TENDER NO. TLKB-04-2022

Schedule 1 : Deliverables Specification

Scope of Supply

1.1. The scope of this contract covers the supply, delivery, testing and commissioning of 2 units New Laden Reach Stackers (hereinafter called "Equipment") capable of handling all types of container configurations for deployment at Laem Chabang Port Terminal B3 or Lad Krabang ICD

1.2. The tenderer shall have proven track records for the design, construction and supply of laden reach stackers.

1.3. The tenderer shall be familiar with the various designs and models of Trailers used in ESCO and in Thailand in general

1.4. Tenderer may propose lithium battery powered or diesel-powered equipment. **Eco-friendly, battery powered solutions are preferred.** In case of battery-powered proposal, the DC charging system shall be proposed and supplied under this contract.

1.5. It is the Contractor's sole responsibility to schedule the delivery of the Equipment such that sufficient time is allowed for checks and testing of each Equipment delivered.

1.6. Contractor are to quote for this tender based on DDP (Delivery Duty Paid Terms)

1.7. Payment terms for equipment are in accordance with Schedule 4 and Schedule 5

2. Operational Requirements

2.1. ESCO operates its container terminals round the clock throughout the year. Diesel powered or battery-powered equipment shall be used to handle transfers of empty and laden containers within yard stacks at ESCO Terminals

2.2. The equipment shall be able to handle containers of not less than 45 tonnes under twist lock and able to handle 20' to 40' ISO Container on terminal tractor trailers. The equipment shall be able to stack the container for up to a height of five (5) stacking high cube containers of 9'6" in ESCO's stacking areas (to note that ESCO's stacking area can be elevated 40cm above ground) and may operate on a gentle incline.

2.3. SWL under twistlock of not less than 45 ton for five (5) stacking high cube containers at the first row and 31 ton for (4) high stacking at the second row.

2.4. The equipment shall be painted in a colour to be determined by ESCO and to be provided with ESCO's logo which will be advised during later stages

2.5. In the case of battery-powered equipment, they are expected to operate continuously for about 6 hours and stopover only for fast DC battery charging. DC charging systems of 300KW shall be used to charge the batteries.

2.6. The expected utilisation of the equipment is 85%.

2.7. The Equipment shall be designed for continuous operation during peak periods, and capable of handling containers at a rate of no less than 22 moves per hour. Average container handling rate is 15 moves per hour

2.8. The equipment shall meet the following operational requirements:

Operating Parameters	Values
Lifting system	4 vertical twistlocks
Forward speed (unloaded)	≥ 16 km/h, limited at 25km/h
Forward speed (loaded)	≥ 5 km/h, limited to 15km/h
Reverse speed (unloaded)	≥ 16 km/h, limited at 25km/h
Reverse speed (loaded)	≥ 5 km/h, limited to 15km/h
Lifting speed (unloaded)	Min 0.42 m/s
Lowering speed (unloaded)	Min 0.36 m/s
Spreader rotation, CW – CCW	Min 195° - 105°
Spreader side shift	± 800 mm
Spreader tilt angle	≥ 2°
Maximum outer width	≤ 4,200 mm
Minimum ground clearance with full load	≥ 280 mm
Operating Capabilities	Minimum 4 hours on a single charge (if battery operated)

2.9. The Tenderer shall state the safe driving speed when the Equipment is operating under various load parameters and boom height. Maximum driving speed shall be restricted to 25 km/h.

2.10. The tenderer shall submit the load chart for different stacking height and operating rows for the equipment

2.11. Operations Climatic Condition

The Reach Stacker must be designed and guaranteed by the Tenderer to operate under the following climatic conditions:

Sea water spray and in general a marine atmosphere.

Temperature up to 50º C.

Relative humidity of 100 %.

Area full of smooth dust (Presence of fine sands, and coal dust).

3. Tenderer's Responsibilities

3.1. The tenderer is deemed to have studied and fully understood the requirements / specifications, the extent and types of works specified in this tender.

3.2. By submitting a tender, the tenderer warrants that he has studied and fully ascertained for himself, the extent of the works, requirements / specifications, including all local conditions, environments, rules and regulations of all the regulatory bodies. The tenderer is deemed to have obtained all the necessary information so that no item shall be omitted from his tender submission.

3.3. The tenderer shall note that all equipment, works and services whether or not specifically stated in this Specification, but are necessary for the efficient and satisfactory operation of the Equipment and/or pertinent to the successful completion of this Contract, shall be included and accounted for in the tender submission and/or contract deliverables. PSA shall not entertain claims for extras in consequence of any ignorance.

3.4. Tenderers shall include in the tender submission a Statement of Compliance, reference to every section and paragraph of this Specification. The format of the statement is given under "Statement of Compliance". Tenderers shall declare in the statement if he is able to meet the specified requirements. For uniformity, only the following categories of replies shall be used: a. COMPLIED (C) b. NOT COMPLIED (N)

3.5. For non-compliance items, Tenderers shall provide further information to explain the non-compliance, deviation or alternative to the specified requirements.

3.6. Partial-compliance to any specific requirements in this Specification shall be recorded as NOT COMPLIED (N) in the statement of compliance. The Tenderers shall explain the degree of non-compliance.

3.7. The Statement of Compliance must be complete. Tenderers shall note that failure to submit the Statement of Compliance may render the tender submission incomplete and disqualified from further consideration by ESCO. Tenderers shall be deemed to be able to comply with those parts that are left out.

TABLE 1 STATEMENT OF COMPLIANCE

Section / Paragraph	Compliance*	Detailed description of how compliance is achieved or otherwise

* NC: Not complied
C: Complied

Date

Signature And Company's Stamp

Sample Table of Compliance

Tenderers shall state the company profile, project references, facilities, capabilities, experience, manufacturers, proposed sub-contractors, proposed project management organisation structure including local maintenance support staff and the curriculum vitae/credentials of key team members.

