a hose or pipe failure, the brakes block the load immediately. A set of counter balance valves are mounted in the winch loop ensuring smooth and accurate winch operation independent of winch load.

The winch is equipped with a galvanized, none rotating, high quality sub sea wire rope and a sub sea counterweight/swivel/hook block of required capacity. The winch system is equipped with an electronic hook stop system, part of the integrated control system. Line load monitoring is possible through a redundant load cell fitted in one of the wire sheaves.
The main winch is equipped with an AOPS (Automatic Overload Protection System) and MOPS (Manual Overload Protection System) system in accordance with latest regulations (EN 13852-1) and recommendations from DnV.

Emergency lowering and hoisting of winch is also possible by use of the main power independent “Emergency power system”, which is part of the crane delivery. (Separate procedures will be included for use under such situations).

The winch is also equipped with a high speed auto-tension system with adjustable tension setting. Both activation (on/off) and tension setting (step-less) is done by operator from crane cabin.

B Main winch unit - Active heave compensator system:

The main winch is equipped with an active heave compensation system (AHC) including constant tension system which can be used to land/retrieve on/from the seabed. The active heave compensation is a pure compensated boost type and compensates the jib tip resulting heave motion, by giving out/hauling in rope, as a pure position controlled system.

The MRU (Motion Reference Unit) is located in crane king machinery room and measures the vessel heave, pitch and roll motion in that particular position. Based on this information the crane computer system calculate the resulting crane tip heave motion/speed, in any crane tip position, and a set of servo valves will compensate this resulting heave by giving out/hauling in wire from the drum directly. A simple, reliable and very accurate system.

C Auxiliary winch:

The auxiliary winch consists of a steel drum with two flanged on planetary gearboxes, each driven by fixed displacement hydraulic motors. The gear boxes are fitted with a fail-safe multidisc brake. The brakes are dimensioned to take the full load plus any additional dynamic forces acting on the winch. In the case of a hose or pipe failure, the brakes block the load immediately. A counter balance valve is mounted in the winch loop ensuring smooth and accurate winch operation independent of winch load.

The winch is equipped with a galvanized, non-rotating wire rope and a subsea rated counterweight/swivel/hook block of required capacity. The winch system is equipped with an electronic hook stop system, part of the integrated control system.

The Auxiliary winch is designed and built for man-riding operations with capacity up to 5,0 tons (MR 50) according to valid rules and regulations.

The Auxiliary winch is equipped with an AOPS (Automatic Overload Protection System) and MOPS (Manual Overload Protection System) system fully in accordance with latest regulations (EN 13852).

Emergency lowering and hoisting of winch is also possible by use of the main power independent “Emergency power system”, which is part of the crane delivery. (separate procedures will be included for use under such situations).

The winch is also equipped with a high speed auto-tension system with adjustable tension setting. Both activation (on/off) and tension setting (step-less) is done by operator from crane cabin.

D Auxiliary winch unit - Active heave compensator system:

The Auxiliary winch is equipped with an active heave compensation system (AHC) including constant tension system which can be used to land/retrieve on/from the seabed. The active heave compensation is a pure compensated type and compensates the jib tip resulting heave motion, by giving out/hauling in rope, as a pure position controlled system.

The MRU (Motion Reference Unit) is located in crane king machinery room and measures the vessel heave, pitch and roll motion in that particular position. Based on this information the crane computer system calculate the resulting crane tip heave motion/speed, in any crane tip position, and a set of
servo valves will compensate this resulting heave by giving out/hauling in wire from the drum directly. A simple, reliable and very accurate system.

### 1.2.4 CRANE JIB SYSTEM:

The crane jib consists of one hydraulic operated luffing main jib section and hydraulic operated Knuckle jib section. Both jib elements are built of plate elements, steel profiles and hollow sections. The inner main jib is connected to the king structure by two main bearings in at top of the king and to the rod bearing of the cylinders in the lower end. The knuckle jib section is supported to main jib outer end by two bearings in the inner end, and two hydraulic cylinders in the lower end. The knuckle jib is hydraulic operated by two heavy duty cylinders especially made for knuckle jib operation. The main jib section are also hydraulic operated by two double acting, heavy duty marine cylinders with integrated counter balance valves. All cylinders are connected to the jib system with spherical bearings. A set of wire sheave brackets, for transfer of each wire rope from inner mounted winches to outer end of the knuckle jib, is installed in the outer end of the main and knuckle jib section.