4. Technical service

Tenderers must assure and provide guarantees for the continues production of spare parts for the Reach Stacker for at least the next ten years (including any parts provided by third party manufacturer) and that their local agents can at any time supply the spare parts required to maintain the equipment in a good working condition. Further assurance is

required that the local agents can provide technical staff to give technical assistance as may be requested by ESCO for maintaining and repairing this equipment.

4.1 Spare parts

4.1.1 Tenderers shall submit the attached spare parts list (1) and the recommended spare parts list (2) in Schedule 4.

4.1.2 Tenderers shall submit itemized recommended spare part list (2) for two years provided that all standard maintenance falls within the 2 year maintenance interval. List shall include the determined spare parts in the list in addition to any other spare parts the manufacturer recommends for safe operating performance.

4.1.3 The supplier undertakes that the prices of the attached &recommended spare parts will be fixed during the guarantee period of two years from date of acceptance).

4.1.4 The financial evaluation includes the attached spare parts and recommended spare parts prices.

4.1.5 Tenderers shall indicate their own sub suppliers / manufacturers for main components in Reach Stacker

4.1.6 Tenderers shall submit a commitment and guarantee for direct supply of spare parts by the specified sub-suppliers to ESCO without any constraint or additional overhead cost.

4.1.7 Tenderers shall state the basic specifications, manufacturers, and codes for main components installed in the Reach Stacker in order to be purchased by ESCO from any local or foreign suppliers.

4.1.8 All mechanical and electrical components to be installed in the Reach Stacker shall be of standard production models / types of their original manufacturer (unique, modified and special products will not be accepted).

4.1.9 Tenderers shall provide all components with their original manufacturer name plates, especially for the following.

- Engine,
- Transmission,
- Drive, Steer axles,
- Spreader,
- Hydraulic pumps/motors

4.2 Documents

The Tenderer must furnish each equipment with 1 set of hardcopy of the following documents and also soft copy files (must be in English language-all the provided documents and technical charts must be for the offered model and not generic).

- Full specification, manual including the name plate data for the Reach Stacker and its different components.

- Operating & maintenance manual.
- OEM descriptive workshop manual (assembly& disassembly) for engine, transmission, drive axle and spreader from their original manufacturers.
- Hydraulic and electric charts &outlay of connecting plugs for the whole equipment (copy must be submit in the technical offer)
- OEM Spare parts manual for each main component (engine, transmission, drive axle, spreader) from their original manufacturers including quantities of parts installed
- Spare parts manual from the Reach Stacker's manufacturer with part no. and remarks.
- Original fault codes lists must be provided for engine, transmission.
- Troubleshooting Manual
- Lubrication and greasing charts for all moving and rotating parts including the recommended and alternative types of oils and grease covered by our local market (Shell, Esso, and Mobil products).

4.3 Software and hardware

The successful tenderer must submit the following items:

- For each Reach Stacker an electric screen sheet (Tab) well-known brand device with display not less than 9.6 inch, with software package of engine, transmission for equipment monitoring purpose
- Include software database for spare parts, maintenance instruction, manual instruction for all Reach Stacker components (engine, transmission, hydraulic system, control system etc.).

4.4 Training and inspection

The Tenderer has to submit training program for two weeks for each of:

- Maintenance engineers, technicians, and drivers, on site during receiving stage (primary test).

The Tenderer shall also make available a qualified engineer / technician for the period of commissioning and up to 1 month after acceptance at tenderer's cost for purpose of troubleshooting, transfer of knowledge and training to ESCO's engineering team.

4.5 Factory and site tests

- Test load under twist locks (handling and manoeuvring) must be 45 ton for five (5) stacking at the first row& 35 ton for four (4) stacking at the second row
- Tenderers must submit the factory test certificates for all main components installed in the Reach Stacker (Engine, axles, transmission, spreader, etc.).
- Inspection and final tests in tenderer's factory should be carried out under the supervision of one of the international societies (LR, GL, ABS, BV).

- The stamped certificates by one of the above-mentioned international societies should be submitted at the receiving stage
- All performance tests on site, is Tenderer's responsibility and on his account to prepare all facilities for performance test in primary acceptance.

Section B : Reach Stacker Specific Requirements

1. Chassis

- The chassis structure shall be fabricated from high strength steel and designed for torsional stability and to resist distortion. The chassis structure shall be rugged, maintenance free and shall have long service life.
- The manufacturer must state the material and the chassis construction type.
- The design calculations for the chassis at maximum rated operation scenario shall be calculated and submitted with the material specifications of the chassis structures, main frame and cross members. The calculations shall take into account impact loading.
- The life span and fatigue life cycle calculations for the chassis shall also be calculated and submitted during design review.
- A towing pin shall be fitted at the rear of the Reach Stacker. The towing pin shall be of high strength steel with diameter of not less than 2 inches. A recess around the pin shall have sufficient space to allow wire rope/sling of diameter 2 inches to go around it. The pin shall be capable of being lifted up from the top to allow wire rope eye to be inserted into the recess.
- The operator access from ground to cabin shall be assisted by walkway and stairs, and ladder is not recommended. Handrails shall be provided to the users for assistance to ensure safety.
- A walkway with handrail shall be built in front of the cabin, allowing the operator to stand outside the cabin to clean the front windscreen.
- Means of access to the cabin and walkway shall conform to ISO14122 or equivalent. Twin walkway shall be made available.
- The walkway for the operator and technician on the Reach Stacker shall be laminated with anti-skid surface.
- The counterweight shall be a single cast material and not tack-welded from steel slabs.
- The design of the cabin shall provide for an alternative escape route in addition to the primary door

2 Boom

- The boom from the pivot to the top shall be submitted with drawings indicating major components. The various actuators, devices, hydraulic hoses, lifting chain and sensors mounted on the boom shall be indicated clearly in the drawings.
- The boom must be telescopic box shape section the tenderer must submit full dimensions of the boom length, width & thickness) for both inner and outer boom.
- The boom must have a suitable construction to withstand high lateral and torsional stresses in accordance to relevant international design standards. Design standards and classes should be mentioned.
- The design calculations and FEM analysis for the boom at maximum rated operation scenario shall be calculated and submitted with the material specifications of the boom structure, main frame and cross members. The calculations shall take into account impact loading.
- The life span and life cycle calculations for the boom shall also be calculated and submitted during design review.
- The requirement on lifting, tilting, side shifting and any other motions at maximum rated operation scenario shall be submitted with sizing and strength of the hydraulic actuators. Detailed calculation showing the designed forces at the cylinder rod and mounting brackets, as well as the safety factor added shall be submitted during design review.
- The field of view by the operator through the boom, or any other obstructions in front, for handling container(s) shall be submitted during design review.
- The greasing system for the pivot and moving parts at the boom shall be available. The greasing point at the various locations of the boom shall also have a steel grease nipple for individual greasing. The distribution manifold for the individual greasing system shall be at low level and accessible. Auto greasing system may be proposed as an option.
- The inspection criteria for the boom structure shall be specified. Tenderer shall indicate procedure to inspect / maintain the components within the boom structure. Means to allow inspection / maintenance of these components without fully dismantling the boom is preferred.
- **The Tenderer guarantees the structure of the boom against any defects including cracks for a period of 10 years.**

3 Transmission

- The transmission system must be of a well-known standard type, robust, and rated to transmit the maximum engine torque, the transmission must be heavy-duty power shift with torque converter suitable for the engine power, preferable: DANA transmission.
- Number of speeds by gear selector with automatic shift not less than 3 forward and 3 reverse.

- The transmission must be equipped with protection device against sudden direction change.
- Tenderer must prove with a certificate from the transmission manufacturer for the compatibility of the offered transmission with the offered engine accomplish with the related calculations & curves to be evaluated.
- The fixation between torque converter and engine must be flexible steel plates (Ring gear will be rejected).
- The conditions to protect the transmission during events (including low oil pressure, high/low oil level, high coolant temperature, low coolant level and transmission overheat) to warn the operator through indicating lights on the operator panel.
- Provide diagnostic tools, equipment and/or software for user to access and diagnose the Transmission during trouble-shooting or monitoring. Handheld set is acceptable with provision to allow for downloading and printing of data. All passwords for access shall be provided.

4 Front (drive) axle

Front drive axle must be Kessler Germany: wider type (not less than 4000 mm) -high strength, heavy- duty rigid type with dual reductions through drives head and planetary gears in wheel hub.

All front wheels should be mounted on the drive axle.

5 Rear (Steer) axle

Steering axle with extra-wide operational range. Full hydro static power steering single cylinder/ double acting type, steering shafts must have an ability for greasing. The Tenderer must submit all detailed information about the axle (manufacturer, capacity, ... etc.).

6 Hydraulic system

- Hydraulic system must consist of pumps, hyd. motors, filters, valves. safety valves must be incorporated in the speed limiting system for both telescoping, lifting and lowering. Relief valves must be provided and fitted to the hydraulic system and also safety valves that prevent boom in and boom lowering in case of hydraulic system failure. Hydraulic oil cooling system must be fitted. Filters must be fitted in the hydraulic return line.
- Separated hydraulic tanks for brake oil and working hydraulics.
- Adequate number of pressures checking points must be provided at suitable positions as recommended by the manufacturer.
- The hydraulic system design must have the proper protocol and components that ensure that no uneven lifting of the RH and LH cylinders that can lead to boom torsion.
- The hydraulic system shall be designed with a damping device to slow down the cylinders for telescopic, hoisting, lowering at the extreme ends.

- Hydraulic piping shall be corrosion resistant and hoses shall be heat resistant supporting an operating temperature of at least 150^{o}C. The hydraulic hose assemblies shall consist of single piece fittings with no-skive hoses.
- The hydraulic system shall be protected against contamination and incorporated with high quality filtration (including desiccant breathers) to remove solid contaminants (up to 0.1 micron), water and chemicals for acid formation. The filter shall be suitably located for ease of serviceability.
- Hydraulic filter shall be monitored, and choke alert raised to the operator via warning light and buzzer.
- The hydraulic oil level shall be monitored with oil level sensor and level switch. The oil level gauge shall be located at the operator panel and equipped with low-level switch to warn the operator through indicating lights on the operator panel.
- Tap-off pressure monitoring points with quick coupling for easy connection to standard pressure gauges shall be available at critical locations of the hydraulic system to facilitate troubleshooting.
- Main pressure line, hoisting and brake release pressure information shall be displayed in the operator cabin. Alarm shall be raised via warning light or buzzer when pressure is at abnormal condition.

7 Brake system

- The brake system must be suitable and durable to perform its function. Tendereras to indicate the manufacturer and specify the system.
- Service brake and parking brake must be separate as follows.
  - Service brake (wet disc brake) on drive axle fully enclosed and maintenance free, actuated from the cabin by pedal.
  - Parking brake must be actuated from cabin, consists of disc brake on the universal drive shaft. Preferable to be between universal drive shaft and differential, actuated by a powerful spring and released hydraulically.

8 Steering system

- Full hydro static power steering single cylinder type. Tenderer are requested to specify and submit full information about the system and manufacturer of its components.
- Steering valve (orbital)should be outside the cabin.