**A Jib luffing cylinders: (Main jib and knuckle jib cylinders)**

The crane is equipped with two high quality luffing cylinders and two knuckle jib cylinders, built especially for use in the marine environment. The cylinder piston rod is made in high grade steel material and chrome plated to first class marine quality in order to obtain improved protection against corrosion.

A load holding valve is mounted direct to the cylinder to maintain a constant luffing speed independent of hook load and to block the jib in case of a hose/pipe failure.

**B Jib Floodlight:**

The outer crane jib is fitted with two pendulum suspended 400W each, Heavy duty Marine floodlights.

**C Helicopter warning light:**

The top of the winch and the fwd part of the inner jib is fitted with red helicopter warning lights to indicate crane position during work under dark conditions.

**D Crane parking cradle system:**

Hydramarine will supply client with drawing of the upper part of the jib cradle, incl. forces and recommended position. Crane jib cradle will be arranged by the client.

### 1.2.5 HYDRAULIC SYSTEM:

The crane king houses the oil reservoir for the hydraulic oil and the hydraulic main pumps are mounted on rubber flanges, outside the tank, for low noise operation. The hydraulic pumps are of low noise variable displacement type operating in Load Sense mode (LS mode). The crane has four main pumps and one circulation pump. In addition a separate “emergency pump” with only 50 kW installed capacity, is fitted to allow emergency operation of all crane functions, in case of main power black out. The Emergency power pack may be supplied from the emergency generator onboard.

The four identical main pumps are driven by identical electric motors. All pumps are feeding hydraulic power into a common control valve system distributing the power to the actual crane motion, based on signals from the crane control system.

This means that the power pack system is redundant as only one pump can run the entire crane, full capacity, reduced speeds. The main hydraulic control valve is a pressure compensated, servo hydraulic operated type and it is installed inside the king engine room. Hand operated servo pilot valves of joy stick type are installed at the operators chair inside the crane cabin. The control valve is electro-servo-hydraulic operated from cabin. The main control valve divides oil out to each actual crane motion dependent of servo pilot lever position. When no lever is operated, the oil pressure stops at the main control valve and the variable pumps de-stroke to zero flow. As soon as one lever is operated, a stepless variable oil flow is directed out to the actual crane motion, giving the motion the required speed.
The hydraulic system is fitted with a separate filtration/cooling pump that ensures full filtration and cooling capacity, even when crane is operated at creep speed for a long time. This is necessary since both main pumps are of variable displacement type and they will de-stroke and give out oil only according to required crane operation. The circulation/filtration circuit ensures a constant filtration / cooling performance, under all crane operational modes. Large electric fan driven oil/air coolers are fitted in aft part of the crane king.

As a result of the pressure compensated control valve system, each crane motion may be operated simultaneously and the control performance is not dependent of variations in actual crane load. Both hydraulic oil level, hydraulic oil temperature, filter status and operation pressures are all general data available on the control panel in the operator cabin. Any abnormal values will result in visual/audible alarm in the crane cabin.

A separate CJC offline filter is fitted in hydraulic system to improve hydraulic oil quality, even when crane is not in use.

### 1.2.6 CONTROL SYSTEM:

The basic crane control is electronic and joy sticks are integrated into operators chair in the crane cabin. All safety functions are cutting off the control signal for the decided motion, upon signals from the crane control system. The control system cabinet is mounted inside the crane cabin and is based on an industry standard PLC system. The control system has a large LCD screen for control and monitoring of all crane functions. The LCD panel is illuminated to ensure excellent reading under all conditions. Load information is shown as analogue bar charts in the graphic display while pay-out lengths are shown as digital information.

The control system receives information from the following heavy duty marine field sensors,

- Knuckle jib position
- Main jib position
- Main hook position (depth/payout)
- Auxiliary hook position (depth/payout)
- Load cell in auxiliary wire
- Load cell in main wire
- Hydraulic oil temperature
- Hydraulic oil level
- Oil filter contamination indication
- Temperature inside electric motors
- MRU (Motion Reference Unit)

Start/stop of main pumps and circulation system, is also done from the operators cabin.

The crane cabin / crane system is equipped with audible and visual alarms according to DNV class requirements.

### 1.2.7 LOAD DIAGRAMS: (FOR OPERATION LIMITATIONS UNDER OTHER WORKING CONDITIONS)

The crane is designed acc to DNV lifting appliances and has overload protection systems exceeding the requirements in this standard. (AOPS & MOPS systems)

The crane will be delivered with a LOAD DERATING TABLE collection, describing alternative SWL under other working conditions than the base case conditions (other specific conditions etc). These tables are part of the crane delivery.

### 1.2.8 SAFETY SYSTEMS:

The crane is fitted with the following safety systems:
A Emergency stop:
An emergency stop is fitted near the operator's cabin and at outside of crane pedestal, if this button is activated, the main pumps will be stopped.

B Spring centered control valves:
All control levers, separate and joy stick type, are spring centered. In order to operate the crane the relevant control lever has to be pushed in the required direction to cause the desired motion. Once the lever is released it will return back to centre position, and the activated motion will cease immediately.

C Crane overload protection:
All crane motions are protected against overload by the control system and the continuously measured line loads and boom position information in the crane computer system. In addition, on top of this safety system, overload is not possible due to setting of the hydraulic relief valves. If a particular motion is tried undertaken which exceeds the load for which the crane is designed, and the control system safety system does not work, the relevant relief valve, for the particular motion, will feed the hydraulic oil back into the hydraulic oil tank. Hence, the crane motion can not be undertaken.

D Load capability system:
The crane control system has all information about working radius and working conditions. Based on this, the system will indicate on the graphic display, how much load that can be handled safely and also show the actual static and dynamic load. If the operator tries to exceed the limits programmed in the system, the crane motion will stop and the operator will be corrected by the graphic display. The crane operator will be informed and have always the possibility to operate crane to a better position (better = less load intensive for the crane)

E Hook stop system: (Both main and aux. winch)
The winch systems are both fitted with an electronic hook stop system. This system is based on a tachometer on the winch giving signals to a set of by-pass valves in upper and lower hook position.

F Luffing cylinder limitation:
The hydraulic cylinders for luffing of the crane jib are fitted with a mechanical stroke limitation.

G Load holding brakes:
The hydraulic cylinders for luffing of the crane jib sections is fitted with pilot operated load holding valves. The valves are mounted direct to the cylinder ports and have a dual function:

1. Maintaining the luffing speed at a constant value independent of the load
2. Blocking the cylinder motion in the case of hydraulic pressure loss. This will freeze the cylinder in the case of hose or pipe failure.

H Fail safe brakes:
Both the winch and the slew gearboxes are fitted with hydraulic operated, oil submerged, failsafe, and multidisc brakes. In the case of hydraulic pressure loss due to hose/pipe failure, the brake will be automatically applied a cease the relevant motion.

I Helicopter warning light:
The top of the inner jib and the aft winch skid is fitted with a red helicopter warning light to indicate crane during dark working conditions.

J Emergency Pay out function:
The main winch and auxiliary winch is equipped with an AOPS (Automatic Overload Protection System) and MOPS (Manual Overload Protection System) system fully in accordance with latest regulations (EN 13852) and recommendations from DNV/NPD.

K Emergency operation:
The winch and other crane functions will be able to run under main power failure by the built in emergency power system, supplied from the emergency generator system onboard.
1.2.9 SPECIAL TOOLS:

A Pressure test instruments:
A set of pressure test manometers is delivered ready for connection to the many pressure test takeoffs installed in the system.

B Wire lubricator:
A MASTO high pressure wire lubricator may be delivered as an option, for future maintenance of the crane wire ropes.
2.0 TECHNICAL SPECIFICATION:

2.1 OPERATION ENVIRONMENT:

Area classification: Safe zone
Description: Offshore/Marine environment, open deck
Operation temperature range: -20 - +45 degrees C
Max. Operational wind speed: 24 m/s
Extreme condition, survival: 44 m/s
Max list/trim conditions: 5+2 degrees
Offload angles: Acc to DNV lifting appliances

2.2 DESIGN REGULATIONS:

Design verification: HM internal, DNV as third party
Manufacturing control: HM internal, DNV as third party, DNV present at FAT
Onboard test: The client is responsible for DNV presence at the overload test onboard.

Dynamic factor: 1.4 on crane and 2.0 on pedestal/slew arrangement:
The crane is designed with a general crane dynamic factor of 1.4 and a pedestal/slew ring and king dynamic factor of 2.0 according to DNV requirement for offshore crane.
De-rating tables for other operation conditions will be provided with crane.