9 Greasing System

- The Reach Stacker should be equipped with 2 separate automatic greasing units with tank capacity not less than 6 kgs /unit, to grease and cover all movable & rotating parts (steering, boom, spreader lifting cylinders, etc.).
- Greasing unit must have the ability to setup its pause and operating time.

10 Tires and wheels

- The wheels provided shall be of industrial grade tyres mounted with pressed steel rims. Only tyres from reputable tyre manufacturers shall be proposed. The tenderer shall submit the specifications for the tyres and rims with the tender submission.
- The recommended tyre pressure (if its pneumatic tyre) shall be indicated on the chassis above each tyre in PSI and kg/sq.cm.
- The checking of tyre pressure and inflating for all tyres using valve extension shall be accessible from the external of the Equipment. The valve extensions shall be closed with valve cap and secured at the end.
- Heavy-duty type interchangeable front and rear wheels pneumatic tires BIAS type.
- Tire size must be not less than 1800x25.
- Tenderer must indicate the manufacturer and specifications of tyres and rims.
- Preferable: Bridgestone, Yokohama.
- Drive axel wheels should be four (4).
- Steer axel wheels should be two (2).

11 Spreader

- Must be telescopic provided with 2 hydraulic extension cylinders (chain type not acceptable) and high mounted, adjustable for 20 and 40 feet (ISO standard) containers and flats (ELME, BROMMA INNOVATION is preferable). Spreader must be equipped with 4 floating/pendular twist locks and relevant indicators, electric cable and hoses for cylinder of twist lock must be inside spreader beam.
- The designed structural life-span for the spreader shall be computed and submitted with the material specifications of the main structures, carriage, telescopic and locking mechanism. The calculations shall consider impact loading.
- The physical twist-lock status shall be visible from the exterior of the spreader.
- The load bearing capability of the twist-lock and any other lifting component for the mechanism shall be designed with at least a safety factor of 2.5. Material specification and proof load certification for the twistlock shall be submitted during design review.
- Spreader signal lights indicating spreader function status, must be provided on the spreader and in driver's cab and must be easily visible by driver for all spreader positions.
- Rotation not less than +190/-95 degree.
- Side shift of spreader must be not less ± 800 mm in both directions.
- The spreader must be able to mechanically pile slope.
- The spreader must be equipped with 2 rotation motors. The Spreader must be provided with the following safeties.

  1. Safety device preventing container locking, when all twist locks are not correctly seated,

2. Safety device preventing container lifting when all twist locks are not correctly locked. (No lock, No lift),

3. Safety device preventing, container unlocking when all twist locks are not correctly seated,

4. Safety device preventing, spreader down when twist locks are seated,

5. Safety device preventing spreader extension when spreader is locked,

6. Safety device preventing spreader extension when spreader is seated.

7. Safety device preventing boom extension when spreader is seated.

8. Each twist lock is protected individually against unwanted rotation (mechanical interlocking against faulty locking and unlocking).

9. Spreader hoisting is disabled under overload condition

- An additional lifting LUG at 4 corners for OH frame purpose.

12 Cabin

- Must be safe and comfortable.
- The operator's chair shall be an ergonomically designed, air cushion seat of durable and robust construction. It shall be adjustable, height, fore and aft and declining with contoured back rest.
- Cabin shall be constructed from high strength steel and reinforced for strength to resist moderate impact and distortion. Corrosion resistant materials shall be used in the construction of the cabin.
- The top and front cabin glass shall be made of safety laminated glass (i.e. A layer of safety laminated material between two layers of glass) and secured firmly on the metal frame. The rest of the cabin glass shall minimally be made of tempered glass.
- Two cabin doors each on the left and right side shall be provided with safety latch/lock at fully opened and closed position. The latch/lock shall be durable and vibration resistant to prevent cabin door being opened when the Reach Stacker is in motion or when the brake is suddenly applied.
- The operator cabin shall conform to ISO3449:2005 for Falling-object protective structures (FOPS) or equivalent standard.
- Provide wide visibility range for the driver to do his job easily and has interior mirror.
- The front shield glass must be safe type (Semi flat is preferable) and equipped with wipers.
- Cabin must be able to be slide electrically or hydraulically.
- Two sides' movable safety glass windows (up to down is preferable).
- Cabin shall be efficiently insulated from heat, noise and vibration. The cabin shall be mounted on anti-vibration materials.
- Cabin light of LED type and an electric horn shall be provided. The electric horn of at least 100dBA shall be provided to warn other port users during operation.

- Provided with suitable firefighting extinguishers (2 x 6 kg powder) to meet regulations.
- Provided with glass tinting to prevent glare and reduce heat in the cabin
- Self-tensioning and self-retractable safety belt integral with the driver seat shall be provided. The seat belt shall be replaceable as a separate module by itself when required. The seat belt offered shall meet European Commissions (EC), Federal Motor Vehicle Safety Standards (FMVSS), DIN or equivalent certifying bodies' specification for seat belt assemblies for Motor Vehicles.
- Seat anchorage must be provided and secured.

The cabin must be equipped with:

1.Indicators for the following functions.

- Spreader correctly seated on the container.
- Spreader twist locks closed.
- Spreader twist locks opened.

2. A multifunctional display must have and indicates.

- Parker IQAN control or equivalent (Parker IQAN is preferable).
- Written and readable faults (engine, transmission, hydraulic system).
- Transmission calibration needed must be done from the display.
- Maintenance intervals must be shown in display (preferable pop up/splash screen).
- Lift height, boom angle & boom length.
- Engine Cooling temperature (if applicable)
- Engine RPM. (if applicable)
- Engine Oil Pressure gauge. i- Fuel level. (if applicable)
- Battery compartment temperature (if applicable)
- Battery power (if applicable)
- Transmission oil temperature and pressure.
- Hour meter.
- Container actual weight and total number of the handled containers.
- m-Safety override by-pass key switch for spreader (preferable done from the display).
- n- Safety overload bypass key switch.
- o- Access steps/ladder to the cabin with handrail must be from both sides.