2.3 MAIN PERFORMANCE DATA:

MAIN HOOK LIFTING CAPACITY:
Dynamic factor \( \psi = 1.4 \) (2.0 on pedestal/slew system)

<table>
<thead>
<tr>
<th>Hook travel length:</th>
<th>2000 meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire rope included in delivery:</td>
<td>2050 m wire (2000 m net hook travel)</td>
</tr>
<tr>
<td>Max single line lift capacity:</td>
<td>SWL 1000 kN (100 metric tons) on outer lay (full drum)</td>
</tr>
<tr>
<td>Max double line lift capacity:</td>
<td>SWL 1500 kN (150 metric tons)</td>
</tr>
<tr>
<td>Hook travel length:</td>
<td>300 meters</td>
</tr>
</tbody>
</table>

Crane lifting capacity is an automatic step less function of the crane outreach with the following main capacities: (Lifting capacity on outer drum layer, full drum)

a. Lifting capacity, single line arr. SWL 250 kN (25 metric tons) at 32 meter outreach
b. Lifting capacity, single line arr. SWL 750 kN (75 metric tons) at 20 meter outreach
c. Lifting capacity, single line arr. SWL 1000 kN (100 metric tons) at 15 meter outreach
d. Lifting capacity, double line arr. SWL 1500 kN (150 metric tons) at 10 meter outreach

Lift capacity at seabed:

Winch / Crane are in base case designed for SWL 100 single line resulting crane load.
Net sub sea lift capacity to be reduced with net weight of submerged rope and net weight of submerged load.

75 ton (SWL) to 2000 meter depth giving 100 ton resulting crane load (at max 15 m radius)

Note: Sub sea lifting capacity calculated conservatively as follows:
Lifting capacity (SWL in air) + hook weight + weight of submerged rope to actual depth – buoyancy of load considered as a massive steel bar. (i.e.: 75t + 2t + (16 x 2000)/1000 – 10 t)
2.4 MAIN WINCH, OTHER DATA:

- Minimum working radius: Approx. 6.5 meters
- Main wire dimension: OD Ø64 mm
- Main wire type: Galvanized, non-rotating type
- Drum diameter, PCD lay 1: Ø 1787 mm
- Drum width: 1510 mm
- Drum barrel: LEBUS grooved

Hoisting speed, single line, 0-33 tons: Approx. 0-60 m/min stepless variable on lay 7 (Load dep.)
Hoisting speed, single line, 33 –66 tons: Approx 0-60-30 m/min stepless variable on lay 7 (Load dep)
Hoisting speed, single line, 66-100 tons: Approx 0-30-15 m/min stepless variable on lay 7 (Load dep)

(Hoisting speeds are automatic a function of load, therefore speeds are approximate values)

2.5 MAIN HOOK ACTIVE HEAVE COMPENSATION (AHC) CAPACITY, 0-50-100 TON AHC MODE:

Complete price for 50/100 ton single, active heave compensation system incl. empty hook compensation system fully installed and integrated to crane. High speed constant tension function is part of above system. Direct drum drive system.

Main Hook Active Heave Compensation (AHC) capacity,

Max top wire tension, single line during AHC: 0-500 kN (0-50 ton single line) (500-1000 kN)
500-1000 kN (50-100t) with 50% of below given speed

Performance case 1:
- Heave period: 10 sec
- Nominal displacement: +/- 3.2 m (6.4 m total motion)
- Max acceleration: 1.8 m/s²
- Max compensation speed: 2.0 m/s

Performance case 2:
- Heave period: 12 sec
- Nominal displacement: +/- 3.9 m (7.8 m total motion)
- Max acceleration: 1.8 m/s²
- Max compensation speed: 2.0 m/s

Reference system: MRU in crane control system

2.6 AUXILIARY WINCH LIFTING CAPACITY:

Dynamic factor $\psi = 1.4$ (2.0 on pedestal/slew system)

- Hook travel length: 400 meters
- Total wire: 450 meters
- Max single line lift capacity: SWL 100 kN (10 metric tons) on outer lay (full drum)
  a. Lifting capacity, single line arr. SWL 100 kN (10 metric tons) at 34 meter outreach
  b. Man riding capacity: MR 15 (SWL MR 1.5 Tons) at 34 meter outreach

2.7 AUXILIARY WINCH, OTHER DATA:

- Min working radius: Approx. 6.5 meters
- Aux wire diameter: OD Ø 26 mm
- Aux wire type: None rotating, galvanized type
- Hoisting speed: 0-100 m/min stepless variable on lay 3 for 0-10 ton
- Constant tension control: From cabin: AT on/off and tension setting
- Emergency pay out function: AOPS & MOPS acc to latest regulations is included.
## 2.8 AUXILIARY WINCH ACTIVE HEAVE COMPENSATION 0-10 TON HIGH PERFORMANCE:

Max top wire tension, single line during AHC: 100 kN (10 ton single line)

**Performance case 1:**
- Heave period: 10 sec
- Nominal displacement: +/- 3.2 m (6.4 m total motion)
- Max acceleration: 1.8 m/s²
- Max compensation speed: 2.0 m/s

**Performance case 2:**
- Heave period: 12 sec
- Nominal displacement: +/- 3.9 m (7.8 m total motion)
- Max acceleration: 1.8 m/s²
- Max compensation speed: 2.0 m/s

Reference system: MRU in crane control system

Note: Sub sea lifting capacity:
Subtract submerged wire weight from SWL, ~250 kg/m (at 400m, i.e. 1T.) add buoyancy of load.

## 2.9 SLEW SYSTEM PERFORMANCE:

- Slew sector: 360 degrees unlimited
- Max list/trim combined: 5 + 2 degrees
- Slew speed, R min to 17 m radius: 0-1.0 RPM stepless variable
- Slew speed, 15-33 m radius: 0-1.0-0.5 RPM stepless variable
- (Speed mode is automatic selectable)
- Slew Brake moment: According to class requirements
- Slew brake system: Failsafe oil submerged multidisc brakes

## 2.10 BOOM SYSTEM PERFORMANCE:

- Inner boom topping speed: Approx. 100 sec (stepless variable speed)
- Outer boom topping speed: Approx. 80 sec (stepless variable speed)
- Cylinder bearings: Fork eye on all cylinder ends, Steel spherical bearing

## 2.11 REQUIRED ELECTRIC POWER SUPPLY:

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>El. motor power, main</td>
<td>3 x 690V / 60 Hz</td>
</tr>
<tr>
<td>Main motor enclosure</td>
<td>IP 56</td>
</tr>
<tr>
<td>El. motor power consumption, max</td>
<td>3 x 300 kW (Max consumption)</td>
</tr>
<tr>
<td></td>
<td>1 x 550 kW (Max consumption)</td>
</tr>
<tr>
<td>Vessel supply circuits: (Power boards)</td>
<td>4 separate inputs, 3x310 and 1x550kW</td>
</tr>
<tr>
<td>El. motor power rating</td>
<td>S1 – 100% duty</td>
</tr>
<tr>
<td>Motor starting method</td>
<td>Star / Delta start, (Starter included in crane system)</td>
</tr>
<tr>
<td>CJC filter unit</td>
<td>1 x 0,5 kW</td>
</tr>
<tr>
<td>Rating</td>
<td>S1 100%</td>
</tr>
<tr>
<td>Starting method</td>
<td>Direct</td>
</tr>
<tr>
<td>Air / Oil cooler</td>
<td>4 x 2.2 kW</td>
</tr>
<tr>
<td>Rating</td>
<td>S1 100%</td>
</tr>
<tr>
<td>Starting method</td>
<td>Direct</td>
</tr>
<tr>
<td>Emergency unit</td>
<td>1 x 50 kW</td>
</tr>
<tr>
<td>Rating</td>
<td>S1 100%</td>
</tr>
<tr>
<td>Starting method</td>
<td>Direct</td>
</tr>
<tr>
<td>Auxiliary power supply</td>
<td>1ph/230VAC / 15kW (To slip ring for transfer to crane)</td>
</tr>
<tr>
<td></td>
<td>(For aux. functions when main power is off)</td>
</tr>
<tr>
<td>Power supply cable termination</td>
<td>At slip ring inside pedestal</td>
</tr>
</tbody>
</table>