3. Multifunction joystick to control hydraulic functions and spreader.

4. Control gear shift selector is preferable to be separate.

5. Warning indicators for:

- Battery Charging. (if applicable)
- Low oil pressure for engine. (if applicable)
- Parking brake.
- Low oil pressure for brake system.

- low engine coolant level. (if applicable)
- Engine high temperature. (if applicable)
- Battery high temperature. (if applicable)

6. Direction indicators

13 Air Conditioner

- The air conditioner shall be sized for thermal load, including heat source from engine and average external environmental temperature of 34°C. The cabin shall be cooled and maintained at 24°C to provide comfort to the operator with good thermal insulation. The thermal load requirement and the air conditioner thermal capability shall be submitted with the tender.
- The specifications for air conditioner compressor with the schematics of the air conditioning system shall be submitted with the tender.
- The air conditioner shall be provided with SAE J2064 hoses and O-ring fittings, high- and low-pressure switches, receiver dryer and fan cooled condenser coil.
- The assembly shall be housed in an area for easy access. The charge point for the high and low pressure shall be located together at accessible locations.
- The water condensed at the cooling unit in the cabin shall be properly directed by hoses and drained to the ground.
- The air conditioner duct shall be routed to blow cold air from dash board level. The adjuster louvre shall be installed.

14 Noise Level

The tenderer shall ensure that the general noise emitted from the Equipment shall comply with the following measurement indicators:

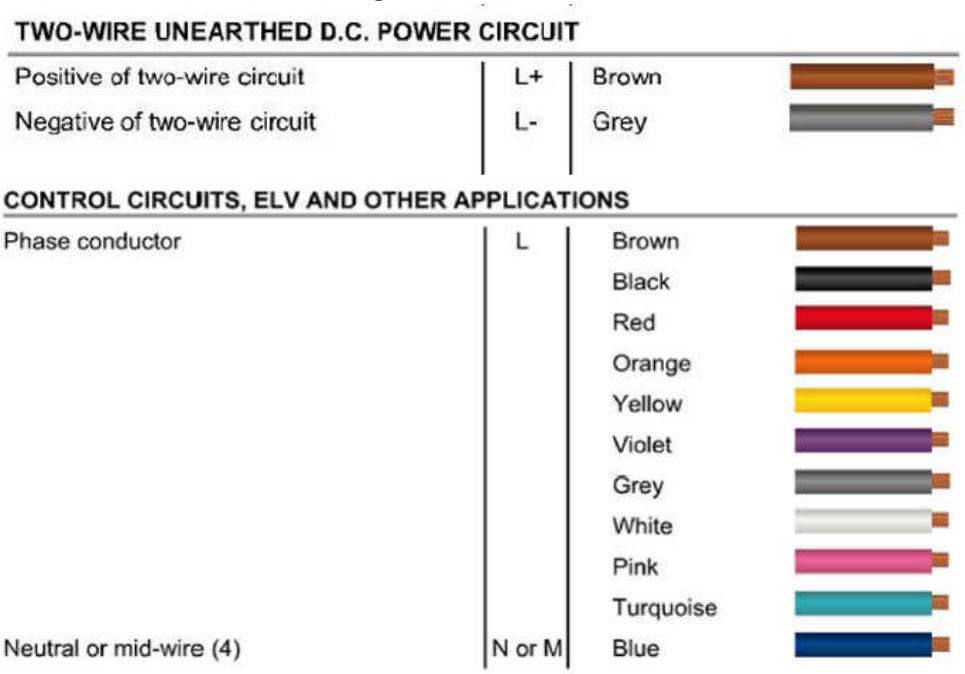
- Noise level inside operator cabin shall not exceed 80dbA when handling containers, and
- Maximum noise level measured at 7.5m from the Equipment for drive-by condition shall not exceed 84dBA making reference to ISO R362 standard.

15 Electrical Systems

- The electrical system shall be designed to eliminate fire hazard and to protect the Equipment from extensive damages in the event of electrical short-circuit. All wire harnesses are to be protected with fire retardant conduit and routed away from the engine heat source.
- The circuit protection shall be implemented with fast acting automotive blade fuses. Each system and device shall be protected individually.
- The Tenderer shall submit the electrical schematic with the tender submission. The information shall reflect the cabling connections between the various panels, control boxes, junction boxes and terminating points on the Equipment.

Cables

- Multi-strand, copper conductors with high bending fatigue life shall be used. Single strand wire is not acceptable. All cables shall be insulated and sheathed with material having flame retardant properties and resistant to petrol, lubrication oils, fuel and dilute acids. Cables that are exposed to the atmosphere shall be flame retardant, oil resistant and UV-resistant. The cables shall have a working temperature of at least 70°C.
- LV DC+ and LV DC- shall use brown and grey cables respectively. Both brown and grey cables shall not be used for signal cables.



- Wirings shall be colour-coded for ease of differentiation and identification during troubleshooting.
- Every wiring shall be identified by a system of systematic numbers and be properly marked at both ends. The labelling shall correspond with terminal reference stated in the electrical single-line diagram. The Tenderers shall propose the wire labelling system for PSA approval after the tender award.

Junction Boxes and Cable Terminations

- Engine Control Unit (ECU), Transmission Control Unit (TCU), controllers, electronic cards, electrical and sensor terminations shall be housed in weather-proofed junction boxes (rated IP65 or higher) at strategic locations outside the engine compartment. The junction boxes and cable installations shall be protected against water ingress and condensation. The junction boxes shall be easily accessible for troubleshooting.
- Cables shall be connected only at terminal blocks in panels, control boxes, junction boxes or at the terminals of electrical equipment. For control boxes, the incoming and outgoing cables shall be terminated at connector or terminal blocks, and not directly to the relays, contactors and components.
- Terminal blocks used shall be resistant to vibration and shock. Tension clamp or spring-cage type of cable connection shall be used. Screwed connections are not preferred and should be

adopted only as a last solution.