## 2.12 OPERATION OF CRANE:

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of control system</td>
<td>Electronic servo operated control valve system</td>
</tr>
<tr>
<td>Operation location</td>
<td>Electronic joy stick levers fitted at operators chair in cabin</td>
</tr>
<tr>
<td>Control and monitoring functions</td>
<td>Siemens PLC based system with graphic user interface</td>
</tr>
</tbody>
</table>
2.13 HYDRAULIC SYSTEM:
Type of system: Load Sense System
Pump: Variable displacement axial piston pumps
Operation pressure: 320 bar max
Control valve: Electro-servo pilot operated control valve
Fitting system up to Ø38 mm pipes: "Walform" DIN 2353. Body in yellow chromate steel
Fitting above Ø38 mm pipes: Flange sys. SAE J518 and ISO6164 in yellow chromate steel
Pipe materials, external OD up to OD Ø 50mm, AISI 316 stainless steel. OD ABOVE Ø 50mm, Mild steel
Hose conn. protection return and drain pipes: DENSO tape protection

2.14 HYDRAULIC LUFFING/KNUCKLE JIB CYLINDERS:
Number of main jib cylinders: 2
Number of knuckle jib cylinders: 2
Type of cylinders: Double acting marine type
Bearings: Spherical bearings with sealing system
Cylinder rod: High grade steel material + hard chrome plated

2.15 TUGGER WINCHES, 2 OF:
Single line SWL: 40 kN (4 tons) at outer lay w 60 m on drum
Winch drum capacity: 60 m
Wire length included in delivery: 60 m
Constant tension: 0-4 ton steeples variable
Hoisting speed, single line: 0-60 m/min
Wire rope, tugger winches: Ø 16 mm
Wire output angle: Adjustable from crane cabin (+/- 30 degrees)

2.16 ELECTRIC EQUIPMENT:
External junction boxes: Stainless steel AISI 316
PG nipples in stainless cabinets: Brass / stainless steel
External junction boxes, heating: Internal space heaters fitted
External Cable trays: Stainless steel AISI 316
Position sensors, housing and support: Stainless steel, AISI 316, heavy duty design

2.17 SURFACE TREATMENT:
Crane external surfaces, including machinery room and pedestal surfaces inside:

- The external surfaces are sandblasted to Sa 2,5
- One coat of zinc epoxy primer, of 50 my dry film thickness, (Interzinc 72 or equal)
- One coat of intermediate coat, of 150 my dry film thickness, (Intershield 300 or equal.)
- One second coat of interm. coat, of 150 my dry film thickness, (Intershield 691 or equal.)
- One top coat, of 50 my dry film thickness, applied as top coat. (Interfine 990 or equal)
  TOTAL DFT: 400 my
- Top coat color crane pedestal and king: RAL 9010 White

Oil reservoir on inside: Special paint system for oil tanks
Galvanized steel:
One coat of Intergard 269, 40 my dry film thickness.
One coat of Interthane 990, 50 my dry film thickness.
Stainless steel details:
Piping, cable tray and junction boxes: Untreated
### 2.18 WEIGHT OF COMPLETE MAIN ELEMENTS AND TOTAL COMPLETE CRANE:

<table>
<thead>
<tr>
<th>Pos:</th>
<th>Unit:</th>
<th>Unit weight: (Complete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Foundation:</td>
<td>17 tons</td>
</tr>
<tr>
<td>B</td>
<td>King structure:</td>
<td>38 tons</td>
</tr>
<tr>
<td>C</td>
<td>Main jib:</td>
<td>31 tons</td>
</tr>
<tr>
<td>D</td>
<td>Outer jib:</td>
<td>16 tons</td>
</tr>
<tr>
<td>E</td>
<td>Complete winch skid incl. 2050 m wire</td>
<td>~90 ton</td>
</tr>
<tr>
<td>F</td>
<td>AHC system</td>
<td>12 ton</td>
</tr>
<tr>
<td>G</td>
<td>Cylinders</td>
<td>25 ton</td>
</tr>
<tr>
<td>H</td>
<td>Auxiliary winch with 250 m wire</td>
<td>6 ton</td>
</tr>
<tr>
<td></td>
<td>TOTAL CRANE WEIGHT, assembled</td>
<td>~235 ton</td>
</tr>
</tbody>
</table>

Preliminary and approximate weights given.

### 2.19 DIMENSIONS AND LAYOUT PLAN:

See general arrangement drawing:

Drawing no: SP1921-1  C.3568.0028.GA01 rev 2 / C.3568.0028.GA02 rev 0
5.0 PICTURE:
OFFSHORE KNUCKLE JIB CRANE TYPE: HMC 3568 LKO 250-32 (750-20) (1000-15) (1500-10) (100-33) AHC