- Terminations of all cables at terminal blocks shall be made with properly crimped insulated lugs or ferrules. No two cables shall be terminated at the same terminal point.
- For outdoor cable-to-cable inter-connection, environmentally sealed outdoor Deutsch connectors with connector latch or equivalent shall be used.
- All cables shall be routed, bundled and arranged systematically. Galvanised perforated trays shall be provided, where relevant. Longitudinally slit, PVC corrugated harness shall be used to protect the cable against abrasion. They shall be securely fixed to the chassis at appropriate spacing.
- Fire retardant conduit of UL94:V0, FMVSS302 or equivalent standards to be used for wirings and cables on the engine. It shall be of slit type, with fire retardant capability up to a minimum 250 ^{o}C.
- Sizing of cables shall be according to international standards. Electrical wiring insulation shall be oil and UV resistant.

16 Lighting and Buzzer

- LED-light assemblies from Hella or equivalent shall be proposed. Its mounting shall be vibration-proof. Wiring terminals shall be protected against water/dirt ingress.
- The lighting provided on the Equipment shall include white head lights with high & low beam, flashing amber turn lights at all four corners of equipment, red tail lights and white reverse lights.
- Amber strobe lights shall be provided on top of boom structure of the Equipment or at a recommended position where it is clearly visible for port user to notice. It shall operate when the engine is running.
- A strobe light with buzzer shall be installed on top of the counter weight and it shall turn on when the reverse gear is engaged. The reverse buzzer shall be at least 100dBA.
- A hazard light switch shall be provided to operate all four turn lights.
- The spreader indicator lights provided shall include one (1) set of unlock light (red), container landed light (amber) and lock light (green), mounted on top of the spreader carriage or on the mast, visible from the operator cabin. The lightings provided shall be of LED type. Another set of spreader indicator lights shall be provided in the operator cabin.
- The Reach Stacker is expected to operate in pitch-dark environment. Work lamps with sufficient light outputs shall be provided to illuminate the work area surrounding spreader attachment, bottom container structure and the Reach Stacker. The Tenderer shall propose the specifications, quantity and placement locations of the work lamps in the tender submission.

17 Camera-Monitor System

- Only ruggedized and reliable camera-monitor system with good track record for similar applications like Orlaco or equivalent shall be proposed.
- The Tenderer shall propose the setup, brand and model of camera-monitor system to be

installed on board the Equipment to assist the operator in local handling the machine. A switcher may be installed to switch between spreader view, front and back view camera.

- The proposed organisation of the camera footages on the operator display monitor shall be submitted during design review.
- A ruggedized, tamper-proofed recording device capable of recording continuously up to a period of 72 hours shall be installed. The recorded footage shall only be accessible to authorised personnel. There shall be indicators to inform the operator if the recording device ceases to perform its recording function.
- The following camera system shall be minimally provided:

a. 4 cameras mounted to monitor spreader twistlock operation,
b. Wide-angle camera mounted on top of boom or other recommended position to provide far side view of container below the spreader.
c. Wide-angle camera installed to provide rear (reverse) view of the Reach Stacker.

- The proposed cameras shall meet the following minimum specifications:

a. Day-night cameras
b. Low-light sensitivity <0.05 lux
c. Operating temperature up to 85°C
d. Minimum IP 67
e. Shock and vibration resistant for usage on trucks and cranes (Up to 50G)
f. No lens condensation
g. Able to withstand high pressure cleaning with water

- The proposed display monitor shall meet the following minimum specifications:

a. Automotive 12” TFT display module with backlight LED and integrated sun visor
b. Button selection of camera views
c. Automatic adjustment of brightness to ambient lighting
d. Operating temperature up to 85°C
e. Shock and vibration resistant for usage on trucks

- All outdoor cables used shall be oil resistant with water-tight connectors. Cables to top platform shall be purposed built and designed for dynamic use.

18 Reverse Warning System

- The Reach Stacker shall be installed with an active reverse warning system to detect personnel and/or objects when it is driven in the reverse direction. In case of a detection, a visible and audible alert shall be raised to alert the operator. Display of the detection zones on the rear-view camera monitor is preferred. In case of a detection, a visible and audible alert shall be raised to alert the operator.
- The proposed reverse warning system shall be robust to operate under all weather (day/night/sunny/rainy) condition with minimal false alarms. Only ruggedized and reliable reverse warning system with good track record for similar applications e.g. Orlaco RadarEye shall be proposed.

19 Stability

- Reach Stacker must be stable at full operating parameters and protected against tipping.
- Stability factor must comply with international standards (standards must be mentioned).

20 Performance

Tenderer must submit in his offer:

- Boom full out/in time (laden, empty).
- Boom full lifting/lowering time (laden, empty).
- Combination time for boom telescopic and derricking.
- Spreader telescopic time.
- Maximum traveling speed for Reach Stacker with load / without load
- Acceleration rate with / without load.

21 Safety Requirements

In addition to the above stated safety requirements, the Reach Stacker must be equipped with:

- Anti - tipping device to prevent boom out and lowering the load when the design limits of the machine have been reached.
- A weight measurement system with built-in overload safety protection feature. The system detect any container exceeding its lifting capacity and preventing any hoisting.
- An audible and visible warning must be fitted to warn the driver when approach 90% of the max. load.
- Automatic twist locks locking activation for spreader when are seated.
- Rotating shafts which are exposed undercarriage, except propeller shafts which do not rotate when the equipment is stationary, shall be protected. The protection shall prevent a person from getting caught by the rotating shafts during maintenance, troubleshooting and testing when working undercarriage. The protection shall be easily removed when required.
- A Lock Out Tag Out (LOTO) device shall be provided at the battery isolator.

- Camera at rear/back up and camera at boom nose with LCD coloured monitor inside the cabin.
- Transmission protection against sudden change of direction.
- Rotating beacon on boom.
- Acoustic back up warning alarm with back up LED light, direction and rear stops indicators
- Extra working LED (not less than 3000 lumen) under front of outer boom.
- LED spotlights on spreader (not less than two).
- LED spotlights (position, reverse, brake, and the mudguards).
- Rear view mirrors in both mudguard sides
- Maintenance free batteries in a suitable place.
- Extra external analogue operating hour meter.

The Reach Stacker Is preferable to be equipped with.

- Automatic thermal fuses (circuit breaker).
- Automatic parking brake activation & gearshift inching in case of driver leave his seat.
- An external oil dipstick for both engine & transmission. 4- Spot light in electric control box.

22 Hybrid / Electric Vehicles

Tenderer are able to propose a hybrid / electric vehicle model for purpose of consideration. In such a proposal, the Tenderer should include performance characteristics of the hybrid / electric vehicle including battery parameters, operation parameters, battery charging parameters including battery life and maintenance process for the batteries.

Section B2 Lithium Batteries / Electric Drives & DC Charging Systems (For battery-powered proposals only)

General

Tenderers shall furnish the overall concept design, general arrangement, selection of Lithium battery system and illustration of energy saving features for their batterypowered empty stacker in their tender submission

Financial studies to support on the potential cost savings from energy and maintenance and the avoidance of green-house gas emissions against the dieselpowered fleet shall be submitted for reference

Lithium Battery Systems

a) Total life cycle cost is an essential evaluation criterion for the proposed battery system. Tenderers shall state the expected useful life-span with supporting justifications in their tender submissions

b) Tenderers shall propose Lithium battery system of established brand with proven track record. Battery systems with local technical and maintenance support e.g. Durapower batteries may be proposed

c) ESCO is expecting a product warranty equivalent to the designed useful life-span of the battery system. Tenderers shall state the number of years of product warranty from the battery OEM or

supplier. ESCOshall manage the product warranty directly with the battery supplier beyond the standard defect liability period

d) The battery system's design and component layout shall consider the following

- **i.** Battery modules shall be housed inside enclosed cabinets for long-term environmental protection
- **ii.** Battery modules and replaceable electrical components shall be front accessible for ease of maintenance
- **iii.** Maintenance access to the cooling system; and
- **iv.** Even weight distribution

e) The Lithium battery system shall meet the following minimum specifications:

- **i.** Operating Voltage Range : Within 450 - 800V
- **ii.** Min Operating Battery Capacity @ End-of-Life : 120kWh (DoD)
- **iii.** Continuous Charging Power : 300Kw
- **iv.** Charging Duration : ≤25 mins for 120 kWh
- **v.** Cooling System : Water-cooled
- **vi.** Working Ambient Temperature : 20 - 40°C
- **vii.** Working Humidity : 90% Condensing
- **viii.** Useful Life-span : Minimum 8 Years

f) Tenderers shall submit computation on the expected peak power output required from the battery system to justify that it is operating within the maximum C-rate allowable by the battery system at its end-of-life

g) Tenderers shall propose the desired chemistry for the Lithium battery. Long-life, support fast charging, high effective capacity (useable energy over permissible SOC range), high safety level, suitability for tropical climate, minimal maintenance and low life cycle cost are key desired characteristics for the proposed battery system

h) Tenderers shall note that the equipment structure and body are constantly subjected to impact shock and vibration during vehicular movements and transfer of containers. It is imperative that the electrical connectivity between battery cells/modules/strings must be resilient against such shocks and vibrations. Tenderers shall illustrate how their design addresses this challenge

i) For maximum reliability, all battery cell connections shall be laser welded

j) Maintenance-free fire suppression system equivalent to BlazeCut "T" series system shall be installed within the battery modules or cabinets to protect the machinery in case of a fire raising from the battery system. Other form of fire suppression means may be proposed for ESCO's approval

k) An isolation switch with LOTO feature shall be available at the HV cabinet to isolate the Lithium Battery System for purpose of maintenance or troubleshooting

Electrical Drives and Motors

a) Tenderers shall propose high efficiency, compact, water-cooled electric AC drives and motors for the driving and hydraulic systems. The latest range of products shall be offered. There shall be local technical, service and sales support office established for the proposed AC drives and motor

b) The drive inverters and motors shall have a minimum protection class of IP65 and can operate at a temperature up to 70°C. Adequate ventilation and cooling shall be provided to keep the drive components within the designed operating temperature

c) The mounting of the drive components shall take into consideration the ease of accessible during maintenance.

d) The inverter drive electronics shall be well protected against short-circuit faults and over-voltage. The protection mechanism shall switch off the inverter output in the event of a high level of earth current being detected. The empty stacker shall manage the pre-charge of the drives independently from the HV battery pack's precharge sequence.

e) All motors shall be provided with over-current, over-speed and over-temperature protection. It shall be suitable for intensive use and continuous operations in local environment with minimum maintenance requirement. The tenderer shall indicate the maintenance programme and service/repair requirements for the motors e.g. bearing lubrication in the tender submission

f) All motors shall be individually tested in the motor factories, and reports of such tests, including the factory insulation resistance test shall be submitted with the Factory Acceptance Test report

g) Motors shall be coupled to the axle via propeller shaft and universal coupling. Other effective methods may be proposed subjected to PSA approval

h) Power wirings must be separated from control wirings, and on long cable runs, separated by earthed shields within the trunking. All wiring for the drive system shall be carried out in accordance with the drive manufacturer's recommendation and comply with all local regulations. The Contractor shall submit the cable routing and layout for PSA's approval

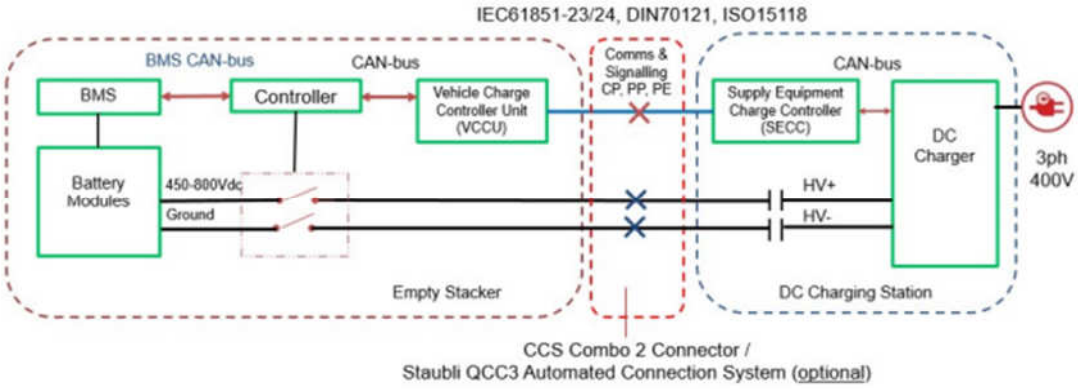
i) The design of the drive inverter system must be fail-safe. Supply power lost, sensor failures, communication failures or line faults shall not cause the motor to accelerate or set into motion indiscriminately. These faults shall be readily detected with immediate stopping of the drive system

j) The drive inverter system shall have the capability to perform self-diagnostics and to retain diagnostic information for future interrogation, inclusive of the date and time of faults logging. Data and information about the behaviour of all signals during each fault condition shall be retained by the drives even if the power supply is turned off. The diagnostics shall include indications for over-current, under-voltage, overvoltage, over-temperature, component failure, communication failure, etc

k) All drive inverter system faults shall be reported to the equipment and displayed on the operator console.

l) The Contractor shall provide the drive system diagnostics and accessories toolkit for access to the drive controller. Configuration and downloading of parameters and firmware to the drive controller and inverters shall be furnished to PSA

DC Charging System



a) Tenderers shall propose outdoor, 300kW, 450-750V DC charging systems to be installed in LKB ESCO premises for the fast charging of lithium batteries on-board the empty stacker in the tender submission

b) The Contractor shall supply and terminate the incoming electrical cables from LKB ESCO 400Vac Electrical Grid Network / Packaged sub-station to the Charging System

c) The DC Charging System shall meet the following minimum specifications:
   i. Charger Capacity : 300 kW (constant)
   ii. DC Output Voltage : 460 - 750 Vdc
   iii. DC Output Current : Up to 500 A
   iv. Input AC Line Voltage : 3-phase, 400V ± 10%
   v. Power Frequency : 50Hz ± 1Hz
   vi. Power Factor (Full Load) : > 0.95
   vii. Efficiency (Full load) : > 94%
   viii. Operating Temperature : Up to 45°C
   ix. Operating Temperature : Up to 45°C
   x. Environmental Protection : IP54
   xi. Charging Standards : IEC 61851-1/23/24, ISO15118, DIN70121
   xii. Connection Device : CCS Combo 2 Connector (IEC62196-3)

2.24 Warranty and Maintenance

i. The Contractor shall provide standard two (2) years warranty for the Equipment from the date of the Acceptance Certificate. The warranty obligations shall include breakdown attendance and first preventive maintenance of the Equipment

ii. 2 The Contractor shall warrant a minimum life-span of 5 years for drive axle and spreader attachment, and 10 years for chassis and boom structure

iii. The Contractor shall have a qualified local service team familiar with the maintenance and repair of the Equipment. In case of a breakdown activation, the Contractor shall respond 24x7 and be on-site within 6 hours with recovery time of no more than 3 days from activation, or any such time period agreed to by ESCO

iv. The preventive maintenance shall cover routine inspection and servicing of essential parts on the Equipment. The Contractor shall submit a copy of the service record stating the work done and the parts replaced after each maintenance

For Submission : Technical / performance data list

1.THE OFFERED MACHINE:

A.	Manufacturer – origin:	
B.	Model:	

2.CAPACITY:

A.	1 row / load center:	ton/mm	
B.	2 row / load center:	ton/mm	
C.	3 row / load center:	ton/mm	

3.OVERALL DIMENSIONS:

A.	Length including spreader	
B.	Width	
C.	Wheelbase	
D.	Ground clearance	
E.	Turning radius	
F.	90° stacking aisle (40 feet container)	

4.PRE-QUALIFICATION:

No. of machines of the same type in operations:	

5.ENGINE:

A.	Manufacturer/origin:		
B.	Type:		
C.	Power:	Hp/r.p.m	

D.	Torque: Nm/r.p.m	
E.	No. of cylinders:	
F.	Malfunction shut off device Yes/No	

6.TRANSMISSION:

A.	Manufacturer/origin –:	
B.	Model /Type:	
C.	No. of gears F/R:	
D.	Power: Hp	
E.	Torque: Nm	
F.	Protection device against sudden change Yes/No	

7 .ESTIMATED ANNUAL OPERATING COST (65,000 lifts per year)

A.	Fuel Consumption	
B.	Consumables (tyres, batteries, lubricants etc)	
C.	Maintenance Cost	
D.	GHG Emission per year	

8. ESTIMATED SCOPE 3 EMISSION FOR PRODUCTION AND DELIVERY OF 1 REACH STACKER TO THAILAND

Estimated Scope 3 Emission for production and transport: