Tacis

Feasibility Study of New Terminal Facilities in the Georgian Ports

Phase 3 Report: Vol. III - Port Handling Equipment Port of Poti

May 1998

Demand of Port Cargo Handling Equipment in the Different Development Phases of the Port of Poti

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1. Introduction

Based on the traffic forecast for the Port of Poti it has been mutually decided by the port management and the Consultants to rehabilitate and extend in a first step of development the existing container terminal of the port. In accordance with the terms of reference of the present project the Consultants have defined the necessary equipment which has to be purchased for this first development phase. This equipment is specified in the attached technical specifications.

In addition to the definition of the equipment for this first development step, equipment necessary to rehabilitate the existing port facilities for handling of bulk and general cargo has been specified. These specifications are also attached in this volume.

It has been agreed that in order to cope with the forecasted volumes of containerised cargo a new container terminal has to be constructed in the near future. The equipment estimated to be required in this new container terminal north has been defined and specified in this report, too.

Also, the equipment estimated to be required in the second and third phase of port development has been defined and specified in the following chapters of his report.

Furthermore, the required rehabilitation of existing port handling equipment has been defined and a rehabilitation programme with cost estimates has been added to this report.

It is recommended to combine the tendering for the equipment of the ports of Poti and Batumi in order to receive competitive prices and for the purpose of standardisation of the equipment.

2. New Port Cargo Handling Equipment

The item number in the following tables refers to the item number stated in the detailed technical specifications of the Tender Documents attached as chapter of the present volume..

Equipment should only be purchased for Phase I with a duration of five years.

2.1 Equipment for Container Handling

		Berths 6 & 7	Berths 12, 13 & 14	
Item N°.	**Description**	**Quantity**	**Quantity**	**Total Units**
4	Reach Stacker	5	3	8
5	Terminal Tractor	4	0	4
6	38-t/40' Container Chassis	8	0	8

Remark: In 1998 the following items will be delivered as a Tacis grant:
Item 4: 1 unit, Item 5: 3 units, Item 6: 10 units

3. Demand of new cargo handling equipment and re-habilitation programme of existing equipment of the Port of Poti (Phase 2 Report)

During the first Phase of this project a thorough evaluation of the existing cargo handling equipment has been executed (see Annex 8, Phase 1 report).

Based on the traffic forecast, expected cargo flow and the berth occupancy rate the required port handling equipment was chosen for rehabilitation. Detail concerning type of equipment and costs for rehabilitation and new investment are shown on the following pages.

3.1 Summary of Rehabilitation Costs

Out of the 16 units of Sokol cranes only 13 units should be rehabilitated. Cranes No 10, 16, 18 should not be rehabilitated

3.1.1 Port Handling Equipment to be Rehabilitated

Phase I

Type of Equipment	Price in USD
Port Handling equipment, cranes	4.900.000
Port Handling equipment, cranes	181.100
Subtotal	5.081.100
10% Contingency	508.110
Total phase I	**5.589.210**

Phase II

Type of Equipment	Price in USD
Port Handling equipment, cranes	4.280.000
10% Contingency	428.000
Total phase I	**4.708.000**

Phase III

Type of Equipment	Price in USD
Port Handling equipment, cranes	4.600.000
10% Contingency	460.000
Total phase I	**5.060.000**

A maximum of two cranes can be rehabilitated at the same time. The works should be carried out the operational area to avoid interruptions.

The relocation of the cranes should be considered.

3.4.1 Phase I, 1998

Asset No	Type of Equipment	Rehabilitation costs in USD
2	Kondor 32 t.	700.000
5	Kondor 32 t.	700.000
6	Kondor 32 t.	700.000
22	Sokol 16 t.	500.000
26	Sokol 16 t.	600.000
32	Sokol 16 t.	600.000
36	Sokol 16 t.	600.000
38	Sokol 16 t.	500.000
Subtotal, Cranes		4. 900.000
!0 % contingency		490.000
Total		**5.390.000**

Asset No	Type of Equipment	Rehabilitation costs in USD
230	Jungheinrich FLT 1.5 t.	2.500
231	Jungheinrich FLT 1.5 t	2.500
232	Jungheinrich FLT 1.5 t	2.500
233	Jungheinrich FLT 1.5 t	2.500
234	Jungheinrich FLT 1.5 t	2.500
235	Jungheinrich FLT 1.5 t	2.500
236	Jungheinrich FLT 1.5 t	2.500
237	Jungheinrich FLT 1.5 t	2.500
238	Jungheinrich FLT 1.5 t	2.500
239	Jungheinrich FLT 1.5 t	2.500
240	Jungheinrich FLT 1.5 t	2.500
241	Jungheinrich FLT 1.5 t	2.500
243	Jungheinrich FLT 1.5 t	2.500
281	Kalmar FLT 25 t.	40.000
282	Kalmar FLT 25 t.	50.000
506	Bobcat 843	3.000
507	Bobcat 843	1.000
508	Bobcat 843	1.000
509	Bobcat 843	3.000
510	Bobcat 843	1.000
523	Komatsu WA 200	5.000
524	Komatsu WA 200	5.000

3.5 Rehabilitation Measures by individual berths

3.5.1 Berth No.1 Bulk, Oil and Berth No.2 Rail Ferry/RoRo

Both berths should be seen as one crane area. From the existing 5 units of Sokol crane 16t only 3 units should be repaired with last priority.

Asset No.	Year of construction	Type of equipment	Rehabilitation costs in USD	Priority
3	1981	Sokol 16t	650.000	Last priority
4	1981	Sokol 16t	650.000	Last priority
15	1981	Sokol 16t	650.000	Last priority
17	1984	Sokol 16t	650.000	Second priority
28	1981	Sokol 16t	650.000	Last priority
Subtotal	**3 units only**		**1.850.000**	

3.5.2 Berth No.3 General Cargo

This berth is foreseen for direct handling of general cargo as stand by peak situation. In the year 2002 this berth will be used regularly.
From the existing 5 units Sokol crane 16t only 3 units should be repaired with last priority.

Asset No.	Year of construction	Type of equipment	Rehabilitation costs in USD	Priority
16	1979	Sokol 16t	650.000	no repair
18	1975	Sokol 16t	650.000	no repair
26	1987	Sokol 16t	600.000	first priority
32	1987	Sokol 16t	600.000	first priority
36	1988	Sokol 16t	600.000	first priority
Subtotal	**3 units only**		**1.800.000**	

Cranes No.26, 32 and 36 should be repaired with first priority. Two cranes should be shifted to Berth No.8 in exchange of crane No.10.

All Albatros cranes will be located along berth No.10 and 11.

Both cranes have first priority for the container handling operation.

3.5.3 Berth No.4 Bulk, Scrap

This berth is operated by Messenger Dock Transhipment Poti Ltd. With Port of Poti as share holder.
Crane No.11 and 25 are not taking into account for rehabilitation under this project.

2.2 Equipment for Bulk and General Cargo Handling

In addition to the cargo handling equipment required for the first step of port development the following items necessary for the operation of the existing port area have been defined. Technical Specifications are attached in part 4 of this volume.

		Phase I: 98 - 2002	Phase II: 03 - 07	
Item N°.	Description	Quantity	Quantity	Total Units
5	Terminal Tractor	0	1	1
7	60-t/ 40' Roll Trailer	4	0	4
9	10-t Forklift Truck / Stuffer	0	1	1
11	2.5-t Forklift Truck / Stuffer	0	10	10
14	Wheel Loader / Bobcat	0	4	4
15	"HANNSE" Pallet	500	500	1000
16	Over Height Gear, 40' and 20'	1	0	1
17	Workshop Equipment	1	0	1

2.3 New Handling Equipment for Container Terminal North

		Phase I	Phase II	Phase III	
Item N°.	Description	Quantity	Quantity	Quantity	Total Units
1	Container Gantry Crane	2	1	1	4
2	Rubber-tired Container Gantry Crane	4	4	2	10
3	Rail-mounted Gantry Crane	2	1	0	3
5	Terminal Tractor	15	5	18	38
6	38-t/40' Container Chassis	30	10	5	45
11	2.5-t Forklift Truck / Stuffer	4	0	5	9
12	Empty Container Handler	0	2	1	3
15	"HANSE" Pallet	1000	1000	0	2000
16	Over-Height Gear, 40' and 20'	1	0	0	1
17	Workshop Equipment	1	0	0	1

Asset No.	Year of construction	Type of equipment	Rehabilitation costs in USD	Priority
2	1984	Kondor 32t	700.000	first priority
5	1984	Kondor 32t	700.000	first priority
6	1984	Kondor 32t	700.000	first priority
30	1987	Ganz 5t	380.000	second priority
Subtotal			**2.100.000**	

All three Kondor cranes should receive new rotating light-weight telescopic spreader to increase productivity remarkably.

3.5.7 Berth No. 8, Bulk Grain

The existing three Sokol cranes 16 t for grain handling should be assisted by a fourth unit to compensate Maintenance and Repair time.

Asset No.	Year of construction	Type of equipment	Rehabilitation costs in USD	Priority
10	1977	Sokol 16t	650.000	no repair
24	1980	Sokol 16t	650.000	second priority
35	1987	Sokol 16t	600.000	second priority
Subtotal			**1.900.000**	

Two Sokol cranes from berth No. 3 should be shifted to berth No. 8.
The existing hopper should be repaired by the Port itself. Only simple steel work has to be done.
Crane No. 10 should not be repaired under this programme and shifted to berth No. 3.

3.5.8 Berth No. 9, general cargo

The existing three Ganz 5t cranes for general cargo handling should be assisted by a fourth unit, namely crane No. 30 from berth No. 7. This crane will compensate M + R time.

Asset No.	Year of construction	Type of equipment	Rehabilitation costs	Priority
14	1975	Ganz 5t	400.000	last priority
20	1984	Ganz 5t	400.000	second priority
23	1975	Ganz 5t	400.000	last priority
Subtotal			**1.200.000**	

3.5.9 Berth No. 10, General Cargo and Berth No. 11, Bulk and General cargo, stand by berth for peak time.

The existing three units Albatros 10t cranes should be assisted by a fourth unit, namely Crane No. 31 from berth No. 6 to compensate M + R time.

3.2 Summary of the New Port Handling Equipment (Existing Port)

3.2.1 Phase I, 1998 - 2002

	USD
Berth No 6 and 7	3,135,000
Berths No 12, 13 and 14	1,628,000
CTIS Container Terminal Information System	750,000
Bulk and General Cargo	321,000
Subtotal Phase I	**5,834,000**

3.2.2 Phase II, 2003 - 2007

	USD
Bulk and General Cargo	**789,500**

3.3 Equipment for the New Container Terminal North

3.3.1 Phase I, 2001 - 2002

Equipment: **Total: USD 21,590,000**

Requirements for the years 2003 to 2007 are covered with the equipment purchased in Phase I.

3.3.2 Phase II, 2008 - 2012

Cargo Handling Equipment: **Total: USD 12,840,000**

3.3.3 Phase III, 2012

Cargo Handling Equipment: **Total: USD 15,000,000**
(Only if total cargo turnover exceeds 250,000 TEU.)

3.4 Rehabilitation of Port Handling Equipment

During the evaluation of the existing equipment 31 cranes were inspected. Of these 24 were taken into consideration for rehabilitation under this subject.

Of the following cranes No 3, 4, 15 and 28 two cranes should be shifted to berths No 1,2 and 3.

A faster handling of containers is possible as the location of each container is identified immediately . The time consuming search for containers will be no longer necessary. This will lead to a better utilisation of the equipment. The New Container Terminal North will need such a system anyway, and when the system will be applied already in the rehabilitated old container area the Port personnel will be familiar with the CTIS system and a smooth start-up of the new terminal can be achieved.

A well proven CTIS with multilingual displays, edp hardware, data communication and training will cost approximately $ 750.000 for Poti Port and approximately $ 500.000 for the adaptation for the New Container Terminal North

3.6.2 Berth No 12, 13 and 14

Following port handling equipment is needed for container handling after reconstruction.

Quantity	Type of equipment	Unit price in USD	Total price in USD
3x	Reachstacker 40t	37.000	1.480.000
1x	Spare parts	148.000	148.000
Subtotal			1.628.000

Phase II for Poti Port will correspond with the start of the New Container Terminal North.

Reachstacker and Tractor/Trailer units can be transferred to the new terminal.

The old part of Poti Port will mainly be used bulk and general cargo operations.

3.6.3 New Port Handling Equipment for Bulk and General Cargo

Phase I, 1998 - 2002

Quantity	Type of equipment	Unit price in USD	Total price in USD
4x	Rolltrailer 40'/60t	18.000	96.000
500x	Paletts Hanse 2t	50	25.000
1x	Workshop equipment	100.000	100.000
1x	Stevedoring Equipment	100.000	100.000
Total Phase I			**321.000**

Asset No	Type of Equipment	Rehabilitation costs in USD
525	Komatsu WA 200	15.000
527	Sisu tractor	10.000
528	Sisu tractor	10.000
529	Sisu tractor	2.000
Subtotal		181.000
10% contingency		18.100
Total		**199.100**

Bobcats will be used for grain handling inside the ship.
The Komatsu wheel loader should be used during demolishing and civil construction works.
The Sisu terminal tractor can be used for container transportation.

The Port should repair some of the existing RoRo trailers by cannibalising others.

3.4.2 Phase II

Asset No	Type of Equipment	Rehabilitation costs in USD
1	Sokol 16t	650.000
17	Sokol 16t	650.000
24	Sokol 16t	650.000
35	Sokol 16t	600.000
27	Albatros 10t	550.000
31	Albatros 10t	400.000
20	Ganz 5t	400.000
30	Ganz 5t	380.000
Subtotal		4.280.000
10% Contingency		428.000
Total Phase II		**4.708.000**

3.4.3 Phase III

Asset No	Type of Equipment	Rehabilitation costs in USD
33	Albatros 10t	600.000
34	Albatros 10t	600.000
14	Ganz 5t	400.000
23	Ganz 5t	400.000
3	Sokol 16t	650.000
4	Sokol 16t	650.000
15	Sokol 16t	650.000
28	Sokol 16t	650.000
Subtotal		4.600.000
10% Contingency		460.000
Total Phase II		**5.060.000**

3.7.2 Phase II, 2008 - 2012

Number + Type of Equipment	Unit Price in USD	Total Price in USD
1 Ship/Shore Container Gantry Crane	4,500,000	4,500,000
2 RTG (2 in 2008)	1,400,000	2,800,000
2 RTG (2 in 2010)	1,400,000	2,800,000
1 RMG	1,500,000	1,500,000
5 Terminal Tractors	100,000	500,000
10 Container Chassis 40'-38mt	25,000	250,000
2 Empty Container Handler	150,000	300,000
Spareparts for items 1 to 4 (Basic)	140,000	140,000
1,000 Hanse pallets	50	50,000
Total Phase II		12,840,000

3.7.3 Phase III, appr. 2012

This phase might start earlier or later, only after cargo turnover will have exceeded 250,000 TEU. Furthermore, some of the equipment from Phase I will have reached the end of its life span and will have to be replaced.

Number + Type of Equipment	Unit Price in USD	Total Price in USD
1 Ship/Shore Container Gantry Crane	4,500,000	4,500,000
2 RTG	1,400,000	2,800,000
18 Terminal Tractors	100,000	1,800,000
5 Container Chassis 40'-38mt	25,000	125,000
5 FTL 2,5 mt	35,000	175,000
1 Empty Container Handler	150,000	150,000
Spareparts for items 1 to 4 (Basic)	450,000	450,000
Major overhaul of Ship/Shore Cranes, RMGs and RTGs	5,000,000	5,000,000
Total Phase III		**15,000,000**

3.5.4 Berth No.5 General cargo

Asset No.	Year of construction	Type of equipment	Rehabilitation costs in USD	Priority
1	1987	Sokol 16t	650.000	second priority
31	1991	Albatros 10t	400.000	second priority
Subtotal			**1.050.000**	

Crane No.31, Albatros 10t should be shifted to berth No.10 and 11. All four Albatros cranes will be located along berth No.10 and 11 and allow simultaneous work on both berths with two cranes each.

3.5.5 Berth No.6, Container

The berth will be transferred from bulk/scrap area to container handling area. One unit of the Kondor ,40t crane from berth No.7 should be transferred to berth No.6.

The two units of Sokol 16t cranes should be repaired with the first priority. Alongside the berth No.5 and 6 are three units of Sokol cranes which can serve both berths according the operational requirements.

Asset No.	Year of construction	Type of equipment	Rehabilitation costs in USD	Priority
22	1988	Sokol 16t	500.000	first priority
38	1987	Sokol 16t	500.000	first priority
Subtotal			**1.000.000**	

Both cranes have first priority for the container handling operations.

3.5.6 Berth No.7, Container

This area will be a dedicated container berth. The existing ship repair facilities in the southern part next to berth No.8 has to be removed to berth No.15.
Crane No. 5 a Kondor crane 32t should be shifted from the railway loading area to the quay side either on berth No.5 or No.6.

Crane No.30 a Ganz 5t should be removed to berth No.9 to concentrate all Ganz cranes in one area and relief the very old Ganz cranes. A 5t crane is not sufficient for container handling operation requiring at least a lifting capacity of 30 t under the spreader.

4. Technical Specifications

Asset No.	Year of construction	Type of equipment	Rehabilitation costs in USD	Priority
27	1987	Albatros 10t	550.000	second priority
33	1975	Albatros 10t	600.000	last priority
34	1975	Albatros 10t	600.000	last priority
Subtotal			**1.750.000**	

3.5.10 Berth No. 12, 13 and 14, Container

This area will be transferred into a container handling area for self sustained container- and ro-ro ships. In the moment the rail ferry and some ro-ro ships are handled along berth No. 12 and 13.

Berth No. 14 is blocked by not operating fishery boats.

3.6 New Port Handling Equipment

3.6.1 Berth No. 6 and 7 and Extension area behind berth No. 7

For the container handling operation i.e. loading and unloading of Tractor/Trailers and railway wagons and the transportation of container between the stacks and the ships following equipment is needed. In extreme peak situations equipment can be transferred from berth No. 6 and 7.

Phase I, 1998

Quantity	Type of equipment	Unit price in USD	Total price in USD
5x	Reachstacker 40t	370.000	1.850.000
4x	Terminal tractor	100.000	400.000
8x	Terminal chassis 40'/38t	25.000	200.000
4x	Rotating telescopic lightweight spreader 35t	100.000	400.000
1x	Spare parts 10%	285.000	250.000
Subtotal			3.135.000

One ECH Empty container handler is not foreseen, as the empty stacks are shattered over the three container areas.

To increase the productivity for container handling a CTIS Container Terminal Information System is urgently needed. This computer based system allows a detailed control about all container movements, planning of loading/unloading of ships , trucks and railway wagons and the fast invoicing of port services. This system will lead to a better utilisation of the limited areas for container handling in Poti.

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 1: Container Gantry Crane

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Phase II , 2003 - 2007

Quantity	Type of equipment	Unit price in USD	Total price in USD
10x	FTL 2.5t	35.000	350.000
1x	FLT 10t	85.000	85.000
1x	Terminal Tractor	100.000	100.000
4x	Bobcats	40.000	160.000
1x	Spare parts 10%	69.500	69.500
500x	Paletts Hanse 2t	50	25.000
Total Phase II			**789.500**

Phase III

During this phase no new equipment is required, as the units purchased during phase II have not reached the end of their lifespan.

3.7 New Cargo Handling Equipment for the New Container Terminal North

3.7.1 Phase I, 2001 - 2002

Number + Type of Equipment	Unit Price in USD	Total Price in USD
2 Ship/Shore Container Gantry Cranes	4,500,000	9,000,000
2 Rail Mounted Gantry Cranes (RMG)	1,500,000	3,000,000
4 Rubber Tyred Gantry Cranes (RTG)	1,400,000	5,500,000
15 Terminal Tractors	100,000	1,500,000
30 Container Chassis 40'-38mt	25,000	750,000
Spareparts for items 1 - 4 (Basic)	700,000	700,000
Workshop Equipment	250,000	250,000
1,000 Hanse pallets	50	50,000
Stevedoring Gear	100,000	100,000
4 Container Stuffer	35,000	140,000
1 CTIS Container Terminal Information System		500,000
Total Phase I		**21,590,000**

The requirements for equipment for the years 2003 to 2007 are covered by the above equipment.

1. General Description

These Specifications describe a high-speed 40-t Ship-to-Shore Container Gantry Crane which shall be purchased by the Beneficiary and which shall be used for container handling of 40-t suspended payload under lifting spreaders for handling fully loaded ISO 20' and 40', 9'6" height containers by means of telescopic spreader beams.

The crane shall be capable of continuous and simultaneous lifting and trolley travelling, depositing loaded containers and gantrying in repetitive cycles at the required speeds.

For the purpose of handling heavy general cargo lifts, the spreader shall be replaced by a hook beam.

1.1 Design Features

The design features, all material and equipment to be supplied and protective treatment of steel work must be suitable for use under the environmental conditions in Georgia.

The crane must be designed to operate with minimum maintenance under the defined conditions. It must be made sure that the electrical and mechanical equipment does not overheat, especially where exposed to direct sunshine.

1.2 Design Criteria

Unless otherwise mentioned, the design shall be based on the latest edition of the applicable design standards.

(1) The mechanical and structural design shall comply with

BS 2573 - Part 1 (1983), Group A 7,
BS 2573 - Part 2 (1980) and
BS 466 (1984)

where applicable. (Specification for Classification, Motions, Stress Calculations and Design Criteria for Structures)

(2) The fatigue design shall be based on a conventional number of hoisting cycles on a minimum of 2 million cycles of operation when subject to a load of 80% of the maximum 35 t weight of a 40" ISO-1A container centrally disposed.

(3) The crane shall be fully operational up to wind speeds of 72 km/h (45 mph) equal to a pressure of 250 N/ml and shall withstand an out-of-service wind pressure of at least 1,250 N/ml with no load under spreader and with raised boom.

(4) Electric motors and generator shall conform where applicable to the latest revisions of:

BS 4999 and BS 5000, Part 99-1973, VDE 0530-Rating

State of loading: Q2
Group Classification: A7

The design software used by the successful Bidder in designing the crane structure, shall be certified by an internationally recognised classification society. A certificate acceptable to the Purchaser shall be furnished during contract negotiations.

(2) Drive Mechanism

The drive mechanism shall be designed and selected in accordance with BS 2573, Part 2 - 1980 and shall be classified as follows:

	Hoist/traverse	Long travel	Derrick
Class of utilisation	T7	T5	T4
State of loading	L3	L2	L1
Group of classification	M8	M5	M3

(3) Drive Motors

- main hoist
- trolley drive
- gantry travel
- boom hoist

All electric motors to be rated according to VDE 0530 in conjunction with publication 31-1/Rotating Electrical Machines (Seventh Edition) issued by IEC, and BS 2613, 1970. Winding insulation shall be "Class F".

The following minimum ratings to be applied:

Drive	Duty type	Duty factor
Hoist Motor	Intermittent Periodic S3	80%
Trolley Motors	Intermittent Periodic S3	80%
Long Travel Motors	Intermittent Periodic S3	40%
Boom Hoist Motor	Intermittent Periodic S3	25%

3. Dimensions And Principle Particulars

3.1 Main Crane Dimensions

Span (rail centre distance of existing gantry runway):	18.0 m
Outreach from waterside rail centre:	38.5 m
Backreach from land side rail centre:	18.0 m
Height under spreader (above seaside rail under spreader):	30.0 m
Lowest point of spreader (below waterside rail)	15.0 m
Total spreader hoisting/lowering path:	45.0 m
Clearance between portal legs:	16.0 m
Overall length - buffer to buffer:	24.4 m
Minimum clearance under sill beam (portal cross beam):	14.0 m
Distance from centre of waterside rail to ship:	3.0 m
Number of wheels per corner:	8
Number of driven wheels per corner:	4

3.2 Gantry Runway

The crane shall be designed to operate on A 100 crane rails which have a head width of 100 mm.

Design and layout of the runway rails is according to the following requirements:

Runway rails are designed with level difference of 1 degree between waterside and landside rail (seaside rail is lower).

Tolerances of the runway are

- Rail gauge: ± 5 mm per 10 m of rail length
- Level to one another: ± 4 mm per full length
- The rail is level to within ± 5 mm over the whole length of the track and
- ± 2 mm of intervals of 10 m.
- Rail slope in the direction of travel is zero.

3.3 Wheel Load Limitation

4. Electrical Supply

4.1 Main Power Supply

Power to operate the crane will be 11,000 Volt, 50 Hz, 3-phase + èarth. The permissible voltage tolerance is ± 3%.

4.2 Supply Method

The crane's power supply is ensured by means of a trailing cable which is coiled onto a cable reeling drum to be located at the inside of the waterside crane leg.

The type of trailing cable shall be:	NTSC gewoeu (Siemens or equivalent)
Cable size:	3 x 25 + 3 x 25/3
Cable length:	200 m, for 400 m of track length

4.3 Electrical Feed Point

The Purchaser will provide the 11 KV main power supply cable until the electrical feed point. The Contractor shall furnish and duly install all necessary funnels and installation material required and shall connect the trailing cable to the electrical feed point.

4.4 Fault Level

The power supply system design considers a maximum fault level of 350 MVA and a fault clearance time of 0.2 sec.

4.5 Operating Voltage

The crane operating voltage shall be 415 V, 50 Hz.

4.6 Crane Earthing

All electrical apparatus and motors shall be efficiently earthed by means of copper tape brought to a common point, which shall be connected to the earthing wire of the power cable. Series connections are not permissible. The crane structure shall also be earthed to the power cable.

Earthing conductors shall not run or be fixed on any access path, floor, passage or walkway.

Any stranded earth cables shall be terminated in sweated sockets which, in turn, shall be rigidly bolted to the earth terminals of the materials.

BS 2613 - Performance of Rotating Electrical Machines
BS 2757 - Classification of Insulation Material

(5) Cables, flexible cords for power and lighting shall conform to VDE, DIN 57281/57282, and to BS 6500/6116, where applicable.

(6) Contactors, low voltage control gear, HT switch gear and HT transformer shall correspond to the latest revisions of BS 775, IEC 158-1/IEC 56, VDE 0660 and to the IEC in general, where applicable.

(7) The steel quality shall correspond to FE 360 (ISO) equal to a36 (ASTM).

(8) High-tension friction-grip bolts in galvanized and crack-tested execution shall be used throughout the crane in accordance with:

DIN 931/934/6914-15	-	Hexagon high-tensile bolts
DIN 6915	-	Washers for high-tensile bolts
DIN 267	-	Fasteners and similar parts

(9) All works shall be done in a thorough workmanlike manner and shall follow the most recent practice in the manufacture of high-grade machinery. All work shall be performed by workmen in their particular trades.

All welders and welding operators shall have been certified as qualified for the materials, processes and type of weld being performed. Certificates to be handed over to the Purchaser for revision and approval.

Welding procedures shall come up to the requirements of BS 5135. Test weld samples shall be tested to BS 709, and the Bidder shall include in its Bid all costs incurred in the testing of welding and the provision of test samples.

(10) Ropes
Rope diameter and safety factor to be selected according to BS 2573, Part 2 - 1980.

(11) Pulleys and Drums, Rail Wheels
according to BS 2573, Part 2 - 1980

(12) Gear reducer and crane brakes to be selected according to R 20, DIN 323, DIN 15053 - Cranes Reduction Principle Specifications and DIN 15431/15435, dimensioning of brakes and power transmission engineering respectively.

(13) The general design of the gantry crane shall be in the metric system unless explicitly requested otherwise.

1.3 Classification

(1) Crane Structure

[illegible] calculated and comply to BS 2573, Part 1 - 1983. The crane is to be

5. Main Technical And Design Demands

5.1 Main Frame Construction

The main frame shall be an all-welded, rigid-frame, box-girder type construction, utilising the latest design techniques to provide an attractive structure with a minimum of maintenance. Back-to-back angles or channels or lattice members shall be avoided. Closed type sections of square structural steel tubing or steel pipe shall be used wherever possible. The design shall avoid pockets where water may collect. Bolted special joints or bolted connections of box type or other closed connections where water seepage may occur shall be equipped with steel pipe coupling drains.

All members shall be sealed and air-tested to prevent condensation and internal corrosion.

Manhole with gasket covers shall be provided at the end of the members (beyond the sealed sections), as required, for structural joints and electrical connection checks and maintenance.

Field connection shall be made with high-strength bolts or by field welding.

All members shall be amply proportioned to provide a rigid structure. Maximum deflections for operating conditions shall be included in the calculations submitted to the Purchaser and shall be subject to approval. The crane design shall be such that the maximum deviation at the end of the boom in the horizontal plane is less than 40 mm when the rated load is at the maximum outreach under maximum operating wind load conditions. The gantry shall be designed in a way that the longitudinal deflection at trolley rail level does not exceed 125 mm when the gantry is travelling at rated speed against the gantry bumper stops. This deflection shall not exceed 75 mm in case the gantry is stopped by the emergency stop while travelling at rated speed.

Excessive vibrations of the crane or vibrations harmful to the crane shall be avoided. If required by the Purchaser, the Contractor shall submit detailed calculations that will demonstrate that the design of the trolley travel system and the gantry structure will result in a natural frequency of over 1.0 Hz in the trolley travel direction.

All members, except the ones that have provisions for access to the inside, shall be made air-tight by seal welding. Sealed members shall be pressure-tested using soap film to demonstrate air-tightness.

5.2 Boom Construction

The boom shall be of single-box or mono-beam lattice type construction to provide the greatest possible strength to weight ratio. The boom shall be hinged at the heel end. A wire-rope hoisting system shall be provided, connected to the waterside end, for raising the boom structure into a stowed position so that no part of the crane will interfere with the ship's structures. In the stowed position, the boom shall be secured by boom latches.

The boom hinges shall be easily accessible for maintenance and lubrication. The boom hinge pins shall be mounted in self-aligning anti-friction bearings.

2. Operating Characteristics

2.1 Lifting Capacity Requirements

The maximum lifting capacity below the telescopic spreader shall be 40 mt. This includes a maximum allowed eccentricity in longitudinal direction of one meter of a 40' container with a load of 35 tons. The Bidder shall specify in his quotation the weight of the spreader and the weight and lifting capacity of the heavy-lift cargo beam.

2.2 Operating Cycle

The number of operating cycles shall not be less than 35 containers per hour.

The Bidder shall submit with its proposal a comprehensive speed calculation to verify the required cycles.

2.3 Speed Rates

2.3.1
Long Travel Speed: 45 m/min

2.3.2
Derrick, raise/lower: 5 min

2.3.3
Spreader Tilt and Slew

Means shall be provided to allow the spreader to be tilted not less than ± 5 degrees about axes parallel to and at right angles to the berth face. The spreader must also be allowed to slew by a minimum of ± 5 degrees.

Time to tilt the spreader by 5 : 30 seconds
Time to slew the spreader by 5 : 30 seconds

□

5.4 Operator's Cabin

The operator's cabin shall be mounted below and on the landside of the trolley to provide full visibility of all operations the crane is specified for.

The cabin shall be of double-walled steel construction designed to minimise heat gain. The cabin shall be weather proof under all weather conditions, fire resistant and insulated to restrict noise level to 78 dba or less at the operator's position. The space between the double-Floor plates shall be used for electrical wiring. The upper floor plate shall be vinyl covered and bolted to provide access to the electric wiring. Cabin framing shall be securely fastened to the trolley by means of high-strength structural fasteners and eliminate relative movement. A mirror shall be fitted to enable safe and visible approach to the parking bay of the cab. Final size and layout of operator's cabin shall be submitted to the Purchaser for approval.

All lower windows shall be fitted with safety bars such that if the windows are removed or opened, the safety bars remain in position to prevent the operator falling through an open window.

All cabin windows shall be designed in a way that will allow the operator easy access for cleaning. Wind shield wipers with washers shall be provided for lower front operator cab windows.

Safe exit and entry to the operator's cabin shall be possible at any time from any position of the trolley via a stairway to a platform and a door at the rear of the cabin, and shall be accessible from the access platform only when the trolley is at its special position on the boom, indicated in the operator's cabin. For emergency cases, entry/exit at any location of the boom with corresponding safety interlocks to be provided.

A remote air-conditioning/heating unit of industrial type should be provided, which will direct air via a duct and distribution system to the operator's cabin and which will maintain conditions of 22 to 24° C and 50 per cent of relative humidity under maximum ambient temperatures and humidity.

The unit shall be filled with Frigen, type R 134a or equivalent.

The interior trim shall be accomplished by using modern decor materials (as formica for the walls, PVC for the floor, etc.) which are easy to clean.

Windows of safety glass shall be provided to give the complete view of the container's ship's and chassis position. The upper windows to be made of tinted safety glass.

The cabin door shall be equipped with suitable means for exterior locking.
Upholstered, fully-adjustable spring or air-cushioned chairs with weight adjustment shall be provided with comfortable access to all control and devices and maximum view. The seat/control unit to be provided with a swivel base of at least 120 degrees to each side. the two compartment-type consoles to be provided with lateral movements.

All operations of the crane shall be controlled from the operator's cab with the exception of the boom raising/lowering.

All controls shall be readily accessible to the operator and oriented in a way that the crane will respond in the direction that the operator moves them.

Activation of controls shall be of the "joy-stick" type and automatically position into "O".

Two load indicators shall be provided inside the cabin:

The existing quay-wall design restricts single wheel loads to a maximum of:

40.0 tons under working conditions (acceleration/deceleration) with full rated load and in-service wind pressure of 25 kg/ml.

3.4 Buffer Stops

The crane must be supplied with buffer stops which are to be mounted on the centre line of each rail. Buffers shall be calculated to FEM Para 2.234.

An access hatch shall be provided in the floor to allow for removal and lowering of the largest piece of equipment. The machinery room shall be provided with necessary maintenance equipment such as machinery hoist, rope re-reeving system, work bench fitted with vice. The bench shall be at least 2 m long and 1 m wide. The vice shall be mounted on one side of the bench. space and place for electrical outlet shall be provided for a bench mounted at least 14 mm vertical drilling machine. Adjacent to the bench, space shall be provided for a grinding machine and portable arc welding apparatus. Electrical outlets will be provided for each one of them.

Drilling and grinding machines and welding apparatus will be furnished by the Contractor.

For the hoist system mounted in the machinery house, a re-reeving device shall be provided for the easy replacement of any hoist and trolley ropes. This shall consist of two wire rope spool mounts in the machinery house. One shall support a spool of replacement rope of proper length with a friction drag brake. The other shall support an empty wire rope spool and be powered. To replace any rope, one end of the old rope shall be connected to a new rope with the other end attached to the empty spool. The spool shall be powered to pull the new rope through the system.

Guides with openings as small as practical shall be provided for protection of ropes where they pass through openings in the machinery room. Openings shall be shrouded with heavy-duty rubberised fabric to reduce water and dust penetration to a minimum.

The illumination of the machinery house, which shall be of a level acceptable for safe maintenance operation, etc. shall be of the fluorescent type.

The machinery house shall be adequately ventilated to prevent undue temperature rise under working conditions, such ventilation arrangements shall be duplicated and sited in the most advantageous position for good ventilation with air ingress vents protected against entry of sand and dust by filters. The filters are to be removable for cleaning purposes with easy access platforms duly installed.

All cable conduit pipes runs laid on the machinery house floor are to be grouped together and covered with removable chequered steel plate so that there is no hindrance or hazard to personnel movement within the machinery house.

5.8 Electrical Equipment Control Room

The crane shall be equipped with a separate control room of sufficient size to contain all required electrical control cabinets and motor control centres.

The control room shall be framed of structural steel, thoroughly braced to withstand all stresses produced by operating machinery. The sides of the control room shall be covered with galvanised and painted corrugated sheet steel. The room shall be adequately insulated to prevent undue temperature rise under working conditions. Interior insulation shall be protected by damage-resistant covering. The room should be equipped with two doors on opposite walls.

The room will be made as air tight as practical, with joints, conduit, pipe or other attachments which pierce the insulation, being sealed a the point of entry.

The control room shall be equipped with two (2) split air-cooling/heating units.

The earth connections shall be made on to conduits by means of heavy-type copper clamps.

Where lengths of flexible metallic conduit connect machines or other materials, the earth continuity shall be supplemented by a separate earth conductor connected between the rigid conduit and the earth terminal of the materials.

The whole installation to be carried out in a neat workmanlike manner to comply with the appropriate regulations.

4.7 System Power Demand

The power system demand will be estimated when operating at night time with all lights on and with rated load and the critical theoretical duty.

The Bidder shall furnish with its Bid a detailed calculation for system power demand.

The air-cooling/heating units shall be industrial-rated, thermostatically-controlled units capable of maintaining an inside temperature in the room and the cabinets of 22° C.

Each one of the two units shall be capable of maintaining the specified temperature when operating alone. The split unit enables the cooling of the air inside the room by circulating the inside air through a radiator thus eliminating the need to introduce outside air through a filter and reducing the amount of dust penetrating into the room to a minimum.

The control room shall be provided with necessary maintenance equipment such as work bench, desk for drawings, PCs, etc., lockable cabinets, adequately sized for complete set of documentation, test instruments and gauges as deemed necessary by the Bidder.

The illumination of the control room, which shall be of a level to allow for safe maintenance operation, etc. shall be of the fluorescent type.

5.9 Main Drive Systems

The DC-main drive system shall include 3-phase thyristor power-conversion units, ABB, Siemens or approved equivalent, required motors, brakes, transformers, switch gear, circuit breakers and diagnostic systems.

The Bidder shall - in addition to the above - propose AC-drives using direct torque control technology or pulse width modulation technology (i.e. frequency or flux control).

Provision shall be made for the hoist control system to feed back power into the network during lowering motion (4-quadrant).

The system shall be simplified for easy maintenance and repair applications and shall provide motor drives for:

- main hoist system
- trolley travel system
- gantry travel system
- boom hoist system
- cable reel drive (if applicable)

5.9.1 Main Hoist System

The hoisting motion shall be driven by electric motors through totally enclosed gear. Two fail-safe disc brakes shall bring the load to rest from full speed without undue shock in as short a distance as possible. Each brake is to be capable of bringing to rest and holding the crane's full working load.

The Bidder shall specify the stop distance of emergency main hoist braking with maximum load and maximum lowering speed in case of power failure/actuation of emergency-stop push button.

The drum(s) shall be fitted with high-tensile shafts and run on heavy-duty self-alignment roller bearings enclosed in fabricated steel. Four hoist ropes, double-reeved, shall be used for carrying loads. The length of the spiral grooved portion of the drum(s) shall be sufficient to accommodate the complete hoist rope in a single layer with two additional dead turns and one free grove.

In the lowered load-handling position, the boom shall be supported by forestays and hinges shall have provisions for self-locking the boom into the gantry structure at the heel end to relieve the load on bearings and hinges during operation. Forestays shall be structural shapes with link hinges. Wire rope forestays are not acceptable.

The pivot of the waterside section is to be arranged in a way that when the ship lists 5 degrees, a sufficient distance remains between crane structure and ship when the boom is topped up.

Control for raising and lowering the boom shall be provided at a special operator's station located at the upper part of the crane with maximum view of the boom position.

5.3 Stairs, Ladders, Platforms, Walkways

The crane shall be provided with stairs, ladders, platforms and walkways for safe and easy service, maintenance and inspection. The top handrail shall be not less than 1,000 mm above platform level.

The operator's cab, machinery room(s) and other parts to be serviced, maintained and supervised shall be safely accessible by means of stairs and walkways. Ladders are to be avoided as far as possible.

A walkway shall be provided on full length of the boom.

Service platforms shall be provided at the boom hoist station latched position on the top of the main structure. Every structural connection (welded or bolted) above 30 m high must be accessible for NDT inspection of weldings.

Vertical ladders should be avoided, but - if absolutely necessary as a result of space restrictions - may be accepted subject to the Purchaser's approval.

The pitch between the ladders' rungs shall be not greater than 300 mm, the rungs being at least 300 mm wide and as well raked as possible. Ladders shall be equipped with safety cages unless otherwise approved by the Purchaser.

Ladders exceeding 9.5 m in length are not permitted unless suitable rest platforms are provided.

Platforms may be of open mesh construction, heavily galvanised and of a robust construction with high corrosion allowances.

Open mesh platforms will be supported by steel beams. Any areas of unsupported mesh are not to exceed 0.5 ml.

Access hatchways, where provided, shall be guarded on three sides by handrails and on the fourth side to be closed by means of a hinged gate.

Where an access hatch is positioned in a walkway suitable means shall be provided to ensure that the hatch is closed after use.

Pipe or tubular handrails shall be sealed against the entry of air, and all stanchions are to be of mild steel angles suitably sized to provide rigid support to handrails. All stanchions are to be welded to steel frame structures and not attached to platform mesh.

5.9.2 Trolley Travel System

The trolley shall consist of a structural steel frame supported by four double-flange wheels riding on rails mounted to the crane boom. The trolley shall have mounted on it the main hoist sheaves, and it shall support the operator's cabin.

The trolley and the cabin shall be accessible at any point in its travel and access shall be such that a disabled operator can be removed without special rigging.

The trolley shall be completely decked with chequered plate and shall be enclosed with hand railing with kick plates. All openings shall be fitted with continuous kick plates at least 100 mm high. All parts shall be safely accessible for maintenance and replacement.

The trolley frame shall be equipped with integral jacking device(s) to support the trolley at any point of its travel during wheel replacement. Wheel/axle and sheave mountings shall be such that wheel/axle assemblies and sheaves are removable vertically upward. A drop block shall be provided to support the trolley in case of a broken axle.

Electrical connections between the trolley and boom shall be by means of a festoon system.
The trolley drive system is to be self-propelled. Four driven wheels to be provided. Smooth acceleration and deceleration are required. Details to be discussed during the detailed design to harmonise the system for minimum horizontal movement of the gantry structure during acceleration/deceleration.

Trolley wheels and rails shall be sized in accordance with BS 466 and BS 3037, Part 2. A dry lubrication system shall be provided to minimise wheels' wear and tear. Rail type A 65, ST 60 is acceptable.

The trolley rails shall be either welded to the trolley girder or preferably fastened by means of adjustable bolted clips.

If the trolley rails are not welded to the trolley girder, they shall be continuous and secured with rail clips, as manufactured by GANTREX or equal, bolted to the crane's structure. Rail base and mounting surface shall be painted before installation. Rail sections shall be joined by welding and rail runs be secured against axial movement by means of welded shear bars.

Continuous reinforced rubber bearing pads under the rails may be provided, as manufactured by GANTREX or equal.

The transition from the firm portal to the lowered boom shall be smooth and not cause any undue shocks and noises to the trolley/cabin system.

Suitable anti-derailment devices and a locking pin to prevent movement of the trolley during maintenance operations shall be fitted together with two (2) emergency-stop controls.

The successful Bidder shall specify squareness tolerances of the rail cross section and tolerances for flatness of the rail mounting plate. Calculations of rail web and support web stresses based on these tolerances and inspection procedures for maintaining the tolerances shall be submitted for the review of the Purchaser.

- one digital indicator to be installed at the auxiliary panel
- one coloured analogue indicator marked with red, yellow and green zones, visible to the operator; its location to be approved by the Purchaser

Provisions shall be made for a 12 V supply for installation of a communications radio adjacent to the driver's control together with telephone, microphone and loudspeakers.

Seats, operating and control equipment shall be constructed according to the latest developments in ergonomics and suitable for a permanently-manned working position.

Storage space shall be provided for items such as coats, lunch buckets and a portable water cooler.

One collapsible wall-mounted cushioned chair for an instructor/second driver shall be provided at a suitable location. Both, driver's seat and wall-mounted seat to be fitted with seat belts.

Complete operating instructions for the proper use of the crane shall be provided in the cab.

The Bidder shall submit with its Bid a layout of the driver's cabin including proposed locations of all control systems.

5.5 Boom Operator's Cabin

This cabin shall be suitably positioned to give the operator a clear view on and to control all operations of boom and safety latches as well as long travel. The cabin shall be fire proof, thermally insulated and provided with anti-glare glass. Door locks to be provided.

5.6 Checker's Cabin

Provisions shall be made for a checker's cabin incorporated in the landside structure with easy access by means of a sliding door from the waterside of the landside portal beam. The cabin to be equipped with sliding windows and a desk (bench) to be installed. Adequate ventilation shall be provided.

5.7 Machinery House

A water- and dust-tight machinery house shall be provided with design and dimensions of ample size to adequately accommodate all items of mechanical equipment including the transformer.

The structure shall be a galvanised steel-frame-covered roof, and steel plates of at least 3 mm galvanised steel sheets with chequered plate floor on steel supporting members, positively fixed to the crane's superstructure to prevent vibration. Insulated cladding shall be double-skin sandwich type for machinery house walls and roofs of approximately 65 mm.

Access doors with windows (safety glass) shall be furnished at the sides and shall be provided with automatic door closers and latching devices to hold the doors open if desired.

Stowage pins shall be supplied with limit switch to prevent starting up the gantry drive system if the stowage pins are not out of the holding position.

The final distance between the stowage pin and the rail centre shall be submitted to the Bidder during contract negotiations.

The crane shall be equipped with a mechanically-operating rail clamp capable of arresting the crane in any position. The clamp shall be interlocked to the long-travel drive system in a way that the system cannot be activated if the clamp is in the grip position.

Two proximity switches designed to give warning of the approach within the safe distance of another crane or the approach to the end track buffers is desirable.

Four (4) emergency stop push-buttons shall be provided on the bogies to stop the long-travel motion. Push buttons shall be reset at quay level.

5.9.5 Boom Hoist System

The boom shall be raised and lowered by the boom hoist, located in the machinery house, through two independent sets of wire rope and reeving, either one of which shall be adequate to safely raise or lower the boom. The ropes for the boom hoist shall lead from the drum to the gantry frame top, then to a multi-part reeve-up between the boom and the gantry frame top. The dead ends of the reeve-up shall be independent but equalised and shall be safely accessible for inspection. All parts of the reeving system shall be designed to withstand motor stall and maximum brake torque without exceeding 75% of the yield of the material used. Provision shall be made to prevent rope being paid off the boom hoist drum without proportionate lowering of the boom (sag rope protection).

A boom latching system shall be provided for securing the boom in the elevated position. The latch(es) shall be secured at the top of the gantry frame, shall automatically engage, and shall be released by push-button operation at the boom hoist control cabin. The latching system shall unload the boom hoist ropes. Bumpers shall be provided to cushion the entry of the boom into the latch(es). The mechanical design of the latch(es) shall prohibit unlatching the boom unless it is suspended by the boom hoist.

The boom hoist shall be a single complete unit consisting basically of a direct current motor, brake, enclosed helical gear reduction unit, rope drum and an electrically released spring-set brakes.

The boom hoist latching mechanism shall be fully visible from the hoist control cabin.

The brake system shall consist of two independent brake systems. The main brake to be fail-safe, spring-applied electro-hydraulic unit, located between the motor and the gear reduction unit. The secondary (emergency) brake to be a fail-safe disk brake to be installed at the non-driven end of the rope drum, actuated by a set of pre-loaded springs and released by an electro-hydraulic activator unit in case of power failure or emergency stop.

Over-speeding shall be controlled by an over-speed switch connected to the hoist machinery and set to engage the secondary brake at 10% over-speed.

5.9.6 Emergency Drive Control System

The air-cooling/heating units shall be industrial-rated, thermostatically-controlled units capable of maintaining an inside temperature in the room and the cabinets of 22° C.

Each one of the two units shall be capable of maintaining the specified temperature when operating alone. The split unit enables the cooling of the air inside the room by circulating the inside air through a radiator thus eliminating the need to introduce outside air through a filter and reducing the amount of dust penetrating into the room to a minimum.

The control room shall be provided with necessary maintenance equipment such as work bench, desk for drawings, PCs, etc., lockable cabinets, adequately sized for complete set of documentation, test instruments and gauges as deemed necessary by the Bidder.

The illumination of the control room, which shall be of a level to allow for safe maintenance operation, etc. shall be of the fluorescent type.

5.9 Main Drive Systems

The DC-main drive system shall include 3-phase thyristor power-conversion units, ABB, Siemens or approved equivalent, required motors, brakes, transformers, switch gear, circuit breakers and diagnostic systems.

The Bidder shall - in addition to the above - propose AC-drives using direct torque control technology or pulse width modulation technology (i.e. frequency or flux control).

Provision shall be made for the hoist control system to feed back power into the network during lowering motion (4-quadrant).

The system shall be simplified for easy maintenance and repair applications and shall provide motor drives for:

- main hoist system
- trolley travel system
- gantry travel system
- boom hoist system
- cable reel drive (if applicable)

5.9.1 Main Hoist System

The hoisting motion shall be driven by electric motors through totally enclosed gear. Two fail-safe disc brakes shall bring the load to rest from full speed without undue shock in as short a distance as possible. Each brake is to be capable of bringing to rest and holding the crane's full working load.

The Bidder shall specify the stop distance of emergency main hoist braking with maximum load and maximum lowering speed in case of power failure/actuation of emergency-stop push button.

The drum(s) shall be fitted with high-tensile shafts and run on heavy-duty self-alignment roller bearings enclosed in fabricated steel. Four hoist ropes, double-reeved, shall be used for carrying loads. The length of the spiral grooved portion of the drum(s) shall be sufficient to accommodate the complete hoist rope in a single layer with two additional dead turns and one free grove.

5.10.2 Drums and Sheaves

Rope drums and sheaves shall be of high-grade cast or welded rolled steel with machined grooves. The grooves shall be smooth and well-rounded and shall have a depth and groove pitch compatible with the wire rope that will be spooled.

The drums shall conform to BS 2573 and be stress relieved before machining.

All hoist wire rope drums shall be driven directly from the low-speed shaft of the respective reducer.

Drums shall be mounted on shafts utilising anti-friction type bearings to assure shaft alignment and minimise vibration.

Rope anchorages shall be of approved design and shall avoid the necessity for splicing rope ends after the ropes have been reeved onto the crane.

The arrangement of the drums and sheaves shall be such that the fleet angle of the rope shall not exceed 3 degrees.

Sheaves shall be provided with steel guards of at least 12 mm thick steel plates to prevent the ropes from jumping out of the grooves.

Tolerances shall be indicated and gauges provided to indicate worn-out sheaves. In addition, the Contractor shall recommend repair/replacement methods and periods to ensure safe operation.

Running sheaves shall have a minimum pitch diameter of 30 rope diameters for the main hoist and trolley drive and 24 rope diameters for the boom drive.

5.10.3 Gear Reducers

Manufactured gear reducers for the main hoist and trolley drive shall be selected by multiplying the nameplate kW rating of the designed driving motor by a service factor of 1.75 in order to obtain the equivalent nominal mechanical rating which shall be used as the basis for selecting the respective gear reducer from the manufacturer's rating tables. Lifting lugs shall be provided on upper and lower section.

All other gear reducers shall be similarly selected using a service factor of 1.

The thermal ratings of the gear reducers shall not be exceeded during continuous duty-cycle operations in 45 °C of ambient temperature.

The high-speed stage of the reducers to be of helical or herring-bone gears. The other stages can be either helical or spur gears. The reducers shall be entirely self-contained in an oil-tight steel or cast iron housing. Bearing shall be of anti-friction type.

All gear housing shall be provided with suitable means to gauge the oil-level and an outlet for oil particle sampling. Each reducer shall be provided with a permanently attached name plate containing the following information: the name of the manufacturer, the reduction ratio, the rated mechanical and thermal capacity, the rated speed and the service rating or service class.

Couplings shall be flanged forged steel with exposed bolts, except for the main hoist drum couplings, be flexible gear type and shall transmit only torque.

Calculations of couplings will be based on the manufacturer recommendation and shall be verified by published catalogue data. The service factor will be calculated for:

- crane operation
- moderate shock load
- over 16 hours of daily operation
- over 160 starts per hour

Removable steel guards shall be installed over all couplings.

All couplings' nuts shall be self-locking to prevent their release due to vibration.

5.10.7 Lubrication

Lubrication of all mechanical operating parts shall be provided in accordance with manufacturer's instructions. Oil lubrication shall be provided for speed reducers and other items needing lubrication. Lubrication of other mechanical parts shall be by means of high-pressure grease introduced through industrial button-type fittings. The fittings shall be readily accessible or shall be piped to convenient locations. Each greasing point must be clearly labelled with a stainless steel or plastic label to indicate which mechanism it serves.

The Contractor shall furnish lubricants in accordance with the original manufacturer recommendations in sufficient quantities for initial lubrication of the cranes. The Contractor provide a signed checklist signifying the equipment has been properly lubricated. All motors shall be lubricated at the manufacturing site.

The Contractor shall also supply a list of oil and grease lubricants needed for each reducer, coupling and all other equipment prior to the start of field erection to ensure that all recommended types of lubricants are available in Georgia.

5.10.8 Hydraulic System

All hydraulic power packs shall be appropriately designed for each duty required, self-contained with filters, gangs, test points and level indicator. Wherever possible, components shall be standardised and interchangeable.

The hydraulic system shall be designed in accordance with BS 4575 tested to 2.5 times the safe working pressure with no component used in excess of the original manufacturer's regular catalogue rating. It shall be capable of working in the climatic conditions specified, for the long periods appropriate to intensive container handling.

The whole apparatus shall be equipped with over-pressure protection.

Piping shall not be used to support valves or equipment. Suitable supports shall be provided to eliminate vibrations or movements of pipe and equipment.

5.9.3 Trolley Protection Devices

For end-of-track limit on both ends, the trolley shall be equipped with contactless-type slow-down switches and mechanically-actuated main limit switches. The slow-down switches will ensure that the trolley is approached to the end of the track at a reduced speed.

The design shall permit to operate the fully-loaded trolley on the fixed section of the boom when the waterside hinged section is raised. For this operation, the slow-down and main switch should perform the same task as at end of the track.

Buffer stops shall be provided at the end of the track on the water side and land side of the boom and on the trolley corners. An additional buffer arrangement shall be provided to stop the trolley at the seaside end of the fixed boom when the trolley is in operation and the hinged boom section is raised.

The trolley buffers shall be calculated to FEM classification para 2.234.

An interlock shall be provided to prevent that the hinged section of the boom is raised if the trolley is not in its rest position on the fixed landside section of the boom.

5.9.4 Gantry Travel System

Each corner of the crane shall be supported by an articulated gantry truck assembly designed to distribute the corner loads equally to all wheels within the limitation as specified in para 3 above.

The equalisers and truck frames shall be of heavy-steel-plate boxed construction. Wheel gears shall be within the frame for maximum protection.

The motor can be mounted vertically (V1) or horizontally (B3) but in any case should not protrude from the equaliser side wall line and shall not be mounted on the end track.

Each motor shall drive two wheels through special gearing, to provide ample traction under the most adverse operating conditions.

Provisions shall be made for the drive wheels to be disengaged from the gearing to allow the crane to be moved when its motors are out of service. Gantry travel to be possible if one motor fails.

Adequate braking arrangement shall be provided to the motors, the motors being properly interconnected to ensure that the driving load is shared equally.

The wheel trucks shall be fitted with drop blocks and rail sweepers and the truck assemblies be furnished with bumpers, arranged to contact quay bumper stops or adjacent crane bumpers.

It must be possible to disassemble any wheel without disassembling the whole truck unit.

Truck units shall be arranged to allow removal without elevating the gantry legs. Suitable jack-up points lifting beam and portable hydraulic jacks to allow one complete bogie to be removed for repair or maintenance shall be provided under the Contract.

Stowage pins shall be provided to keep the crane from moving under stowed conditions at its designated parking area at maximum wind velocity.

However, the spreader shall be fitted with electrical sockets to accept an external power supply and a remote control unit that will allow the spreader to be operated through its full range of motions for maintenance testing at a workshop remote from the crane. One remote control unit is to be provided.

5.10.11 Hook Beam

The Bidder shall offer a hook beam for heavy-cargo lifts.

5.11 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the crane design whenever practical. The Bidder shall include in its Bid diagnostic ("trouble-shooting") techniques, procedures and test equipment to achieve an overall reduction of system's down time by providing for rapid location of a fault. The Bidder will list in its proposal crane systems for which such diagnostic procedures have been developed.

5.11.1 Accessibility

Restricted accessibility of modules, assemblies and other items largely contributes to the extension of repair time. The configuration of the hardware and its layout in the crane shall make sure that free and easy access is provided to maintenance personnel, tools and equipment required to perform the repair task.

5.12 Miscellaneous

5.12.1 Overload and Slack Cable System

A system shall be provided which shall automatically stop the hoisting motion and allow lowering only if an operator attempts to lift a load in excess of 110 ± 5% of the rated capacity of the crane. An override shall be supplied to allow adjustment to 125% by maintenance personnel for testing purposes only. An analogue load indicator with the corresponding loading zones marked in green, yellow and red must be provided with the system.

The system shall automatically shut down the lowering motion and allow hoisting only when the main hoist rope becomes slack. This shall prevent the operator from playing out too much rope and then accelerating rapidly under no load before the load is lifted up again.

The system shall prevent ropes from jumping out of sheaves, reduce the shock loads on ropes and structure and reduce the possibility of the spreader jumping in ship's hatches.

5.12.2 Anti-Sway Device

An efficient anti-sway device shall be incorporated to prevent container sway during operation. The anti-sway device shall also be designed to prevent involuntary sluing of the spreader.

Auxiliary AC emergency drive systems are to be provided for:

- main hoist
- boom hoist
- trolley travel system

Each system shall consist of one electrical motor, coupling, (chain) gear reducer and control panel and shall be adequately rated, i.e. time to raise the boom from horizontal to stowed position shall be approximately 30 minutes.

Each system to be installed in line with each main drive motor opposite to the main reducer at the machinery house.

Proper means to operate respective brake systems during emergency operation shall be provided. Key selector switches and appropriate fail-safe limit switches to be provided.

The power supply to operate the emergency drives and brake system shall be taken from the main crane power supply system, and in case of power failure from temporary AC power supply source via appropriate AC power adaptors located at the crane leg for incoming and outgoing power to a failing neighbouring crane.

Necessary AC power adaptors including appropriate wiring shall be provided and installed on the crane.
The Bidder shall submit with its bid a detailed description of the proposed system.

5.10 Mechanical Design

All parts shall be designed so that easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance is achieved.

5.10.1 Ropes

The Bidder shall furnish all wire ropes complete with fittings.

Wire ropes shall be selected according to FEM specification, para 4.2.2.

The calculated safety factor should be determined in loads as specified the FEM sub-para 4.2.2.1.2 and shall not be less than six (6).

All wire ropes shall be treated with the lubricant approved by the Purchaser at the point of manufacture. The wire ropes shall also be re-lubricated in the field prior to being placed in service. The Contractor shall furnish the Purchaser one (1) copy of the wire test certificate for each wire rope on the crane prior to the time the crane is to be certified.

Blocks of hardwood or of other suitable material shall be mounted on the crane structure to prevent damage to wire rope which would otherwise contact steel during operations.

The type, construction and lay of the wire ropes shall be:

Warrington/Seale 6 x 36 = 216 wires with fibre core (DIN 3064), with wire breaking strength of 180 kg/mml.

5.12.7 Fire Extinguisher

Fire extinguishers of approved type and in quantities to be determined by the Bidder shall be provided. The following minimum provisions are to be made:

- one (1) unit to be installed in the operator's cabin
- one (1) at the machinery house
- two (2) in the electrical-control room
- one (1) at dock level, adjacent to the access ladder

5.13 Electrical Design

5.13.1 General

All material shall be new and of the highest grade and quality.

All materials with electrical components shall be suitable for the tropical marine corrosive conditions and the temperatures and humidity indicated before.

All materials shall be of the type normally furnished for heavy-duty crane applications and shall be designed to satisfactorily operate under conditions of moisture and adequately treated or protected against corrosion, moisture, salt, mould, dust, sand or other destructive elements to which it may be exposed during operation in the climate.

All electrical equipment must be derated to suit the specified conditions.

All enclosures of electrical equipment shall be arranged to minimise the entry of dust, and where components generate heat, they shall be suitably cooled.

All electrical materials (components, sub-assemblies, etc.) shall be thoroughly tested to demonstrate compliance with their design requirements.

The Contractor shall demonstrate with his drawings and specifications and with the required tests that the material is capable of performing all of the required functions with a minimum of down time. A complete listing and description of all electrical systems and components shall be included in the manuals required in these Specifications.

The electrical system shall provide reliable power for safe, rapid and precise handling of containers in continuous loading and unloading operations.

The control system for main hoist, trolley, boom hoist and gantry drives shall be DC variable voltage steplessly-regulated control over the entire range of speeds.

The electrical installation shall include the necessary power units and appropriate distribution and control system as well as all necessary motors, controls, signals, indicators, instruments, alarms, protective devices, wiring, software and all other features.

Main hoist, trolley, boom hoist and gantry gearing shall be designed and rated in accordance with BS 436, BS 545, BS 721, Part 2 or the latest applicable standards issued by AGMA.

All gear boxes shall be horizontally mounted.

Gear reducers and their gearing shall be manufactured by a company which is regularly engaged in the commercial production of catalogued, standardised gear reducers for heavy industrial application for at least twenty (20) years. The proposed manufacturer and the quality level of manufacture must be acceptable to the Purchaser.

5.10.4 Bearings

Rotating bearings on the crane shall be of the anti-friction type in metric sizes.

Bearings' life for the defined systems shall be selected on the minimum basis of 20,000 hours, based on the rated load of the crane at the rated speed of the motion.

The tabulated static capacity of the bearings shall not be exceeded under any operating conditions.

Bronze sleeve bearings, if approved by the Purchaser for use in certain locations, shall be designed on a conservative basis after determination of the PV-factor (unit pressure times surface velocity) and proper consideration of the operating conditions.

All bearing stands shall be of cast or fabricated steel machined as required and securely mounted on base by means of bolts and dowels.

Adequate shim allowance shall be provided between all bearing stands and structural bases to permit initial alignment and subsequent realignments, if required.

Bearings and housings shall be sealed by caps or spring loaded lip-garter type seals, and except for reducer bearings, provided with pressure grease lubrication. Bearing seals shall be one of the more commonly used sizes.

Bearing housings shall have removable caps to facilitate periodic inspection of the shafts by non-destructive methods. Closed end cartridges shall not be used.

All bearings used throughout the crane shall be standardised as far as possible. All gantry wheel bearings shall be identical.

5.10.5 Shafts

All shafts shall be fabricated from high-grade steel and shall be adequately sized for the drums, bearings and/or gears. Complete data covering the physical and chemical properties and heat treatment of the material proposed shall be shown on the drawings.

5.10.6 Couplings and Coupling Guards

The electrical wirings shall be sized in accordance with the relevant IEE Regulations and Codes of Practice and BS Specifications, appropriately derated to suit the ambient temperature and multiple parallel runs. It shall be installed to the standards normally accepted as the best of modern international practice.

Electrical wiring suitable for the equipment is:

(1) Internal wiring not subject to direct sunlight may be 600/1,100-V-grade PVC cables or butyl/hypolene cable or equivalent, installed in heavily-galvanised steel conduit or trunking or steel ducting built into the structure. It is essential that the crane's electrical services are easily rewirable, and any conduit systems used must be of the draw-in-type.

(2) External wiring shall be of 600/1,100-V-grade PVC cables supported by suitable cable cleats and adequately protected from direct sunlight.

All wiring shall be stranded copper for moving components and/or hard-drawn copper for fixed installations with a minimum cross section of not less than 1.5 mml for control circuits and 2.5 mml for power circuits, flame retardant, heat resistant, oil and moisture resistant, thermoplastic with nylon jacket and shall be sized in accordance with applicable IEE Regulations and British Standards, adequately derated to suit ambient temperatures and multiple runs.

All wiring shall run in suitable rigid heavy wall galvanised conduit amply dimensioned for the size and number of conductors to be accommodated.

The conduit system shall be generally arranged within the interior crane structure where practical. Where conduit is run on the exterior of the crane, it shall be located so as to prevent any possible damage due to swinging loads. Where conduits enter or leave the structure, doubler plates, where required, shall be used and rigid couplings shall be welded at these locations. Draw-in-type conduit systems must be used and wiring must be easily removed and replaced.

Cable entrances to all panel boards, junction boxes and/or other enclosures exposed to the weather shall be from below. Side entrance may be provided only where entry from below is impractical, and approval must be obtained in each specific case.

All cable not running in conduit shall be protected from direct sunlight when stowed, by adequate shields of robust construction and arranged as such that motor air circulation is not restricted.

All flexible conduit used shall be liquid tight flexible metal type with approved fittings.

Colour codings to be according to applicable standards of BS and IEC.

The wiring for the lighting system and for the electronic control system shall be kept separate from the power and control wiring and shall be run in a separate conduit and junction box system to avoid magnetic and electrostatic interference.

5.13.5 Space Heaters

Space heaters shall be provided for all control panels, switch boards and motors. They shall be capable of operating at 230 V, 50 Hz. A red warning plate shall be provided at each heater location, warning of this separate power source. Heaters in motors and brakes shall be automatically cut off during crane operation.

Where feasible, connections between components shall be flexible hose, adequately supported, with swivel fitting terminals. The number of different sizes and variations of fittings shall be kept to a minimum. Plastic hose shall not be used. Tapered pipe thread connections shall be avoided wherever possible.

Flexible pipe lines shall be of wire braid reinforced rubber hose tube according to BS 3832 and shall be of the preferred nominal sizes unless otherwise approved by the Purchaser. End connections of flexible pipes shall have threads of the re-usable type, capable of being fitted without the use of special tools.

Systems shall have adequate filtration to remove particles 10 micron or greater in size. Filter elements shall be readily replaced and serviceable during system operation, located in readily accessible areas. Automatically switched dual filters shall be used throughout. Indicators shall be provided on each filter.

Cylinders shall have chrome plated stainless steel rods and pins shall be hardened with grease provisions. Cylinders shall withstand pressures at least 1.5 times the maximum operating pressure. The safe working pressure shall be stamped on the cylinder. Cylinders shall be cushioned at each end.

All cylinders and rotary actuators shall be equipped with ball check quick-disconnect fittings at their ports.

All hydraulic components shall be of standard manufacture. Pumping and control units shall be furnished by one supplier who has been regularly engaged in manufacturing similar units for at least ten years.

5.10.9 Head Block

The head block shall consist of a structural frame with two sets of hoist blocks and guarded sheaves that are permanently reeved into the hoist system. The head block shall not exceed 5,800 mm in length.

A cable tub with entry guides shall be mounted on top of the head block to receive the multiple- conductor electrical cable from the trolley. This shall provide a positive maintenance-free system of connecting power and control conductors to the spreader.

The head block shall be designed for quick manual connection to the telescopic spreader using twistlocks. The connection between head block and spreader shall be designed for the specified loads and shall limit interface movement horizontally and vertically to a maximum of 1.5 mm. Locking devices with limit switches shall be provided at each point of connection to the spreader. Limit switches shall prevent hoisting of the head block/spreader or operating the spreader unless the locking devices are all fully engaged or fully disengaged. The interlocks shall be arranged in a way that a key-operated switch will enable hoisting/lowering of head block when the spreader is removed. A selector switch provided for this purpose must be lockable in each of its modes by means of a removable key. A warning light shall be provided a the operator's control console to indicate when the "without spreader" mode has been activated.

5.10.10 Spreader

One 20/40' telescopic spreader is to be supplied. The Bidder shall offer its standard spreader. A BROMMA spreader system will be preferred.

The Bidder may offer an alternative telescopic spreader of approved design and acceptable to the Purchaser, fully compatible with the head block offered.

7. Final Adjustment and Testing

After the crane has been erected, adjusted, lubricated and otherwise made ready for operation, it shall be tested to demonstrate conformity to all requirements for structural, mechanical and electrical components as built. These test procedures will prove the compliance of this crane with the Technical Specifications.

The Contractor shall prepare formal test procedures for all required tests and submit them to the Purchaser for approval 90 days prior to the scheduled handover tests.

(1) The final testing process shall consist of the following main stages:

a) static test
b) dynamic test under varying load conditions
c) overload test
d) testing of safety devices and emergency systems
e) general crane inspection

(2) The crane shall hoist a certified weight of 35 tons simulating as closely as possible the theoretical duty cycle. The duration of this test shall be at least one (1) hour. Should down time occur during this test, the test will be repeated until the one (1) hour duration is accomplished.

(3) The crane shall be operated through full operation cycles of placing and removing fully-loaded containers. The duration of these test cycles is to be repeated for twenty (20) hours, the last eight (8) of which are to be trouble-free.

(4) During the full load and overload testing, measurements are to be taken of the voltage and ampere readings at the generators, drive motors and speeds as well as temperature readings of motors, gear reducer and brakes, and shall form part of the test report to be established by the Contractor.

(5) The Purchaser will furnish crane operators and necessary power supply to the crane.

All test loads and required instruments, measuring and recording devices shall be provided by the Contractor.

7.1 Special Tools

The Bidder shall optionally quote in its Bid for:

(1) Special electrical instruments, measuring/recording and testing devices required for fault detection and maintenance/repair on the electric control and drive system

(2) Special mechanical tools required for the crane operation, maintenance, repair and inspection. These shall include, but not be limited to, special adjusting tools, snap ring pliers, impact wrenches and wrenches for bolts in excess of 38 mm body diameter. Each tool and wrench shall be stamped so as to be easily identified as to its size and special use, if any.

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5.12.3 Wire-Rope Reeving System

A self-contained motor-driven wire-rope reeving device shall be provided and arranged to allow convenient re-reeving of the main hoist ropes and trolley traverse ropes during routine rope replacement.

The winch shall accommodate regular commercial cable reels for the size and lengths of the rope used in the system. A hand-applied friction brake shall be supplied on the winch to control the payout of the replacement rope during re-reeving operations.

5.12.4 Maintenance Hoist

A bridge crane of adequate capacity, complete in all respects, to undertake all lifting of the equipment and machinery for maintenance and removal, shall be installed. The crane shall be so arranged that it can lower any of the equipment and machinery to ground level. The hoist/lower motion shall be driven by an electric motor. Other motions may be manually operated. Arrangements shall be provided to secure the crane against movement when not in use.

5.12.5 Passengers and Freight Elevator

A suitable electric passenger and freight elevator shall be offered for the comfortable, safe and quick delivery of operation and maintenance personnel, portable tools and spare parts up to the level of the main machinery house and operator cabin.

The main technical characteristics are:

a) lifting capacity: 400 kg
b) nominal lifting speed: 30 - 40 m/min

The design, manufacturing and erection of the elevator shall be in accordance with the producer's standard specifications for such type of elevators and comply with BS 5655 - Lifts and Service Lifts.

5.12.6 Air Compressor

An electrically-driven air compressor rated 18 cfm at 125 psi, with a 5 HP motor, complete with automatic-manual reloader and equipped with a 60-gallon ASME receiver shall be furnished and installed in the machinery house for blast cleaning of the machinery and operation of small auxiliary units or tools. The air compressor/receiver shall be equipped with a filter and water trap. A hose reel, with hose of sufficient length to reach any part of the machinery hose and pistol-grip blow gun, is to be furnished and installed above the air compressor.

A heavy-duty warning-siren switch shall also be mounted to ease the use by the operator when he is seated. The switch shall be used for general warning.

5.13.10 AC Sockets and Outlets

At least sixteen (16) 230 V single-phase 16 amp outlets shall be provided as follows:

- one in the operator's cabin
- two in the boom (one at each end)
- one on the peak of the gantry frame
- four in the machinery house
- two in the electrical control room, plus those required for printer, PC and associated equipment
- two at dock level (one adjacent to each rail)
- one at the boom control cabin
- one on the trolley

Three (3) 400/230 V three-phase, 5-pole 60 amp welding outlets:

- one on the trolley
- one in the machinery house
- one at dock level

All outlets shall be of CEE-approved type, suitable for operation of conventional hand power tools, and in case their location is directly exposed to the weather, they shall be weather-proof. Wiring shall be 1,000 V insulation.

5.13.11 Lighting System

A permanent 230 V single-phase lighting system shall be furnished on the crane to provide sufficient illumination for all access ladders, platform walkways, control cabin and machinery house.

The following level of illumination shall be maintained:

• along walkways, ladders and stairs luffing mechanism platform	50 Lux
• machinery house and electrical control room	200 Lux
• in each of the electrical cabinets	200 Lux
• floodlights mounted along the boom to provide illumination at quay level at an area of ± 25 metres from boom centre line	200 Lux
• 2 searchlights below operator's cabin	
• light on the boom on tower to enable the operator to monitor	
• the raising and latching of the boom	70 Lux

Floodlights will be of the high-pressure sodium type, 2 x 400 W, watertight and shall be shock-proof mounted at respective locations. All mountings to be of stainless steel.

Floodlights shall be controlled by means of sealed push buttons on the panel, on the foot of the crane near the staircase and in the driver's cabin. Switches for the ascent lighting in form of push buttons at all necessary points shall be provided. Floodlights mounted along the boom shall be intermeshed in two circuits.

Maximum allowable temperature rise on equipment and wiring shall be predicted. Space heaters shall be sized to protect the equipment when stowed and under operating conditions at ambient temperatures as specified. Due consideration shall be given to temperatures within enclosures and to ventilation during operation.

All materials shall be designed and located so as to ensure easy access for repair and/or removal. In order to facilitate routine repairs or adjustments, ladders, walkways, or access platforms shall be provided as required for convenient access, and shall be fitted with handrails and toe plates as appropriate for the location.

Materials used for the same or similar or allied service shall be of the same manufacture and, when of the same rating, be interchangeable to facilitate maintenance and reduce spare part requirements.

5.13.2 Electrical Materials

All materials or combination of materials shall be selected for maximum corrosion resistance. Aluminium or aluminium alloys shall not be used for housings, fans, blowers, motors, motor brakes, festoon parts or weather-exposed parts or components unless otherwise indicated in the specification.

Ferrous components not contained in weather-proof enclosures shall be galvanised after fabrication and before painting. Cadmium plating is not acceptable.

All screws, bolts, nuts, washers, pins, studs, springs, and other miscellaneous fastenings and fittings shall be of stainless steel unless otherwise approved.

5.13.3 Enclosures

Weather-proof or watertight enclosures of the hood-latch type shall be used in all locations permanently exposed to the weather, withstanding vibrations encountered in the crane.

Junction boxes, terminal boxes, outlet boxes and similar fittings in locations exposed to weather shall be made of stainless steel or other approved corrosion-resistant material. Cover screws shall not extend into boxes or any other weather-tight enclosures.

Panels shall be accessible and removable from the front.

Covers of machinery and panel enclosures shall be hinged and capable of being opened to fully expose and allow removal of panels and/or other materials mounted inside. Latches shall be provided to secure all covers when opened for servicing. The latches shall be adequate to secure covers in high winds.

Larger terminal boxes (e.g. terminal boxes for cable festoons) shall be equipped with space heaters and an internal fluorescent lighting fitting, switch-operated.

5.13.4 Wiring

Cables and insulation must be selected for resistance to insect and vermin attack and comply with relevant BSS.

5.13.6 Transformer and HT Switch Board

The high-tension (HT) step-down transformer and switch gear shall be located inside the machinery house. The transformer shall be amply rated and suitably protected by means of relays or equivalent protective devices monitoring temperature. Transformers with reduced losses of cast resin-insulated type and with shock/vibration-proof windings to be selected.

A HT switch board shall be provided for the 11 kV incoming line. The standards of the local power supply authority shall be adhered to.

5.13.7 Motors and Brakes

All motors and electric motor brakes shall be totally enclosed, non-ventilated except where housed in watertight enclosures or in the machinery house. Aluminum or aluminum alloys shall not be used for enclosures or windings.

Motors of the protection class IP 21 - 23 shall be equipped with ventilators and micro-filters. The fans shall be switched off automatically after a cooling-off period.

All motors and brakes shall be sized for torque ratings and for the duty cycle specified and shall meet the requirements of applicable codes and safety regulations.

All motors shall be equipped with a minimum of three (3) integral temperature sensing devices and the associated evaluation and release equipment inside the switch/control boards.

All motors shall be of the same type and rating as far as practical in order to facilitate maintenance and reduce spare parts requirements. In any case, they shall be made by a manufacturer with an excellent service record and world wide service organisation available in most port cities.

Waterproof motors shall be provided with suitable drain plugs and breathers as recommended by the manufacturer.

All motors shall be equipped with regreasable anti-friction bearings designed to meet the requirements of thrust and radial loads and to provide a 50,000 hour minimum life expectancy, except fan motors which shall have a 100,000 hour minimum life expectancy. Grease fittings for these bearings shall be of a different configuration than the other grease fittings used on the crane. Motors shall be completely greased prior to shipment from their place of manufacture.

Sun shields shall be provided over all motors that are exposed to direct heat from the sun. The shields shall be of robust construction and arranged in a manner that air can circulate around the motor. All sun shields are to be painted white.

Electrical brakes shall be of the spring set DC magnet or thruster released shoe or disc type of sufficient capacity to stop test loads from full speed, with integral thermal protection.

Brakes shall be fitted with non-combustible linings not adversely affected by moisture and with waterproof coils. Watertight brakes shall be equipped with external hand release.

Electrical brakes for motors exposed to the weather shall be fully enclosed in a watertight housing with easily removable access cover for adjustment and repair, and with external hand releases.

(14) Trolley clear: to interlock with the boom hoist control so that the trolley cannot travel unless the boom is in the lowered position and supported by the forestays or is in the fully raised and secured position.

(15) Sill beam protection

LANDSIDE:

(1) Emergency stop, 40 + 70 t

(2) Stop, 40 + 70 t: to stop the trolley at the maximum back-reach position.

(3) Slow-down check, 40 + 70 t

(4) Slow-down limit switch, 40 + 70 t: to slow the trolley speed when approaching the back-reach end position.

The activation of the 40-t/70-t limit switch will be effected by the load-sensing equipment.

Boom Hoist

(1) Lower stop: to stop the boom lowering when the weight of the boom is supported by the forestays and to be interlocked with the hoist and trolley motions to prevent trolley travel onto the boom unless the boom is supported by the forestays.

(2) Upper stop: to stop the boom in the raised position after it has entered the boom locking devices.

(3) Lower slow-down: to reduce the speed of the drive when the boom is near the down position so that shock loads to forestays and boom reeving is minimised.

(4) Upper slow-down: to reduce that speed of the drive and to recalibrate the current limit so that the stall torque of the drive will not damage any part or the crane if the upper stop fails.

Gantry (to be co-ordinated with the prevailing dock conditions)

(1) Slow-down: to slow the crane speed at ends of gantry travel.

(2) Slow-down check: to control if step number (1) has been effected.

(3) Stop: to stop the crane at ends of gantry travel.

(4) Anti-collision between crane: analogue to steps (1) to (3).

Slack Rope

(1) Slack rope devices shall be provided both for the main hoist ropes and the boom hoist ropes to prevent excessive rope motions.

⇒ armature current of cable reel drive

- hourmeters for
  ⇒ crane "on"
  ⇒ hoist
  ⇒ trolley motors (4)
  ⇒ gantry motors (8)
  ⇒ boom hoist motor

- "on"-impulse counters for main crane circuit breaker

The Bidder shall furnish with its Bid detailed information on the proposed system.

5.13.9 Operator's Console

All necessary controls, indicators and materials for emergency action shall be conveniently located to ease operation when the operator is seated in the fully adjustable chair provided for his use. All controls shall be clearly marked to indicate operation and direction of motion.

The operator's console shall contain all control mechanisms (and indicating lights) necessary for cyclic container handling operation. "Set-up" type of controls and indicating lights such as "control power on", spreader indicator lights and hydraulic-pump controls may be placed elsewhere but shall be within easy reach of the operator.

The console shall contain at least the following:

Ball handle lever switches shall be provided for each of the following functions:

(a) Twist-locks - lock - unlock
(b) Flippers - extend - retract with each flipper able to be operated independently
(c) Selector switch for trolley drive/boom hoist drive

Indicating lights (separate control board visible to the operator at any time) for each of the following functions:

(a) Twist-locks - locked - unlocked - landed
(b) Control power - on
(c) "Without spreader" operating mode

Push-button for the following:

(a) Emergency stop
(b) Control reset

Master switches for the following:

(a) Hoist
(b) Trolley
(c) Gantry

- in the electrical control room
- the transformer vault
- at the HT switch board
- any other location deemed necessary by the manufacturer

5.13.17.3
Any one of the drives which activate an emergency limit switch shall switch off only this particular drive, leaving all other drives unharmed. An emergency limit switch by-pass push button shall be provided in the particular drive section of the control board for use of the maintenance personnel only, in order to reactivate the drive and move the device into the opposite direction to clear the limit switch. The maintenance personnel has to investigate the cause of the failure, repair or make good any defects and only thereafter return the crane to service.

5.13.18 Anemometer

An anemometer shall be provided on the crane.

The unit should include a time delay adjustable from 3 to 30 seconds in order to eliminate the nuisance tripping due to sudden wind gusts and shall not be sensitive to salty environment and vibration.

The instrument shall be provided with channel set points adjustable for field setting at any desired wind velocity, and shall be installed in the electrical control room.

5.13.19 Communication System

A low-voltage telephone system with battery back-up shall be furnished and installed between the operator's cabin, the machinery/electrical-control room and at ground level. Loudspeakers shall be connected to the system to permit user at any station to address persons in the machinery house or on the wharf. All stations shall have call buttons and "press to talk" buttons and be equipped with a volume control. Units exposed to weather shall be housed in weather-proof enclosures.

A telephone handset plugged into the unit with flexible coiled cord, shall be installed at the machinery/electrical-control room. The extended length shall be such as to allow its use anywhere in the rooms.

A loudspeaker shall be mounted on the underside of the operator's cabin pointing downward so that the operator can talk via a microphone in his control console to persons on the ship when the trolley is over the ship.
In addition, provisions shall be included in operator's cabin for radio communication materials. This will include mounting platform, power supply, antenna, etc.

5.13.20 Automatic Warning Sounders

Two electrically-operated automatic warning "sounders" shall be mounted on diagonally opposite gantry legs and shall sound automatically whenever the gantry motors are energised.

Two (2) aircraft warning lights shall be provided, one on top of the main frame (highest point during operation) and one at the end of the boom (highest point when stowed).

The machinery and electrical control rooms shall be equipped with self-contained, battery-operated emergency lighting units. This system shall have a 3-hour duration in case of main or auxiliary power-supply failure and shall provide sufficient illumination for safe transit through the control rooms. The illumination level of emergency lights shall be not less than 1 Lux.

Additional units shall be installed in the operator's cabin and on the entrances to ladders and to the lift. Illumination of the operator's cabin to be provided with dimmer.

5.13.12 Festoon System

Power and control wiring shall be run in flexible insulated cables form junction boxes on the landside end of the trolley rail girder via festoon systems to junction boxes on the trolley.

Tracks shall be "I"-shaped members and inclined to minimise collision forces on the system.

The cables shall have the greatest number of strands per conductor per current catalogue listing. Cable grips shall be used to relieve strains on the cables before they enter junction boxes.

A platform with lights and convenience outlet shall be furnished to service the festoon systems.

5.13.13 Spreader Control System

(1) Electrical power and control shall be supplied to the spreader from the trolley by means of a flexible multi-conductor cable which coils into a cable tub on the head block. The cable shall be "SPREADER FLEX" as manufactured by Siemens or an approved equal. The cable shall have a right hand lay and coil into the tub in a clockwise direction viewed from above. The cable shall be greased with a suitable silicone grease after installation. 20% of the conductors shall be spare (minimum of 6).

A quick disconnect connector shall be installed at both ends of the cable. Strain on the cable plugs shall be eliminated by suitable means. A junction box shall be provided for quick connection of damaged conductors.

(2) Controls, control wiring, limit switches and all other necessary materials shall be provided to furnish interlocking and indication in the operator's cabin of the position of the telescopic end beams, twist-locks and flipper devices.

(3) As a minimum, the safety features in the electrical system shall be provided with the following interlocks:

a) Spreader cannot be hoisted unless all four twist-locks are fully locked or unlocked.

b) Spreader twist-locks can only be locked or unlocked when all four corners are properly seated on a container, hatch cover or stacking frame. In addition, spreader twist-locks shall not be able to be locked or unlocked, unless slack rope interlock indicates that rope is slack.

The Purchaser's logo shall be prominently displayed in size and at a location to be approved by the Purchaser.

In addition, the Purchaser's logo identification tag shall be displayed analogue to the logo.

(7) All warning and instruction boards (first aid, fire-fighting instructions, general warning for maintenance and work on electrical equipment, danger signs, "men at work" signs, etc.) have to be included and installed at the proper locations.

5.15 Paint and Surface Protection System

The surface preparation and paint application shall be carried out in accordance with the German Standard DIN 55928, British Standard BS 5493 and Swedish Standard SIS 05 5900 as well as the paint manufacturer's recommendations.

(1) The Bidder shall provide a detailed description of the paint system using an internationally recognised paint system and approved by the paint manufacturer and will guarantee the paint system for a period of ten years from handover. The final colour scheme shall be approved by the Purchaser.

(2) A minimum of total dry film thickness of 250 µ shall be applied.

(3) The extreme tip of the boom shall be painted fluorescent red. Gantry bogies, sill beams and bottom of legs to top of sill beam level shall be painted fluorescent yellow with black diagonal stripes.

(4) The Contractor shall furnish jointly with the paint manufacturer a ten-year guarantee for the paint system.

The proposed form of guarantee shall be submitted to the Purchaser for approval upon contract negotiations.

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(4) *Up over-hoist stop:* to stop the main hoist in case the up stop switch fails 500 mm above the extreme spreader hoist travel.

(5) *Dock slow-down:* to slow the field weakening speed to 60 m/min when the trolley is over the dock and the spreader descends to a level of approximately 4,000 mm above the dock. These contacts are jumped when the trolley is above water.

(6) *Dock slow-down:* to slow the main hoist lowering speed to a predetermined lower value (10%), at a level of approximately 2,000 mm above the dock. These contacts are jumped when the trolley is above water.

(7) *Down slow-down:* to slow the main hoist lowering when five turns are left on the cable drum.

(8) *Down slow-down check:* to control if step number (7) has been effected.

(9) *Down stop:* to stop the main hoist lowering when two turns are left on the cable drum.

Trolley Travel

WATERSIDE:

(1) Emergency stop, 40 t

(2) Stop, 40 t: to stop the trolley at the maximum outreach position.

(3) Slow-down check, 40 t

(4) Slow-down, 40 t: to slow the trolley speed when approaching the forward end position.

(5) Emergency stop, 70 t

(6) Stop, 70 t

(7) Slow-down, limit switch

(8) Emergency stop (boom raised)

(9) Stop (boom raised): to stop the trolley at the forward limit of travel.

(10) Slow-down check

(11) Slow-down, limit switch: to slow the trolley speed when approaching the forward limit of travel with the boom raised.

(12) Parking position: to interlock with the boom hoist control so that the boom cannot be raised unless the trolley is over the dock in its parking position.

(13) Boom clear: to interlock with the boom hoist control so that the boom cannot be raised unless the trolley is over the dock in its parking position.

The controller system shall provide real-time display of programmes and all plant data and status at remote sites. The PLCs shall be provided with in- and out (I/O) ports which are interchangeable, i.e. can be individually programmed to be either inputs or outputs.

The I/O ports shall be capable of handling standard input and output signals. The I/O ports shall provide proper isolation from dangerous voltages and currents. There shall be provisions for adding I/O ports.

Access to the series links of the PLCs shall be provided at the following areas:

1. Electric control room
2. Operator's cabin
3. Wharf checker's cabin
4. Boom operator cabin

6.2 Computer-Aided Operation System

A computer-aided automatic operation system shall be incorporated to assist the crane operator to perform semi-automatic operation. Its objective is to relieve the operator of the task of moving the spreader/container between the ship and the chassis on the wharf so as to reduce fatigue and to increase productivity.

The basic control of the crane shall be designed to function independently of the automation features. The operator may either operate the crane under the manual or the automated mode. Whichever the operating mode may be, there shall be adequate safety features in the design to prevent any accidental damages to equipment or human lives around the vicinity.

To facilitate proper understanding of the container operation cycle to and from the vessel, the cycle is divided into four stages:

a) movement between the clear height setting and the final landing on the vessel
b) movement between the ship and the sea-side legs of the crane
c) movement between the sea-side legs of the crane and the safety height above the chassis lane
d) movement between the safety height above the cassis lane and the final landing of spreader/container on the chassis

The table below summarises the possible mode of operation of the various stages of an operation cycle:

Movement of spreader/container	Operation mode	Trigger by
• between clear height and final landing on vessel	manual/semi-automated	crane operator
• between vessel and crane	manual/semi-automated	crane operator
• over the wharf	manual/semi-automated	crane operator
• between safety height and final landing on chassis	manual/semi-automated	crane operator

However, during actual operation, there may be no obvious distinction between these stages of operation. During automatic operation, the transition between the stages shall be smooth and safe and shall not cause discomfort to the operator.

5.13.15 Interlocking Devices

Adverse results of system faults and incorrect operation shall be avoided through a fail-safe design based upon a variety of interlocking functions. Interlocks shall be provided for, but not necessarily limited to, the following:

(1) Interlocks to prevent spreader hoisting until the connecting pins on the quick change head block are correctly located.

(2) Interlocks to prevent boom hoisting until the trolley is over the dock in its parking position.

(3) Interlocks to prevent trolley travel until the boom is entirely lowered or raised and secured.

(4) Interlocks to prevent main hoist, trolley travel and gantry travel during hoisting and lowering of the boom.

(5) Interlocks to prevent gantry travel when the stowage pins are engaged in the wharf sockets.

5.13.16 Overload Protection

The hoist system will be equipped with an overload system, which will switch off the hoist motors if the system is overloaded to 110% ± 5%. A manual override for maintenance and testing purposes shall be provided.

5.13.17 Emergency Features

Three emergency situations will be distinguished, i.e.:

5.13.17.1 Emergency Stop

In this case, the operation personnel shall activate the emergency stop push buttons (mushroom head, red) which will cause every motor drive of the crane to stop, thus preventing any danger arising from moving machinery or parts.

Location of the push buttons:

- one inside the operator's cabin on the lateral control board
- one in the machinery house
- one at each crane leg, to be reached from ground level
- at any other location deemed necessary by the manufacturer

All other consumers on the crane remain in function.

5.13.17.2 Emergency Off

In case the maintenance crew is working on HT equipment, transformer, LT equipment inside the electrical room and if there is the danger of coming into contact with live parts of the electrical system, the emergency-off push button will trip the main switch/circuit breaker of the 11 kV supply on the crane.

Location of these push buttons:

6.2.3 Description of Movement between Clear Height and the Final Landing of Container/Spreader on Vessel

This stage of operation includes the lowering/hoisting of the spreader/container between the clear height setting and the final landing position, and the locking and unlocking of twist-locks.

The lowering down of the spreader/container and twist-locks operations must always be done manually. Whilst the hoisting up of the spreader/container may be done semi-automatically under condition that

a) a learn cycle has been done to set the clear height,
b) the learn cycle is still valid,
c) the operator has manually hoisted up the spreader/container to a pre-set height after performing the twist-lock operation, and that
d) the operator has selected the automatic operation mode,

the semi-automated operation shall be initiated by the operator by activating the joystick.

6.2.4 Description of Movement between Vessel and Crane

This stage of operation includes the trolley operation along the clear height between the crane's sea-side legs and the targeted cell location on the vessel.

When the spreader/container reaches the target cell location, the system shall stop the trolley motion and notify the operator to take over manual control. The notification shall be in the form of an indicator light installed in the operator's cabin.

6.2.5 Description of Movement over the Wharf

This stage involves the movement of the spreader/container between the sea-side legs and the safety height above the selected chassis lane on the wharf. The movement includes trolley and hoisting of the spreader/container along the shortest path. This stage of operation shall be fully automated and shall not need any learn cycle as the path can be predetermined based on the crane structure and the chassis lanes' location.

6.2.6 Description of Final Loading on the Wharf

This stage of operation includes the lowering/hoisting of the spreader/container between the safety height setting and the final landing on the chassis, and the locking and unlocking of twist-locks.

This stage of operation shall be done either manually or semi-automatically. The hoisting down and the twist-lock's lock/unlock operation shall be done manually. During lifting, the operator must hoist up about 1.5 m before he can activate automatic operation.

In addition, a flashing light, 230 V, AC, with red dome, 360 -rotation and weather-proof shall be provided outboard at each gantry leg at dock level.

5.13.21 Anti-Collision Device

An ultra-sonic or infra-red laser-based type anti-collision device to prevent the crane from colliding with adjacent cranes during gantry travel shall be provided. The device shall reduce the gantry speed of the crane to creeping speed of 5 m/min when it is 10 metres from the adjacent cranes, and shall bring the crane to a complete stop before the crane's bumper comes into contact with that of adjacent cranes. The gap between the bumper of one crane to the bumper of the next crane shall be maintained at 300 mm when the crane comes to the complete halt. An override shall allow to position the cranes adjacent to each other (bumper/bumper).

5.14 Labelling, Nameplates

All materials the function and application of which is not immediately self-evident as judged by appearance, location or other indications, or the service relationship to other materials is not readily apparent, shall be supplied with a function-indicating nameplate immediately adjacent and symmetrical to the materials. The nameplates shall carry appropriate inscriptions or identification markings, which will enable the operator and maintenance personnel to get a quick and accurate picture of the overall relationship and relative functions of the components. Additionally, each component shall be identified by its code number according to the wiring diagrams.

(1) Nameplates shall be provided for all devices on switchboards to identify function, indication, circuit or purpose. Nameplates for voltage coils show voltage rating and value of external resistance used. Nameplates for function or service to include code number of device as per wiring diagrams. All cables to be clearly identified at both ends.

(2) Any special precaution, maintenance or operating instructions shall be included on the nameplates or on a separate plate attached to the materials.

(3) In addition to the nameplates provided by the manufacturer of individual components, each major item of electrical materials shall have a nameplate designating its function and service.

(4) Nameplates shall be engraved phenolic, UV- and heat-resistant.

Standard nameplates for motors and brakes must be legible and may be engraved or stamped.
All nameplates shall be attached with stainless steel screws or stainless steel wire.

Painted-over nameplates will be cause for rejection.

(5) All conductors shall be identified by colour codes, wire numbers and prefix at each terminal to which they are connected, in accordance with the wiring diagram. Wire markers shall be yellow hot-foil-stamped sleeves with machine-printed black, permanently legible lettering and numbering or an approved equal.

(6) A nameplate showing the manufacturer's name, address and trademark shall be attached to both sides of the crane. Separate nameplates showing the safe working load (SWL) of the crane in tons shall be attached to the gantry in a visible manner at the lower part of the sill beams.

6.2.10 Communication Cable/Hardware Requirements

The Contractor shall install necessary equipment for radio data transfer for communicating between the crane and the operation and maintenance centres (approximately 500 m distance).

6.3 Crane Management System

A complete computerised CRANE MANAGEMENT SYSTEM (CMS) with the necessary sensors and transducers shall be installed on each crane and work in conjunction with the PROGRAMMABLE LOGIC CIRCUITS (PLCs) to provide continuous monitoring, diagnostics, and data collection on the crane's operating systems.

Status and performance of the drives including the AC supply, DC motor control, AC motor control, operator control, safety interlocks, and essential components like motors, gear reducers, rope drums, etc. shall be captured and displayed on the screen for evaluation of the crane's mechanism.

The CMS shall be independent from the computer-aided operation system specified in Clause 6.2 above and shall be capable of - but not be limited to - the functions mentioned hereinafter.

A detailed description of the crane management system shall be submitted with the tender documents.

6.3.1 Condition Monitoring

The status and operating data for the electrical systems and sub-systems and all the essential components which are critical to the proper function of the crane shall be monitored in terms of real time. Any abnormality in the crane's systems and components shall be prompted and immediately displayed on the screen indicated.

Vibration level and temperatures of all gear reducers, rope drums and motors for the main hoist, boom hoist, gantry travel and trolley travel systems shall be monitored continuously and displayed on the screen whenever desired. The operating voltages, currents and speeds of all motors shall also be monitored.

Threshold values for warning and shut-down of respective systems and components shall be incorporated. Easy means of adjustment to the threshold values by the engineers shall be made available.
On-off status and failure of all safety interlocks, brakes, ventilation fans, air-conditioners for the electrical and computer rooms, emergency switches, etc., shall be displayed on the screen.

Details of the proposal for this monitoring system shall be submitted with the bid.

6.3.2 Fault Diagnosis

Data of the conditions as mentioned in Clause 6.3.1 above shall be stored and easily traced back at a later stage to facilitate fault diagnosis. Information what crane functions have been selected or were performing before and during a failure shall also be stored.

Fault diagnosis and help screen that prompt the Port's technicians with the information on the nature of crane failure and remedial actions shall be provided. An expert system shall be incorporated in the fault diagnosis to narrow down the faults to the exact components, interlocks, switches, etc.

6. Computerised Systems

6.1 Sequence Control (PLC)

All sequencing and inter-locking functions for drives, except emergency protection functions shall be performed by PROGRAMMABLE LOGIC CONTROLLER (PLC). The PLCs shall be able to intercommunicate with each other through a standard network following the OPEN SYSTEM INTERCONNECTION (OSI) communication architecture. The system of communication shall be properly structured, organised and standardised.

The PLC shall have multi-tasking and remote communication capabilities. Any of these PLCs in the network shall readily be able to interrogate other PLCs connected to the same network.

The Bidder shall submit details (product data sheets and schematic diagrams) showing the structure of the communication system reflecting the above required qualities.

All components of the PLC shall be robust for use in industrial environments of high temperatures, dust, vibration , humidity, electrical noise or other harsh conditions. The PLC shall be provided with redundant components for maintaining smooth operations. Power failure protection shall be provided to ensure safe operation.

The PLCs shall have sufficient memory capacity to hold control algorithms for more than one process plus at least 30% redundant memory capacity. There shall be facilities and space provided for adding memories for future developments. It is envisaged that flexible data logging functions will be utilised in the future.

The PLCs shall be provided with interactive programming and monitoring facilities for maintenance and future development. For this purpose, lap-top screen display type terminals with floppy and hard-disk drives and printer shall be provided on every crane within a suitable location in the electrical control room, on proper desks with two chairs each.

There shall be provision for logging of fault data. The storage device shall be sized to provide 30% spare capacity above the requirements of the delivered system. The terminal shall be capable of providing independent off-line development of programmes and documentation.

Expansion of the programmable logic controllers shall be by plug-in modules to the common rack. The PLCs shall have self diagnostic capability both upon power on and continuously during operation. Faults detected shall be clearly and promptly annunciated by audio alarm and visual displays.

The PLCs shall be capable of detecting the following categories of faults:

a) out-of-sequence faults
b) under time faults
c) overtime faults

The programming language shall be of any international operating system language and suitable for sequence control purposes. It shall also allow referencing devices by English names consisting of alphanumeric characters of adequate length. There shall be provisions for incorporating comments in the documentation of programmes. Security features that permit only authorised users to amend the programmes shall be incorporated.

vi) brake shoes
vii) carbon brushes of motors

The system shall have the capacity and flexibility for adding new items and changing any of the existing items from the above mentioned list by the engineers.

6.3.4.2 Indication of Low Oil and Grease Level in Reservoirs

The oil and grease level of each and every one of the reservoirs for the respective lubrication systems shall be measured by the CMS and indication shall be given when replenishment of oil/grease is required.

6.3.5 Generating of Job List

The Bidder shall propose a comprehensive facilities maintenance management programme to be supplied together with the CMS.

Details of the proposed programme shall be submitted together with the bid. The maintenance job list shall at least include all the outstanding faults, conditional and preventive maintenance works due. The system shall have the provision of the user to add other works to the job list which are not monitored by the system.

The system shall allow the selection of outstanding faults lists, and conditional and preventive maintenance works list, or the combination of both.

Details of the proposal to meet this requirement shall be submitted with the tender documents.

6.3.6 Software and Hardware Requirements

Each crane shall have a computer and printer which shall be installed at a suitable location in the electrical control room.

The requirements of the CMS are as follows:

6.3.6.1 Software Requirements

The operating system and application software shall be developed using Windows environments with commands in English language. Final details of the monitoring system and the software shall be developed in conjunction with the Purchaser.

The software shall display the status of any systems and components monitored by the CMS as well as the job list upon request by the user. It shall also allow the access of the source code files of the application programmes and sequence control programmes (ladder diagrams, boolean logic, etc.) by the respective crane computer.

Modification to the sequence control programmes by the Purchaser shall be made possible. A key switch and password control shall be implemented to prevent unauthorised modification of the programmes. Forcing-on and forcing-off of switches, relays, contracts, etc. in the programmes shall also be made possible.

Any abnormal conditions in the systems and components shall be annunciated distinctly in real-time mode on the display monitor. Such events/alarms shall be logged on a disk file which is accessible to the user for review at any time.

6.2.1 Definition of Operation Modes

Manual: In manual operation mode, the operator shall take full control of the crane and operate the crane manually. The computer and automated features of the crane shall have no way of interfering or disrupting the normal operation.

Learn: Before automatic operation can be started, the operator must teach the system by handling the first container manually. The learn cycle enables the system to set the clear height and learn the cell locations of the vessel.

Semi-automatic: In semi-automatic operation mode, the crane operator can start automatic operation by activating the joystick. The crane operator shall be able to take over the crane operation at any time and the crane shall fully respond to his command as in the case of manual operation.

Clear height: It is a trolley travel height above the vessel, which is just high enough to clear all the obstruction on the vessel. It is set during the learn cycle and automatically adjusted during the operation to compensate for the changes in container loading and tidal condition.

Safety height: It is a pre-set height above the wharf to provide a safety margin between the bottom of spreader/container and the towhead. It shall be a fixed value to be determined by the engineers and shall be changeable by the engineers if necessary.

6.2.2 Learn Cycle

The learn cycle is started by pressing the *"LEARN"* button on the operator's console. The operator shall then handle the container manually as usual. The system shall remember the clear height for subsequent automatic operation.

Once a learn cycle is completed, it shall remain valid until one of the following events occurs:

- The crane had gantry to another bay; or
- a crane function was not attended for a period of approximately 30 minutes (to be adjustable),

or

- the emergency button was activated.

Upon completion of the very learn cycle, the crane computer must make available the following data to the port's computer on board the crane:

- *"learn cycle complete"* indication
- operation mode - loading or discharging
- ship cells' location of the cycle in centimetres of hoist and trolley movement

The Bidder is to note that after a learn cycle is completed, every manual intervention by the operator shall constitute another learn cycle. In this case, the clear height and the allowable zone for automatic operation is adjusted accordingly.

6.3.8 Documentation

Three (3) sets each of the following documentation shall be provided in Portuguese and in English:

Software

a) Operating system manuals
b) Manuals describing the overview of the PLC/CMS
c) System manuals describing the functions of all the software programmes, including data communication/terminal emulation software
d) User manuals with clear instructions on how to run the PLC/CMS software
e) Annotated source listings of all the software programmes, including data communication/terminal emulation software

Hardware & Data Communication

a) Operating manuals
b) User guides
c) Technical manuals describing the circuit functions of the equipment complete with circuits diagrams
d) Maintenance manuals complete with parts lists

6.3.9 Other Requirements

All equipment for the PLC/CMS (hardware, data communication) shall operate on 230 V, 50 Hz, single phase power supply.

Original licensed software package shall be used, including the latest international operating system programme, Windows application programme, development compilers, etc. One copy of the software package shall be provided for every computer provided in the contract.

Uninterrupted power supply shall be provided for each computer to sustain operation of the PLC/CMS for a reasonable period of time in the event of a power failure.

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6.2.7 Data Interfacing between the Crane System and the Port's Computer

In order to perform semi- and fully-automatic operation, it is necessary that the Port's computer and the crane control system share a data interface and exchange information. The data to be provided are categorised below so as to describe how the two systems are expected to work together. However, they are not detailed enough for system development. Detailed discussions will be necessary during the system's design and development stages.

Data to be provided by the Port

Job command
These data provide the cell location, handling mode (load/discharge, etc.), size and weight of the container to be handled and other necessary information pertaining to the container. It is sent from the Port's computer at the beginning of each container vessel handling.

Data to be provided by the crane system

Operational status
The current status (whether the system is in auto or manual mode), the final position where a container is being picked up or landed on the vessel as well as on the wharf, and the status of the current handling cycle.

Message/instruction to the operator
When the crane system needs to display a message or instruction to the operator through the display terminal installed, it has to pass the message or instruction to the Port's computer to perform the task.

6.2.8 Computer Requirements

The Contractor shall install a computer, a terminal and a UPS for interfacing with the crane system and the Port's host computer, and a single-phase power supply at 240 V, complete with 16 A socket outlets. The computer system to be suitably installed within the crane's electrical control room.

6.2.9 Operator's Cabin Requirements

The Contractor shall install, at an appropriate place, a display terminal for simple fault messages. In addition, the Contractor shall propose in its layout a suitable location for the future installation of a display terminal (by others) and two indicator lights (the auto take-over and manual take-over light), on the front windscreen of the operator's cabin.

The left-right movement of either the left-hand or right-hand master controller is for activating and stopping of the automatic movement during the semi-automatic operation.

Push button switches complete with indicator lights shall be installed on the console panel of the operator's cabin for selecting of chassis lane, automatic or manual mode and for setting of clear height.

Push button switches and illumination shall be installed for the operator to select the desired row on the ship.

7.2 Bidder's Recommended Spare Parts

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists including electrical consumables, i.e. fuses, switches, etc., for a period of operation of 3,000 hours (two years of operation).

The spare parts list should include the following data elements:

- Sequence number
- Bidder's part number
- Item description
- Quantity
- Unit price
- Total price

On the help screen there shall be information on the schematic drawing number, software page number, component locations and possible actions to be taken to remedy the fault. Means for updating and enhancement of the help messages and information shall be made available to the engineers.

The fault diagnosis and help messages shall be designed to enable the Port's technicians to remedy the fault or confirm the exact nature of a major fault within a very short time.

In addition to the screen display of the CMS, simple fault messages shall be displayed on the screen in the operator's cabin and in the electrical control room. These simple messages shall be used by the operator to make breakdown reports to the maintenance workshop.

Historical records of faults shall be stored and they shall be easily retrieved on to the screen or on printed formats. Such historical records are required for analysis and corrective actions to eliminate recurring faults.

Up to 1000 historical records shall be made available on real-time display mode. Earlier records exceeding 500 shall automatically be downloaded to the hard disk. Download of all historical records to diskettes shall also be made possible.

6.3.3 Operating Log

The CMS shall provide operational data such as number of containers handled according to size and weight, crane operating and idle time, utilisation hours of main hoist motors, trolley motor, boom motor and gantry motors, crane utilisation time and container handling rate, etc. These data shall be available in trend graphs plotted against variable time spans. All data shall be stored and be easily retrieved on to the screen or on printed formats.

The above data shall be categorised in the following manner:

a) per vessel
b) per 8-hours shift
c) daily
d) monthly

6.3.4 Maintenance

6.3.4.1 Replacement Programme for Consumables

The utilisation hours of the crane's consumables shall be captured on-line and compared with the respective pre-set replacement interval. The system shall prompt the user when a part is due for replacement.

The pre-set replacement interval shall be adjustable and the Contractor shall advise the Purchaser on the optimal replacement intervals for the respective parts. Adjustment of the intervals shall be possible. The consumables shall include but not be limited to the following items:

i) lubrication in gear reducers and motors
ii) oil and air filter elements
iii) wire ropes
iv) bearings
v) brake pads

ANNEX - TO BE COMPLETED BY THE BIDDER

Clause-by-Clause Comments to the Technical Specifications

Time-based graphs displaying several signals simultaneously shall be incorporated in the CMS. Such graphs shall be able to be stored on disks in graphic format and printed out on a high speed printer.

6.3.6.2 Hardware Requirements

All components to be provided by the Contractor shall be industrial-grade personal computers (PC) of suitable model and of sufficient capacity, size and other accessories for handling the software programmes.

The crane computers shall be designed to operate satisfactorily under the harsh environment on the crane. The Bidder shall propose its optimum selection for radio data transmission.

Other equipment to be installed:

a) One standard printer and parallel interface for each crane computer. One standard printer with parallel interface shall be provided for the control centre.

b) Two TFT screens linked with the CMS shall be provided, one in the operator's cabin and another in the electrical control room, to display brief fault messages.

6.3.7 Data Communication Requirements

One of the ports shall link the crane computer to the PLC. Another port shall be used to link the crane computer through fibre optic cable to the control centre computer at the maintenance workshop.

It is envisaged that the computer at the control centre shall monitor the status of all the cranes by radio data transmission under this tender.

The control centre computer shall be able to access the CMS software of every crane in the network. All the information as spelt out in the Software Requirements Section (6.3.6.1) shall be accessible by the control centre computer.

The control centre computer shall be able to display such information on its monitor, process the information, store them on disk, and print them out on a colour paint jet printer.

The control centre computer shall also have real-time access to the diagnostics, status and operation data of every crane. This can be achieved by allowing the control crane computer to read the source codes of all the application software, including the sequence control programmes of the PLCs.

When a crane computer registers an abnormal condition concerning the crane, it shall be able to interrupt the control centre computer through hardware or software means.

The data communication hardware/software shall facilitate the control centre computer to handle multiple interrupts from the crane computers on either a first-come-first-served basis or user-delectable basis or both.

A serial link shall be provided to facilitate the connection of a lap-top personal computer or printer in the checker's cabin to access information from the crane computer.

ANNEX

Clause-by-Clause Comments to the Technical Specifications

The Bidder shall furnish a list with clause-by-clause comments containing all deviations/alterations or options from the given Technical Specifications of the Tender Document.

The list shall refer to the numbers in sequence of the Specifications in the following way:

Item No of Technical Specifications	Required by the Purchaser	Fulfilled: YES/NO	Deviation
1.2 1.3			

7. Final Adjustment and Testing

After the crane has been erected, adjusted, lubricated and otherwise made ready for operation, it shall be tested to demonstrate conformity to all requirements for structural, mechanical and electrical components as built. These test procedures will prove the compliance of this crane with the Technical Specifications.

The Contractor shall prepare formal test procedures for all required tests and submit them to the Purchaser for approval 90 days prior to the scheduled handover tests.

(1) The final testing process shall consist of the following main stages:

a) static test
b) dynamic test under varying load conditions
c) overload test
d) testing of safety devices and emergency systems
e) general crane inspection

(2) The crane shall hoist a certified weight of 35 tons simulating as closely as possible the theoretical duty cycle. The duration of this test shall be at least one (1) hour. Should down time occur during this test, the test will be repeated until the one (1) hour duration is accomplished.

(3) The crane shall be operated through full operation cycles of placing and removing fully-loaded containers. The duration of these test cycles is to be repeated for twenty (20) hours, the last eight (8) of which are to be trouble-free.

(4) During the full load and overload testing, measurements are to be taken of the voltage and ampere readings at the generators, drive motors and speeds as well as temperature readings of motors, gear reducer and brakes, and shall form part of the test report to be established by the Contractor.

(5) The Purchaser will furnish crane operators and necessary power supply to the crane.

All test loads and required instruments, measuring and recording devices shall be provided by the Contractor.

7.1 Special Tools

The Bidder shall optionally quote in its Bid for:

(1) Special electrical instruments, measuring/recording and testing devices required for fault detection and maintenance/repair on the electric control and drive system

(2) Special mechanical tools required for the crane operation, maintenance, repair and inspection. These shall include, but not be limited to, special adjusting tools, snap ring pliers, impact wrenches and wrenches for bolts in excess of 38 mm body diameter. Each tool and wrench shall be stamped so as to be easily identified as to its size and special use, if any.

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Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 2: Rubber-Tired Container Gantry Crane

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1. General Description

These Specifications describe a Diesel-electric 40-t Rubber-Tired Container Gantry Crane which shall be purchased by the Beneficiary and which shall be used for container handling of 40-t suspended payload under lifting spreader for handling fully loaded ISO 20' and 40', 9'6" height containers by means of telescopic spreader beams under a 360 ° rotating unit.

The crane shall be capable of continuous and simultaneous lifting and trolley travelling, depositing loaded containers and gantrying in repetitive cycles at the required speeds, and of lifting one 9'6"-high container over five stacked 9'6"-high containers. It shall span six rows of 8"0'-wide containers with a gap of 400 mm between adjacent containers plus a roadway of 4,500 mm in width.

1.1 Design Features

The design features, all material and equipment to be supplied and protective treatment of steel work must be suitable for use under the environmental conditions in Georgia.

The crane must be designed to operate with minimum maintenance under the defined conditions. It must be made sure that the electrical, mechanical and hydraulic equipment does not overheat, especially where exposed to direct sunshine.

1.2 Design Criteria

Unless otherwise mentioned, the design shall be based on the latest edition of the applicable design standards.

(1) The mechanical and structural design shall comply with

- BS 2573 - Part 1 (1983), Group A 7,
- BS 2573 - Part 2 (1980) and
- BS 466 (1984)

where applicable. (Specification for Classification, Motions, Stress Calculations and Design Criteria for Structures)

(2) The fatigue design shall be based on a conventional number of hoisting cycles on a minimum of 2 million cycles of operation when subject to a load of 80% of the maximum 35 t weight of a 40" ISO-1A container centrally disposed.

(3) The crane shall be fully operational up to wind speeds of 72 km/h (45 mph).

(4) Electric motors and generator shall conform where applicable to the latest revisions of:

- BS 4999 and BS 5000, Part 99-1973, VDE 0530-Rating
- BS 2613 - Performance of Rotating Electrical Machines
- BS 2757 - Classification of Insulation Material

The crane structure shall be computer-calculated and comply to BS 2573, Part 1 - 1983. The crane is to be classified as follows:

- Class of utilisation: U7 (2 million cycles)
- State of loading: Q2
- Group Classification: A7

The design software used by the successful Bidder in designing the crane structure, shall be certified by an internationally recognised classification society. A certificate acceptable to the Purchaser shall be furnished during contract negotiations.

(2) Drive Mechanism

The drive mechanism shall be designed and selected in accordance with BS 2573, Part 2 - 1980 and shall be classified as follows:

	Hoist/traverse	Long travel
Class of utilisation	T7	T5
State of loading	L3	L2
Group of classification	M8	M5

(3) Drive Motors and Generator

A Diesel-engine powered AC alternator provides AC motor drives for:

- main hoist
- trolley drive
- gantry travel

All electric motors and generator to be rated according to VDE 0530 in conjunction with publication 31-1/Rotating Electrical Machines (Seventh Edition) issued by IEC, and BS 2613, 1970. Winding insulation shall be "Class F".

The following minimum ratings to be applied:

Drive	Duty type	Duty factor
AC alternator	Intermittent Periodic S6	80%
Hoist Motor	Intermittent Periodic S3	60%
Trolley Motors	Intermittent Periodic S3	60%
Long Travel Motors	Intermittent Periodic S3	60%

The Diesel alternator set to be rated to operate continuously within the ambient temperatures as specified in para 1.1 above.

3. Dimensions And Principle Particulars

3.1 Main Crane Dimensions

• Span (wheel centre distance):	22.60 m
• Overall width:	24.60 m
• Height under spreader (above yard level):	15.00 m
• Lowest point of spreader (yard level)	0 m
• Overall length - buffer to buffer:	12.0 m
• Number of wheels per corner:	2

3.2 Wheel Loads

The Bidder shall calculate and furnish with its Bid respective wheel/corner loads under working conditions (acceleration/deceleration) with full rated load and trolley positioned at one side of the gantry and in-service wind pressure of 25 kg/ml.

A further set of engine controls shall be provided in the operator's cabin. They shall include a keyed start/idle full-speed switch, engine "start" and "stop" push buttons as well as engine speed-control, fuel-level indication and warning lights.

(8) A tray shall be provided beneath the engine to be of sufficient capacity to contain the total quantity of engine oil or cooling water which could be released in the event of a spillage. Drain valves shall be fitted at each end of this tray. No pipe-work or cables may pass through this tray.

(9) Particular attention shall be paid to provide easy access to those parts of the engine and generating equipment which require daily maintenance checks.

(10) The engine should be manufactured by an internationally reputed manufacturer with a well-established world-wide service organization.

4.2 Operating Voltage

The crane operating voltage shall be 400/230 V, 50 Hz, 3-phase plus neutral plus protective earth.

4.3 System Power Demand

The power system demand will be estimated when operating at night time with all lights on and with rated load and the critical theoretical duty.

The Bidder shall furnish with its Bid a detailed calculation for system power demand.

4.4 Crane Earthing

All electrical apparatus and motors shall be efficiently earthed by means of copper tape or conductor terminating at a common point, which shall be connected to the earthing wire of the power cable. Connections in series are not permissible. The crane structure shall also be earthed to the equipotential busbar in the LT switch gear room.

Earthing conductors shall not run or be fixed on any access path, floor, passage or walkway.

Any stranded earth cables shall be terminated in sweated sockets which, in turn, shall be rigidly bolted to the earth terminals of the materials.

The earth connections of conduits shall be made by means of approved galvanised steel connectors.

Where lengths of flexible metallic conduit connect machines or other materials, the earth continuity shall be supplemented by a separate earth conductor connected between the rigid conduit and the earth terminal of the materials.

The whole installation to be carried out in a neat workmanlike manner to comply with the appropriate regulations.

- VDI 2056 - Vibrations of Motors/Machines
- DIN ISO 2372/3 - Mechanical Vibrations of Machines

(5) Cables, flexible cords for power and lighting shall conform to VDE, DIN 57281/57282, and to BS 6500/6116, where applicable.

(6) Contactors, circuit breakers, low voltage control gear, HT switch gear and HT transformer shall correspond to the latest revisions of BS 775, IEC 158-1/IEC 56, VDE 0660 and to the IEC in general, where applicable. The design of the electrical distribution and control system shall conform to VDE 0100/Part 726/3.90.

(7) The steel quality for the main structure shall correspond to FE 360 (ISO) equal to a 36 (ASTM).

(8) High-tension friction-grip bolts in galvanised and crack-tested execution shall be used throughout the crane in accordance with:

- DIN 931/934/6914-15 - Hexagon high-tensile bolts
- DIN 6915 - Washers for high-tensile bolts
- DIN 267 - Fasteners and similar parts

(9) All works shall be done in a thorough workmanlike manner and shall follow the most recent practice in the manufacture of high-grade machinery. All work shall be performed by workmen in their particular trades.

All welders and welding operators shall have been certified as qualified for the materials, processes and type of weld being performed. Certificates to be handed over to the Purchaser for revision and approval.

Welding procedures shall come up to the requirements of BS 5135.

(10) Ropes
Rope diameter and safety factor to be selected according to BS 2573, Part 2 - 1980.

(11) Pulleys and Drums
according to BS 2573, Part 2 - 1980

(12) Gear reducer and crane brakes to be selected according to R 20, DIN 323, DIN 15053 - Cranes Reduction Principle Specifications and DIN 15431/15435, dimensioning of brakes and power transmission engineering respectively.

(13) Diesel Engine
The Diesel engine shall be rated according to DIN 70020, with direct fuel injection.

(14) The general design of the gantry crane shall be in the metric system unless explicitly requested otherwise.

1.3 Classification

(1) Crane Structure

Where an access hatch is positioned in a walkway suitable means shall be provided to ensure that the hatch is closed after use.

Pipe or tubular handrails shall be sealed against the entry of air, and all stanchions are to be of mild steel angles suitably sized to provide rigid support to handrails. All stanchions are to be welded to steel frame structures and not attached to platform mesh.

5.3 Operator's Cabin

The operator's cabin shall be mounted below the trolley to provide full visibility of all operations the crane is specified for.
The cabin shall be of double-walled steel construction designed to minimise heat gain. The cabin shall be weather proof under all weather conditions, fire resistant and insulated to restrict noise level to 78 dba or less at the operator's position. The space between the double-floor plates shall be used for electrical wiring. The upper floor plate shall be vinyl covered and bolted to provide access to the electric wiring. Cabin framing shall be securely fastened to the trolley by means of high-strength structural fasteners and eliminate relative movement. Final size and layout of operator's cabin shall be submitted to the Purchaser for approval.

All lower windows shall be fitted with safety bars such that if the windows are removed or opened, the safety bars remain in position to prevent the operator falling through an open window.

In addition, provision shall be made for the operator's safe exit and entry from and to the cabin at any position of the trolley along the boom in case of a hazard condition.

A remote air-conditioning/heating unit of industrial type should be provided, which will direct air via a duct and distribution system to the operator's cabin and which will maintain conditions of 22 to 24 °C and 50 per cent of relative humidity under maximum ambient temperatures and humidity specified.

The unit shall be filled with Frigen, type R 134a or equivalent.

Interior trim shall be accomplished by using modern decor materials (such as formica for the walls, PVC for the floor, etc).

Windows of safety glass shall be provided to give the complete view of the container's chassis position. The upper row of the windows to be made of tinted safety glass.

The door shall be equipped with suitable means for exterior locking.

All cabin windows shall be designed in a way that will allow the operator easy access for cleaning. Wind shield wipers with washers shall be provided. Upholstered fully-adjustable spring or air-cushioned chairs with weight adjustment shall be provided with comfortable access to all control and devices and maximum view.

Seats, operating and control equipment shall be constructed according to the latest developments in ergonomics and suitable for a permanently-manned working position.

Electrical enclosures shall have hinged tops to permit ready and easy access to the apparatus wiring and devices.

2. Operating Characteristics

2.1 Lifting Capacity Requirements

The minimum lifting capacity below the telescopic spreader shall be 40 mt. This includes a maximum allowed eccentricity in longitudinal direction of one metre of a 40' container with a load of 30.5 tons. The Bidder shall specify in his quotation the weight of the spreader and the crane capacity under the ropes.

2.2 Speed Rates

The Bidder shall submit with its proposal a comprehensive speed calculation. The productivity shall be 20 moves per hour.

2.2.1	Hoisting with rated load under spreader	20 m/min
2.2.2	Hoisting, empty spreader	40 m/min
2.2.3	Trolley travel with rated load under spreader	60 m/min
2.2.4	Gantry long travel without load	120 m/min

2.3 Spreader Tilt and Slew

Means shall be provided to allow the spreader to be tilted not less than ± 5 degrees about axes parallel to and at right angles.

Time to tilt the spreader by 5 °:	30 seconds
Time to slew the spreader by 360 °:	30 seconds

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5.6 Electrical Equipment Control Room

The crane shall be equipped with a separate control room of sufficient size to contain all required electrical control cabinets and motor control centres.

The control room shall be framed of structural steel; thoroughly braced to withstand all stresses produced by operating machinery. The sides of the control room shall have hinged doors with galvanised and painted corrugated sheet steel. The room shall be adequately insulated and ventilated to prevent undue temperature rise under working conditions. Interior insulation shall be protected by damage-resistant covering. (If desirable, air condition shall be used.)

The room will be made as air tight as practical, with joints, conduit, pipe or other attachments which pierce the insulation, being sealed a the point of entry.

5.7 Main Drive Systems

A Diesel generator set is required to provide AC motor drives for:

- main hoist system
- trolley drive
- gantry drive

The complete Diesel engine/generator set is to be mounted in the genset enclosure. The system shall be simplified for ease of maintenance and repair.

5.7.1 Main Hoist System

The hoisting motion shall be driven by an electric motor through totally enclosed gear. Two fail-safe shoe or disc brakes shall bring the load to rest from full speed without undue shock in as short as distance as possible. Each brake is to be capable of bringing to rest and holding the crane's full working load.

The Bidder shall specify the stop distance of emergency main hoist braking with maximum load and maximum lowering speed in case of power failure/actuation of emergency-stop push button.

The drum(s) shall be fitted with high-tensile shafts and run on heavy-duty self-alignment roller bearings enclosed in fabricated steel. Four hoist ropes, double-reeved, shall be used for carrying loads. The length of the spiral grooved portion of the drum(s) shall be sufficient to accommodate the complete hoist rope in a single layer with two additional dead turns and one free grove.
The location of the hoist system shall be on top of the trolley.

5.7.2 Trolley Travel System

The trolley shall consist of a structural steel frame supported by at least four wheels. The trolley shall have mounted on it the main hoist sheaves, and it shall support the operator's cabin.

4. Power Supply And Electrical System

4.1 Main Power Supply

Power to operate the crane will be provided by one electric generator set driven by a Diesel engine. The generator set shall be sufficiently rated to start and accelerate simultaneously both the hoist and trolley traverse motions to full speed when handling the rated maximum load and to supply all other services in use. The set shall be mounted below the sill beam.

4.1.1 Diesel Engine

(1) The engine shall be capable of operation in tropical climate with a temperature range of -20 °C to + 45 °C and 100% humidity.

(2) The engine air inlet system shall be of Donaldson type or equivalent, cyclonic pre-cleaner and double-stage dry paper element type with air-restriction indicator.

(3) The engine starting system shall be 24 V.

(4) The fuel tank capacity shall be sufficient for 24 hrs continuous operation. Refuelling to be undertaken from quay level.

(5) The engine shall be provided with an engine protection system that will shut down the engine in case of:

- high water temperature
- low oil pressure
- engine over-speed

A warning light panel located at the operator's cabin will indicate the cause for the engine's shut-down.

(6) A heavy-duty silencer is required.

(7) A control panel located adjacent to the engine compartment shall include a keyed start/idle full-speed switch, engine "start" and "stop" push buttons, engine speed control and speed indication, an engine "hours run"-metre, preferably of the vibration type, cooling-water temperature and oil-pressure gauges and a safety lock-out switch to prevent engine start-up for the other control panels when maintenance is being performed in the engine compartment.

The panel shall include the following instruments:

- electric power switch-on
- voltmeter for the generator
- ammeter for the generator
- battery voltmeter
- battery ammeter
- engine rpm-indicator
- fuel tank gauge

(5) The Bidder shall also specify the maximum corner load and the maximum pressure that the tires will infect on the paths along the yards in N/cml and ton/corner. The maximum corner load will be calculated in working position when the trolley is over the chassis lane plus maximum wind forces. The difference in elevation between the two paths is 1%, and the slope along the path is 1%, too.

The electric motors shall be protected with anti-condensation heaters and shall drive the wheels through suitable gearing.

Adequate braking arrangement shall be provided to the motors, the motors being properly interconnected to ensure that the driving load is share equally.

Four (4) emergency stop push-buttons shall be provided on the bogies to stop the long-travel motion. Push buttons shall be reset at quay level.

5.8 Mechanical Design

All parts shall be designed so that easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance is achieved.

5.8.1 Ropes

The Bidder shall furnish all wire ropes complete with fittings.

Wire ropes shall be selected according to FEM specification, para 4.2.2.

The calculated safety factor should be determined in loads as specified in the FEM sub-para 4.2.2.1.2 and shall not be less than six (6).

All wire ropes shall be treated with the lubricant approved by the Purchaser at the point of manufacture. The wire ropes shall also be re-lubricated in the field prior to being placed in service. The Contractor shall furnish the Purchaser one (1) copy of the wire test certificate for each wire rope on the crane prior to the time the crane is to be certified.

The type, construction and lay of the wire ropes shall be:

Warrington/Seale 6 x 36 = 216 wires with fibre core (DIN 3064), with wire breaking strength of 180 kg/mml.

5.8.2 Drums and Sheaves

Rope drums and sheaves shall be of high-grade cast or welded rolled steel with machined grooves. The grooves shall be smooth and well-rounded and shall have a depth and groove pitch compatible with the wire rope that will be spooled.

The drums shall conform to BS 2573 and be stress relieved before machining.

All hoist wire rope drums shall be driven directly from the low-speed shaft of the respective reducer.

5. Main Technical And Design Demands

5.1 Main Frame Construction

The main frame shall be an all-welded, rigid-frame, box-girder type construction, utilising the latest design techniques to provide an attractive structure with a minimum of maintenance. Back-to-back angles or channels or lattice members shall be avoided. Closed type sections of square structural steel tubing or steel pipe shall be used wherever possible. The design shall avoid pockets where water may collect. Bolted special joints or bolted connections of box type or other closed connections where water seepage may occur shall be equipped with steel pipe coupling drains.

All members shall be sealed and air-tested to prevent condensation and internal corrosion.

Field connection shall be made with high-strength bolts or by field welding.

All members shall be amply proportioned to provide a rigid structure. Minimum deflections for operating conditions shall be included in the calculations submitted to the Purchaser and shall be subject to approval.

Excessive vibrations of the crane or vibrations harmful to the crane shall be avoided. If required by the Purchaser, the Contractor shall submit detailed calculations that will demonstrate that the design of the trolley travel system and the gantry structure will result in a natural frequency of over 1.0 Hz in the trolley travel direction.

5.2 Stairs, Ladders, Platforms, Walkways

The crane shall be provided with stairs, ladders, platforms and walkways for safe and easy service, maintenance and inspection. The top handrail shall be not less than 1,000 mm above platform level.

The operator's cab, machinery room(s) and other parts to be serviced, maintained and supervised shall be safely accessible by means of stairs and walkways. Ladders are to be avoided as far as possible.

A walkway with handrails shall be provided along the full length of both top beams.

Vertical ladders should be avoided, but - if absolutely necessary as a result of space restrictions - may be accepted subject to the Purchaser's approval.

The pitch between the ladders' rungs shall be not greater than 300 mm, the rungs being at least 300 mm wide and as well raked as possible. Ladders shall be equipped with safety cages unless otherwise approved by the Purchaser.

Platforms may be of open mesh construction, heavily galvanised and of a robust construction with high corrosion allowances.

Open mesh platforms will be supported by steel beams. Any areas of unsupported mesh are not to exceed 0.5 ml.

Access hatchways, where provided, shall be guarded on three sides by handrails and on the fourth side to be closed by means of a hinged gate.

5.8.4 Bearings

Rotating bearings on the crane shall be of the anti-friction type in metric sizes.

Bearings' life for the defined systems shall be selected on the minimum basis of 20,000 hours, based on the rated load of the crane at the rated speed of the motion.

The tabulated static capacity of the bearings shall not be exceeded under any operating conditions.

Bronze sleeve bearings, if approved by the Purchaser for use in certain locations, shall be designed on a conservative basis after determination of the PV-factor (unit pressure times surface velocity) and proper consideration of the operating conditions.

All bearing stands shall be of cast or fabricated steel machined as required and securely mounted on base by means of bolts and dowels.

Adequate shim allowance shall be provided between all bearing stands and structural bases to permit initial alignment and subsequent realignments, if required.

Bearings and housings shall be sealed by caps or spring loaded lip-garter type seals, and except for reducer bearings, provided with pressure grease lubrication. Bearing seals shall be one of the more commonly used sizes.

Bearing housings shall have removable caps to facilitate periodic inspection of the shafts by non-destructive methods. Closed end cartridges shall not be used.

All bearings used throughout the crane shall be standardised as far as possible.

5.8.5 Shafts

All shafts shall be fabricated from high-grade steel and shall be adequately sized for the drums, bearings and/or gears. Complete data covering the physical and chemical properties and heat treatment of the material proposed shall be shown on the drawings.

5.8.6 Couplings and Coupling Guards

Couplings shall be flanged forged steel with exposed bolts, except for the main hoist drum couplings, be flexible gear type and shall transmit only torque.

Calculations of couplings will be based on the manufacturer recommendation and shall be verified by published catalogue data. The service factor will be calculated for:

- crane operation
- moderate shock load
- over 16 hours of daily operation
- over 160 starts per hour

Removable steel guards shall be installed over all couplings.

All operations of the crane shall be controlled from the operator's cab with the exception of the start-up of the equipment, which shall be controlled also from the control panel located next to the engine compartment as described above.

All controls shall be readily accessible to the operator and oriented in a way that the crane will respond in the direction that the operator moves them.

Activation of controls shall be of the "joy-stick" type and automatically position into "O".

An analogue load indicator shall be suitably located inside the cabin.

Provisions shall be made for a 12 V supply for installation of a communications radio adjacent to the driver's control.

The Bidder shall submit with its Bid a layout of the driver's cabin including proposed locations of all control systems.

Storage space shall be provided for items such as coats, lunch buckets and a portable water cooler.

Complete operating instructions for the proper use of the crane shall be provided in the cab.

5.4 Checker's Cabin

Provisions shall be made for a checker's cabin incorporated in the structure with easy access. The cabin shall be equipped with sliding windows, sliding door, desk (bench) and adequate ventilation.

5.5 Engine-Generator Set Enclosure

A water- and dust-tight enclosure shall be provided with design and dimensions of ample size to adequately accommodate the Diesel-engine and items of electrical and mechanical equipment.

The structure shall be a galvanised steel-frame-covered roof, and steel plates of at least 3 mm galvanised steel sheets on steel supporting members, positively fixed to the crane's superstructure to prevent vibration.

Hinged removable doors shall be furnished at the sides and be provided with door closers and latching devices to hold the doors open if desired.

The genset enclosure shall be adequately ventilated to prevent undue temperature rise under working conditions, such ventilation arrangements shall be duplicated and sited in the most advantageous position for good ventilation with air ingress vents protected against entry of sand and dust by filters. The filters are to be removable for cleaning purposes with easy access.

All cable conduit pipes runs laid on the machinery house floor are to be grouped together and covered with removable chequered steel plates where applicable.

5.9 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the crane design whenever practical.

The Bidder shall include in its Bid diagnostic ("trouble-shooting") techniques, procedures and test equipment to achieve an overall reduction of system's down time by providing for rapid location of a fault. The Bidder will list in its proposal crane systems for which such diagnostic procedures have been developed.

5.9.1 Accessibility

Restricted accessibility of modules, assemblies and other items largely contributes to the extension of repair time. The configuration of the hardware and its layout in the crane shall make sure that free and easy access is provided to maintenance personnel, tools and equipment required to perform the repair task.

5.10 Miscellaneous

5.10.1 Overload and Slack Cable System

A system shall be provided which shall automatically stop the hoisting motion and allow lowering only if an operator attempts to lift a load in excess of 110 ± 5% of the rated capacity of the crane. An override shall be supplied to allow adjustment to 125% by maintenance personnel for testing purposes only.

An analogue load indicator with the corresponding loading zones marked in green, yellow and red must be provided with the system.

The system shall automatically shut down the lowering motion and allow hoisting only when the main hoist rope becomes slack. This shall prevent the operator from playing out too much rope and then accelerating rapidly under no load before the load is lifted up again.

The system shall prevent ropes from jumping out of sheaves, reduce the shock loads on ropes and structure and reduce the possibility of the spreader jumping.

5.10.2 Anti-Sway Device

An efficient anti-sway electronic device shall be incorporated to prevent container sway during operation.

5.10.3 Fire Extinguisher

Fire extinguishers of approved type and in quantities to be determined by the Bidder shall be provided. The following minimum provisions are to be made:

- one (1) unit to be installed in the operator's cabin
- one (1) at the Diesel engine/generator enclosure
- one (1) at the electrical-control enclosure

The trolley and the cabin shall be accessible at any point in its travel and access shall be such that a disabled operator can be removed without special rigging.

The trolley frame shall be equipped with integral jacking device(s) to support the trolley at any point of its travel during wheel replacement. Wheel/axle and sheave mountings shall be such that wheel/axle assemblies and sheaves are removable vertically upward. A drop block shall be provided to support the trolley in case of a broken axle.

The trolley shall be driven by an electric motor located on the trolley, driving at least one wheel on each rail.

The trolley traversing machinery shall be of adequate power and rating to provide the accelerating and braking forces required to enable the actual operating cycle to be worked continuously when handling the rated safe working container load. It shall be designed to accelerate and drive the trolley when loaded to its rated capacity up a gradient of 1.0% against the maximum safe wind load and to brake the trolley when running downwind under the same conditions.

Suitable anti-derailment devices and a locking pin to prevent movement of the trolley during maintenance operations shall be fitted together with two (2) emergency-stop controls.

5.7.3 Trolley Protection Devices

For end-of-track limit on both ends, the trolley shall be equipped with contactless-type slow-down switches and mechanically-actuated main limit switches. The slow-down switches will ensure that the trolley is approached to the end of the track at a reduced speed.

Buffer stops shall be provided at the end of the track on both sides.

The trolley buffers shall be calculated to FEM classification para 2.234.

5.7.4 Gantry Travel System

The crane will be carried by eight pneumatic tires. Driven wheels shall be provided on each side of the machine. Preferably, the tire size shall be 18.00 x 25.

(1) Steering along the yard will be performed by a selector switch that will cause a differential speed between the two gantry drive motors.

(2) All eight wheels shall be capable of a 90°-rotation by means of an hydraulic cylinder. This will enable the crane to travel from one yard to the other at a right angle to its original direction. In addition, the crane should be able to turn in both directions while pivoting on one of the idler wheels, in a way that the crane moves in a circle.

The turning and movement between yards will be performed without load.

(3) Suitable locking devices shall be provided to ensure that the wheel-rotation motion is locked before the long-travel drive can be energised. Interlocking shall be provided also to prevent the wheel locks from operating unless the wheels are in the correct position.

(4) The Bidder shall specify in its Bid the tires and wheel size, loading capacity and inflation pressure.

5.11.2 Electrical Materials

All materials or combination of materials shall be selected for maximum corrosion resistance. Aluminium or aluminium alloys shall not be used for housings, fans, blowers, motors, motor brakes, festoon parts or weather-exposed parts or components unless otherwise indicated in the specification.

Ferrous components not contained in weather-proof enclosures shall be galvanized after fabrication and before painting. Cadmium plating is not acceptable.

All screws, bolts, nuts, washers, pins, studs, springs, and other miscellaneous fastenings and fittings shall be of stainless steel unless otherwise approved.

5.11.3 Enclosures

Weather-proof or watertight enclosures of the hood-latch type shall be used in all locations permanently exposed to the weather, withstanding vibrations encountered in the crane.

Junction boxes, terminal boxes, outlet boxes and similar fittings in locations exposed to weather shall be made of stainless steel or other approved corrosion-resistant material. Cover screws shall not extend into boxes or any other weather-tight enclosures.

Panels shall be accessible and removable from the front.
Covers of machinery and panel enclosures shall be hinged and capable of being opened to fully expose and allow removal of panels and/or other materials mounted inside. Latches shall be provided to secure all covers when opened for servicing. The latches shall be adequate to secure covers in high winds.

Larger terminal boxes (e.g. terminal boxes for cable festoons) shall be equipped with space heaters and an internal fluorescent lighting fitting, switch-operated.

5.11.4 Wiring

Cables and insulation must be selected for resistance to insect and vermin attack and comply with relevant BSS.

The electrical wirings shall be sized in accordance with the relevant IEE Regulations and Codes of Practice and BS Specifications, appropriately derated to suit the ambient temperature and multiple parallel runs. It shall be installed to the standards normally accepted as the best of modern international practice.

Electrical wiring suitable for the equipment is:

(1) Internal wiring not subject to direct sunlight may be 600/1,100-V-grade PVC cables or butyl/hypolene cable or equivalent, installed in heavily-galvanised steel conduit or trunking or steel ducting built into the structure. It is essential that the crane's electrical services are easily rewirable, and any conduit systems used must be of the draw-in-type.

(2) External wiring shall be of 600/1,100-V-grade PVC cables supported by suitable cable cleats and adequately protected from direct sunlight.

Drums shall be mounted on shafts utilising anti-friction type bearings to assure shaft alignment and minimise vibration.

Rope anchorages shall be of approved design and shall avoid the necessity for splicing rope ends after the ropes have been reeved onto the crane.

The arrangement of the drums and sheaves shall be such that the fleet angle of the rope shall not exceed 3 degrees.

Sheaves shall be provided with steel guards of at least 12 mm thick steel plates to prevent the ropes from jumping out of the grooves, where applicable.

Tolerances shall be indicated and gauges provided to indicate worn-out sheaves. In addition, the Contractor shall recommend repair/replacement methods and periods to ensure safe operation.

Running sheaves shall have a minimum pitch diameter of 30 rope diameters for the main hoist.

5.8.3 Gear Reducers

Manufactured gear reducers for the main hoist drive shall be selected by multiplying the nameplate kW rating of the designed driving motor by a service factor of 1.75 in order to obtain the equivalent nominal mechanical rating which shall be used as the basis for selecting the respective gear reducer from the manufacturer's rating tables. Lifting lugs shall be provided on upper and lower section.

All other gear reducers shall be similarly selected using a service factor of 1.

The thermal ratings of the gear reducers shall not be exceeded during continuous duty-cycle operations in 45 °C of ambient temperature.

The high-speed stage of the reducers to be of helical or herring-bone gears. The other stages can be either helical or spur gears. The reducers shall be entirely self-contained in an oil-tight steel or cast iron housing. Bearing shall be of anti-friction type.

All gear housing shall be provided with suitable means to gauge the oil-level and an outlet for oil particle sampling. Each reducer shall be provided with a permanently attached name plate containing the following information: the name of the manufacturer, the reduction ratio, the rated mechanical and thermal capacity, the rated speed and the service rating or service class.

Main hoist and trolley gearing shall be designed and rated in accordance with BS 436, BS 545, BS 721, Part 2 or the latest applicable standards issued by AGMA.

All gear boxes shall be horizontally mounted.

Gear reducers and their gearing shall be manufactured by a company which is regularly engaged in the commercial production of catalogued, standardised gear reducers for heavy industrial application for at least twenty (20) years. The proposed manufacturer and the quality level of manufacture must be acceptable to the Purchaser.

All motors shall be of the same type and rating as far as practical in order to facilitate maintenance and reduce spare parts requirements. In any case, they shall be made by a manufacturer with an excellent service record and worldwide service organisation available in most port cities.

Waterproof motors shall be provided with suitable drain plugs and breathers as recommended by the manufacturer.

All motors shall be equipped with regreasable anti-friction bearings designed to meet the requirements of thrust and radial loads and to provide a 50,000 hour minimum life expectancy, except fan motors which shall have a 100,000 hour minimum life expectancy. Grease fittings for these bearings shall be of a different configuration than the other grease fittings used on the crane. Motors shall be completely greased prior to shipment from their place of manufacture.

Sun shields shall be provided over all motors that are exposed to direct heat from the sun. The shields shall be of robust construction and arranged in a manner that air can circulate around the motor. All sun shields are to be painted white.

Electrical brakes shall be of the spring-set-magnetic or thruster-released, preferably disc type of sufficient capacity to stop test loads from full speed.

Brakes shall be fitted with non-combustible linings not adversely affected by moisture and with waterproof coils. Watertight brakes shall be equipped with external hand release.

Electrical brakes for motors exposed to the weather shall be fully enclosed in a watertight housing with easily removable access cover for adjustment and repair, and with external hand releases.

All pins in the brake shall be of high-strength bronze or stainless steel. Adequate clearance shall be provided at the coil and level end, with the base of the enclosure flat to facilitate removal. The enclosures shall also be provided with drain check valves.

5.11.7 Control System

Master switches, controllers, circuit breakers, limit switches and similar gear shall be of the same manufacture, type and rating wherever possible to facilitate maintenance and to keep spare parts required at a minimum. This may be accomplished by using oversized relays and conductors for the lowest rated demand.

All automatic controls including limit switches and interlocks shall have provisions for manual override.

Circuit breakers shall be capable of opening circuits when carrying the maximum fault currents obtainable at their point of application. The protective features and interrupting ratings of all circuit breakers shall be co-ordinated to provide protection for the entire electric installation without exposing any materials to excessive thermal or mechanical stress.

Circuit breakers shall be equipped with thermal-magnetic overload trips that are ambient compensated.

A uniform electrical control system shall be provided by ABB, Siemens or other approved equivalent manufacturer of electrical controls. The system shall include power conversation units, transformer switch gear, circuit breakers, motors, brakes and trouble-shooting systems.

All couplings' nuts shall be self-locking to prevent their release due to vibration.

5.8.7 Lubrication

Lubrication of all mechanical operating parts shall be provided in accordance with manufacturer's instructions. Oil lubrication shall be provided for speed reducers and other items needing lubrication. Lubrication of other mechanical parts shall be by means of high-pressure grease introduced through industrial button-type fittings. The fittings shall be readily accessible or shall be piped to convenient locations. Each greasing point must be clearly labelled with a stainless steel or plastic label to indicate which mechanism it serves.

The Contractor shall furnish lubricants in accordance with the original manufacturer recommendations in sufficient quantities for initial lubrication of the cranes. The Contractor provide a signed checklist signifying the equipment has been properly lubricated. All motors shall be lubricated at the manufacturing site.

The Contractor shall also supply a list of oil and grease lubricants needed for each reducer, coupling and all other equipment.

5.8.8 Head Block

The head block shall consist of a structural frame with two sets of hoist blocks and guarded sheaves that are permanently reeved into the hoist system.

A cable tub with entry guides shall be mounted on top of the head block to receive the multiple- conductor electrical cable from the trolley. This shall provide a positive maintenance-free system of connecting power and control conductors to the spreader.

The head block shall be designed for quick manual connection to the telescopic spreader using twist-locks. The connection between head block and spreader shall be designed for the specified loads and shall limit interface movement horizontally and vertically to a maximum of 1.5 mm. Locking devices with limit switches shall be provided at each point of connection to the spreader. Limit switches shall prevent hoisting of the head block/spreader or operating the spreader unless the locking devices are all fully engaged or fully disengaged. The interlocks shall be arranged in a way that a key-operated switch will enable hoisting/lowering of head block when the spreader is removed. A selector switch provided for this purpose must be lockable in each of its modes by means of a removable key. A warning light shall be provided a the operator's control console to indicate when the "without spreader" mode has been activated.

5.8.9 Spreader

One 20/40' telescopic spreader is to be supplied. The Bidder shall offer its standard spreader system.

The Bidder shall offer an alternative telescopic spreader of approved design and acceptable to the Purchaser, fully compatible with the head block offered.

However, the spreader shall be fitted with electrical sockets to accept an external power supply and a remote control unit that will allow the spreader to be operated through its full range of motions for maintenance testing at a workshop remote from the crane. One remote control units is to be provided.

(i) Wheel turn
(j) Floodlight switch

Indicating lights for each of the following functions:

(a) Twist-locks - locked - unlocked - landed
(b) Control power - on
(c) "Without spreader" operating mode

Push-button for the following:

(a) Emergency stop
(b) Control reset

A heavy-duty warning-siren foot switch shall also be mounted to ease the use by the operator when he is seated. Foot switch shall be used for general warning.

5.11.9 AC Sockets and Outlets

Four (4) 16 amp, 230 V switched socket outlets shall be provided. The outlet circuits shall be supplied from a 400/230 V, double-wound, single-phase, 50 Hz, air-cooled transformer with earthed secondary winding.

One socket shall be located at the centre of each beam of the trolley girder and two at ground level, diagonally opposite to each other and adjacent to a wheel assembly.

All outlets shall be of grounded type, suitable for operation of conventional hand power tools, and in case their location is directly exposed to the weather, they shall be weather-tight. Wiring shall be 600 V insulation.

5.11.10 Lighting System

A permanent 230 V single-phase lighting system shall be furnished on the crane to provide sufficient illumination for all access ladders, platform walkways, engine compartment and electrical enclosure.

The following level of illumination shall be maintained:

-	along walkways, ladders and stairs luffing mechanism platform	50 Lux
-	engine compartment and electrical enclosure	200 Lux
-	sufficient floodlights to provide illumination at quay level at an area of ± 5 metres from boom centre lines	230 Lux
-	2 searchlights below operator's cabin	

Lights shall be watertight and mounted shock-proof at respective locations.

Lights shall be controlled by means of sealed push buttons on the panel, on the foot of the crane and in the driver's cabin.

The engine compartment, electrical enclosure and operator's cabin shall be equipped with self-contained, battery-operated emergency lighting units. This system shall have a 3-hour duration in case of main or auxiliary power-supply failure and shall provide sufficient illumination for safe access in such cases.

5.11 Electrical Design

5.11.1 General

All material shall be new and of the highest grade and quality.

All materials with electrical components shall be suitable for the tropical marine corrosive conditions and the temperatures and humidity indicated before.
All materials shall be of the type normally furnished for heavy-duty crane applications and shall be designed to satisfactorily operate under conditions of moisture and adequately treated or protected against corrosion, moisture, salt, mould, dust, sand or other destructive elements to which it may be exposed during operation in the climate.

All electrical equipment must be derated to suit the specified conditions.

All enclosures of electrical equipment shall be arranged to minimise the entry of dust, and where components generate heat, they shall be suitably cooled.

All electrical materials (components, sub-assemblies, etc.) shall be thoroughly tested to demonstrate compliance with their design requirements.

The Contractor shall demonstrate with his drawings and specifications and with the required tests that the material is capable of performing all of the required functions with a minimum of down time. A complete listing and description of all electrical systems and components shall be included in the manuals required in these Specifications.

The electrical system shall provide reliable power for safe, rapid and precise handling of containers in continuous loading and unloading operations.

The control system for main hoist, trolley and gantry drives shall be DC variable voltage steplessly-regulated control over the entire range of speeds.

The electrical installation shall include the necessary power units and appropriate distribution and control system as well as all necessary motors, controls, signals, indicators, instruments, alarms, protective devices, wiring, software and all other features.

Maximum allowable temperature rise on equipment and wiring shall be predicted. Space heaters shall be sized to protect the equipment when stowed and under operating conditions at ambient temperatures as specified. Due consideration shall be given to temperatures within enclosures and to ventilation during operation.

All materials shall be designed and located so as to ensure easy access for repair and/or removal. In order to facilitate routine repairs or adjustments, ladders, walkways, or access platforms shall be provided as required for convenient access, and shall be fitted with handrails and toe plates as appropriate for the location.

Materials used for the same or similar or allied service shall be of the same manufacture and, when of the same rating, be interchangeable to facilitate maintenance and reduce spare part requirements.

- twist-locks locked
- twist-locks unlocked

(4) For maintenance purposes only, an interlock bypass switch shall be locked or unlocked without the spreader being seated on a container or stacking frame. This switch shall be lockable by means of a removable key.

5.11.13 Limit Switches

Limit switches shall be fail-safe and selected and applied to ensure trouble-free operation under all conditions. Care shall be taken to protect the limit switches by adequate positioning or other means to prevent malfunction or spurious operation.

All switches shall be dust-proof and watertight and suitable for marine use. Lever-operated limit switches shall be rated for the speed on the tripping cam and, where space permits, shall be heavy-duty type. Fork lever switches shall not be used.

All limit switches shall be mounted in easily accessible positions to facilitate adjustments, maintenance and replacement.

In addition to the functions specified or identified elsewhere in these specifications, limit switches shall be furnished for any additional functions that may be required for safe and efficient operation. Such switches shall meet the specifications above.

Limit switches shall be furnished and installed for the following functions:

Hoist

(1) *Up slow-down:* to slow the main hoist speed to predetermined value when approaching the upper limit of spreader hoist travel.

(2) *Up slow-down check:* to control if step number (1) has been effected.

(3) *Up stop:* to stop the main hoist at the extremes of spreader hoist travel.

(4) *Up over-hoist stop:* to stop the main hoist in case the up stop switch fails 500 mm above the extreme spreader hoist travel.

(5) *Down slow-down:* to slow the main hoist lowering when five turns are left on the cable drum.

(6) *Down slow-down check:* to control if step number (7) has been effected.

(7) *Down stop:* to stop the main hoist lowering when two turns are left on the cable drum.

(8) Slack rope device shall be provided for the hoist ropes to avoid excessive rope motions.

Trolley Travel

(1) *Forward slow-down:* to slow the trolley speed when approaching the forward end position.

(2) *Forward/reverse stop:* to stop the trolley at each end of its position.

All wiring shall be stranded copper for moving components and/or hard-drawn copper for fixed installations with a minimum cross section of not less than 1.5 mml for control circuits and 2.5 mml for power circuits, flame retardant, heat resistant, oil and moisture resistant, thermoplastic with nylon jacket and shall be sized in accordance with applicable IEE Regulations and British Standards, adequately derated to suit ambient temperatures and multiple runs.

All wiring shall run in suitable rigid heavy wall galvanised conduit amply dimensioned for the size and number of conductors to be accommodated.

The conduit system shall be generally arranged within the interior crane structure where practical. Where conduit is run on the exterior of the crane, it shall be located so as to prevent any possible damage due to swinging loads. Where conduits enter or leave the structure, doubler plates, where required, shall be used and rigid couplings shall be welded at these locations. Draw-in-type conduit systems must be used and wiring must be easily removed and replaced.

Cable entrances to all panel boards, junction boxes and/or other enclosures exposed to the weather shall be from below. Side entrance may be provided only where entry from below is impractical, and approval must be obtained in each specific case.

All cable not running in conduit shall be protected from direct sunlight when stowed, by adequate shields of robust construction and arranged as such that motor air circulation is not restricted.

All flexible conduit used shall be liquid tight flexible metal type with approved fittings.

Colour codings to be according to applicable standards of BS and IEC.

The wiring for the lighting system and for the electronic control system shall be kept separate from the power and control wiring and shall be run in a separate conduit and junction box system to avoid magnetic and electrostatic interference.

5.11.5 Space Heaters

Space heaters shall be provided for all control panels, switch boards and motors. They shall be capable of operating at 230 V, 50 Hz. A red warning plate shall be provided at each heater location, warning of this separate power source. Heaters in motors and brakes shall be automatically cut off during crane operation.

5.11.6 Motors and Brakes

All motors and electric motor brakes shall be totally enclosed, non-ventilated except where housed in watertight enclosures. Aluminum or aluminum alloys shall not be used for enclosures or windings.

All motors and brakes shall be sized for torque ratings and for the duty cycle specified and shall meet the requirements of applicable codes and safety regulations.

All motors shall be equipped with a minimum of three (3) integral temperature sensing devices and the associated evaluation and release equipment inside the switch/control boards.

particular drive section of the control board for use of the maintenance personnel only, in order to reactivate the drive and move the device into the opposite direction to clear the limit switch. The maintenance personnel has to investigate the cause of the failure, repair or make good any defects and only thereafter return the crane to service.

5.11.17 Communication System

A low-voltage telephone system with battery back-up shall be furnished and installed between the operator's cabin, the ground level and the electrical control room. Loudspeakers shall be connected to the system to permit user at any station to address persons on the wharf. All stations shall have call buttons and "press to talk" buttons and be equipped with a volume control. Units exposed to weather shall be housed in weather-proof enclosures.

A loudspeaker shall be mounted on the underside of the operator's cabin pointing downward so that the operator can talk via a microphone in his control console to persons on ground.

In addition, provisions shall be included in operator's cabin for radio communication materials. This will include mounting platform, power supply, antenna, etc.

5.11.18 Automatic Warning Sounders

Two electrically-operated automatic warning "sounders" shall be mounted on diagonally opposite gantry legs and shall sound automatically whenever the gantry motors are energised.

In addition, a flashing light, 230 V, AC, with red dome, 360 -rotation and weather-proof shall be provided outboard at each gantry leg at dock level.

5.11.19 Auxiliary Power Supply

A change-over switch, sufficiently rated, fuses and a connecting terminal block will be provided in a totally enclosed (IP 65) box to enable the connection to the external shore (park) supply when the main power supply is switched off. The nominal rating of the shore supply is 400/230 V, 3-phase, 5-pole, 50 Hz. The system will energize all lightings, air-conditioning and ventilation systems, communications, space heater, control circuits for testing and socket outlets.

The auxiliary power supply cable shall be located at the right side in driving direction. Provision shall be made for cable, reeling mechanism and a power plug to fit the existing cable sockets.

Measuring Instruments
Every measuring point, current or potential shall be equipped with the proper terminals to enable the maintenance crew to connect an external instrument into the circuit. At least the following meters/instruments shall be installed:

- voltmeters for LT supply

- ammeters and voltmeters (one each) for
  armature current of hoist motor(s)
  every trolley motor
  gantry travel motors

- ammeters for
  field current of hoist motor(s)
  field current of every trolley motor
  every gantry crane motor

- hourmeters for
  - crane "on"
  - hoist
  - trolley motors (4)
  - gantry motors (8)

- "on"-impulse counters for main crane circuit breaker

The Bidder shall furnish with its Bid detailed information on the proposed system.

5.11.8 Operator's Console

All necessary controls, indicators and materials for emergency action shall be conveniently located to ease operation when the operator is seated in the fully adjustable chair provided for his use. All controls shall be clearly marked to indicate operation and direction of motion.

The operator's console shall contain all control mechanisms and indicating lights necessary for cyclic container handling operation. "Set-up" type of controls and indicating lights such as "control power on" may be placed elsewhere but shall be within easy reach of the operator.

The console shall contain at least the following:

(Ball handle lever) switches shall be provided for each of the following functions:

(a) Hoist/lowering
(b) Long travel
(c) Trolley travel
(d) Long travel steering
(e) Twist-locks - lock - unlock
(f) Flippers - extend - retract with each flipper able to be operated independently
(g) Selector switch for trolley drive
(h) Lock/unlock wheels, 0 - 90°, intermediate positions

5.13 Paint and Surface Protection System

The surface preparation and paint application shall be carried out in accordance with the German Standard DIN 55928, British Standard BS 5493 and Swedish Standard SIS 05 5900 as well as the paint manufacturer's recommendations.

(1) The Bidder shall provide a detailed description of the paint system using an internationally recognised paint system and approved by the paint manufacturer and will guarantee the paint system for a period of ten years from handover. The final colour scheme shall be approved by the Purchaser.

(2) A minimum of total dry film thickness of 250 µ shall be applied.

(3) Gantry bogies, sill beams and bottom of legs to top of sill beam level shall be painted fluorescent yellow with black diagonal stripes.

(4) The Contractor shall furnish, jointly with the paint manufacturer, a five-year guarantee on the paint system. The proposed form of guarantee shall be submitted to the Purchaser for approval upon contract negotiations.

5.11.11 Festoon System

Power and control wiring shall be run in flexible insulated cables from junction boxes on the trolley rail girder via festoon systems to junction boxes on the trolley.

Tracks shall be "I"-shaped members and inclined to minimise collision forces on the system.

The cables shall have the greatest number of strands per conductor per current catalogue listing. Cable grips shall be used to relieve strains on the cables before they enter junction boxes.

The festoon systems shall be conveniently located at the top beam providing easy and safe access for maintenance purposes.

5.11.12 Spreader Control System

(1) Electrical power and control shall be supplied to the spreader from the trolley by means of a flexible multi-conductor cable which coils into a cable tub on the head block. The cable shall be "SPREADER FLEX" as manufactured by Siemens or an approved equal. The cable shall have a right hand lay and coil into the tub in a clockwise direction viewed from above. The cable shall be greased with a suitable silicone grease after installation. 20% of the conductors shall be spare (minimum of 6).

A quick disconnect connector shall be installed at both ends of the cable. Strain on the cable plugs shall be eliminated by suitable means. A junction box shall be provided for quick change-over of connections in case of broken leads.

(2) Controls, control wiring, limit switches and all other necessary materials shall be provided to furnish interlocking and indication in the operator's cabin of the position of the telescopic end beams, twist-locks and flipper devices.

(3) As a minimum, the safety features in the electrical system shall be provided with the following interlocks:

a) Spreader cannot be hoisted unless all four twist-locks are fully locked or unlocked.

b) Spreader twist-locks can only be locked or unlocked when all four corners are properly seated on a container or stacking frame. In addition, spreader twist-locks shall not be able to be locked or unlocked, unless slack rope interlock indicates that rope is slack.

c) Timer(s) that will delay actuation of twist-locks for up to two seconds after spreader is properly seated.

d) Spreader expand/retract can only be actuated if twist-locks are in unlocked position and the four point centre sensor system is not actuated.

e) Actuation of following cabin-mounted lights:

- spreader landed

The controller system shall provide real-time display of programmes and all plant data and status at remote sites. The PLCs shall be provided with in- and out (I/O) ports which are interchangeable, i.e. can be individually programmed to be either inputs or outputs.

The I/O ports shall be capable of handling standard input and output signals. The I/O ports shall provide proper isolation from dangerous voltages and currents. There shall be provisions for adding I/O ports.

Access to the series links of the PLCs shall be provided at the following areas:

1. Electric control room
2. Operator's cabin
3. Wharf checker's cabin

An interface shall be provided to accommodate a future automated steering and positioning system.

6.2 Computer-Aided Operation System

6.2.1 Computer Requirements

The Contractor shall install a computer, a terminal and a UPS for interfacing with the crane system and a single-phase power supply at 230 V, complete with 16 A socket outlets. The computer system to be suitably installed within the crane's electrical control room.

6.2.2 Operator's Cabin Requirements

The Contractor shall install, at a suitable location, a display terminal for simple fault messages.

6.3 Crane Management System

A complete computerised CRANE MANAGEMENT SYSTEM (CMS) with the necessary sensors and transducers shall be installed on each crane and work in conjunction with the PROGRAMMABLE LOGIC CIRCUITS (PLCs) to provide continuous monitoring, diagnostics, and data collection on the crane's operating systems.

Status and performance of the drives including the AC supply, AC motor control, operator control, safety interlocks, and essential components like motors, gear reducers, rope drums, etc. shall be captured and displayed on the screen for evaluation of the crane's mechanism.

The CMS shall be capable of - but not be limited to - the functions mentioned hereinafter.

A detailed description of the CMS shall be submitted with the tender documents.

(3) *Reverse slow-down:* to slow the trolley speed when approaching the backward end position.

(4) *Slow-down check:* to control if step numbers (1) and (3) have been effected.

5.11.14 Interlocking Devices

Adverse results of system faults and incorrect operation shall be avoided through a fail-safe design based upon a variety of interlocking functions. Interlocks shall be provided for, but not necessarily limited to, the following:

(1) Interlocks to prevent spreader hoisting until the connecting pins on the quick change head block are correctly located.

(2) Wheel rotational interlock to prevent the wheel locks from being energised unless the wheels are in the correct position (indicate to the operator the direction of the wheel assemblies), if applicable.

(3) Wheel lock position interlock to prevent the wheel assembly from rotating until the locks are fully retracted (indicate the position of the locks to the operator), if applicable.

5.11.15 Overload Protection

The hoist system will be equipped with an overload system, which will switch off the hoist motors if the system is overloaded to 110% ± 5%. A manual override for maintenance and testing purposes shall be provided.

5.11.16 Emergency Features

Two emergency situations will be distinguished, i.e.:

5.11.16.1 Emergency Stop

In this case, the operation personnel shall activate the emergency stop push buttons (mushroom head, red) which will cause every motor drive of the crane to stop, thus preventing any danger arising from moving machinery or parts.

Location of the push buttons:

- one inside the operator's cabin on the lateral control board
- one at the engine compartment and electrical enclosure each
- one at each crane leg, to be reached from ground level
- at any other location deemed necessary by the manufacturer

All other consumers on the crane remain in function.

5.11.16.2

Any one of the drives which activate an emergency limit switch shall switch off only this particular drive, leaving all other drives unharmed. An emergency limit switch by-pass push button shall be provided in the

6.3.3 Operating Log

The CMS shall provide operational data such as number of containers handled according to size and weight, crane operating and idle time, utilisation hours of main hoist motors, trolley motor and gantry motors, crane utilisation time and container handling rate, etc. These data shall be available in trend graphs plotted against variable time spans. All data shall be stored and be easily retrieved on to the screen or on printed formats.

The above data shall be categorised in the following manner:

a) per 8-hours shift
b) daily
c) monthly

6.3.4 Maintenance

6.3.4.1 Replacement Programme for Consumables

The utilisation hours of the crane's consumables shall be captured on-line and compared with the respective pre-set replacement interval. The system shall prompt the user when a part is due for replacement.

The pre-set replacement interval shall be adjustable and the Contractor shall advise the Purchaser on the optimal replacement intervals for the respective parts. Adjustment of the intervals shall be possible. The consumables shall include but not be limited to the following items:

i) lubrication in gear reducers and motors
ii) oil and air filter elements
iii) wire ropes
iv) bearings
v) brake pads
vi) brake shoes (if used)
vii) carbon brushes of motors

The system shall have the capacity and flexibility for adding new items and changing any of the existing items from the above mentioned list by the engineers.

6.3.5 Generating of Job List

The CMS shall be capable of interfacing with the Port's facilities maintenance management programme, and the maintenance status of a particular crane shall be updated automatically based on all on-line data captured by the system and on information input by the user.

Details of the facilities maintenance management programme will be given to the successful Bidder. Alternatively, the Bidder may propose a comprehensive facilities maintenance management programme to be supplied together with the CMS.

Details of the proposed programme shall be submitted together with the bid. The maintenance job list shall at least include all the outstanding faults, conditional and preventive maintenance works due. The system shall have the provision of the user to add other works to the job list which are not monitored by the system.

5.12 Labelling, Nameplates

All materials the function and application of which is not immediately self-evident as judged by appearance, location or other indications or the service relationship to other materials is not readily apparent, shall be supplied with a nameplate immediately adjacent and symmetrical to the materials. The nameplates shall carry appropriate inscriptions or identification markings, which will enable the operator and maintenance personnel to get a quick and accurate picture of the overall relationship and relative functions of the components. Additionally, each component shall be identified by its code number according to the wiring diagrams.

(1) Nameplates shall be provided for all devices on switchboards to identify function, indication, circuit or purpose. Nameplates for voltage coils show voltage rating and value of external resistance used.

(2) Any special precaution, maintenance or operating instructions shall be included on the nameplates or on a separate plate attached to the materials.

(3) In addition to the nameplates provided by the manufacturer of individual components, each major item of electrical materials shall have a nameplate designating its function and service.

(4) Nameplates shall be engraved brass or aluminium if exposed to the weather and may be engraved phenolic if located in the operator's cabin or inside watertight/weather-proof enclosures.

Standard nameplates for motors and brakes must be legible and may be engraved or stamped.

All nameplates exposed to weather shall be attached with stainless steel screws.

Painted-over nameplates will be cause for rejection.

(5) All conductors shall be identified by colour codes, wire numbers and prefix at each terminal to which they are connected, in accordance with the wiring diagram. Wire markers shall be yellow hot-foil-stamped sleeves with machine-printed black, permanently legible lettering and numbering or an approved equal.

(6) A nameplate showing the manufacturer's name, address and trademark shall be attached to both sides of the crane. Separate nameplates showing the safe working load (SWL) of the crane in tons shall be attached to the gantry in a visible manner at the lower part of the sill beams.

The Purchaser's logo shall be prominently displayed in size and at a location to be approved by the Purchaser.

In addition, the Purchaser's logo identification tag shall be displayed analogue to the logo.

(7) All warning and instruction boards (first aid, fire-fighting instructions, general warning for maintenance and work on electrical equipment, danger signs, "men at work" signs, etc.) have to be included and installed at the proper locations.

6.3.8 Documentation

Six (6) sets of the following documentation shall be provided in English language:

Software

a) Operating system manuals
b) Manuals describing the overview of the PLC/CMS
c) System manuals describing the functions of all the software programmes, including data communication/terminal emulation software
d) User manuals with clear instructions on how to run the PLC/CMS software
e) Annotated source listings of all the software programmes, including data communication/terminal emulation software

Hardware & Data Communication

a) Operating manuals
b) User guides
c) Technical manuals describing the circuit functions of the equipment complete with circuits diagrams
d) Maintenance manuals complete with parts lists

6.3.9 Other Requirements

All equipment for the PLC/CMS (hardware, data communication) shall operate on 230 V, 50 Hz, single phase power supply.

Original licensed software package shall be used, including the latest international operating system programme, Windows application programme, development compilers, etc. One copy of the software package shall be provided for every computer provided in the contract.

Uninterrupted power supply shall be provided for each computer to sustain operation of the PLC/CMS for a reasonable period of time in the event of a power failure.

6. Computerised System

6.1 Sequence Control (PLC)

All sequencing and inter-locking functions for drives, except emergency protection functions shall be performed by PROGRAMMABLE LOGIC CONTROLLER (PLC). The PLCs shall be able to intercommunicate with each other through a standard network following the OPEN SYSTEM INTERCONNECTION (OSI) communication architecture. The system of communication shall be properly structured, organised and standardised.

The PLC shall have multi-tasking and remote communication capabilities. Any of these PLCs in the network shall readily be able to interrogate other PLCs connected to the same network.

The Bidder shall submit details (product data sheets and schematic diagrams) showing the structure of the communication system reflecting the above required qualities.

All components of the PLC shall be robust for use in industrial environments of high temperatures, dust, vibration , humidity, electrical noise or other harsh conditions. The PLC shall be provided with redundant components for maintaining smooth operations. Power failure protection shall be provided to ensure safe operation.

The PLCs shall have sufficient memory capacity to hold control algorithms for more than one process plus at least 30% redundant memory capacity. There shall be facilities and space provided for adding memories for future developments. It is envisaged that flexible data logging functions will be utilised in the future.

The PLCs shall be provided with interactive programming and monitoring facilities for maintenance and future development. For this purpose, lap-top screen display type terminals with floppy and hard-disk drives and printer shall be provided on every crane within a suitable location in the electrical control room, on proper desks with two chairs each.

There shall be provision for logging of fault data. The storage device shall be sized to provide 30% spare capacity above the requirements of the delivered system. The terminal shall be capable of providing independent off-line development of programmes and documentation.

Expansion of the programmable logic controllers shall be by plug-in modules to the common rack. The PLCs shall have self diagnostic capability both upon power on and continuously during operation. Faults detected shall be clearly and promptly announced by audio alarm and visual displays.

The PLCs shall be capable of detecting the following categories of faults:

a) out-of-sequence faults
b) under time faults
c) overtime faults

The programming language shall be of any international operating system language and suitable for sequence control purposes. It shall also allow referencing devices by English names consisting of alphanumeric characters of adequate length. There shall be provisions for incorporating comments in the documentation of programmes. Security features that permit only authorised users to amend the programmes shall be incorporated.

8. Final Adjustment And Testing

After the crane has been erected, adjusted, lubricated and otherwise made ready for operation, it shall be tested to demonstrate conformity to all requirements for structural, mechanical and electrical components as built. These test procedures will prove the compliance of this crane with the Technical Specifications.

The Contractor shall prepare formal test procedures for all required tests and submit them to the Purchaser for approval 60 days prior to the scheduled handover tests.

(1) The final testing process shall consist of the following main stages:

a) static test
b) dynamic test under varying load conditions
c) overload test
d) eccentric load test
e) testing of safety devices and emergency systems
f) general crane inspection

(2) The crane shall hoist an average container load simulating as closely as possible the operation cycle to be defined in the test procedures. The duration of this test shall be at least one (1) hour. Should down time occur during this test, the test will be repeated until the one (1) hour duration is accomplished.

(3) The crane shall be operated through full operation cycles of driving full free length of runway and placing and removing fully-loaded containers. The duration of these test cycles is to be repeated for eight (8) hours, the last two (2) of which are to be trouble-free.

(4) During the full load and overload testing, measurements are to be taken of the voltage and ampere readings at the generator, drive motors and speeds as well as temperature readings of motors, gear reducer and brakes, and shall form part of the test report to be established by the Contractor.

(5) Preferably, all tests to be carried out prior to shipment at the Contractor's premises in the presence of the Purchaser's appointed representative.

8.1 Special Tools

The Bidder shall optionally quote in its Bid for:

(1) Special electrical instruments, measuring/recording and testing devices required for fault detection and maintenance/repair on the electric control and drive system.

(2) Special mechanical tools required for the crane operation, maintenance, repair and inspection. These shall include, but not be limited to, special adjusting tools, snap ring pliers, impact wrenches and wrenches for bolts in excess of 38 mm body diameter. Each tool and wrench shall be stamped so as to be easily identified as to its size and special use, if any.

6.3.1 Condition Monitoring

The status and operating data for the electrical systems and sub-systems and all the essential components which are critical to the proper function of the crane shall be monitored in terms of real time. Any abnormality in the crane's systems and components shall be prompted and immediately displayed on the screen indicated.

Vibration level and temperatures of all gear reducers, rope drums and motors for the main hoist, gantry travel and trolley travel systems shall be monitored continuously and displayed on the screen whenever desired. The operating voltages, currents and speeds of all motors shall also be monitored.

Threshold values for warning and shut-down of respective systems and components shall be incorporated. Easy means of adjustment to the threshold values by the engineers shall be made available.

On-off status and failure of all safety interlocks, brakes, ventilation fans, air-conditioners for the electrical and computer rooms, emergency switches, etc., shall be displayed on the screen.

Details of the proposal for this monitoring system shall be submitted with the bid.

6.3.2 Fault Diagnosis

Data of the conditions as mentioned in Clause 6.3.1 above shall be stored and easily traced back at a later stage to facilitate fault diagnosis. Information what crane functions have been selected or were performing before and during a failure shall also be stored.

Fault diagnosis and help screen that prompt the Port's technicians with the information on the nature of crane failure and remedial actions shall be provided. An expert system shall be incorporated in the fault diagnosis to narrow down the faults to the exact components, interlocks, switches, etc.

On the help screen there shall be information on the schematic drawing number, software page number, component locations and possible actions to be taken to remedy the fault. Means for updating and enhancement of the help messages and information shall be made available to the engineers.

The fault diagnosis and help messages shall be designed to enable the Port's technicians to remedy the fault or confirm the exact nature of a major fault within a very short time.

In addition to the screen display of the CMS, simple fault messages shall be displayed on the screen in the operator's cabin and in the electrical control room. These simple messages shall be used by the operator to make breakdown reports to the maintenance workshop.

Historical records of faults shall be stored and they shall be easily retrieved on to the screen or on printed formats. Such historical records are required for analysis and corrective actions to eliminate recurring faults.

Up to 1000 historical records shall be made available on real-time display mode. Earlier records exceeding 500 shall automatically be downloaded to the hard disk. Download of all historical records to diskettes shall also be made possible.

ANNEX - TO BE COMPLETED BY THE BIDDER

Clause-by-Clause Comments to the Technical Specifications

The system shall allow the selection of outstanding faults lists, and conditional and preventive maintenance works list, or the combination of both.

Details of the proposal to meet this requirement shall be submitted with the tender documents.

6.3.6 Software and Hardware Requirements

The requirements of the CMS are as follows:

6.3.6.1 Software Requirements

The operating system and application software shall be developed using Windows environments with commands in English language. Final details of the monitoring system and the software shall be developed in conjunction with the Purchaser.

The software shall display the status of any systems and components monitored by the CMS as well as the job list upon request by the user. It shall also allow the access of the source code files of the application programmes and sequence control programmes (ladder diagrams, boolean logic, etc.) by the respective crane computer.

Modification to the sequence control programmes by the Purchaser shall be made possible. A key switch and password control shall be implemented to prevent unauthorized modification of the programmes. Forcing-on and forcing-off of switches, relays, contracts, etc. in the programmes shall also be made possible.

Any abnormal conditions in the systems and components shall be annunciated distinctly in real-time mode on the display monitor. Such events/alarms shall be logged on a disk file which is accessible to the user for review at any time.

Time-based graphs displaying several signals simultaneously shall be incorporated in the CMS. Such graphs shall be able to be stored on disks in graphic format and printed out on a high speed printer.

6.3.6.2 Hardware Requirements

All components to be provided by the Contractor shall be industrial-grade personal computers (PC) of suitable model and of sufficient capacity, size and other accessories for handling the software programmes.

The crane computers shall be designed to operate satisfactorily under the harsh environment on the crane. The Bidder shall propose its optimum selection.

Other equipment to be installed:

a) One standard printer and parallel interface for each crane computer.
b) Two TFT screens linked with the CMS shall be provided, one in the operator's cabin and another in the electrical control room, to display brief fault messages.

6.3.7 Data Communication Requirements

A serial link shall be provided to facilitate the connection of a lap-top personal computer or printer in the checker's cabin to access information from the crane computer.

ANNEX

Clause-by-Clause Comments to the Technical Specifications

The Bidder shall furnish a list with clause-by-clause comments containing all deviations/alterations or options from the given Technical Specifications of the Tender Document.

The list shall refer to the numbers in sequence of the Specifications in the following way:

Item No of Technical Specifications	Required by the Purchaser	Fulfilled: YES/NO	Deviation
1.2 1.3			

7. Automated Steering And Positioning System (Optional)

The Bidder shall optionally propose in its Bid an advanced automated steering and positioning system. A detailed description of the proposed system shall be provided which shall be discussed during Contract negotiations, including hardware and software requirements.

□

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 3: Rail-Mounted Gantry Crane

Table of Contents

8.2 Bidder's Recommended Spare Parts

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists for a period of operation of 3,000 hours for each unit (two years of operation).

The spare parts list should include the following data elements:

- Sequence number
- Bidder's part number
- Item description
- Quantity
- Unit price
- Total price

□

1. General Description

These Specifications describe a high-speed 40-t Rail-Mounted Container Gantry Crane which shall be purchased by the Beneficiary and which shall be used for container handling of 40-t suspended payload under lifting spreaders for handling fully loaded ISO 20' and 40', 9'6" height containers by means of telescopic spreader beams, infinitely rotating by 360 degrees.

The crane shall be capable of continuous and simultaneous lifting and trolley travelling, depositing loaded containers and gantrying in repetitive cycles at the required speeds, lifting one over two stacked containers.

For the purpose of handling heavy general cargo lifts, the spreader shall be replaced by a hook beam of 45 tons capacity.

1.1 Design Features

The design features, all material and equipment to be supplied and protective treatment of steel work must be suitable for use under the environmental conditions in the Beneficiary's country.

The crane must be designed to operate with minimum maintenance under the defined conditions. It must be made sure that the electrical and mechanical equipment does not overheat, especially where exposed to direct sunshine.

1.2 Design Criteria

Unless otherwise mentioned, the design shall be based on the latest edition of the applicable design standards.

(1) The mechanical and structural design shall comply with

BS 2573 - Part 1 (1983), Group A 7,
BS 2573 - Part 2 (1980) and
BS 466 (1984)

where applicable. (Specification for Classification, Motions, Stress Calculations and Design Criteria for Structures)

(2) The fatigue design shall be based on a conventional number of hoisting cycles on a minimum of 2 million cycles of operation when subject to a load of 80% of the maximum 35 t weight of a 40" ISO-1A container centrally disposed.

(3) The crane shall be fully operational up to wind speeds of 72 km/h (45 mph) equal to a pressure of 250 N/ml and shall withstand an out-of-service wind pressure of at least 1,250 N/ml with no load under spreader.

(4) Electric motors and generator shall conform where applicable to the latest revisions of:

1.3 Classification

(1) Crane Structure

The crane structure shall be computer-calculated and comply to BS 2573, Part 1 - 1983. The crane is to be classified as follows:

Class of utilization: U7
State of loading: Q2
Group Classification: A7

The design software used by the successful Bidder in designing the crane structure, shall be certified by an internationally recognized classification society. A certificate acceptable to the Purchaser shall be furnished during contract negotiations.

(2) Drive Mechanism

The drive mechanism shall be designed and selected in accordance with BS 2573, Part 2 - 1980 and shall be classified as follows:

	Hoist/traverse	Long travel
Class of utilization	T8	T8
State of loading	L3	L3
Group of classification	M8	M8

(3) Drive Motors

- main hoist
- trolley drive
- gantry travel

All electric motors to be rated according to VDE 0530 in conjunction with publication 31-1/Rotating Electrical Machines (Seventh Edition) issued by IEC, and BS 2613, 1970. Winding insulation shall be "Class F".

The following minimum ratings to be applied:

Drive	Duty type	Duty factor
Hoist Motor	Intermittent Periodic S3	80%
Trolley Motors	Intermittent Periodic S3	80%
Long Travel Motors	Intermittent Periodic S3	40%

3. Dimensions And Principle Particulars

3.1 Main Crane Dimensions

Span (rail centre distance of existing gantry runway):	30.0 m
Height under spreader (above yard level):	10.0 m
Lowest point of spreader (yard level)	0.0 m
Overall length - buffer to buffer:	25.0 m
Number of wheels per corner:	6
Number of driven wheels per corner, minimum:	3

3.2 Gantry Runway

The crane shall be designed to operate on A 100 crane rails which have a head width of 100 mm.

Design and layout of the runway rails will be submitted to the successful Bidder during contract negotiations.

3.3 Wheel Load Limitation

The single wheel loads shall not exceed 35 tons. under working conditions (acceleration/deceleration) with full rated load and in-service wind pressure of 25 kg/ml.

3.4 Buffer Stops

The crane must be supplied with buffer stops which are to be mounted on the centre line of each rail. Buffers shall be calculated to FEM Para 2.234.

4.6 Crane Earthing

All electrical apparatus and motors shall be efficiently earthed by means of copper tape brought to a common point, which shall be connected to the earthing wire of the power cable. Series connections are not permissible. The crane structure shall also be earthed to the power cable.

Earthing conductors shall not run or be fixed on any access path, floor, passage or walkway.

Any stranded earth cables shall be terminated in sweated sockets which, in turn, shall be rigidly bolted to the earth terminals of the materials.

The earth connections shall be made on to conduits by means of heavy-type copper clamps.

Where lengths of flexible metallic conduit connect machines or other materials, the earth continuity shall be supplemented by a separate earth conductor connected between the rigid conduit and the earth terminal of the materials.

The whole installation to be carried out in a neat workmanlike manner to comply with the appropriate regulations.

4.7 System Power Demand

The power system demand will be estimated when operating at night time with all lights on and with rated load and the critical theoretical duty.

The Bidder shall furnish with its Bid a detailed calculation for system power demand.

□

BS 4999 and BS 5000, Part 99-1973, VDE 0530-Rating
BS 2613 - Performance of Rotating Electrical Machines
BS 2757 - Classification of Insulation Material

(5) Cables, flexible cords for power and lighting shall conform to VDE, DIN 57281/57282, and to BS 6500/6116, where applicable.

(6) Contactors, low voltage control gear, HT switch gear and HT transformer shall correspond to the latest revisions of BS 775, IEC 158-1/IEC 56, VDE 0660 and to the IEC in general, where applicable.

(7) The steel quality shall correspond to FE 360 (ISO) equal to a36 (ASTM).

(8) High-tension friction-grip bolts in galvanized and crack-tested execution shall be used throughout the crane in accordance with:

DIN 931/934/6914-15	-	Hexagon high-tensile bolts
DIN 6915	-	Washers for high-tensile bolts
DIN 267	-	Fasteners and similar parts

(9) All works shall be done in a thorough workmanlike manner and shall follow the most recent practice in the manufacture of high-grade machinery. All work shall be performed by workmen in their particular trades.

All welders and welding operators shall have been certified as qualified for the materials, processes and type of weld being performed. Certificates to be handed over to the Purchaser for revision and approval.

Welding procedures shall come up to the requirements of BS 5135. Test weld samples shall be tested to BS 709, and the Bidder shall include in its Bid all costs incurred in the testing of welding and the provision of test samples.

(10) Ropes
Rope diameter and safety factor to be selected according to BS 2573, Part 2 - 1980.

(11) Pulleys and Drums, Rail Wheels
according to BS 2573, Part 2 - 1980

(12) Gear reducer and crane brakes to be selected according to R 20, DIN 323, DIN 15053 - Cranes Reduction Principle Specifications and DIN 15431/15435, dimensioning of brakes and power transmission engineering respectively.

(13) The general design of the gantry crane shall be in the metric system unless explicitly requested otherwise.

Access hatchways, where provided, shall be guarded on three sides by handrails and on the fourth side to be closed by means of a hinged gate.

Where an access hatch is positioned in a walkway suitable means shall be provided to ensure that the hatch is closed after use.

Pipe or tubular handrails shall be sealed against the entry of air, and all stanchions are to be of mild steel angles suitably sized to provide rigid support to handrails. All stanchions are to be welded to steel frame structures and not attached to platform mesh.

5.3 Operator's Cabin

The operator's cabin shall be mounted below the trolley to provide full visibility of all operations the crane is specified for.

The cabin shall be of double-walled steel construction designed to minimize heat gain. The cabin shall be weather proof under all weather conditions, fire resistant and insulated to restrict noise level to 78 dba or less at the operator's position. The space between the double-floor plates shall be used for electrical wiring. The upper floor plate shall be vinyl covered and bolted to provide access to the electric wiring. Cabin framing shall be securely fastened to the trolley by means of high-strength structural fasteners and eliminate relative movement. Final size and layout of operator's cabin shall be submitted to the Purchaser for approval.

All lower windows shall be fitted with safety bars such that if the windows are removed or opened, the safety bars remain in position to prevent the operator falling through an open window.

In addition, provision shall be made for the operator's safe exit and entry from and to the cabin at any position of the trolley along the boom in case of a hazard condition.

A remote air-conditioning/heating unit of industrial type should be provided, which will direct air via a duct and distribution system to the operator's cabin and which will maintain conditions of 22 to 24 °C and 50 per cent of relative humidity under maximum ambient temperatures and humidity specified.

The unit shall be filled with Frigen, type R 134a or equivalent.

Interior trim shall be accomplished by using modern decor materials (such as formica for the walls, PVC for the floor, etc).

Windows of safety glass shall be provided to give the complete view of the container's chassis position. The upper row of the windows to be made of tinted safety glass.

The door shall be equipped with suitable means for exterior locking.

All cabin windows shall be designed in a way that will allow the operator easy access for cleaning. Wind shield wipers with washers shall be provided. Upholstered fully-adjustable spring or air-cushioned chairs with weight adjustment shall be provided with comfortable access to all control and devices and maximum view.

Seats, operating and control equipment shall be constructed according to the latest developments in ergonomics and suitable for a permanently-manned working position.

2. Operating Characteristics

2.1 Lifting Capacity Requirements

The maximum lifting capacity below the telescopic spreader shall be 40 mt. This includes a maximum allowed eccentricity in longitudinal direction of one meter of a 40' container with a load of 35 tons. The Bidder shall specify in his quotation the weight of the spreader and the weight and lifting capacity of the heavy-lift cargo beam.

2.2 Operating Cycle

The number of operating cycles shall not be less than 30 containers per hour.

The Bidder shall submit with its proposal a comprehensive speed calculation to verify the required cycles.

2.3 Speed Rates

2.3.1
Long Travel: 120 m/min

2.3.2
Trolley Travel: 60 m/min

2.3.3
Hoist 20/40 m/min

2.3.4
Spreader Tilt and Slew

Means shall be provided to allow the spreader to be tilted not less than ± 5 degrees about axes parallel to and at right angles to the berth face. The spreader must also be allowed to slew by a minimum of ± 5 degrees.

Time to tilt the spreader by 5 : 30 seconds
Time to slew the spreader by 5 : 30 seconds

5.6 Main Drive Systems

The DC-main drive system shall include 3-phase thyristor power-conversion units, ABB, Siemens or approved equivalent, required motors, brakes, transformers, switchgear, circuit breakers and diagnostic systems.

The Bidder shall - in addition to the above - propose AC-drives using direct torque control technology or pulse width modulation technology (i.e. frequency or flux control).

Provision shall be made for the hoist control system to feed back power into the network during lowering motion (4-quadrant).

The system shall be simplified for easy maintenance and repair applications and shall provide motor drives for:

- main hoist system
- trolley travel system
- gantry travel system
- cable reel drive

5.6.1 Main Hoist System

The hoisting motion shall be driven by electric motors through totally enclosed gear. Two fail-safe disc brakes shall bring the load to rest from full speed without undue shock in as short a distance as possible. Each brake is to be capable of bringing to rest and holding the crane's full working load.

The Bidder shall specify the stop distance of emergency main hoist braking with maximum load and maximum lowering speed in case of power failure/actuation of emergency-stop push button.

The drum(s) shall be fitted with high-tensile shafts and run on heavy-duty self-alignment roller bearings enclosed in fabricated steel. Four hoist ropes, double-reeved, shall be used for carrying loads. The length of the spiral grooved portion of the drum(s) shall be sufficient to accommodate the complete hoist rope in a single layer with two additional dead turns and one free grove.

5.6.2 Trolley Travel System

The trolley shall consist of a structural steel frame supported by four double-flange wheels riding on rails mounted to the crane boom. The trolley shall have mounted on it the main hoist sheaves, and it shall support the operator's cabin.

The trolley and the cabin shall be accessible at any point in its travel and access shall be such that a disabled operator can be removed without special rigging.

The trolley frame shall be equipped with integral jacking device(s) to support the trolley at any point of its travel during wheel replacement. Wheel/axle and sheave mountings shall be such that wheel/axle assemblies and sheaves are removable vertically upward. A drop block shall be provided to support the trolley in case of a broken axle.

4. Electrical Supply

4.1 Main Power Supply

Power to operate the crane will be 11,000 Volt, 50 Hz, 3-phase + earth. The permissable voltage tolerance is ± 3%.

4.2 Supply Method

The crane's power supply is ensured by means of a trailing cable which is coiled onto a cable reeling drum to be located outside the crane leg between the rail and border fence area.

The type of trailing cable shall be:	NTSC gewoeu (Siemens or equivalent)
Cable size:	3 x 25 + 3 x 25/3
Cable length:	200 m, for 400 m of track length

4.3 Electrical Feed Point

The Purchaser will provide the 11 KV main power supply cable until the electrical feed point. The Contractor shall furnish and duly install all necessary funnels and installation material required and shall connect the trailing cable to the electrical feed point.

4.4 Fault Level

The power supply system design considers a maximum fault level of 350 MVA and a fault clearance time of 0.2 sec.

4.5 Operating Voltage

The crane operating voltage shall be 415 V, 50 Hz.

The wheel trucks shall be fitted with drop blocks and rail sweepers and the truck assemblies be furnished with bumpers, arranged to contact quay bumper stops or adjacent crane bumpers.

It must be possible to disassemble any wheel without disassembling the whole truck unit.

Truck units shall be arranged to allow removal without elevating the gantry legs. Suitable jack-up points lifting beam and portable hydraulic jacks to allow one complete bogie to be removed for repair or maintenance shall be provided under the Contract.

Stowage pins shall be provided to keep the crane from moving under stowed conditions at its designated parking area at maximum wind velocity.

Stowage pins shall be supplied with limit switch to prevent starting up the gantry drive system if the stowage pins are not out of the holding position.

The final distance between the stowage pin and the rail centre shall be submitted to the Bidder during contract negotiations.

The crane shall be equipped with a mechanically-operating rail clamp capable of arresting the crane in any position. The clamp shall be interlocked to the long-travel drive system in a way that the system cannot be activated if the clamp is in the grip position.

Two proximity switches designed to give warning of the approach within the safe distance of another crane or the approach to the end track buffers is desirable.

Four (4) emergency stop push-buttons shall be provided on the bogies to stop the long-travel motion. Push buttons shall be reset at quay level.

5.6.5 Emergency Drive Control System

Auxiliary AC emergency drive systems are to be provided for:

- main hoist
- trolley travel system

Each system shall consist of one electrical motor, coupling, (chain) gear reducer and control panel and shall be adequately rated.

Each system to be installed in line with each main drive motor opposite to the main reducer.

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Tolerances shall be indicated and gauges provided to indicate worn-out sheaves. In addition, the Contractor shall recommend repair/replacement methods and periods to ensure safe operation.

Running sheaves shall have a minimum pitch diameter of 30 rope diameters for the main hoist and trolley drive.

5.7.3 Gear Reducers

Manufactured gear reducers for the main hoist and trolley drive shall be selected by multiplying the

5. Main Technical And Design Demands

5.1 Main Frame Construction

The main frame shall be an all-welded, rigid-frame, box-girder type construction, utilizing the latest design techniques to provide an attractive structure with a minimum of maintenance. Back-to-back angles or channels or lattice members shall be avoided. Closed type sections of square structural steel tubing or steel pipe shall be used wherever possible. The design shall avoid pockets where water may collect. Bolted special joints or bolted connections of box type or other closed connections where water seepage may occur shall be equipped with steel pipe coupling drains.

All members shall be sealed and air-tested to prevent condensation and internal corrosion.

Field connection shall be made with high-strength bolts or by field welding.

All members shall be amply proportioned to provide a rigid structure. Minimum deflections for operating conditions shall be included in the calculations submitted to the Purchaser and shall be subject to approval.

Excessive vibrations of the crane or vibrations harmful to the crane shall be avoided. If required by the Purchaser, the Contractor shall submit detailed calculations that will demonstrate that the design of the trolley travel system and the gantry structure will result in a natural frequency of over 1.0 Hz in the trolley travel direction.

5.2 Stairs, Ladders, Platforms, Walkways

The crane shall be provided with stairs, ladders, platforms and walkways for safe and easy service, maintenance and inspection. The top handrail shall be not less than 1,000 mm above platform level.

The operator's cab, machinery room(s) and other parts to be serviced, maintained and supervised shall be safely accessible by means of stairs and walkways. Ladders are to be avoided as far as possible.

A walkway shall be provided on full length of both top beams.

Vertical ladders should be avoided, but - if absolutely necessary as a result of space restrictions - may be accepted subject to the Purchaser's approval.

The pitch between the ladders' rungs shall be not greater than 300 mm, the rungs being at least 300 mm wide and as well raked as possible. Ladders shall be equipped with safety cages unless otherwise approved by the Purchaser.

Platforms may be of open mesh construction, heavily galvanized and of a robust construction with high corrosion allowances.

Open mesh platforms will be supported by steel beams. Any areas of unsupported mesh are not to exceed 0.5 ml.

Tolerances shall be indicated and gauges provided to indicate worn-out sheaves. In addition, the Contractor shall recommend repair/replacement methods and periods to ensure safe operation.

Running sheaves shall have a minimum pitch diameter of 30 rope diameters for the main hoist and trolley drive.

5.7.3 Gear Reducers

Manufactured gear reducers for the main hoist and trolley drive shall be selected by multiplying the nameplate kW rating of the designed driving motor by a service factor of 1.75 in order to obtain the equivalent nominal mechanical rating which shall be used as the basis for selecting the respective gear reducer from the manufacturer's rating tables. Lifting lugs shall be provided on upper and lower section.

All other gear reducers shall be similarly selected using a service factor of 1.

The thermal ratings of the gear reducers shall not be exceeded during continuous duty-cycle operations in 45 °C of ambient temperature.

The high-speed stage of the reducers to be of helical or herring-bone gears. The other stages can be either helical or spur gears. The reducers shall be entirely self-contained in an oil-tight steel or cast iron housing. Bearing shall be of anti-friction type.

All gear housing shall be provided with suitable means to gauge the oil-level and an outlet for oil particle sampling. Each reducer shall be provided with a permanently attached name plate containing the following information: the name of the manufacturer, the reduction ratio, the rated mechanical and thermal capacity, the rated speed and the service rating or service class.

Main hoist, trolley, boom hoist and gantry gearing shall be designed and rated in accordance with BS 436, BS 545, BS 721, Part 2 or the latest applicable standards issued by AGMA.

All gear boxes shall be horizontally mounted.

Gear reducers and their gearing shall be manufactured by a company which is regularly engaged in the commercial production of catalogued, standardised gear reducers for heavy industrial application for at least twenty (20) years. The proposed manufacturer and the quality level of manufacture must be acceptable to the Purchaser.

5.7.4 Bearings

Rotating bearings on the crane shall be of the anti-friction type in metric sizes.

Bearings' life for the defined systems shall be selected on the minimum basis of 20,000 hours, based on the rated load of the crane at the rated speed of the motion.

The tabulated static capacity of the bearings shall not be exceeded under any operating conditions.

Bronze sleeve bearings, if approved by the Purchaser for use in certain locations, shall be designed on a conservative basis after determination of the PV-factor (unit pressure times surface velocity) and proper consideration of the operating conditions.

Electrical enclosures shall have hinged tops to permit ready and easy access to the apparatus wiring and devices.

All operations of the crane shall be controlled from the operator's cab with the exception of the start-up of the equipment, which shall be controlled also from the control panel as described above.

All controls shall be readily accessible to the operator and oriented in a way that the crane will respond in the direction that the operator moves them.

Activation of controls shall be of the "joy-stick" type and automatically position into "O".

An analogue load indicator shall be suitably located inside the cabin.

Provisions shall be made for a 12 V supply for installation of a communications radio adjacent to the driver's control.

The Bidder shall submit with its Bid a layout of the driver's cabin including proposed locations of all control systems.

Storage space shall be provided for items such as coats, lunch buckets and a portable water cooler.

Complete operating instructions for the proper use of the crane shall be provided in the cab.

5.4 Checker's Cabin

Provisions shall be made for a checker's cabin incorporated in the structure with easy access. The cabin shall be equipped with sliding windows, sliding door, desk (bench) and adequate ventilation.

5.5 Electrical Equipment Control Room

The crane shall be equipped with a separate control room of sufficient size to contain all required electrical control cabinets and motor control centres.

The control room shall be framed of structural steel, thoroughly braced to withstand all stresses produced by operating machinery. The sides of the control room shall have hinged doors with galvanised and painted corrugated sheet steel. The room shall be adequately insulated and ventilated to prevent undue temperature rise under working conditions. Interior insulation shall be protected by damage-resistant covering. (If desirable, air condition shall be used.)

The room will be made as air tight as practical, with joints, conduit, pipe or other attachments which pierce the insulation, being sealed a the point of entry.

The Contractor shall furnish lubricants in accordance with the original manufacturer recommendations in sufficient quantities for initial lubrication of the cranes. The Contractor provide a signed checklist signifying the equipment has been properly lubricated. All motors shall be lubricated at the manufacturing site.

The Contractor shall also supply a list of oil and grease lubricants needed for each reducer, coupling and all other equipment prior to the start of field erection to ensure that all recommended types of lubricants are available in the Beneficiary's country.

5.7.8 Hydraulic System

All hydraulic power packs shall be appropriately designed for each duty required, self-contained with filters, gangs, test points and level indicator. Wherever possible, components shall be standardised and interchangeable.

The hydraulic system shall be designed in accordance with BS 4575 tested to 2.5 times the safe working pressure with no component used in excess of the original manufacturer's regular catalogue rating. It shall be capable of working in the climatic conditions specified, for the long periods appropriate to intensive container handling.

The whole apparatus shall be equipped with over-pressure protection.

Piping shall not be used to support valves or equipment. Suitable supports shall be provided to eliminate vibrations or movements of pipe and equipment.

Where feasible, connections between components shall be flexible hose, adequately supported, with swivel fitting terminals. The number of different sizes and variations of fittings shall be kept to a minimum. Plastic hose shall not be used. Tapered pipe thread connections shall be avoided wherever possible.

Flexible pipe lines shall be of wire braid reinforced rubber hose tube according to BS 3832 and shall be of the preferred nominal sizes unless otherwise approved by the Purchaser. End connections of flexible pipes shall have threads of the re-useable type, capable of being fitted without the use of special tools.

Systems shall have adequate filtration to remove particles 10 micron or greater in size. Filter elements shall be readily replaced and serviceable during system operation, located in readily accessible areas. Automatically switched dual filters shall be used throughout. Indicators shall be provided on each filter.

Cylinders shall have chrome plated stainless steel rods and pins shall be hardened with grease provisions. Cylinders shall withstand pressures at least 1.5 times the maximum operating pressure. The safe working pressure shall be stamped on the cylinder. Cylinders shall be cushioned at each end.

All cylinders and rotary actuators shall be equipped with ball check quick-disconnect fittings at their ports.

All hydraulic components shall be of standard manufacture. Pumping and control units shall be furnished by one supplier who has been regularly engaged in manufacturing similar units for at least ten years.

The trolley drive system is to be self-propelled. Four driven wheels to be provided. Smooth acceleration and deceleration are required. Details to be discussed during the detailed design to harmonise the system for minimum horizontal movement of the gantry structure during acceleration/deceleration.

Trolley wheels and rails shall be sized in accordance with BS 466 and BS 3037, Part 2. A dry lubrication system shall be provided to minimise wheels' wear and tear. Rail type A 65, ST 60 is acceptable.

The trolley rails shall be either welded to the trolley girder or preferably fastened by means of adjustable bolted clips.

Suitable anti-derailment devices and a locking pin to prevent movement of the trolley during maintenance operations shall be fitted together with two (2) emergency-stop controls.

5.6.3 Trolley Protection Devices

For end-of-track limit on both ends, the trolley shall be equipped with contactless-type slow-down switches and mechanically-actuated main limit switches. The slow-down switches will ensure that the trolley is approached to the end of the track at a reduced speed.

The design shall permit to operate the fully-loaded trolley on the fixed section of the boom when the waterside hinged section is raised. For this operation, the slow-down and main switch should perform the same task as at end of the track.

Buffer stops shall be provided at the end of the track on both sides.

The trolley buffers shall be calculated to FEM classification para 2.234.

5.6.4 Gantry Travel System

Each corner of the crane shall be supported by an articulated gantry truck assembly designed to distribute the corner loads equally to all wheels within the limitation as specified in para 3 above.

The equalisers and truck frames shall be of heavy-steel-plate boxed construction. Wheel gears shall be within the frame for maximum protection.

The motor can be mounted vertically (V1) or horizontally (B3) but in any case should not protrude from the equaliser side wall line and shall not be mounted on the end track.

Each motor shall drive two wheels through special gearing, to provide ample traction under the most adverse operating conditions.

Provisions shall be made for the drive wheels to be disengaged from the gearing to allow the crane to be moved when its motors are out of service. Gantry travel to be possible if one motor fails.

Adequate braking arrangement shall be provided to the motors, the motors being properly interconnected to ensure that the driving load is shared equally.

5.8.1 Accessibility

Restricted accessibility of modules, assemblies and other items largely contributes to the extension of repair time. The configuration of the hardware and its layout in the crane shall make sure that free and easy access is provided to maintenance personnel, tools and equipment required to perform the repair task.

5.9 Miscellaneous

5.9.1 Overload and Slack Cable System

A system shall be provided which shall automatically stop the hoisting motion and allow lowering only if an operator attempts to lift a load in excess of 110 ± 5% of the rated capacity of the crane. An override shall be supplied to allow adjustment to 125% by maintenance personnel for testing purposes only.

An analogue load indicator with the corresponding loading zones marked in green, yellow and red must be provided with the system.

The system shall automatically shut down the lowering motion and allow hoisting only when the main hoist rope becomes slack. This shall prevent the operator from playing out too much rope and then accelerating rapidly under no load before the load is lifted up again.

The system shall prevent ropes from jumping out of sheaves, reduce the shock loads on ropes and structure and reduce the possibility of the spreader jumping in ship's hatches.

5.9.2 Anti-Sway Device

An efficient anti-sway device shall be incorporated to prevent container sway during operation.

The anti-sway device shall also be designed to prevent involuntary slewing of the spreader.

5.9.3 Maintenance Hoist

A service crane of adequate capacity, complete in all respects, to undertake all lifting of the equipment and machinery for maintenance and removal, shall be installed. The crane shall be so arranged that it can lower any of the equipment and machinery to ground level. The hoist/lower motion shall be driven by an electric motor. Other motions may be manually operated. Arrangements shall be provided to secure the crane against movement when not in use.

5.7 Mechanical Design

All parts shall be designed so that easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance is achieved.

5.7.1 Ropes

The Bidder shall furnish all wire ropes complete with fittings.

Wire ropes shall be selected according to FEM specification, para 4.2.2.

The calculated safety factor should be determined in loads as specified the FEM sub-para 4.2.2.1.2 and shall not be less than six (6).

All wire ropes shall be treated with the lubricant approved by the Purchaser at the point of manufacture. The wire ropes shall also be re-lubricated in the field prior to being placed in service. The Contractor shall furnish the Purchaser one (1) copy of the wire test certificate for each wire rope on the crane prior to the time the crane is to be certified.

Blocks of hardwood or of other suitable material shall be mounted on the crane structure to prevent damage to wire rope which would otherwise contact steel during operations.

The type, construction and lay of the wire ropes shall be:

Warrington/Seale 6 x 36 = 216 wires with fibre core (DIN 3064), with wire breaking strength of 180 kg/mml.

5.7.2 Drums and Sheaves

Rope drums and sheaves shall be of high-grade cast or welded rolled steel with machined grooves. The grooves shall be smooth and well-rounded and shall have a depth and groove pitch compatible with the wire rope that will be spooled.

The drums shall conform to BS 2573 and be stress relieved before machining.

All hoist wire rope drums shall be driven directly from the low-speed shaft of the respective reducer.

Drums shall be mounted on shafts utilizing anti-friction type bearings to assure shaft alignment and minimise vibration.

Rope anchorages shall be of approved design and shall avoid the necessity for splicing rope ends after the ropes have been reeved onto the crane.

The arrangement of the drums and sheaves shall be such that the fleet angle of the rope shall not exceed 3 degrees.

Sheaves shall be provided with steel guards of at least 12 mm thick steel plates to prevent the ropes from jumping out of the grooves.

All bearing stands shall be of cast or fabricated steel machined as required and securely mounted on base by means of bolts and dowels.

Adequate shim allowance shall be provided between all bearing stands and structural bases to permit initial alignment and subsequent realignments, if required.

Bearings and housings shall be sealed by caps or spring loaded lip-garter type seals, and except for reducer bearings, provided with pressure grease lubrication. Bearing seals shall be one of the more commonly used sizes.

Bearing housings shall have removable caps to facilitate periodic inspection of the shafts by non-destructive methods. Closed end cartridges shall not be used.

All bearings used throughout the crane shall be standardised as far as possible. All gantry wheel bearings shall be identical.

5.7.5 Shafts

All shafts shall be fabricated from high-grade steel and shall be adequately sized for the drums, bearings and/or gears. Complete data covering the physical and chemical properties and heat treatment of the material proposed shall be shown on the drawings.

5.7.6 Couplings and Coupling Guards

Couplings shall be flanged forged steel with exposed bolts, except for the main hoist drum couplings, be flexible gear type and shall transmit only torque.

Calculations of couplings will be based on the manufacturer recommendation and shall be verified by published catalogue data. The service factor will be calculated for:

- crane operation
- moderate shock load
- over 16 hours of daily operation
- over 160 starts per hour

Removable steel guards shall be installed over all couplings.

All couplings' nuts shall be self-locking to prevent their release due to vibration.

5.7.7 Lubrication

Lubrication of all mechanical operating parts shall be provided in accordance with manufacturer's instructions. Oil lubrication shall be provided for speed reducers and other items needing lubrication. Lubrication of other mechanical parts shall be by means of high-pressure grease introduced through industrial button-type fittings. The fittings shall be readily accessible or shall be piped to convenient locations. Each greasing point must be clearly labelled with a stainless steel or plastic label to indicate which mechanism it serves.

The electrical installation shall include the necessary power units and appropriate distribution and control system as well as all necessary motors, controls, signals, indicators, instruments, alarms, protective devices, wiring, software and all other features.

Maximum allowable temperature rise on equipment and wiring shall be predicted. Space heaters shall be sized to protect the equipment when stowed and under operating conditions at ambient temperatures as specified. Due consideration shall be given to temperatures within enclosures and to ventilation during operation.

All materials shall be designed and located so as to ensure easy access for repair and/or removal. In order to facilitate routine repairs or adjustments, ladders, walkways, or access platforms shall be provided as required for convenient access, and shall be fitted with handrails and toe plates as appropriate for the location.

Materials used for the same or similar or allied service shall be of the same manufacture and, when of the same rating, be interchangeable to facilitate maintenance and reduce spare part requirements.

5.10.2 Electrical Materials

All materials or combination of materials shall be selected for maximum corrosion resistance. Aluminium or aluminium alloys shall not be used for housings, fans, blowers, motors, motor brakes, festoon parts or weather-exposed parts or components unless otherwise indicated in the specification.

Ferrous components not contained in weather-proof enclosures shall be galvanised after fabrication and before painting. Cadmium plating is not acceptable.

All screws, bolts, nuts, washers, pins, studs, springs, and other miscellaneous fastenings and fittings shall be of stainless steel unless otherwise approved.

5.10.3 Enclosures

Weather-proof or watertight enclosures of the hood-latch type shall be used in all locations permanently exposed to the weather, withstanding vibrations encountered in the crane.

Junction boxes, terminal boxes, outlet boxes and similar fittings in locations exposed to weather shall be made of stainless steel or other approved corrosion-resistant material. Cover screws shall not extend into boxes or any other weather-tight enclosures.

Panels shall be accessible and removable from the front.

Covers of machinery and panel enclosures shall be hinged and capable of being opened to fully expose and allow removal of panels and/or other materials mounted inside. Latches shall be provided to secure all covers when opened for servicing. The latches shall be adequate to secure covers in high winds.

Larger terminal boxes (e.g. terminal boxes for cable festoons) shall be equipped with space heaters and an internal fluorescent lighting fitting, switch-operated.

5.7.9 Head Block

The head block shall consist of a structural frame with two sets of hoist blocks and guarded sheaves that are permanently reeved into the hoist system. The head block shall not exceed 5,800 mm in length.

A cable tub with entry guides shall be mounted on top of the head block to receive the multiple- conductor electrical cable from the trolley. This shall provide a positive maintenance-free system of connecting power and control conductors to the spreader.

The head block shall be designed for quick manual connection to the telescopic spreader using twistlocks. The connection between head block and spreader shall be designed for the specified loads and shall limit interface movement horizontally and vertically to a maximum of 1.5 mm. Locking devices with limit switches shall be provided at each point of connection to the spreader. Limit switches shall prevent hoisting of the head block/spreader or operating the spreader unless the locking devices are all fully engaged or fully disengaged. The interlocks shall be arranged in a way that a key-operated switch will enable hoisting/lowering of head block when the spreader is removed. A selector switch provided for this purpose must be lockable in each of its modes by means of a removable key. A warning light shall be provided a the operator's control console to indicate when the "without spreader" mode has been activated.

5.7.10 Spreader

One 20/40' telescopic spreader rotating by 360° is to be supplied. The Bidder shall offer its standard spreader. A BROMMA spreader system will be preferred.

The Bidder may offer an alternative telescopic spreader of approved design and acceptable to the Purchaser, fully compatible with the head block offered.

However, the spreader shall be fitted with electrical sockets to accept an external power supply and a remote control unit that will allow the spreader to be operated through its full range of motions for maintenance testing at a workshop remote from the crane. One remote control unit is to be provided.

5.7.11 Hook Beam

The Bidder shall offer a 45-t hook beam for heavy-cargo lifts.

5.8 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the crane design whenever practical.

The Bidder shall include in its Bid diagnostic ("trouble-shooting") techniques, procedures and test equipment to achieve an overall reduction of system's down time by providing for rapid location of a fault. The Bidder will list in its proposal crane systems for which such diagnostic procedures have been developed.

5.10.5 Space Heaters

Space heaters shall be provided for all control panels, switch boards and motors. They shall be capable of operating at 230 V, 50 Hz. A red warning plate shall be provided at each heater location, warning of this separate power source. Heaters in motors and brakes shall be automatically cut off during crane operation.

5.10.6 Transformer and HT Switch Board

The high-tension (HT) step-down transformer and switch gear shall be amply rated and suitably protected by means of relays or equivalent protective devices monitoring temperature. Transformers with reduced losses of cast resin-insulated type and with shock/vibration-proof windings to be selected.

A HT switch board shall be provided for the 11 kV incoming line. The standards of the local power supply authority shall be adhered to.

5.10.7 Motors and Brakes

All motors and electric motor brakes shall be totally enclosed, non-ventilated except where housed in watertight enclosures or in the machinery house. Aluminium or aluminium alloys shall not be used for enclosures or windings.

Motors of the protection class IP 21 - 23 shall be equipped with ventilators and micro-filters. The fans shall be switched off automatically after a cooling-off period.

All motors and brakes shall be sized for torque ratings and for the duty cycle specified and shall meet the requirements of applicable codes and safety regulations.

All motors shall be equipped with a minimum of three (3) integral temperature sensing devices and the associated evaluation and release equipment inside the switch/control boards.

All motors shall be of the same type and rating as far as practical in order to facilitate maintenance and reduce spare parts requirements. In any case, they shall be made by a manufacturer with an excellent service record and world-wide service organisation available in most port cities.

Waterproof motors shall be provided with suitable drain plugs and breathers as recommended by the manufacturer.

All motors shall be equipped with regreasable anti-friction bearings designed to meet the requirements of thrust and radial loads and to provide a 50,000 hour minimum life expectancy, except fan motors which shall have a 100,000 hour minimum life expectancy. Grease fittings for these bearings shall be of a different configuration than the other grease fittings used on the crane. Motors shall be completely greased prior to shipment from their place of manufacture.

Sun shields shall be provided over all motors that are exposed to direct heat from the sun. The shields shall be of robust construction and arranged in a manner that air can circulate around the motor. All sun shields are to be painted white.

5.9.4 Fire Extinguisher

Fire extinguishers of approved type and in quantities to be determined by the Bidder shall be provided. The following minimum provisions are to be made:

- one (1) unit to be installed in the operator's cabin
- one (1) at the Diesel engine/generator enclosure
- one (1) in the electrical-control enclosure

5.10 Electrical Design

5.10.1 General

All material shall be new and of the highest grade and quality.

All materials with electrical components shall be suitable for the tropical marine corrosive conditions and the temperatures and humidity indicated before.

All materials shall be of the type normally furnished for heavy-duty crane applications and shall be designed to satisfactorily operate under conditions of moisture and adequately treated or protected against corrosion, moisture, salt, mould, dust, sand or other destructive elements to which it may be exposed during operation in the climate.

All electrical equipment must be derated to suit the specified conditions.

All enclosures of electrical equipment shall be arranged to minimise the entry of dust, and where components generate heat, they shall be suitably cooled.

All electrical materials (components, sub-assemblies, etc) shall be thoroughly tested to demonstrate compliance with their design requirements.

The Contractor shall demonstrate with his drawings and specifications and with the required tests that the material is capable of performing all of the required functions with a minimum of down time. A complete listing and description of all electrical systems and components shall be included in the manuals required in these Specifications.

The electrical system shall provide reliable power for safe, rapid and precise handling of containers in continuous loading and unloading operations.

The control system for main hoist, trolley and gantry drives shall be DC variable voltage steplessly-regulated control over the entire range of speeds.

- ammeters and voltmeters (one each) for
  ⇒ armature current of hoist motor(s)
  ⇒ every trolley motor
  ⇒ gantry travel motors

- ammeters for
  ⇒ field current of hoist motor(s)
  ⇒ field current of every trolley motor
  ⇒ every gantry crane motor
  ⇒ armature current of cable reel drive

- hourmeters for
  ⇒ crane "on"
  ⇒ hoist
  ⇒ trolley motors
  ⇒ gantry motors

- "on"-impulse counters for main crane circuit breaker

The Bidder shall furnish with its Bid detailed information on the proposed system.

5.10.9 Operator's Console

All necessary controls, indicators and materials for emergency action shall be conveniently located to ease operation when the operator is seated in the fully adjustable chair provided for his use. All controls shall be clearly marked to indicate operation and direction of motion.

The operator's console shall contain all control mechanisms (and indicating lights) necessary for cyclic container handling operation. "Set-up" type of controls and indicating lights such as "control power on", spreader indicator lights and hydraulic-pump controls may be placed elsewhere but shall be within easy reach of the operator.

The console shall contain at least the following:

Ball handle lever switches shall be provided for each of the following functions:

(a) Twist-locks - lock - unlock
(b) Flippers - extend - retract with each flipper able to be operated independently
(c) Selector switch for trolley drive/boom hoist drive

Indicating lights (separate control board visible to the operator at any time) for each of the following functions:

(a) Twist-locks - locked - unlocked - landed
(b) Control power - on
(c) "Without spreader" operating mode

Push-button for the following:

(a) Emergency stop
(b) Control reset

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The electrical system shall provide reliable power for safe, rapid and precise handling of containers in continuous loading and unloading operations.

The control system for main hoist, trolley and gantry drives shall be DC variable voltage steplessly-regulated control over the entire range of speeds.

The cables shall have the greatest number of strands per conductor per current catalogue listing. Cable grips shall be used to relieve strains on the cables before they enter junction boxes.

The festoon systems shall be conveniently located at the top beam providing easy and safe access for maintenance purposes.

5.10.13 Spreader Control System

(1) Electrical power and control shall be supplied to the spreader from the trolley by means of a flexible multi-conductor cable which coils into a cable tub on the head block. The cable shall be "SPREADER FLEX" as manufactured by Siemens or an approved equal. The cable shall have a right hand lay and coil into the tub in a clockwise direction viewed from above. The cable shall be greased with a suitable silicone grease after installation. 20% of the conductors shall be spare (minimum of 6).

A quick disconnect connector shall be installed at both ends of the cable. Strain on the cable plugs shall be eliminated by suitable means. A junction box shall be provided for quick change-over of connections in case of broken leads.

(2) Controls, control wiring, limit switches and all other necessary materials shall be provided to furnish interlocking and indication in the operator's cabin of the position of the telescopic end beams, twist-locks and flipper devices.

(3) As a minimum, the safety features in the electrical system shall be provided with the following interlocks:

(a) Spreader cannot be hoisted unless all four twist-locks are fully locked or unlocked.

(b) Spreader twist-locks can only be locked or unlocked when all four corners are properly seated on a container or stacking frame. In addition, spreader twist-locks shall not be able to be locked or unlocked, unless slack rope interlock indicates that rope is slack.

(c) Timer(s) that will delay actuation of twist-locks for up to two seconds after spreader is properly seated.

(d) Spreader expand/retract can only be actuated if twist-locks are in unlocked position and the four point centre sensor system is not actuated.

(e) Actuation of following cabin-mounted lights:

- spreader landed
- twist-locks locked
- twist-locks unlocked

(4) For maintenance purposes only, an interlock bypass switch shall be locked or unlocked without the spreader being seated on a container or stacking frame. This switch shall be lockable by means of a removable key.

5.10.4 Wiring

Cables and insulation must be selected for resistance to insect and vermin attack and comply with relevant BSS.

The electrical wirings shall be sized in accordance with the relevant IEE Regulations and Codes of Practice and BS Specifications, appropriately derated to suit the ambient temperature and multiple parallel runs. It shall be installed to the standards normally accepted as the best of modern international practice.

Electrical wiring suitable for the equipment is:

(1) Internal wiring not subject to direct sunlight may be 600/1,100-V-grade PVC cables or butyl/hypolene cable or equivalent, installed in heavily-galvanised steel conduit or trunking or steel ducting built into the structure. It is essential that the crane's electrical services are easily rewirable, and any conduit systems used must be of the draw-in-type.

(2) External wiring shall be of 600/1,100-V-grade PVC cables supported by suitable cable cleats and adequately protected from direct sunlight.

All wiring shall be stranded copper for moving components and/or hard-drawn copper for fixed installations with a minimum cross section of not less than 1.5 mml for control circuits and 2.5 mml for power circuits, flame retardant, heat resistant, oil and moisture resistant, thermoplastic with nylon jacket and shall be sized in accordance with applicable IEE Regulations and British Standards, adequately derated to suit ambient temperatures and multiple runs.

All wiring shall run in suitable rigid heavy wall galvanised conduit amply dimensioned for the size and number of conductors to be accommodated.

The conduit system shall be generally arranged within the interior crane structure where practical. Where conduit is run on the exterior of the crane, it shall be located so as to prevent any possible damage due to swinging loads. Where conduits enter or leave the structure, doubler plates, where required, shall be used and rigid couplings shall be welded at these locations. Draw-in-type conduit systems must be used and wiring must be easily removed and replaced.

Cable entrances to all panel boards, junction boxes and/or other enclosures exposed to the weather shall be from below. Side entrance may be provided only where entry from below is impractical, and approval must be obtained in each specific case.

All cable not running in conduit shall be protected from direct sunlight when stowed, by adequate shields of robust construction and arranged as such that motor air circulation is not restricted.

All flexible conduit used shall be liquid tight flexible metal type with approved fittings.

Colour codings to be according to applicable standards of BS and IEC.

The wiring for the lighting system and for the electronic control system shall be kept separate from the power and control wiring and shall be run in a separate conduit and junction box system to avoid magnetic and electrostatic interference.

5.10.15 Interlocking Devices

Adverse results of system faults and incorrect operation shall be avoided through a fail-safe design based upon a variety of interlocking functions. Interlocks shall be provided for, but not necessarily limited to, the following:

(1) Interlocks to prevent spreader hoisting until the connecting pins on the quick change head block are correctly located.

5.10.16 Overload Protection

The hoist system will be equipped with an overload system, which will switch off the hoist motors if the system is overloaded to 110% ± 5%. A manual override for maintenance and testing purposes shall be provided.

5.10.17 Emergency Features

Two emergency situations will be distinguished, i.e.:

5.10.17.1 Emergency Stop
In this case, the operation personnel shall activate the emergency stop push buttons (mushroom head, red) which will cause every motor drive of the crane to stop, thus preventing any danger arising from moving machinery or parts.

Location of the push buttons:

- one inside the operator's cabin on the lateral control board
- one at the electrical enclosure
- one at each crane leg, to be reached from ground level
- at any other location deemed necessary by the manufacturer

All other consumers on the crane remain in function.

5.10.17.2
Any one of the drives which activate an emergency limit switch shall switch off only this particular drive, leaving all other drives unharmed. An emergency limit switch by-pass push button shall be provided in the particular drive section of the control board for use of the maintenance personnel only, in order to reactivate the drive and move the device into the opposite direction to clear the limit switch. The maintenance personnel has to investigate the cause of the failure, repair or make good any defects and only thereafter return the crane to service.

5.10.18 Communication System

A low-voltage telephone system with battery back-up shall be furnished and installed between the operator's cabin, the ground level and the electrical control room. Loudspeakers shall be connected to the system to permit user at any station to address persons on the wharf. All stations shall have call buttons and "press to

Electrical brakes shall be of the spring set DC magnet or thruster released shoe or disc type of sufficient capacity to stop test loads from full speed, with integral thermal protection.

Brakes shall be fitted with non-combustible linings not adversely affected by moisture and with waterproof coils. Watertight brakes shall be equipped with external hand release.

Electrical brakes for motors exposed to the weather shall be fully enclosed in a watertight housing with easily removable access cover for adjustment and repair, and with external hand releases.

All pins in the brake shall be of high-strength bronze or stainless steel. Adequate clearance shall be provided at the coil and level end, with the base of the enclosure flat to facilitate removal. The enclosures shall also be provided with drain check valves.

5.10.8 Control System

Master switches, controllers, circuit breakers, limit switches and similar gear shall be of the same manufacture, type and rating wherever possible to facilitate maintenance and to keep spare parts required at a minimum. This may be accomplished by using oversized relays and conductors for the lowest rated demand.

All automatic controls including limit switches and interlocks shall have provisions for manual override.

Circuit breakers and contactors in safety-related circuits shall be capable of opening circuits when carrying the maximum fault currents obtainable at their point of application. The protective features and interrupting ratings of all circuit breakers shall be co-ordinated to provide protection for the entire electric installation without exposing any materials to excessive thermal or mechanical stress.

Circuit breakers shall be equipped with thermal-magnetic overload trips that are ambient compensated.

Drive control panels shall be installed in the electrical control room in NEMA 12 gasket enclosures, class II, type B wiring with both ends of each conductor labelled with permanent wire numbers. Each section shall have hinged front doors, front access only, open bottoms and 240 V space heater.

A uniform electrical control system shall be provided by ABB, Siemens or other approved equal manufacturer of electrical controls. The system shall include power conversation units, transformer switch gear, circuit breakers, motors, brakes, trouble-shooting systems and PLC-system.

Measuring Instruments

Every measuring point, current or potential shall be equipped with the proper terminals to enable the maintenance crew to connect an external instrument into the circuit. At least the following meters/instruments shall be installed:

- kWh-meter for day/night tariff, with switch-over relay, with integral kW-maximum indicator, for both power flow directions

- voltmeters for LT supply for every power transformer

hot-foil-stamped sleeves with machine-printed black, permanently legible lettering and numbering or an approved equal.

(6) A nameplate showing the manufacturer's name, address and trademark shall be attached to both sides of the crane. Separate nameplates showing the safe working load (SWL) of the crane in tons shall be attached to the gantry in a visible manner at the lower part of the sill beams.

The Purchaser's logo shall be prominently displayed in size and at a location to be approved by the Purchaser.

In addition, the Purchaser's logo identification tag shall be displayed analogue to the logo.

(7) All warning and instruction boards (first aid, fire-fighting instructions, general warning for maintenance and work on electrical equipment, danger signs, "men at work" signs, etc.) have to be included and installed at the proper locations.

5.12 Paint and Surface Protection System

The surface preparation and paint application shall be carried out in accordance with the German Standard DIN 55928, British Standard BS 5493 and Swedish Standard SIS 05 5900 as well as the paint manufacturer's recommendations.

(1) The Bidder shall provide a detailed description of the paint system using an internationally recognised paint system and approved by the paint manufacturer and will guarantee the paint system for a period of ten years from handover. The final colour scheme shall be approved by the Purchaser.

(2) A minimum of total dry film thickness of 250 µ shall be applied.

(3) Gantry bogies, sill beams and bottom of legs to top of sill beam level shall be painted fluorescent yellow with black diagonal stripes.

(4) The Contractor shall furnish, jointly with the paint manufacturer, a five-year guarantee on the paint system. The proposed form of guarantee shall be submitted to the Purchaser for approval upon contract negotiations.

□

Master switches for the following:

(a) Hoist
(b) Trolley
(c) Gantry

A heavy-duty warning-siren switch shall also be mounted to ease the use by the operator when he is seated. The switch shall be used for general warning.

5.10.10 AC Sockets and Outlets

Four (4) 16 amp, 230 V switched socket outlets shall be provided. The outlet circuits shall be supplied from a 400/230 V, double-wound, single-phase, 50 Hz, air-cooled transformer with earthed secondary winding.

One socket shall be located at the centre of each beam of the trolley girder and two at ground level, diagonally opposite to each other and adjacent to a wheel assembly.

All outlets shall be of grounded type, suitable for operation of conventional hand power tools, and in case their location is directly exposed to the weather, they shall be weather-tight. Wiring shall be 600 V insulation.

5.10.11 Lighting System

A permanent 230 V single-phase lighting system shall be furnished on the crane to provide sufficient illumination for all access ladders, platform walkways and electrical enclosure.

The following level of illumination shall be maintained:

- along walkways, ladders and stairs luffing mechanism platform — 50 Lux
- electrical enclosure — 200 Lux
- sufficient floodlights to provide illumination at quay level at an area of ± 5 metres from boom centre lines — 230 Lux
- 2 searchlights below operator's cabin

Lights shall be watertight and mounted shock-proof at respective locations.

Lights shall be controlled by means of sealed push buttons on the panel, on the foot of the crane and in the driver's cabin.

The electrical enclosure and operator's cabin shall be equipped with self-contained, battery-operated emergency lighting units. This system shall have a 3-hour duration in case of main or auxiliary power-supply failure and shall provide sufficient illumination for safe access in such cases.

5.10.12 Festoon System

Power and control wiring shall be run in flexible insulated cables from junction boxes on the trolley rail girder via festoon systems to junction boxes on the trolley.

Tracks shall be "I"-shaped members and inclined to minimize collision forces on the system.

The controller system shall provide real-time display of programmes and all plant data and status at remote sites. The PLCs shall be provided with in- and out (I/O) ports which are interchangeable, i.e. can be individually programmed to be either inputs or outputs.

The I/O ports shall be capable of handling standard input and output signals. The I/O ports shall provide proper isolation from dangerous voltages and currents. There shall be provisions for adding I/O ports.

Access to the series links of the PLCs shall be provided at the following areas:

1. Electric control room
2. Operator's cabin
3. Wharf checker's cabin

6.2 Computer-Aided Operation System

6.2.1 Computer Requirements

The Contractor shall install a computer, a terminal and a UPS for interfacing with the crane system and a single-phase power supply at 230 V, complete with 16 A socket outlets. The computer system to be suitably installed within the crane's electrical control room.

6.2.2 Operator's Cabin Requirements

The Contractor shall install, at a suitable location, a display terminal for simple fault messages.

6.3 Crane Management System

A complete computerised CRANE MANAGEMENT SYSTEM (CMS) with the necessary sensors and transducers shall be installed on each crane and work in conjunction with the PROGRAMMABLE LOGIC CIRCUITS (PLCs) to provide continuous monitoring, diagnostics, and data collection on the crane's operating systems.

Status and performance of the drives including the AC supply, AC motor control, operator control, safety interlocks, and essential components like motors, gear reducers, rope drums, etc. shall be captured and displayed on the screen for evaluation of the crane's mechanism.

The CMS shall be capable of - but not be limited to - the functions mentioned hereinafter.

A detailed description of the CMS shall be submitted with the tender documents.

6.3.1 Condition Monitoring

The status and operating data for the electrical systems and sub-systems and all the essential components which are critical to the proper function of the crane shall be monitored in terms of real time. Any abnormality

5.10.14 Limit Switches

Limit switches shall be fail-safe and selected and applied to ensure trouble-free operation under all conditions. Care shall be taken to protect the limit switches by adequate positioning or other means to prevent malfunction or spurious operation.

All switches shall be dust-proof and watertight and suitable for marine use. Lever-operated limit switches shall be rated for the speed on the tripping cam and, where space permits, shall be heavy-duty type. Fork lever switches shall not be used.

All limit switches shall be mounted in easily accessible positions to facilitate adjustments, maintenance and replacement.

In addition to the functions specified or identified elsewhere in these specifications, limit switches shall be furnished for any additional functions that may be required for safe and efficient operation. Such switches shall meet the specifications above.

Limit switches shall be furnished and installed for the following functions:

Hoist

(1) *Up slow-down:* to slow the main hoist speed to predetermined value when approaching the upper limit of spreader hoist travel.

(2) *Up slow-down check:* to control if step number (1) has been effected.

(3) *Up stop:* to stop the main hoist at the extremes of spreader hoist travel.

(4) *Up over-hoist stop:* to stop the main hoist in case the up stop switch fails 500 mm above the extreme spreader hoist travel.

(5) *Down slow-down:* to slow the main hoist lowering when five turns are left on the cable drum.

(6) *Down slow-down check:* to control if step number (7) has been effected.

(7) *Down stop:* to stop the main hoist lowering when two turns are left on the cable drum.

(8) Slack rope device shall be provided for the hoist ropes to avoid excessive rope motions.

Trolley Travel

(1) *Forward slow-down:* to slow the trolley speed when approaching the forward end position.

(2) *Forward/reverse stop:* to stop the trolley at each end of its position.

(3) *Reverse slow-down:* to slow the trolley speed when approaching the backward end position.

(4) *Slow-down check:* to control if step numbers (1) and (3) have been effected.

The above data shall be categorised in the following manner:

(a) per 8-hours shift
(b) daily
(c) monthly

6.3.4 Maintenance

6.3.4.1 Replacement Programme for Consumables

The utilisation hours of the crane's consumables shall be captured on-line and compared with the respective pre-set replacement interval. The system shall prompt the user when a part is due for replacement.

The pre-set replacement interval shall be adjustable and the Contractor shall advise the Purchaser on the optimal replacement intervals for the respective parts. Adjustment of the intervals shall be possible. The consumables shall include but not be limited to the following items:

i) lubrication in gear reducers and motors
ii) oil and air filter elements
iii) wire ropes
iv) bearings
v) brake pads
vi) brake shoes (if used)
vii) carbon brushes of motors

The system shall have the capacity and flexibility for adding new items and changing any of the existing items from the above mentioned list by the engineers.

6.3.5 Generating of Job List

The CMS shall be capable of interfacing with the Port's facilities maintenance management programme, and the maintenance status of a particular crane shall be updated automatically based on all on-line data captured by the system and on information input by the user.

Details of the facilities maintenance management programme will be given to the successful Bidder. Alternatively, the Bidder may propose a comprehensive facilities maintenance management programme to be supplied together with the CMS.

Details of the proposed programme shall be submitted together with the bid. The maintenance job list shall at least include all the outstanding faults, conditional and preventive maintenance works due. The system shall have the provision of the user to add other works to the job list which are not monitored by the system.

The system shall allow the selection of outstanding faults lists, and conditional and preventive maintenance works list, or the combination of both.

Details of the proposal to meet this requirement shall be submitted with the tender documents.

talk" buttons and be equipped with a volume control. Units exposed to weather shall be housed in weather-proof enclosures.

A loudspeaker shall be mounted on the underside of the operator's cabin pointing downward so that the operator can talk via a microphone in his control console to persons on ground.

In addition, provisions shall be included in operator's cabin for radio communication materials. This will include mounting platform, power supply, antenna, etc.

5.10.19 Automatic Warning Sounders

Two electrically-operated automatic warning "sounders" shall be mounted on diagonally opposite gantry legs and shall sound automatically whenever the gantry motors are energised.

In addition, a flashing light, 230 V, AC, with red dome, 360°-rotation and weather-proof shall be provided outboard at each gantry leg at dock level.

5.11 Labelling, Nameplates

All materials the function and application of which is not immediately self-evident as judged by appearance, location or other indications or the service relationship to other materials is not readily apparent, shall be supplied with a nameplate immediately adjacent and symmetrical to the materials. The nameplates shall carry appropriate inscriptions or identification markings, which will enable the operator and maintenance personnel to get a quick and accurate picture of the overall relationship and relative functions of the components. Additionally, each component shall be identified by its code number according to the wiring diagrams.

(1) Nameplates shall be provided for all devices on switchboards to identify function, indication, circuit or purpose. Nameplates for voltage coils show voltage rating and value of external resistance used.

(2) Any special precaution, maintenance or operating instructions shall be included on the nameplates or on a separate plate attached to the materials.

(3) In addition to the nameplates provided by the manufacturer of individual components, each major item of electrical materials shall have a nameplate designating its function and service.

(4) Nameplates shall be engraved brass or aluminium if exposed to the weather and may be engraved phenolic if located in the operator's cabin or inside watertight/weather-proof enclosures.

Standard nameplates for motors and brakes must be legible and may be engraved or stamped.

All nameplates exposed to weather shall be attached with stainless steel screws.

Painted-over nameplates will be cause for rejection.

(5) All conductors shall be identified by colour codes, wire numbers and prefix at each terminal to which they are connected, in accordance with the wiring diagram. Wire markers shall be yellow

6. Computerized System

6.1 Sequence Control (PLC)

All sequencing and inter-locking functions for drives, except emergency protection functions shall be performed by PROGRAMMABLE LOGIC CONTROLLER (PLC). The PLCs shall be able to intercommunicate with each other through a standard network following the OPEN SYSTEM INTERCONNECTION (OSI) communication architecture. The system of communication shall be properly structured, organised and standardised.

The PLC shall have multi-tasking and remote communication capabilities. Any of these PLCs in the network shall readily be able to interrogate other PLCs connected to the same network.

The Bidder shall submit details (product data sheets and schematic diagrams) showing the structure of the communication system reflecting the above required qualities.

All components of the PLC shall be robust for use in industrial environments of high temperatures, dust, vibration , humidity, electrical noise or other harsh conditions. The PLC shall be provided with redundant components for maintaining smooth operations. Power failure protection shall be provided to ensure safe operation.

The PLCs shall have sufficient memory capacity to hold control algorithms for more than one process plus at least 30% redundant memory capacity. There shall be facilities and space provided for adding memories for future developments. It is envisaged that flexible data logging functions will be utilised in the future.

The PLCs shall be provided with interactive programming and monitoring facilities for maintenance and future development. For this purpose, lap-top screen display type terminals with floppy and hard-disk drives and printer shall be provided on every crane within a suitable location in the electrical control room, on proper desks with two chairs each.

There shall be provision for logging of fault data. The storage device shall be sized to provide 30% spare capacity above the requirements of the delivered system. The terminal shall be capable of providing independent off-line development of programmes and documentation.

Expansion of the programmable logic controllers shall be by plug-in modules to the common rack. The PLCs shall have self diagnostic capability both upon power on and continuously during operation. Faults detected shall be clearly and promptly announced by audio alarm and visual displays.

The PLCs shall be capable of detecting the following categories of faults:

(a) out-of-sequence faults
(b) under time faults
(c) overtime faults

The programming language shall be of any international operating system language and suitable for sequence control purposes. It shall also allow referencing devices by English names consisting of alphanumeric characters of adequate length. There shall be provisions for incorporating comments in the documentation of programmes. Security features that permit only authorised users to amend the programmes shall be incorporated.

6.3.8 Documentation

Four (4) sets of the following documentation shall be provided in English language:

Software

(a) Operating system manuals
(b) Manuals describing the overview of the PLC/CMS
(c) System manuals describing the functions of all the software programmes, including data communication/terminal emulation software
(d) User manuals with clear instructions on how to run the PLC/CMS software
(e) Annotated source listings of all the software programmes, including data communication/terminal emulation software

Hardware & Data Communication

(a) Operating manuals
(b) User guides
(c) Technical manuals describing the circuit functions of the equipment complete with circuits diagrams
(d) Maintenance manuals complete with parts lists

6.3.9 Other Requirements

All equipment for the PLC/CMS (hardware, data communication) shall operate on 230 V, 50 Hz, single phase power supply.

Original licensed software package shall be used, including the latest international operating system programme, Windows application programme, development compilers, etc. One copy of the software package shall be provided for every computer provided in the contract.

Uninterrupted power supply shall be provided for each computer to sustain operation of the PLC/CMS for a reasonable period of time in the event of a power failure.

in the crane's systems and components shall be prompted and immediately displayed on the screen indicated.

Vibration level and temperatures of all gear reducers, rope drums and motors for the main hoist, gantry travel and trolley travel systems shall be monitored continuously and displayed on the screen whenever desired. The operating voltages, currents and speeds of all motors shall also be monitored.

Threshold values for warning and shut-down of respective systems and components shall be incorporated. Easy means of adjustment to the threshold values by the engineers shall be made available.

On-off status and failure of all safety interlocks, brakes, ventilation fans, air-conditioners/heaters, emergency switches, etc., shall be displayed on the screen.

Details of the proposal for this monitoring system shall be submitted with the bid.

6.3.2 Fault Diagnosis

Data of the conditions as mentioned in Clause 6.3.1 above shall be stored and easily traced back at a later stage to facilitate fault diagnosis. Information what crane functions have been selected or were performing before and during a failure shall also be stored.

Fault diagnosis and help screen that prompt the Port's technicians with the information on the nature of crane failure and remedial actions shall be provided. An expert system shall be incorporated in the fault diagnosis to narrow down the faults to the exact components, interlocks, switches, etc.

On the help screen there shall be information on the schematic drawing number, software page number, component locations and possible actions to be taken to remedy the fault. Means for updating and enhancement of the help messages and information shall be made available to the engineers.

The fault diagnosis and help messages shall be designed to enable the Port's technicians to remedy the fault or confirm the exact nature of a major fault within a very short time.

In addition to the screen display of the CMS, simple fault messages shall be displayed on the screen in the operator's cabin and in the electrical control room. These simple messages shall be used by the operator to make breakdown reports to the maintenance workshop.

Historical records of faults shall be stored and they shall be easily retrieved on to the screen or on printed formats. Such historical records are required for analysis and corrective actions to eliminate recurring faults.

Up to 1000 historical records shall be made available on real-time display mode. Earlier records exceeding 500 shall automatically be downloaded to the hard disk. Download of all historical records to diskettes shall also be made possible.

6.3.3 Operating Log

The CMS shall provide operational data such as number of containers handled according to size and weight, crane operating and idle time, utilisation hours of main hoist motors, trolley motor and gantry motors, crane utilisation time and container handling rate, etc. These data shall be available in trend graphs plotted against variable time spans. All data shall be stored and be easily retrieved on to the screen or on printed formats.

7.2 Bidder's Recommended Spare Parts

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists for a period of operation of 3,000 hours for each unit (two years of operation).

The spare parts list should include the following data elements:

- Sequence number
- Bidder's part number
- Item description
- Quantity
- Unit price
- Total price

6.3.6 Software and Hardware Requirements

The requirements of the CMS are as follows:

6.3.6.1 Software Requirements

The operating system and application software shall be developed using Windows environments with commands in English language. Final details of the monitoring system and the software shall be developed in conjunction with the Purchaser.

The software shall display the status of any systems and components monitored by the CMS as well as the job list upon request by the user. It shall also allow the access of the source code files of the application programmes and sequence control programmes (ladder diagrams, boolean logic, etc.) by the respective crane computer.

Modification to the sequence control programmes by the Purchaser shall be made possible. A key switch and password control shall be implemented to prevent unauthorised modification of the programmes. Forcing-on and forcing-off of switches, relays, contracts, etc. in the programmes shall also be made possible.

Any abnormal conditions in the systems and components shall be announced distinctly in real-time mode on the display monitor. Such events/alarms shall be logged on a disk file which is accessible to the user for review at any time.

Time-based graphs displaying several signals simultaneously shall be incorporated in the CMS. Such graphs shall be able to be stored on disks in graphic format and printed out on a high speed printer.

6.3.6.2 Hardware Requirements

All components to be provided by the Contractor shall be industrial-grade personal computers (PC) of suitable model and of sufficient capacity, size and other accessories for handling the software programmes.

The crane computers shall be designed to operate satisfactorily under the harsh environment on the crane. The Bidder shall propose its optimum selection.

Other equipment to be installed:

(a) One standard printer and parallel interface for each crane computer.
(b) Two TFT screens linked with the CMS shall be provided, one in the operator's cabin and another in the electrical control room, to display brief fault messages.

6.3.7 Data Communication Requirements

A serial link shall be provided to facilitate the connection of a lap-top personal computer or printer in the checker's cabin to access information from the crane computer.

ANNEX - TO BE COMPLETED BY THE BIDDER

Clause-by-Clause Comments to the Technical Specifications

6.3.6 Software and Hardware Requirements

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ANNEX

Clause-by-Clause Comments to the Technical Specifications

The Bidder shall furnish a list with clause-by-clause comments containing all deviations/alterations or options from the given Technical Specifications of the Tender Document.

The list shall refer to the numbers in sequence of the Specifications in the following way:

Item No of Technical Specifications	Required by the Purchaser	Fulfilled: YES/NO	Deviation
1.2 1.3			

7. Final Adjustment And Testing

After the crane has been erected, adjusted, lubricated and otherwise made ready for operation, it shall be tested to demonstrate conformity to all requirements for structural, mechanical and electrical components as built. These test procedures will prove the compliance of this crane with the Technical Specifications.

The Contractor shall prepare formal test procedures for all required tests and submit them to the Purchaser for approval 60 days prior to the scheduled handover tests.

(1) The final testing process shall consist of the following main stages:

(a) static test
(b) dynamic test under varying load conditions
(c) overload test
(d) eccentric load test
(e) testing of safety devices and emergency systems
(f) general crane inspection

(2) The crane shall hoist an average container load simulating as closely as possible the operation cycle to be defined in the test procedures. The duration of this test shall be at least one (1) hour. Should down time occur during this test, the test will be repeated until the one (1) hour duration is accomplished.

(3) The crane shall be operated through full operation cycles of driving full free length of runway and placing and removing fully-loaded containers. The duration of these test cycles is to be repeated for eight (8) hours, the last two (2) of which are to be trouble-free.

(4) During the full load and overload testing, measurements are to be taken of the voltage and ampere readings at the generator, drive motors and speeds as well as temperature readings of motors, gear reducer and brakes, and shall form part of the test report to be established by the Contractor.

7.1 Special Tools

The Bidder shall optionally quote in its Bid for:

(1) Special electrical instruments, measuring/recording and testing devices required for fault detection and maintenance/repair on the electric control and drive system.

(2) Special mechanical tools required for the crane operation, maintenance, repair and inspection. These shall include, but not be limited to, special adjusting tools, snap ring pliers, impact wrenches and wrenches for bolts in excess of 38 mm body diameter. Each tool and wrench shall be stamped so as to be easily identified as to its size and special use, if any.

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 4: 41-t Reach Stacker

Table of Contents

1. General Description

These Specifications describe a 41-t Reach-Stacker which shall be purchased by the Beneficiary as mentioned in the Bill of Quantities, and which shall be used for container handling. The Reach-Stacker will be particularly used for top-handling of empty and fully loaded ISO 20' and 40', 9'6" height containers; for loading, unloading and stacking them four containers high, by means of a 20 - 40' telescopic spreader unit.

2. Operating Characteristics

2.1 Operations Characteristics

2.1.1 Lifting Capacity

2.1.1.1
The basic capacity under twistlocks at a first row distance of 2,000 mm shall be 41,000 kg

2.1.1.2
The basic capacity under twistlocks at a second row distance of 4,000 mm shall be 24,000 kg

2.1.1.3
Lifting height under twistlocks, minimum 12,000 mm

2.1.1.4
Spreader rotation, minimum ± 95 degrees

2.1.2 Speeds

2.1.2.1
Driving speed forward 20 km/h - 25 km/h

2.1.2.2
Driving speed backward 20 km/h - 25 km/h

2.1.2.3
Lifting with load 0.15 m/s - 0.20 m/s

2.1.2.4
Lifting without load 0.20 m/s - 0.25 m/s

2.2 Main Technical and Design Demands

2.2.1 Main Frame Construction

The main frame shall be an all-welded, torsion-resistant frame, utilizing the most modern design techniques to provide an attractive structure with a minimum of maintenance. The design shall avoid pockets where water may collect.

The frame structure shall provide efficient protection for all internal parts, especially for the fuel and hydraulic oil tanks.

2.2.2 Power Plant

2.2.2.1 Diesel Engine

A Diesel Engine with direct fuel injection shall be provided. Preferably, the engine shall not be turbo-charged. The Bidder shall offer two alternative makes of engines with full technical details, type Euro II.

2.2.2.2 Engine Power

The engine power shall be	minimum	180 kW
	maximum	220 kW

(rating according to DIN 6271).

2.2.2.3 Engine-Cooling System

The engine-cooling system shall be designed to work in a tropical climate within a temperature range from -20 °C to +45 °C and 100% humidity.

2.2.2.4 Engine Air Inlet

The engine air inlet system shall be of Donaldson type or equivalent, cyclonic pre-cleaner and double-stage dry paper element type with air-restriction indicator. Air inlets shall be at least 2,000 mm above ground level.

2.2.2.5 Silencer

Required is a heavy-duty type, mounted in an upswept position.

2.2.2.6 Engine Oil Filter

Full-flow heavy-duty engine oil filters with a replaceable filter element shall be supplied.

2.2.2.7 Engine Protection System

An automatic engine shut-off protection system, which shall be electrically operated via solenoid valve at the injection pump, shall be provided.

The system shall monitor:
- low engine oil pressure
- high engine oil temperature
- high coolant temperature
- high transmission oil temperature

Independent lines shall be provided for
- steering
- piloting
- lifting
- telescoping
- side-shifting
- rotation

2.2.6.2
The hydraulic system shall be protected against pump failures by high-pressure cartridge-type filters fitted on the delivery lines.

In addition, in the return line, full flow, replaceable cartridge-type filters shall be provided. These filters shall have a bypass protection and a clogged condition indicator. The preferable filter micron rating shall be 10 microns.

2.2.6.3
A full flow fin and tube-type, oil to air hydraulic fluid cooler shall be provided in the hydraulic system to maintain safe operating temperatures.

2.2.6.4
The hydraulic oil tank drain plug shall be of magnetic type.

2.2.6.5
The main valve of the boom-lowering and boom-telescoping brake shall be installed in or directly mounted to the lifting cylinder.

2.2.6.6
Quick detachable hose couplings for spreader operation shall be provided on the Reach-Stacker.

2.2.7 Driver's Cabin

A cabin for increased visibility and improved safety and productivity shall be offered.

The driver's cabin shall be of the single-man-type, mounted on anti-vibration rubber mountings. Door locks (keys) shall be provided. The cabin shall be provided with sound insulation. Driver's seat shall be fully suspended. The left and right hand cabin windows shall be installed in a way that opening for ventilation is possible. Tinted safety glass for all windows shall be provided, roof window to be fitted with safety bars. Windscreen wipers fitted at the front and at the rear window.

The cabin shall meet FOPS criteria ISO 3449 and FEM.

2.2.7.1 Operator's Console
The operator's console shall include all necessary controls for the Reach-Stacker's normal operations. All control wiring shall end on terminal blocks appropriately marked with corresponding wire numbers. All console control equipment shall be dimensioned for heavy-duty continuous operations.

2.2.11 Surface Protection

All structural parts shall be blasted to DIN 55928 SA 2.5 standard and painted with a high-built paint system according to the manufacturer's standard, preferably a solvent and heavy-metal-free paint (acrylic water-based paint) with not less than four (4) coats of paint:

- paint specification shall be attached to the tender
- primer
- two (2) coats of intermediate layers
- top coat

Total dry film thickness shall be not less than 180 microns.

Paint:	Shade to	RAL 2009 Traffic Orange
or		RAL 1023 Traffic Yellow

Telescopic boom and spreader: RAL 9005 Flat Black.

Danger stripes in black paint across the counter-weight are required.

This colour scheme may be altered by the Purchaser.

2.2.11.1 Purchaser's Logo

The Purchaser's logo shall be prominently displayed on the outside of the Reach-Stacker in positions indicated by the Purchaser. Exterior finishing paints according to manufacturer's standard.

2.3 Design Criteria

2.3.1 General Design

The general design and the stability design of the Reach-Stacker shall conform to the applicable requirements of

- DIN
- FEM
- ISO

The Bidder shall state the standards used in its design.

2.1.2.5 Lowering with load	0.22 m/s - 0.30 m/s	
2.1.2.6 Lowering without load	0.18 m/s - 0.22 m/s	

2.1.3 Major Dimensions

2.1.3.1 Overall length including spreader	maximum	11,500 mm
2.1.3.2 Overall width B without spreader	maximum minimum	4,500 mm 4,100 mm
2.1.3.3 Height, mast lowered H3	maximum	4,800 mm
2.1.3.4 Turning radius R1	maximum	8,000 mm
2.1.3.5 Wheel base	minimum	5,900 mm

2.1.4 Protective Devices

2.1.4.1 Safety Hydraulic Lock Valves

Safety hydraulic lock valves shall be provided on all load-bearing hydraulic cylinders (tilting and lifting).

2.1.4.2 Hydraulic Counterbalance Valves

Hydraulic counterbalance valves shall be provided on load-lowering motions.

2.1.4.3 Locking/Unlocking

In the driver's cabin indication lights "twistlock in position" shall be provided. Hoisting shall be prevented unless all twistlocks are either latched or unlatched. Unlocking of the twistlocks shall be prevented if the container is in the air.

A light indicator for twistlocks is required on the spreader.

2.1.4.4 Beacon Light

A beacon light shall be mounted on top of the cabin.

2.1.4.5 Overload Protection Device

An overload protection device shall be installed to cut off twisting motion if loads exceed 10% of rated load.

As far as practicable, all screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastenings and fittings shall be of corrosion-resistant material or shall be treated or plated in a manner to render them resistant to corrosion.

2.3.4.2 Wiring

Electrical wiring throughout the Reach-Stacker shall be dimensioned in accordance with the circuit's current-carrying requirements.

Wiring shall be of PVC or neoprene insulation with approved flexible-type switchboard wiring, for control panels to minimize vibration damage.

2.3.5 Quality Control

Quality control shall be employed to assume a vital role in establishing and maintaining a high-quality product. Detailed inspections and controls shall be made and data shall be gathered for analysis and evaluation to ensure that the required quality standards are met.

The Contractor shall be responsible for providing inspection methods, maintaining surveillance and control over all testing and special processes, checking manufacturing methods, materials and bought-in supplied items, for compliance with the applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspections reports shall be furnished for:

(a) Engine
(b) Transmission
(c) Hydraulic pumps and cylinders
(d) Steel used in load bearing structural frame members
(e) Brakes
(f) Welders' certifications
(g) Safety devices
(h) Attachments (spreader, twistlocks)
(i) Capacity certificate

The Purchaser shall submit a certificate of his quality control system according to ISO 9000 - 9004.

2.4 Final Adjustment and Testing

After the Reach-Stacker has been erected, adjusted, lubricated and otherwise made ready for operations, it shall be tested to demonstrate conformity to all requirements defined in these Specifications.

The Contractor shall submit to the Purchaser for approval the full testing programme, including the contents of tests, methods of conducting, control and measuring, required instruments and equipment.

The Purchaser will provide the operator and the necessary loads.

2.2.2.8 Fuel System

Fuel tank capacity shall be 300 - 400 litres. Water separator and dual fuel filter with replaceable elements shall be provided. The fuel inlet shall be lockable. The fuel cap shall be chained to the chassis.

2.2.3 Transmission

2.2.3.1 Power Shift Transmission

A power shift transmission incorporating a torque converter, with multiple stages for forward and reverse, shall be provided. Pressure-testing connections on the gearbox and power take-offs for the hydraulic pump shall be provided.

2.2.3.2 Transmission Oil System

The transmission oil system shall have a separate oil cooler and a full-flow heavy-duty oil filter with a replaceable element. The system shall be capable of operations within a temperature range from -20 °C to +45 °C and 100% of humidity.

2.2.4 Travel Gear

2.2.4.1 Drive Axle

The drive axle shall be fixed and be of heavy-duty type with planetary axle and hub reduction.

2.2.4.2 Steering Axle

The steering axle shall be of heavy-duty type with a single-double acting hydraulic cylinder.

2.2.4.3 Tires

Tires shall be of pneumatic type. The tires on the drive axle and the two tires on the steering axle shall be of the same size and have the same number of PR. The Bidder shall offer alternative sizes of tires to reach the maximum reduction of the front axle load.

Size: Front 18.00 x 25 - 40 PR
Rear 18.00 x 25 - 40 PR

2.2.5 Brakes

2.2.5.1 Service Brakes

The service brakes shall either be two hydraulically-operated disk brakes or a wet-disc brake system on the drive axle.

2.2.5.2 Parking Brake

The parking brake shall be spring-actuated and mechanically operated.

2.2.6 Hydraulic System

2.2.6.1

The hydraulic system shall preferably be powered by gear-type hydraulic pumps, driven by power take-offs mounted on the torque converter.

2.6 General Instructions

2.6.1 Bidder-Supplied Information

The Bidder shall submit with its proposal detailed specifications for all listed items, a list of all standard equipment and a price list of all available options which were not included in the basic prices.

The Bidder shall offer its standard equipment as close as possible to the given technical specifications. Special design and prototypes will not be accepted.

The offered type of equipment must have been manufactured for at least one year and shall be from the same production lot.

The following instruments shall be provided:

- Hourmeter
- Fuel gauge
- Engine coolant temperature gauge
- Engine oil-pressure warning light and buzzer
- Torque converter oil-temperature gauge
- Torque converter oil-pressure light
- Alternator control lamp
- Parking brake indicator light
- Twistlocks indicator lights
- Ammeter charging

2.2.8 Boom

The Reach-Stacker shall be equipped with a heavy-duty boom of one basic and one telescopic part. Bearings to be of self-lubricating type.

2.2.9 Electrical System

The systems voltage shall be 24 V.

Two batteries of 12 V, at least 130 Ah at 20-hr-rate, maintenance free and suitable for tropical conditions with a battery main isolating switch shall be supplied. The battery compartment must be lockable.

Lighting:
- Head lights, well protected
- Stop/tail lights, well protected
- Direction indicator front rear, well protected
- Floodlight mounted to rear of cab
- Four working lights on the boom

A central fuse box is required, in-line fuses are not permitted.

2.2.10 Attachment

The Reach-Stacker shall be equipped with a side-shifting spreader positioner with 800 mm to each side.

The Reach-Stacker shall be equipped with a 20 - 40' telescopic spreader for ISO containers, fully loaded, top handling, hydraulic twistlocks and integrated rotating system allowing diagonal movement of up to ± 95 degrees.

The spreader shall be equipped with 2 x 4 pcs of lash-hooks for sling operation of general cargo.

4. Spare Parts and Special Tools

4.1 Purchaser's Required Spare Parts Lists

The Bidder shall submit with its bid the following list of required spare parts, duly completed and priced:

Group 1: Cylinder Block and Head
Group 2: Injection System
Group 3: Cooling System and Oil Cooler
Group 4: Air Lines
Group 5: Electrical System
Group 6: Torque Converter and Transmission
Group 7: Drive Shaft and Differential
Group 8: Steering and Brake System
Group 9: Hydraulic Systems
Group 10: Frame and Cabin
Group 11: Telescopic Boom
Group 12: Attachment 20 - 40' Telescopic Spreader

Price basis shall be "Ex Works".

□

2.3.2 Mechanical Design

2.3.2.1 General

The mechanical design of load-carrying parts shall be calculated to FEM. Any pinch and shear points on the upright and carriage shall be avoided.

All fasteners or parts likely to become loose by vibration shall be secured by approved devices.

All parts shall be designed to ensure easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance.

2.3.2.2 Bearings

Bearings on the Reach-Stacker shall be of the anti-friction type.

2.3.2.3 Lubrication

Lubrication of all mechanical operating parts shall be provided in accordance with manufacturers' instructions. Oil-type lubrication shall be provided for speed reducer and other major components where lubrication is needed. Lubrication of other mechanical parts shall be effected by means of high-pressure grease introduced through industrial button-type fittings. All pedal shafts, steering axles and lift cylinder mountings shall be greasable. The oil for lubrication shall be of the type and make as used in the Beneficiary's country.

2.3.3 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the Reach-Stacker's design, whenever practical.

2.3.3.1

Diagnostic ("trouble-shooting") techniques, procedures and test-equipment shall be developed for rapid location of a fault in order to achieve an overall reduction of systems down time. The Bidder shall list in its proposal systems for which such diagnostic procedures will be supplied.

2.3.3.2 Accessibility

Restricted accessibility of modules, assemblies and other items is a large contributor to the extension of repair time. Configuration of the hardware and its layout in the Reach-Stacker shall allow free and easy access for maintenance personnel and for tools and equipment which are required to perform the repair task.

2.3.4 Electrical Design

2.3.4.1 General

All electrical equipment, materials and workmanship shall conform to the applicable current standards of BS, ASA, VDE or their equivalents. All equipment and materials furnished shall be suitable for operations in a humid, marine atmosphere up to 50 degrees centigrade of ambient temperature. Nameplates shall be engraved on phenolic plastic, attached to the equipment with corrosion-resistant rivets.

All electrical equipment furnished shall resist deterioration from corrosion when exposed to severe moisture conditions near salt water.

4.1.3 Group 3: Cooling System and Oil Cooler

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	V-belt set		
2	1	pc	Radiator		
3	1	pc	Oil cooler		
4	1	pc	Water pump assy		
Total Price, ex works					

4.1.4 Group 4: Air Lines

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Turbocharger, assy		
2	1	pc	Air filter, element		
3	1	pc	Exhaust muffler		
4	1	pc	Exhaust tube, assy		
Total Price, ex works					

Final testing process shall consist of the following main stages:

(a) Static test
(b) Dynamic test
(c) Testing of safety devices
(d) Testing of speeds
(e) Operations test

These tests shall prove that all indicated data are in conformity with the Contractor's specifications.

2.5 Safety Arrangements

2.5.1

General assembly and detailed design of the Reach-Stacker shall conform to the safety regulations and codes listed in the Contract added by the following:

2.5.2

All nuts connecting the moving and rotating parts shall be of the self-locking type to prevent their loosening due to vibration.

2.5.3

All rotating parts shall be provided with rigid safety guards.

2.5.4

The Contractor shall install one (1) 2-kg powder fire extinguisher in the cab.

2.5.5

Unavoidable hazardous points shall be marked with a special warning paint (yellow/orange and black stripes).

2.5.6

Walk ways shall be covered with anti-slip coat.

2.5.7

Automatic reversing lights with acoustic warning signal.

4.1.7 Group 7: Drive Shaft and Differential

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Gasket kit differential assy		
2	1	pc	Oil seal ring differential assy		
3	1	pc	Bearing set differential assy		
4	1	pc	Joint cardan		
5	1	pc	Oil seal ring, drive axle front		
6	1	pc	Bearing set, drive axle front		
7	1	pc	Tire, front		
8	1	pc	Tire, rear		
Total Price, ex works					

3. Data Sheet

3.1

The Bidder shall enclose with its proposal a data sheet according to VDI 3598/2198 specification.

3.2

Additionally, the following shall be provided with the data sheet:

3.2.1

Data sheets on all main components such as engine, transmission and hydraulic components.

3.2.2

Dimensional drawing of the Reach-Stacker.

3.2.3

Dimensional drawing of spreader.

3.2.4

Load diagram for container top handling operations with spreader.

3.2.5

Statement-indicating maximum ground pressure.

□

4.1.10 Group 10: Frame and Cabin

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Windscreen, front		
2	1	pc	Windscreen, rear		
3	1	pc	Windscreen, side		
Total Price, ex works					

4.1.11 Group 11: Telescopic Boom

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Fixed boom		
2	1	pc	Roller set, boom		
3	1	pc	Roller set, spreader rotation		
4	1	pc	Telescopic boom		
Total Price, ex works					

4.1.12 Group 12: Attachment, 20 - 40' Telescopic Spreader

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Limit switch		
2	1	pc	Twistlock cylinder		
3	1	pc	Hose assy twistlock		
4	1	pc	Twistlock		
Total Price, ex works					

4.1.1 Group 1: Cylinder Block and Head

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Liner, cylinder		
2	1	pc	Crankshaft assy		
3	1	pc	Main bearing, crankshaft		
4	1	pc	Cylinder head assy		
5	1	pc	Exhaust valve		
6	1	pc	Inlet valve		
7	1	pc	Cylinder head gasket		
8	1	pc	Oil filter element		
9	1	pc	Oil pump		
10	1	pc	Cylinder ring set		
11	1	pc	Gasket set, overhauling		
12	1	pc	Engine complete, new		
Total Price, ex works					

4.1.2 Group 2: Injection System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Fuel filter elements		
2	1	pc	Fuel pump assy		
3	1	pc	Injection pump assy		
Total Price, ex works					

5. Bill of Quantities

Item	Description	Unit	Qty	Unit Cost	TotalCost
	41-t Reach-Stacker	pc	1		
	Telescopic Spreader	pc	1		
4.1	Purchaser's Required Spare Parts	set	1		
Total, FOB					
Sea freight to Poti					
Insurance to Poti					
Total, CIF Poti					

Delivery Period to the Port of Poti ..... weeks

4.1.5 Group 5: Electrical System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Battery		
2	1	pc	V-belt set		
3	1	pc	Alternator		
4	1	pc	Starter		
5	1	pc	Lamp assy, front		
6	1	pc	Horn		
7	1	pc	Lamp assy, rear		
8	1	pc	Beacon light, assy		
Total Price, ex works					

4.1.6 Group 6: Torque Converter and Transmission

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Oil filter element		
2	1	pc	Oil filter assy		
3	1	pc	Clutch group		
4	1	pc	Control valve		
5	1	pc	Transmission, group		
Total Price, ex works					

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 5: Terminal Tractor

Table of Contents

4.1.8 Group 8: Steering and Brake System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Steering cylinder assy		
2	1	pc	Bearing set		
3	1	set	Brake disc/wet disc - front		
4	1	pc	Brake disc - rear		
5	1	pc	Pump, assy		
6	1	pc	Repair kit, pump assy		
7	1	pc	Brake master cylinder		
Total Price, ex works					

4.1.9 Group 9: Hydraulic Systems

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Hydraulic pump assy		
2	1	pc	Repair kit, hydraulic pump		
3	1	pc	Control valve, hydraulic pump		
4	1	pc	Hydraulic filter elements		
5	1	pc	Telescopic cylinder, assy		
6	1	pc	Tilt cylinder		
7	1	pc	Gasket kit, tilt cylinder		
8	1	pc	Hose assy, telescope cylinder		
9	1	pc	Hose assy, tilt cylinder		
10	1	pc	Hose assy, sideshift cylinder		
11	1	pc	Hose assy, twistlock spreader		
Total Price, ex works					

1. General Description

These Specifications describe a Terminal Tractor (4 x 2 drive), which shall be purchased by the Beneficiary as mentioned in the Bill of Quantities, and which shall be used for handling trailers in port operations.

The Terminal Tractor will be particularly used for the handling of 40'-standard truck-type trailers and goose-neck Ro/Ro-type trailers within the terminal.

2. Operation Characteristics

The Terminal Tractor (4 x 2 drive) shall be designed to operate with a minimum tractive effort of 80 kN, and for handling trailers with a load of up to 50,000 kgs.

2.1 Lifting Capacity Requirements

The following requirements of the fifth wheel shall be met:

2.1.1 Fifth Wheel

Fully oscillating fifth wheel capable of lifting an imposed fifth wheel load of 25 tons.

2.1.2

Minimum lowered fifth wheel height: 1,150 mm

2.1.3

Maximum raised fifth wheel height: 2,100 mm

2.1.4

The lift rams shall be heavy-duty double extension, hydraulically operated with two cylinder and equalising control valve for three operating stages, i. e.: raising, holding and lowering.

2.1.5

The fifth-wheel locking device shall be actuated by air pressure for locking and unlocking, operating shall only be possible at stand-still of the Tractor. The locking device shall be of rigid design and easily accessible for maintenance.

4.2 Bidder's Recommended Spare Parts and Special Tools Lists

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists for a period of operation of 3,000 hours.

The spare parts lists should include the following data elements:

- Sequence number
- Bidder's part number
- Item description
- Figure and item number in the illustrated parts breakdown/drawing if applicable
- Quantity
- Unit price
- Total price

The Bidder shall prepare and submit to the Purchaser recommended and priced special tools which are required but not included in the delivery.

□

2.4.4 Engine Protection System

An automatic engine shut-off protection system is to be supplied.

2.5 Main Technical and Design Demands

The main frame shall be an all-welded, torsion-resistant frame, with the most modern design techniques to provide an attractive structure with a minimum of maintenance. The design shall avoid pockets where water may collect. A rear skid plate to facilitate the picking-up of semi-trailers is to be provided.

The frame structure shall provide efficient protection for all internal parts, especially for the main hydraulic pump. The extra heavy-duty bumpers shall provide protection for the lights. Suitable covers are to ensure anti-slip walk ways.

The Tractor shall be equipped with towing couplers for drawbars in the front and rear.

2.6 Engine

2.6.1 Engine Type

A Diesel Engine with direct fuel injection is required. The engine shall preferably not be turbo-charged. The Bidder shall offer two alternative makes of engines with technical details, type Euro II.

2.6.2 Engine Power

The engine power shall be minimum 115 kW
minimum 135 kW

(rating according to DIN 6271).

2.6.3 Engine-Cooling System

The engine-cooling system shall be designed to work within a temperature range from -20 C to +45 C and a relative humidity of up to 100%.

2.6.4 Engine Air Inlet

The engine air-inlet-system shall be of Donaldson type or equivalent, cyclonic pre-cleaner and double-stage dry paper element type with air-restriction indicator. Air inlets shall be at least 1,600 mm above ground level.

2.7.3 Transmission Oil System

The transmission oil system shall have a separate oil cooler and a full-flow heavy-duty oil filter with a replaceable element. The system shall be designed to work under tropical conditions within a temperature range from -20 C to +45 C.

2.8 Travel Gear

2.8.1 Front Axle

The front axle shall be of heavy-duty type with steel spring suspension assisted by hollow rubber springs, and with a minimum static axle load of 15 t.

It shall be cushioned by hydraulic shock absorbers. Protection rings for the front wheel nuts are to be supplied.

2.8.2 Rear Axle

The rear axle shall be of heavy-duty type double-reduction drive axle, air-suspended with a minimum suspended axle load of 12 t and a minimum static axle load of 20 t without air-suspension.

2.8.3 Tires

Minimum tire size required:: 11.00 x 20 - PR 16 pneumatic type

The tires of the Terminal Tractor and the Terminal Chassis (Item 6) shall be of the same size and have the same PR-rating.

2.9 Brakes

2.9.1 Service Brakes

The service brakes shall be drum/disc brakes, dual circuit air-operated, engine-driven compressor.

The brakes shall be calculated to handle fully-loaded Ro-Ro-trailers which are not equipped with brakes. The brake system must provide connections to standard highway trailers equipped with brakes.

2.12 Auxiliary Systems

2.12.1 Hydraulic System

The hydraulic system shall preferably be powered by gear-type hydraulic pumps, driven by power take-offs mounted on the torque converter.

Full flow, return line, replaceable cartridge-type filters shall be provided. These filters shall have a bypass protection. Preferable filter micron rating is 10 microns.

2.12.2 Electrical System

The system's voltage shall be 24 V.

Two batteries of 12 V, of 140 Ah at a 20-hr-rate, maintenance free and suitable for tropical conditions within a temperature range from -20 C to +45 C, shall be fitted in a lockable battery container with a battery main isolating switch.

Lighting:

- Head lights
- Stop/tail lights
- Direction indicator front/rear
- Floodlight mounted to rear of cab to illuminate the coupling

Trailer electrical connection of Type 7 pin SAE is to be provided.

A central fuse box is required, inline fuses are not permitted.

2.12.3 Surface Protection

All structural parts shall be blasted to DIN 55928 SA 2.5 standard and painted with a paint system according to the manufacturers standard. Preferably it shall be a solvent and heavy-metal free paint (acrylic water-based paint) with not less than four (4) coats of paint:

- primer
- two (2) coats of intermediate layers
- top coat

Total dry film thickness shall be not less than 240 microns.

Paint specifications shall be attached to the tender.

Paint shade to	RAL 2004 Orange
or	RAL 1023 Traffic Yellow

2.2 Speed Rates

Maximum speed forward (unladen):	45 km/h
Minimum speed forward (unladen):	30 km/h

2.3 Major Dimensions

2.3.1

Overall length:	5,300 mm

2.3.2

Overall width:	2,500 mm

2.3.3

Maximum turning radius over body:	7,500 mm

2.3.4

Fitting radius, front clearance:	2,200 mm

2.3.5

Fitting radius, rear clearance:	1,600 mm

2.4 Protective Devices

2.4.1

Safety hydraulic lock valves and counterbalance valves shall be provided on the load-bearing hydraulic cylinders.

2.4.2

A King-pin locking device indicator shall be provided.

2.4.3

A beacon light is to be mounted on top of the cabin.

2.13.5 Electrical Design

2.13.5.1 General

All electrical equipment, materials and workmanship shall conform to the applicable current standards of VDE or their equivalents. All equipment and materials furnished shall be suitable for operations in a humid, marine atmosphere up to 50 degrees centigrade of ambient temperature. Nameplates shall be of engraved phenolic plastic, attached to the equipment with corrosion-resistant screws.

All electrical equipment furnished shall resist deterioration from corrosion when exposed to severe moisture conditions near salt water.

As far as practicable, all screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastenings and fittings shall be of corrosion-resistant material or shall be treated or plated in a manner to render them resistant to corrosion.

2.13.5.2 Wiring

Electrical wiring throughout the tractor shall be dimensioned in accordance with the circuit's current-carrying requirements. The cables shall be rigidly and securely saddled to the Tractor structure and shall be protected along their full length by removable covers.

Wiring shall be of PVC or neoprene insulation with approved flexible-type switchboard wiring, for control panels to minimise vibration damage.

2.13.6 Quality Control

The Contractor shall be responsible for inspection methods, maintaining surveillance and control over all testing and special processes, checking manufacturing methods, materials and bought-in supplied items, for compliance with the applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspections reports shall be furnished for:

(a) Engine
(b) Transmission
(c) Hydraulic pumps and cylinders
(d) Steel used in load-bearing structural frame members
(e) Brakes
(f) Welders' certifications
(g) Safety devices
(h) Fifth wheel assembly.

The Purchaser shall submit a certificate of his quality control system according to ISO 9000 - 9004.

2.6.5 Silencer

Required is a heavy-duty type, mounted in an upswept position.

2.6.6 Engine Oil Filter

Full-flow heavy-duty engine oil filters with a replaceable filter element shall be supplied.

2.6.7 Engine Protection System

An automatic engine shut-off protection system is required, which shall monitor:

- low engine oil pressure
- high engine oil temperature
- high coolant temperature
- high transmission oil temperature

Operation shall be done via a solenoid valve at the injection pump.

2.6.8 Fuel System

Fuel tank capacity: 185 - 200 ltr

Water separator and dual fuel filter with replaceable elements shall be provided.

2.7 Transmission

2.7.1 Transmission Type

A power shift transmission incorporating a torque converter with multiple stages for forward and reverse shall be provided. Testing connections on the gearbox are necessary.

2.7.2 Hydraulic Take-off

The power shift transmission shall drive the hydraulic pumps.

A detailed load calculation must be provided with the maximum pay load (40 t) of the terminal chassis for the following components of the tractor:

(1) Load distribution between the front and rear axle
(2) Front axle at 25 km/h
(3) Rear axle at 25 km/h
(4) Tires at 25 km/h
(5) Rims at 25 km/h

2.9.2 Parking Brake

The parking brake shall be spring-type on rear axles, working independently.

2.10 Steering

Left-hand side in driving direction, fully hydraulic steering of the front axle shall be provided. Steering shall still be possible in case of pump failure.

2.11 Driver's Cabin

2.11.1 Cabin

The driver's cabin shall be of the single-man-type, mounted on anti-vibration rubber mountings. It shall be hydraulically tiltable for easy access to maintain the engine. The cabin shall be equipped with one sliding window installed at the driver's side. The entrance door shall be a sliding door accessible from the back side of the cabin. It is to be provided with sound insulation and shall meet ROPS criteria ISO 3471.

The driver's seat shall be fully suspended according to VDI-regulations 2057. Tinted safety glass windows shall be supplied with windscreen wipers in the front and rear. The required tinted roof window must be secured by metal bars.

2.11.2 Operator's Console

The operator's console shall include all necessary controls for the Tractor's normal operations. All control wiring shall end on terminal blocks appropriately marked with corresponding wire numbers. All console control equipment shall be dimensioned for heavy-duty continuous operations.

The following instruments shall be provided:

- Hourmeter
- Fuel gauge
- Dual air pressure gauge
- Low air pressure warning light and buzzer
- Engine coolant temperature gauge
- Engine oil-pressure warning light and buzzer
- Torque converter oil-temperature gauge
- Torque converter oil-pressure light
- Alternator control lamp
- Parking brake indicator light
- King-pin locking device indicator
- Ammeter charging

The Bidder shall include in its proposal a full list of the devices and their functions on the operator's console and on the auxiliary panel as well as a scheme of this layout.

3.1.1 Group 1: Cylinder Block and Head

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Liner, cylinder		
2	1	pc	Crankshaft assy		
3	1	pc	Main bearing, crankshaft		
4	1	pc	Cylinder head assy		
5	1	pc	Exhaust valve		
6	1	pc	Inlet valve		
7	1	pc	Cylinder head gasket		
8	1	pc	Oil filter element		
9	1	pc	Oil pump		
10	1	pc	Cylinder ring set		
11	1	pc	Gasket set, overhauling		
12	1	pc	Engine complete, new		
Total Price, ex works					

3.1.2 Group 2: Injection System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Fuel filter elements		
2	1	pc	Fuel pump assy		
3	1	pc	Injection pump assy		
Total Price, ex works					

This colour scheme may be altered by the Purchaser.

2.12.3.1 Purchaser's Logo

The Purchaser's logo shall be prominently displayed on the outside of the Terminal Tractor, in positions indicated by the Purchaser. Exterior finishing paints, chlorinated-rubber-based, are to be used.

2.13 Design Criteria

2.13.1 General Design

The general design, the stability design and the mechanical design of the Terminal Tractor shall conform to recognised international standards. The Bidder shall explicitly state the standards used in its design.

All fasteners or parts likely to become loose by vibration shall be secured by approved devices.

All parts shall be designed to ensure easy assembly, adjustment, removal for replacement and accessibility.

2.13.2 Lubrication

Lubrication of all mechanical operating parts shall be provided in accordance with manufacturers' instructions. Oil-type lubrication shall be provided for planetary drive and other major components where lubrication is needed. Lubrication of other mechanical parts shall be effected by means of high-pressure grease introduced through industrial button-type fittings. The lubricants shall be of types and makes available in the Beneficiary's country.

2.13.3 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the tractor's design, whenever practical.

2.13.4 Diagnostic Techniques

Diagnostic ("trouble-shooting") techniques, procedures and test-equipment shall be developed for rapid location of a fault in order to achieve an overall reduction of system's down time. The Bidder shall list in its proposal systems for which such diagnostic procedures will be supplied.

3.1.5 Group 5: Electrical System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Battery		
2	1	pc	V-belt set		
3	1	pc	Alternator		
4	1	pc	Starter		
5	1	pc	Lamp assy, front		
6	1	pc	Horn		
7	1	pc	Lamp assy, rear		
Total Price, ex works					

3.1.6 Group 6: Torque Converter and Transmission

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Oil filter element		
2	1	pc	Oil filter assy		
3	1	pc	Clutch group		
4	1	pc	Control valve		
5	1	pc	Transmission, group		
Total Price, ex works					

2.14 Final Adjustment and Testing

The Contractor shall submit to the Purchaser for approval the full testing programme, including the contents of tests, methods of conducting, control and measuring, required instruments, equipment and power.

The Purchaser will provide the equipment operator and the necessary loads.

Final testing process shall consist of the following main stages:

(a) Dynamic test
(b) Testing of safety devices
(c) Testing of speeds
(d) Operations test

2.15 Safety Arrangements

General assembly and detail design of the Tractor shall conform to the safety regulations and codes listed in the Contract, added by the following:

2.15.1

All nuts connecting the moving and rotating parts (couplings, drums, sheaves, etc.) shall be of the self-locking type to prevent their loosening due to vibration.

2.15.2

All rotating parts shall be provided with rigid safety guards.

2.15.3

The Contractor shall install one (1) 2-kg powder fire extinguisher in the cab.

2.15.4

Unavoidable hazardous points shall be marked with a special warning paint (yellow and black stripes).

2.16 General Instructions

The Bidder shall submit with its proposal detailed specifications for all listed items, a list of all standard equipment and a price list of all available options which were not included in the basic prices.

The Bidder shall offer its standard equipment as close as possible to the given technical specifications. Special design and prototypes will not be accepted.

The offered type of equipment must have been manufactured for at least one year and shall be from the same production lot.

3.1.9 Group 9: Hydraulic Systems

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Hydraulic pump assy		
2	1	pc	Repair kit, hydraulic pump		
3	1	pc	Control valve, hydraulic pump		
4	1	pc	Hydraulic filter elements		
5	1	pc	Lift cylinder, assy		
Total Price, ex works					

3.1.10 Group 10: Frame and Cabin

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Windscreen, front		
2	1	pc	Windscreen, rear		
3	1	pc	Windscreen, side		
4	1	pc	Windscreen wiper		
5	1	pc	Mirror outside		
6	1	pc	Driver's seat, complete		
Total Price, ex works					

3. Spare Parts And Special Tools

3.1 Purchaser's Required Spare Parts Lists

The Bidder shall submit with its bid the following list of required spare parts, duly completed and priced:

Group 1: Cylinder Block and Head
Group 2: Injection System
Group 3: Cooling System and Oil Cooler
Group 4: Air Lines and Turbocharger
Group 5: Electrical System
Group 6: Torque Converter and Transmission
Group 7: Drive Shaft and Differential
Group 8: Steering and Brake System
Group 9: Hydraulic Systems
Group 10: Frame and Cabin
Group 11: Fifth Wheel

Price basis shall be "Ex Works".

4. Bill of Quantities

Item	Description	Unit	Qty	Unit Cost	Total Cost
	Terminal Tractor	pc	4		
3.1	Purchaser's Required Spare Parts	set	1		
Total, FOB					
Sea freight to Poti					
Insurance to Poti					
Total, CIF Poti					

Delivery Period to the Port of Poti ..... weeks

3.1.3 Group 3: Cooling System and Oil Cooler

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	V-belt set		
2	1	pc	Radiator		
3	1	pc	Oil cooler		
4	1	pc	Water pump assy		
Total Price, ex works					

3.1.4 Group 4: Air Lines and Turbocharger

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Turbocharger, assy		
2	1	pc	Air filter, element		
3	1	pc	Exhaust muffler		
4	1	pc	Exhaust tube, assy		
Total Price, ex works					

Technical

Port

3.1.7 Group 7: Drive Shaft and Differential

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Gasket kit differential assy		
2	1	pc	Oil seal ring differential assy		
3	1	pc	Bearing set differential assy		
4	1	pc	Joint cardan		
5	1	pc	Oil seal ring, drive axle front		
6	1	pc	Bearing set, drive axle front		
7	1	pc	Tyre, front		
8	1	pc	Tyre, rear		
Total Price, ex works					

3.1.8 Group 8: Steering and Brake System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Steering cylinder assy		
2	1	pc	Bearing set		
3	1	pc	Brake disc		
4	1	set	Brake pad		
5	1	pc	Pump, assy		
6	1	pc	Repair kit, pump assy		
7	1	pc	Brake master cylinder		
Total Price, ex works					

3.1.11 Group 11: Fifth Wheel

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Fifth wheel plate		
2	1	pc	Lift boom, assy		
3	1	pc	Locking cylinder		
4	1	pc	Control valve, locking cylinder		
5	1	pc	Locking device		
6	1	pc	Limit switch		
7	1	pc	Bowden cable, control valve		
Total Price, ex works					

3.2 Bidder's Recommended Spare Parts and Special Tools Lists

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists for a period of operation of 3,000 hours.

The spare parts lists should include the following data elements:

- Sequence number
- Bidder's part number
- Item description
- Figure and item number in the illustrated parts breakdown/drawing if applicable
- Quantity
- Unit price
- Total price

The Bidder shall prepare and submit to the Purchaser recommended and priced special tools which are required but not included in the delivery.

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 6: 38-t/40' Terminal Chassis

Table of Contents

1. General Description

These Specifications describe a 40'/38-t Terminal Chassis which will be purchased by the Beneficiary as mentioned in the Bill of Quantities, and which shall be used for supplementing crane and container operation, handling of 2 x 20' and 1 x 40' ISO containers.

2. Operations Characteristics

2.1 Capacity Requirements

The terminal chassis shall be designed to operate with the following capacities:

- 38 t pay-load at a travelling speed of 25 km/h
- 2 x 20' ISO containers
- 1 x 40' ISO container
- King pin load with maximum pay load, less than 25 tons

2.2 Travelling Speed

The travelling speed of the terminal chassis shall be:

- fully loaded/maximum pay load:	not less than	25 km/h
- unladen:	not less than	30 km/h
	not more than	45 km/h

2.3 Dimensions

Overall length:	not more than	12,500 mm
Overall width:	not more than	2,700 mm
Chassis bed height:	not more than	1,450 mm
Bed length:	not more than	12,200 mm
Height of sliding plate:	1,150 mm - 1,250 mm	
Front fitting radius:	not more than	1,700 mm
Rear fitting radius:	1,800 - 1,900 mm	
Rear overhang	not more than:	3,000 mm
King pin SAE:	2 inches	

Total dry film thickness shall be not less than 140 microns.

Paint system according to the manufacturer's standard, preferably it shall be a solvent and heavy-metal-free paint (acrylic water-based paint). Paint specifications shall be attached to the tender.

Paint: Shade to RAL 2004 Orange or RAL 1023 Traffic Yellow

This colour scheme may be altered on demand of the Purchaser.

2.7 Design Criteria

2.7.1 Lubrication

Lubrication of mechanical parts shall be by means of high pressure grease introduced through industrial button-type fittings.

2.7.2 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors shall be introduced into the chassis' design, whenever practical.

2.7.3 Quality Control

Quality control shall be employed to assume a vital role in establishing and maintaining a high quality product. Detailed inspections and controls shall be made and data shall be gathered for analysis and evaluation to ensure that the required quality standards are met.

The Contractor shall be responsible for providing inspection methods, maintaining surveillance and controls over all testing and special processes, checking manufacturing methods, materials and bought-in items, for compliance with applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspection reports shall be furnished for:

(a) steel used in load bearing structural frame members
(b) welder's certifications
(c) axles

The Purchaser shall submit a certificate of his quality control system according to ISO 9000 - 9004.

2.4 Main Technical and Design Demands

2.4.1 Main Frame Construction

The main frame shall be an all welded, torsion resistant frame, utilising the most modern design techniques to provide an attractive structure with a minimum of maintenance. The design shall avoid pockets where water may collect. A fifth-wheel sliding plate shall be solidly connected to the chassis frame.

The chassis shall be equipped with a telescopic or foldable landing gear with a minimum static capacity of 30 t.

2.4.2 Axles and Wheels

Two (2) heavy-duty fabricated, leaf-spring suspended axles shall be assembled. Each axle shall be provided with four (4) heavy duty pneumatic tired wheels.

2.4.3 Tires

Minimum tire size required: 11.00 x 20 - PR 16, pneumatic type

The tires of the Terminal Chassis and the Terminal Tractor (Item 5) shall be of the same size and have the same PR-rating.

2.5 Special Arrangements

The Terminal Chassis shall be equipped with

- four fixed corner guides including fixed pins and
- two container guides in the centre

and allow opening of container doors at the rear for loading and unloading.

2.6 Surface Protection

All structural parts shall be blasted to DIN 55928, SA 2.5 standard and painted with a paint system that will include four (4) paint layers:

- primer
- two (2) coats of intermediate layers
- top coat

3. Data Sheet

The Bidder shall enclose with its proposal the following filled-out data sheet:

3.1	Manufacturer	_____	
3.2	Model	_____	
3.3	Loads		
3.3.1	Dead weight	_____	kg
3.3.2	Maximum pay load	_____	kg
3.3.3	Total weight	_____	kg
3.3.4	King pin load with maximum pay load	_____	kg
3.4	Travelling Speed		
3.4.1	Laden with maximum pay load	_____	km/h
3.4.2	Unladen	_____	km/h
3.5	Dimensions		
3.5.1	Overall length	_____	mm
3.5.2	Overall width	_____	mm
3.5.3	Bed length	_____	mm
3.5.4	Bed height	_____	mm
3.5.5	King pin size	_____	inch
3.5.6	Front tilting radius	_____	mm
3.5.7	Rear tilting radius	_____	mm
3.5.8	Rear overhang	_____	mm
3.5.9	Height of sliding plate	_____	mm
3.6	Construction		
3.6.1	Main beam shape and size	_____	
3.6.2	Main beam steel strength	_____	N/mml
3.6.3	Side beam shape and size	_____	
3.6.4	Side beam steel strength	_____	N/mml

2.8 Final Adjustment and Testing

After the chassis has been adjusted, lubricated and otherwise made ready for operations, it shall be tested to demonstrate conformance to all requirements defined in these Specifications.

The Contractor shall provide the operator and the necessary loads.

Final testing process shall consist of such main stages:

(a) static test
(b) testing of speeds
(c) running test

2.9 Safety Arrangements

General assembling and detailed design of the chassis shall conform to the safety regulations and codes listed in the Special Conditions of Contract with the addition of the following:

All nuts connecting the moving and rotating parts shall be of the self-locking type to prevent their loosening due to vibration.

Unavoidable hazardous points shall be marked with a special warning paint (yellow and black stripes).

Reflectors shall be mounted on the chassis as follows:

- four (4) on each side (yellow)
- two (2) triangles on the rear (red)
- two (2) on the front (yellow)

A rear protection cross bar at a height of 500 mm above the ground shall be installed.

2.10 General Instructions

The Bidder shall submit with its proposal detailed specifications and main and transverse beams strength calculations.

Detailed load calculation must be provided with maximum pay load for:

(1) King pin load
(2) Landing legs
(3) Axles at 25 km/h
(4) Tires at 25 km/h
(5) Rims at 25 km/h

All terminal chassis shall be from one production lot.

4. Spare Parts and Special Tools

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists for a period of operation of 3,000 hours.

The spare parts list shall include one complete axle with wheels and tires.

The spare parts lists shall include the following data elements:

- sequence number
- Bidder's part number
- item description
- figure and item number in the illustrated parts breakdown/drawing if applicable
- quantity
- unit price
- total price

The Bidder shall prepare and submit to the Purchaser recommended and priced tools which are required but not included in the delivery.

3.6.5	Transverse beam shape and size		
3.6.6	Transverse beam steel strength		N/mml
3.6.7	Quantity of transverse beams		
3.7	Axles		
3.7.1	Manufacturer		
3.7.2	Model		
3.7.3	Rated load at 25 km/h		kg
3.7.4	Total axle load at 25 km/h		kg
3.8	Tires		
3.8.1	Manufacturer		
3.8.2	Size		
3.8.3	Rated load at 25 km/h		kg
3.8.4	Total tire load at 25 km/h		kg
3.8.5	Ground pressure		kp/cml
3.9	Landing Legs		
3.9.1	Manufacturer		
3.9.2	Type		
3.9.3	Capacity per leg		kg

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 7: 40'/60-t Roll Trailer

Table of Contents

5. Bill of Quantities

Item	Description	Unit	Qty	Unit Cost	Total Cost
	38-t/40' Terminal Chassis	pc	8		
Sea freight to Poti					
Insurance to Poti					
Total, CIF Poti					

Delivery Period to the Port of Poti ..... weeks

1. General Description

These Specifications describe a 40'/60-t Roll Trailer which will be purchased by the Beneficiary, and which shall be used for supplementing crane and container operation, handling of 2 x 20' and 1 x 40' ISO containers, bulk and general cargo.

2. Operations Characteristics

2.1 Capacity Requirements

The roll trailer shall be designed to operate with the following capacities:

- pay load of 60 t general cargo at a speed of 10 km/h
- 2 x 20' ISO containers
- 1 x 40' ISO container

2.2 Travelling Speed

The travelling speed of the roll trailer shall be:

- fully loaded, 60 t:	not less than	10 km/h
- unloaded:	not less than	25 km/h

2.3 Dimensions

Overall length:	not more than	12,600 mm
Overall width:	not more than	2,800 mm
Trailer bed height:	not more than	1,100 mm
Bed length:	not more than	12,300 mm
Rear overhang	not more than:	3,000 mm

2.6 Surface Protection

All structural parts shall be blasted to DIN 55928, SA 2.5 standard and painted with a paint system according to the manufacturer's standard that will include four (4) paint layers:

- primer
- two (2) coats of intermediate layers
- top coat

Total dry film thickness shall be not less than 240 microns.

Shade to RAL 2009 Traffic Orange or RAL 1023 Traffic Yellow

This colour scheme may be altered on demand of the Purchaser.

2.7 Design Criteria

2.7.1 Lubrication

Lubrication of mechanical parts shall be by means of high pressure grease introduced through industrial button-type fittings.

2.7.2 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors shall be introduced into the trailer's design, whenever practical.

2.7.3 Quality Control

Quality control shall be employed to assume a vital role in establishing and maintaining a high quality product. Detailed inspections and controls shall be made and data shall be gathered for analysis and evaluation to ensure that the required quality standards are met.

The Contractor shall be responsible for providing inspection methods, maintaining surveillance and controls over all testing and special processes, checking manufacturing methods, materials and bought-in items, for compliance with applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspection reports shall be furnished for:

(a) steel used in load bearing structural frame members
(b) welder's certifications
(c) bed surface cover (timber treatment)

2.4 Main Technical and Design Demands

2.4.1 Main Frame Construction

The main frame shall be an all welded, torsion resistant frame, utilising the most modern design techniques to provide an attractive structure with a minimum of maintenance. The trailer shall have a coupling mouth for detachable goose-necks with safety hooks beside the mouth.

The maximum King pin load shall not exceed 22 t at maximum pay load.

2.4.2 Axles and Wheels

Two (2) heavy-duty fabricated longitudinal rocker beams with four (4) fully-oscillating axle sets shall be assembled one to each end of each rocker beam. Each axle shall be provided with two (2) heavy-duty super-elastic wheels.

2.4.3 Tires

Minimum tire size required: 350 - 15 super-elastic

2.4.4 Brakes

Brakes are not required.

2.4.5 Bed Surface Covering

The bed surface covering shall be of treated selected pinewood, with spaced chamfered timbers fixed to the beams to allow the drainage of water.

2.5 Special Arrangements

The 40'/60 t roll trailer shall be equipped with

- heavy-angled retractable corner guides with fixed centring pins
- retractable middle guides for ISO container location
- combined cargo and deck lashings (6 on each side)

2.10 General Instructions

The Bidder shall submit with its proposal detailed specifications and main and transverse beams strength calculations.

All roll trailers shall be from one production lot.

2.8 Final Adjustment and Testing

After the trailer has been adjusted, lubricated and otherwise made ready for operations, it shall be tested to demonstrate conformance to all requirements defined in these Specifications.

The Contractor shall provide the operator and the necessary loads.

Final testing process shall consist of such main stages:

(a) static test
(b) testing of speeds
(c) running test

2.9 Safety Arrangements

2.9.1

General assembling and detailed design of the trailer shall conform to the safety regulations and codes listed in the Special Conditions of Contract with the addition of the following:

2.9.2

All nuts connecting the moving and rotating parts shall be of the self-locking type to prevent their loosening due to vibration.

2.9.3

Unavoidable hazardous points shall be marked with a special warning paint (yellow and black stripes).

2.9.4

- Reflectors shall be mounted on the trailer, well protected in the steel construction:
- four (4) on each side (yellow)
- two (2) in the rear (red)
- two (2) in the front (yellow)

3.6.2 Main beam steel strength

_____ N/mml

3.6.3 Side beam shape and size _____

3.6.4 Side beam steel strength

_____ N/mml

3.6.5 Transverse beam shape and size _____

3.6.6 Transverse beam steel strength

_____ N/mml

3.6.7 Quantity of transverse beams _____

3.7 Axles

3.7.1 Manufacturer _____

3.7.2 Model _____

3.7.3 Rated load at 10 km/h

_____ kg

3.7.4 Total rated axle load

_____ kg

3.8 Tires

3.8.1 Manufacturer _____

3.8.2 Size _____

3.8.3 Rated load at 10 km/h per tire

_____ kg

3.8.4 Rated load at 10 km/h - all tires

_____ kg

3.8.5 Ground pressure

_____ kp/cml

3.9 Bed Surface Cover Description

_____

_____

_____

3. Data Sheet

The Bidder shall enclose with its proposal the following filled-out data sheet:

3.1	Manufacturer	_____	
3.2	Model		
3.3	Loads		
3.3.1	Dead weight	_____	kg
3.3.2	Maximum load at 10 km/h	_____	kg
3.3.3	Maximum rated fifth-wheel load	_____	kg
3.4	Travelling Speed		
3.4.1	Laden	_____	km/h
3.4.2	Unladen	_____	km/h
3.5	Dimensions		
3.5.1	Overall length	_____	mm
3.5.2	Overall width	_____	mm
3.5.3	Bed length	_____	mm
3.5.4	Bed height	_____	mm
3.6	Construction		
3.6.1	Main beam shape and size	_____	

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 9: 10-t Forklift Truck

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4. Spare Parts And Special Tools

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists for a period of operation of 3,000 hours.

The spare parts list shall include one complete axle with wheels and tires.

The spare parts lists shall include the following data elements:

- sequence number
- Bidder's part number
- item description
- figure and item number in the illustrated parts breakdown/drawing if applicable
- quantity
- unit price
- total price

The Bidder shall prepare and submit to the Purchaser recommended and priced tools which are required but not included in the delivery.

1. General Description

These specifications describe a 10-t forklift truck which shall be purchased by the Beneficiary and which shall be used for general cargo handling.

2. Operating Characteristics

2.1 Operations Characteristics

(see Data Sheet, Clause 3, for abbreviations)

2.1.1 Lifting Capacity

2.1.1.1
Basic capacity with side-shifting fork positioning carriage shall be at a load centre of 1,200 mm 10,000 kg

2.1.1.2
Lifting Height, minimum 4,500 mm

2.1.1.3
Mast Construction shall be of the double-stage free-view type.

2.1.1.4 Tilt Angles

- Forward 5 degrees
- Backward 10 degrees

2.1.2 Speeds

2.1.2.1
Driving Speed Forward 25 km/h - 30 km/h

2.1.2.2
Driving Speed Backward 25 km/h - 30 km/h

2.1.2.3
Lifting with load 0.25 m/s - 0.30 m/s

2.1.2.4
Lifting without load 0.30 m/s - 0.35 m/s

2.1.2.5
Lowering with load 0.30 m/s - 0.35 m/s

2.1.2.6
Lowering without load 0.25 m/s - 0.30 m/s

2.1.3 Major Dimensions

2.1.3.1
Overall length L1 + L2 including forks, maximum 8,000 mm

2.1.3.2
Overall width B, maximum 2,500 mm

2.1.3.3
Height, mast lowered h1, maximum (container loader) 3,000 mm

2.1.3.4
Turning radius WA, maximum 5,000 mm

2.1.3.5
Ast 4, maximum 8,500 mm

2.1.4 Protective Devices

2.1.4.1
Safety hydraulic lock valves shall be provided on all load-bearing hydraulic cylinders (tilting and lifting).

2.1.4.2
Hydraulic counterbalance valves shall be provided on load-lowering motions.

2.1.4.3
A beacon light shall be mounted on top of the cabin.

2.2 Main Technical and Design Demands

2.2.1 Main Frame Construction

The main frame shall be an all-welded, torsion-resistant frame, utilizing the most modern design techniques to provide an attractive structure with a minimum of maintenance. The design shall avoid pockets where water may collect.

The frame structure shall provide efficient protection for all internal parts, especially for the battery storage and the hydraulic oil tanks.

2.2.2 Power Plant

2.2.2.1
A Diesel Engine with direct fuel injection shall be provided. Preferably, the engine shall not be turbo-charged. The Bidder shall offer two alternative makes of engines with full technical details.

2.2.2.2 Engine Power
The engine power shall be minimum 100 kW
maximum 120 kW

2.2.2.3 Engine-Cooling System
The engine-cooling system shall be designed to work in a tropical climate.

2.2.2.4 Engine Air Inlet
The engine air inlet system shall be of Donaldson type or equivalent, cyclonic pre-cleaner and double-stage-dry paper element type with air-restriction indicator. Air inlets shall be at least 2000 mm above ground level.

2.2.2.5 Silencer
Required is a heavy-duty type, mounted in an upswept position.

2.2.2.6 Engine Oil Filter
Full-flow heavy-duty engine oil filters with a replaceable filter element shall be supplied.

2.2.2.7 Engine Protection System
An automatic engine shut-off protection system shall be provided:

The system shall monitor:
- low engine oil pressure
- high engine oil pressure
- high coolant temperature
- high transmission oil temperature

2.2.2.8 Fuel Systems
Fuel tank capacity shall be 120 - 150 litres. Water separator and dual fuel filter with replaceable elements shall be provided.

2.2.3 Transmission

2.2.3.1
A power shift transmission incorporating a torque converter, with multiple stages for forward and reverse, shall be provided. Pressure-testing connections on the gearbox and power take-offs for the hydraulic pump shall be provided.

2.2.3.2 Transmission Oil System
The transmission oil system shall have a separate oil cooler and a full-flow heavy-duty oil filter with a replaceable element. The system shall be capable of tropical zone operations with a temperature range of - 20 °- +45 °C and 100% humidity.

2.2.4 Travel Gear

2.2.4.1 Drive Axle

The drive axle shall be fixed and be of heavy-duty type with planetary axle and hub reduction.

2.2.4.2 Steering Axle

The power steering axle shall be of heavy-duty type with a single double-acting hydraulic cylinder.

2.2.4.3 Tires

Tires shall be of pneumatic type. The twin tires on the drive axle and the two tires on the steering axle shall be of the same size.

Size: Front 12.00 x 20 - 18 PR
Rear 12.00 x 20 - 18 PR

All tires shall be filled up with tirefill.

2.2.5 Brakes

2.2.5.1 Service Brakes

The service brakes shall either be two hydraulically-operated disk brakes or wet disc brakes.

2.2.5.2 Parking Brake

The parking brake shall be spring-actuated and mechanically operated.

2.2.6 Hydraulic System

2.2.6.1

The hydraulic system shall preferably be powered by gear-type hydraulic pumps, driven by power take-offs mounted on the torque converter.

Independent lines shall be provided for

- steering
- piloting
- lifting
- tilting
- side-shifting
- swivelling

2.2.6.2

The hydraulic system shall be protected against pump failures due to contamination by high-pressure cartridge-type filters fitted on the delivery lines.

In addition, in the return line, full flow, replaceable cartridge-type filters shall be provided. These filters shall have a bypass protection and a clogged condition indicator. The preferable filter micron rating shall be 10 microns.

2.2.6.3
A full flow fin and tube-type, oil to air hydraulic fluid cooler shall be provided in the hydraulic system to maintain safe operating temperatures.

2.2.6.4
The hydraulic oil tank drain plug shall be of magnetic type.

2.2.6.5
The main valve of the mast-lowering brake shall be installed in or directly mounted to the lifting cylinder.

2.2.6.6
Quickly-detachable hose couplings for spreader operation shall be provided on the truck.

2.2.7 Driver's Cabin

A cabin for increased visibility and improved safety and productivity shall be offered.

The driver's cabin shall be of the single-man-type, mounted on anti-vibration rubber mountings. Doorlocks (keys) on all lift trucks shall be provided. The cabin shall be provided with sound insulation. Driver's seat shall be fully suspended. The left and right hand cabin windows shall be installed in a way that opening for ventilation is possible. Tinted safety glass for all windows shall be provided with windscreen wipers fitted at the front and at the rear window.

The cabin shall meet FOPS criteria ISO 3449 and FEM.

A heating system shall be installed.

2.2.7.1 Operator's Console

The operator's console shall include all necessary controls for the Forklift Truck's normal operations. All control wiring shall end on terminal blocks appropriately marked with corresponding wire numbers. All console control equipment shall be dimensioned for heavy-duty continuous operations.

The following instruments shall be provided:

- Hourmeter
- Fuel gauge
- Engine coolant temperature gauge
- Engine oil pressure warning light and buzzer
- Torque converter oil-temperature gauge
- Torque converter oil-pressure light
- Alternator control lamp
- Dual air pressure gauge, if applicable
- Parking brake indicator light
- Twistlocks indicator lights
- Ammeter charging

2.2.8 Electrical System

The systems voltage shall be 24 V.

Two batteries of 12 V, alt least 130 Ah at 20-hr-rate, maintenance free and with a battery main isolating switch shall be supplied. The battery compartment must be lockable.

Lighting:
- Head lights, well protected
- Stop/tail lights, well protected
- Direction indicator front rear, well protected
- Floodlight mounted to rear of cab
- Four working lights on the mast

A central fuse box is required, inline fuses are not permitted.

2.2.9 Fork Attachment

The forklift truck shall be equipped with a side-shifting fork positioner and standard forks of 2,200 mm in length.

2.2.10 Surface Protection

All structural parts shall be blasted to DIN 55928 SA 2.5 standard and painted with a high-built paint system according to the manufacturers standard preferably it shall be a solvent and heavy-metal-free paint (acrylic water-based paint) with not less than four (4) coats of paint:

- paint specifications shall be attached to the tender
- primer
- two (2) coats of intermediate layers
- top coat

Total dry film thickness shall be not less than 180 microns.

Paint	Shade to	RAL 2009 Traffic Orange
	or	RAL 1023 Traffic Yellow

Mast, carriage and forks RAL 9005 Flat Black.

Danger stripes in black paint across the counter-weight are required.

This colour scheme may be altered by the Purchaser.

2.2.10.1 Purchaser's Logo

The Purchaser's logo shall be prominently displayed on the outside of the truck in positions indicated by the Purchaser. Exterior finishing paints, according to manufacturers standard, shall be used.

2.3 Design Criteria

2.3.1 General Design

The general design and the stability design of the forklift truck shall conform to the requirements of

- DIN 15138
- FEM Section III
- ISO
- BS 5750 Part 1.

The Bidder shall state the standards used in its design.

2.3.2 Mechanical Design

2.3.2.1 General

The mechanical design of load-carrying parts shall be calculated to FEM Section III A, DIN 15173. Any pinch and shear points on the upright and carriage shall be avoided.

All fasteners or parts likely to become loose by vibration shall be secured by approved devices.

All parts shall be designed to ensure easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance.

2.3.2.2 Bearings

Bearings on the forklift truck shall be of the anti-friction type.

2.3.2.3 Lubrication

Lubrication of all mechanical operating parts shall be provided in accordance with manufacturers' instructions. Oil-type lubrication shall be provided for speed reducer and other major components where lubrication is needed. Lubrication of other mechanical parts shall be effected by means of high-pressure grease introduced through industrial button-type fittings. All pedal shafts, steering axles and lift cylinder mountings shall be greasable. The oil for lubrication shall be of the type and make as used in Georgia.

2.3.3 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the forklift truck's design, whenever practical.

2.3.3.1

Diagnostic ("trouble-shooting") techniques, procedures and test-equipment shall be developed for rapid location of a fault in order to achieve an overall reduction of systems down time. The Bidder shall list in its proposal systems for which such diagnostic procedures will be supplied.

2.3.3.2 Accessibility

Restricted accessibility of modules, assemblies and other items is a large contributor to the extension of repair time. Configuration of the hardware and its layout in the forklift truck shall allow free and easy access for maintenance personnel and for tools and equipment which are required to perform the repair task.

2.3.4 Electrical Design

2.3.4.1 General

All electrical equipment, materials and workmanship shall conform to the applicable current standards of BS, ASA, VDE or their equivalents. All equipment and materials furnished shall be suitable for operations in a humid, marine atmosphere up to 40 degrees centigrade of ambient temperature. Nameplates shall be engraved on phenolic plastic, attached to the equipment with corrosion-resistant rivets.

All electrical equipment furnished shall resist deterioration from corrosion when exposed to severe moisture conditions near salt water.

As far as practicable, all screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastenings and fittings shall be of corrosion-resistant material or shall be treated or plated in a manner to render them resistant to corrosion.

2.3.4.2 Wiring

Electrical wiring throughout the forklift truck shall be dimensioned in accordance with the circuit's current-carrying requirements.

Wiring shall be of PVC or neoprene insulation with approved flexible-type switchboard wiring, for control panels to minimize vibration damage.

2.3.5 Quality Control

Quality control shall be employed to assume a vital role in establishing and maintaining a high-quality product. Detailed inspections and controls shall be made and data shall be gathered for analysis and evaluation to ensure that the required quality standards are met.

The Contractor shall be responsible for providing inspection methods, maintaining surveillance and control over all testing and special processes, checking manufacturing methods, materials and bought-in supplied items, for compliance with the applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspections reports shall be furnished for:

(a) Engine
(b) Transmission
(c) Hydraulic pumps and cylinders
(d) Steel used in load bearing structural frame members
(e) Brakes
(f) Welders' certifications
(g) Safety devices
(h) Forks
(i) Chain certificate
(j) Capacity certificate

The Purchaser shall submit a certificate of his quality control system according to ISO 9000-9004.

2.4 Final Adjustment and Testing

After the forklift truck has been erected, adjusted, lubricated and otherwise made ready for operations, it shall be tested to demonstrate conformity to all requirements defined in these Specifications.

The Contractor shall submit to the Purchaser for approval the full testing program, including the contents of tests, methods of conducting, control and measuring, required instruments, equipment and power.

The Purchaser will provide the operator and the necessary loads.

Final testing process shall consist of the following main stages:

(a) Static test
(b) Dynamic test
(c) Testing of safety devices
(d) Testing of speeds
(e) Operations test

These tests shall prove that all indicated data are in conformity with the Contractor's specifications.

2.5 Safety Arrangements

2.5.1

General assembly and detail design of the forklift truck shall conform to the safety regulations and codes listed in the Special Conditions of Contract added by the following:

2.5.2

All nuts connecting the moving and rotating parts shall be of the self-locking type to prevent their loosening due to vibration.

2.5.3

All rotating parts shall be provided with rigid safety guards.

2.5.4

The Contractor shall install one (1) 3-kg powder fire extinguisher in the cab.

2.5.5

Unavoidable hazardous points shall be marked with a special warning paint (yellow/orange and black stripes).

2.5.6

Walk ways shall be covered with anti-slip coat.

2.5.7

Automatic reversing lights with acoustic warning signal.

2.6 General Instructions

2.6.1 Bidder-Supplied Information

The Bidder shall submit with its proposal detailed specifications for all listed items, a list of all standard equipment and a price list of all available options which were not included in the basic prices.

The Bidder shall offer its standard equipment as close as possible to the given technical specifications. Special design and prototypes will not be accepted.

The offered type of equipment must have been manufactured for at least one year and shall be from the same production lot.

3. Data Sheet

3.1

The Bidder shall enclose with its proposal the following data sheet according to DIN 15140 specification.

3.2

Additionally, the following shall be provided with the data sheet:

3.2.1

Data sheets on all main components such as engine, transmission and hydraulic components.

3.2.2

Dimensional drawing of the forklift truck.

3.2.3

Load diagram for standard fork operations.

3.2.4

Statement-indicating maximum ground pressure.

3.2.5

Paint specification

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 11: 2.5-t Forklift Truck/ Stuffer

Table of Contents

1. General Description

These Specifications describe a 2.5-t-Forklift-Truck (stevedoring configuration) which shall be purchased by the Beneficiary as mentioned in the Bill of Quantities, and which shall be used for stripping and stuffing of 8'-6" height containers.

2. Operating Characteristics

2.1 Operations Characteristics

2.1.1 Lifting Capacity

2.1.1.1
Basic capacity with side-shifting fork positioning carriage at load centre of 500 mm shall be: 2,500 kg

2.1.1.2
Residual capacity at the required lifting height of 3,000 mm at a load centre of 800 mm shall be: 2,000 kg

2.1.1.3
Lifting height with standard drop forks, minimum 4,000 mm

2.1.1.4
Mast construction shall be of the free-view-type, triplex, full free lift, minimum 1,300 mm

2.1.1.5 Tilt Angles
Forward 6 degrees
Backward 12 degrees

2.1.1.6 Forks
Standard forks, length 1,100 mm

2.1.2 Speeds

2.1.2.1	Driving speed forward	25 km/h - 30 km/h
2.1.2.2	Driving speed backward	25 km/h - 30 km/h
2.1.2.3	Lifting with load	0.45 m/s - 0.50 m/s
2.1.2.4	Lifting without load	0.50 m/s - 0.60 m/s
2.1.2.5	Lowering with load	0.40 m/s - 0.55 m/s
2.1.2.6	Lowering without load	0.40 m/s - 0.50 m/s

2.1.3 Major Dimensions

2.1.3.1	Overall length L1 + L2 incl. forks, maximum	4,000 mm
2.1.3.2	Overall width B, maximum	1,900 mm
2.1.3.3	Height, mast lowered h1, maximum	2,150 mm
2.1.3.4	Turning radius WA, maximum	3,100 mm
2.1.3.5	Ast 4, maximum	4,500 mm

2.1.4 Protective Devices

2.1.4.1
Safety hydraulic lock valves shall be provided on all load-bearing hydraulic cylinders (tilting and lifting).

2.1.4.2
Hydraulic counterbalance valves shall be provided on load-lowering motions.

2.2 Main Technical and Design Demands

2.2.1 Main Frame Construction

The main frame shall be an all-welded, torsion-resistant frame, utilising the most modern design techniques to provide an attractive structure with a minimum of maintenance. The design shall avoid pockets where water may collect.

The frame structure shall provide efficient protection for all internal parts, especially for the fuel and hydraulic oil tanks.

Sling eyes shall be provided on the frame structure and counterweight to enable the lifting of the truck by crane. The counterweight is to be quickly detachable.

The Bidder shall indicate the length of the lifting ropes required.

2.2.2 Power Plant

2.2.2.1
A Diesel Engine with direct fuel injection shall be provided. Preferably, the engine shall not be turbo-charged. The Bidder shall offer two alternative makes of engines with full technical details.

2.2.2.2

The engine power shall be	minimum	35 kW
	maximum	50 kW

(rating according to DIN 6271).

2.2.2.3 Engine-Cooling System
The engine-cooling system shall be designed to work in a tropical climate.

2.2.2.4 Engine Air Inlet
The engine air inlet system shall be of Donaldson type or equivalent, cyclonic pre-cleaner and double-stage dry paper element type with air-restriction indicator.

2.2.2.5 Silencer
Required is a heavy-duty type, mounted in an upswept position.

2.2.2.6 Engine Oil Filter
Full-flow heavy-duty engine oil filters with a replaceable filter element shall be supplied.

2.2.2.7 Engine Protection System
An automatic engine shut-off protection system, which shall be electrically operated via solenoid valve at the injection pump, shall be provided.
The system shall monitor:

- low engine oil pressure
- high engine oil temperature
- high coolant temperature
- high transmission oil temperature

2.2.2.8 Fuel System
Fuel tank capacity shall be 40 - 60 litres. Water separator and dual fuel filter with replaceable elements shall be provided.

2.2.3 Transmission

2.2.3.1
A power shift transmission incorporating a torque converter, with multiple stages for forward and reverse, shall be provided. Pressure-testing connections on the gearbox and power take-offs for the hydraulic pump shall be provided.

2.2.3.2 Transmission Oil System
The transmission oil system shall have a separate oil cooler and a full-flow heavy-duty oil filter with a replaceable element. The system shall be capable of tropical zone operations.

2.2.4 Travel Gear

2.2.4.1 Drive Axle
The drive axle shall be fixed and be of heavy-duty type with planetary axle and hub reduction.

2.2.4.2 Steering Axle
The steering axle shall be of heavy-duty type with one hydraulic cylinder.

2.2.4.3 Tyres

Tyres shall be of superelastic type. The two tyres on the drive axle and the two tyres on the steering axle shall preferably be of the same size. The Bidder shall offer alternative sizes of tyres to reach the maximum reduction of the front axle load.

2.2.5 Brakes

2.2.5.1 Service Brakes

The service brakes shall either be two hydraulically-operated disk or drum brakes on the drive axle.

2.2.5.2 Parking Brake

The parking brake shall be spring-actuated and mechanically operated.

2.2.6 Hydraulic System

2.2.6.1

The hydraulic system shall preferably be powered by gear-type hydraulic pumps, driven by power take-offs mounted on the torque converter.

Independent lines shall be provided for
- steering
- piloting
- lifting
- tilting
- side-shifting

2.2.6.2

The hydraulic system shall be protected against pump failures due to contamination by high-pressure cartridge-type filters fitted on the delivery lines.
In addition, in the return line, full flow, replaceable cartridge-type filters shall be provided. These filters shall have a bypass protection and a clogged condition indicator. The preferable filter micron rating shall be 10 microns.

2.2.6.3

A full flow fin and tube-type, oil to air hydraulic fluid cooler shall be provided in the hydraulic system to maintain safe operating temperatures.

2.2.6.4

The hydraulic oil tank drain plug shall be of magnetic type.

2.2.6.5

The main valve of the mast-lowering brake shall be installed in or directly mounted to the lifting cylinder.

2.2.6.6

The truck shall be equipped with a 4-way hydraulic valve.

2.2.6.7

Quick detachable hose couplings for attachments shall be provided on the truck.

2.2.7 Operator's Compartment and Overhead Guard

The driver's seat shall be of the full suspension type. Compartment and overhead guard shall meet FOPS criteria ISO 3449 and FEM.

The driver's overhead guard shall be covered with a suitable transparent plastic, fastened in a noise-reducing manner.

2.2.7.1 Operator's Console

The operator's console shall include all necessary controls for the Forklift's normal operations. All control wiring shall end on terminal blocks appropriately marked with corresponding wire numbers. All console control equipment shall be dimensioned for heavy-duty continuous operations.

The following instruments shall be provided:

- Hourmeter
- Fuel gauge
- Engine coolant temperature gauge
- Engine oil-pressure warning light and buzzer
- Torque converter oil-temperature gauge
- Torque converter oil-pressure light
- Alternator control lamp
- Parking brake indicator light
- Ammeter charging

2.2.8 Electrical System

The systems voltage shall be 12 V.

One battery of 12 V, at least 90 Ah at 20-hr.-rate, maintenance free and suitable for tropical conditions with a battery main isolating switch shall be supplied.

Lighting:

- Head lights, well protected
- Floodlight mounted to rear of cab

A central fuse box is required, inline fuses are not permitted.

2.2.9 Fork Attachment

The forklift truck shall be equipped with a fork carriage and hydraulic harbour clamp with load protection guard.

2.2.10 Surface Protection

All structural parts shall be blasted to DIN 55928 SA 2.5 standard and painted with a paint system according to the manufacturer's standard, preferably a solvent and heavy-metal-free (acrylic water based paint), with not less than four (4) coats of paint:

- primer
- two (2) coats of intermediate layers
- top coat

Total dry film thickness shall be not less than 240 microns.

Paint shade to RAL 2009 Traffic Orange
or RAL 1023 Traffic Yellow

Mast, carriage and forks RAL 9005 Flat Black.

Danger stripes in black paint across the counter-weight are required.

This colour scheme may be altered by the Purchaser.

2.2.10.1 Purchaser's Logo
The Purchaser's logo shall be prominently displayed on the outside of the truck in positions indicated by the Purchaser.

2.3 Design Criteria

2.3.1 General Design

The general design and the stability design of the forklift truck shall conform to the requirements of

DIN 15138
FEM Section III
ISO
BS 5750 Part 1.

The Bidder shall state the standards used in its design.

2.3.2 Mechanical Design

2.3.2.1 General
The mechanical design of load-carrying parts shall be calculated to FEM Section III A, DIN 15173. Any pinch and shear points on the upright and carriage shall be avoided.

All fasteners or parts likely to become loose by vibration shall be secured by approved devices.

All parts shall be designed to ensure easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance.

2.3.2.2 Bearings
Bearings on the forklift truck shall be of the anti-friction type.

2.3.2.3 Lubrication

Lubrication of all mechanical operating parts shall be provided in accordance with manufacturers' instructions. Oil-type lubrication shall be provided for speed reducer and other major components where lubrication is needed. Lubrication of other mechanical parts shall be effected by means of high-pressure grease introduced through industrial button-type fittings. All pedal shafts, steering axles and lift cylinder mountings shall be greasable. The oil for lubrication shall be of the type and make as used in the Beneficiary's country.

2.3.3 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the forklift truck's design, whenever practical.

2.3.3.1

Diagnostic ("trouble-shooting") techniques, procedures and test-equipment shall be developed for rapid location of a fault in order to achieve an overall reduction of systems down time. The Bidder shall list in its proposal systems for which such diagnostic procedures will be supplied.

2.3.3.2 Accessibility

Restricted accessibility of modules, assemblies and other items is a large contributor to the extension of repair time. Configuration of the hardware and its layout in the forklift truck shall allow free and easy access for maintenance personnel and for tools and equipment which are required to perform the repair task.

2.3.4 Electrical Design

2.3.4.1 General

All electrical equipment, materials and workmanship shall conform to the applicable current standards of BS, ASA, VDE or their equivalents. All equipment and materials furnished shall be suitable for operations in a humid, marine atmosphere up to 50 degrees centigrade of ambient temperature. Nameplates shall be engraved on phenolic plastic, attached to the equipment with corrosion-resistant rivets.

All electrical equipment furnished shall resist deterioration from corrosion when exposed to severe moisture conditions near salt water.

As far as practicable, all screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastenings and fittings shall be of corrosion-resistant material or shall be treated or plated in a manner to render them resistant to corrosion.

2.3.4.2 Wiring

Electrical wiring throughout the forklift truck shall be dimensioned in accordance with the circuit's current-carrying requirements.

Wiring shall be of PVC or neoprene insulation with approved flexible-type switchboard wiring, for control panels to minimise vibration damage.

2.3.5 Quality Control

Quality control shall be employed to assume a vital role in establishing and maintaining a high-quality product. Detailed inspections and controls shall be made and data shall be gathered for analysis and evaluation to ensure that the required quality standards are met.

The Contractor shall be responsible for providing inspection methods, maintaining surveillance and control over all testing and special processes, checking manufacturing methods, materials and bought-in supplied items, for compliance with the applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspections reports shall be furnished for:

(a) Engine
(b) Transmission
(c) Hydraulic pumps and cylinders
(d) Steel used in load bearing structural frame members
(e) Brakes
(f) Welders' certifications
(g) Safety devices
(h) Forks
(i) Attachments
(k) Chain certificate
(l) Capacity certificate

2.4 Final Adjustment and Testing

After the forklift truck has been erected, adjusted, lubricated and otherwise made ready for operations, it shall be tested to demonstrate conformity to all requirements defined in these Specifications.

The Contractor shall submit to the Purchaser for approval the full testing programme, including the contents of tests, methods of conducting, control and measuring, required instruments and equipment.

The Purchaser will provide the operator and the necessary loads.

Final testing process shall consist of the following main stages:

(a) Static test
(b) Dynamic test
(c) Testing of safety devices
(d) Testing of speeds
(e) Operations test

These tests shall prove that all indicated data are in conformity with the Contractor's specifications.

2.5 Safety Arrangements

2.5.1

General assembly and detail design of the forklift truck shall conform to the safety regulations and codes listed in the Contract added by the following:

2.5.2

All nuts connecting the moving and rotating parts shall be of the self-locking type to prevent their loosening due to vibration.

2.5.3

All rotating parts shall be provided with rigid safety guards.

2.5.4

Unavoidable hazardous points shall be marked with a special warning paint (yellow/orange and black stripes).

2.6 General Instructions

2.6.1 Bidder-Supplied Information

The Bidder shall submit with its proposal detailed specifications for all listed items, a list of all standard equipment and a price list of all available options which were not included in the basic prices.

The Bidder shall offer its standard equipment as close as possible to the given technical specifications. Special design and prototypes will not be accepted.
The offered type of equipment must have been manufactured for at least one year and shall be from the same production lot.

3. Data Sheet

3.1

The Bidder shall enclose with its proposal a data sheet according to DIN 15140 specification.

3.2

Additionally, the following shall be provided with the data sheet:

3.2.1

Data sheets on all main components such as engine, transmission and hydraulic components.

3.2.2

Dimensional drawing of the forklift truck.

3.2.3

Load diagram for standard fork operations.

3.2.4

Statement-indicating maximum ground pressure.

□

4. Spare Parts And Special Tools

4.1 Purchaser's Required Spare Parts Lists

The Bidder shall submit with its bid the following list of required spare parts, duly completed and priced:

Group 1: Cylinder Block and Head
Group 2: Injection System
Group 3: Cooling System and Oil Cooler
Group 4: Air Lines
Group 5: Electrical System
Group 6: Torque Converter and Transmission
Group 7: Drive Shaft and Differential
Group 8: Steering and Brake System
Group 9: Hydraulic Systems
Group 10: Frame and Cabin
Group 11: Mast and Carriage

Price basis shall be "Ex Works".

□

4.1.1 Group 1: Cylinder Block and Head

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Liner, cylinder		
2	1	pc	Crankshaft assy		
3	1	pc	Main bearing, crankshaft		
4	1	pc	Cylinder head assy		
5	1	pc	Exhaust valve		
6	1	pc	Inlet valve		
7	1	pc	Cylinder head gasket		
8	1	pc	Oil filter element		
9	1	pc	Oil pump		
10	1	pc	Cylinder ring set		
11	1	pc	Gasket set, overhauling		
12	1	pc	Engine complete, new		
Total Price, ex works					

4.1.2 Group 2: Injection System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Fuel filter elements		
2	1	pc	Fuel pump assy		
3	1	pc	Injection pump assy		
Total Price, ex works					

4.1.3 Group 3: Cooling System and Oil Cooler

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	V-belt set		
2	1	pc	Radiator		
3	1	pc	Oil cooler		
4	1	pc	Water pump assy		
Total Price, ex works					

4.1.4 Group 4: Air Lines

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Turbocharger, assy		
2	1	pc	Air filter, element		
3	1	pc	Exhaust muffler		
4	1	pc	Exhaust tube, assy		
Total Price, ex works					

4.1.5 Group 5: Electrical System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Battery		
2	1	pc	V-belt set		
3	1	pc	Alternator		
4	1	pc	Starter		
5	1	pc	Lamp assy, front		
6	1	pc	Horn		
7	1	pc	Lamp assy, rear		
Total Price, ex works					

4.1.6 Group 6: Torque Converter and Transmission

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Oil filter element		
2	1	pc	Oil filter assy		
3	1	pc	Clutch group		
4	1	pc	Control valve		
5	1	pc	Transmission, group		
Total Price, ex works					

4.1.7 Group 7: Drive Shaft and Differential

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Gasket kit differential assy		
2	1	pc	Oil seal ring differential assy		
3	1	pc	Bearing set differential assy		
4	1	pc	Joint cardan		
5	1	pc	Oil seal ring, drive axle front		
6	1	pc	Bearing set, drive axle front		
7	1	pc	Tyre, front		
8	1	pc	Tyre, rear		
Total Price, ex works					

4.1.8 Group 8: Steering and Brake System

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Steering cylinder assy		
2	1	pc	Bearing set		
3	1	pc	Brake disc		
4	1	pc	Brake pad		
5	1	pc	Pump, assy		
6	1	pc	Repair kit, pump assy		
7	1	pc	Brake master cylinder		
Total Price, ex works					

4.1.9 Group 9: Hydraulic Systems

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Hydraulic pump assy		
2	1	pc	Repair kit, hydraulic pump		
3	1	pc	Control valve, hydraulic pump		
4	1	pc	Hydraulic filter elements		
5	1	pc	Lift cylinder, assy		
6	1	pc	Tilt cylinder		
7	1	pc	Gasket kit, tilt cylinder		
8	1	pc	Hose assy, lift cylinder		
9	1	pc	Hose assy, tilt cylinder		
10	1	pc	Hose assy, sideshift cylinder		
Total Price, ex works					

4.1.10 Group 10: Frame and Cabin

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Windscreen, front		
2	1	pc	Windscreen, rear		
3	1	pc	Windscreen, side		
Total Price, ex works					

4.1.11 Group 11: Mast and Carriage

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	pc	Chain		
2	1	pc	Roller set, carriage		
3	1	pc	Roller set, mast		
4	1	pc	Sideshift cylinder		
Total Price, ex works					

4.2 Bidder's Recommended Spare Parts and Special Tools Lists

The Bidder shall prepare and submit to the Purchaser recommended and priced spare parts lists for a period of operation of 3,000 hours.

The spare parts lists should include the following data elements:

- Sequence number
- Bidder's part number
- Item description
- Figure and item number in the illustrated parts breakdown/drawing if applicable
- Quantity
- Unit price
- Total price

The Bidder shall prepare and submit to the Purchaser recommended and priced special tools which are required but not included in the delivery.

5. Bill of Quantities

Item	Description	Unit	Qty	Unit Cost	Total Cost
	1.5-t Forklift Truck	pc			
	Bale Clamp, 1.5 t Capacity	pc			
4.1	Purchaser's Required Spare Parts	set	1		
Total, FOB					
Sea freight to Poti					
Insurance to Poti					
Total, CIF Poti					

Delivery Period to Poti ..... weeks

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 12: 12.5-t Empty Container Handler

Table of Contents

1. General Description

These specifications describe a 12.5-t forklift truck which shall be purchased by the Beneficiary and which shall be used for empty-container handling.

2. Operating Characteristics

2.1 Operations Characteristics

(see Data Sheet, Clause 3, for abbreviations)

2.1.1 Lifting Capacity

2.1.1.1 Basic capacity with side-shifting fork positioning carriage shall be at a load centre of 1,200 mm	12,500 kg
2.1.1.2 Residual capacity at the required height of stacking one over tow, ISO 9'6" container height shall be at a load centre of 2,000 mm	8,500 kg
2.1.1.3 Lifting Height under twistlocks/hook of side frame, minimum	12,000 mm
2.1.1.4 Mast Construction shall be of the double-stage free-view type.	
2.1.1.5 Tilt Angles	
• Forward	5 degrees
• Backward	10 degrees

2.1.2 Speeds

2.1.2.1 Driving Speed Forward	25 km/h - 30 km/h
2.1.2.2 Driving Speed Backward	25 km/h - 30 km/h
2.1.2.3 Lifting with load	0.25 m/s - 0.30 m/s
2.1.2.4 Lifting without load	0.30 m/s - 0.35 m/s
2.1.2.5 Lowering with load	0.30 m/s - 0.35 m/s
2.1.2.6 Lowering without load	0.25 m/s - 0.30 m/s

2.1.3 Major Dimensions

2.1.3.1 Overall length L1 + L2 including forks, maximum	8,000 mm
2.1.3.2 Overall width B, maximum	2,500 mm
2.1.3.3 Height, mast lowered h1, maximum (container loader)	7,500 mm
2.1.3.4 Turning radius WA, maximum	5,000 mm
2.1.3.5 Ast 4, maximum	8,500 mm

2.1.4 Protective Devices

2.1.4.1 Safety hydraulic lock valves shall be provided on all load-bearing hydraulic cylinders (tilting and lifting).

2.1.4.2 Hydraulic counterbalance valves shall be provided on load-lowering motions.

2.1.4.3 A beacon light shall be mounted on top of the cabin.

2.2 Main Technical and Design Demands

2.2.1 Main Frame Construction

The main frame shall be an all-welded, torsion-resistant frame, utilising the most modern design techniques to provide an attractive structure with a minimum of maintenance. The design shall avoid pockets where water may collect.

The frame structure shall provide efficient protection for all internal parts, especially for the battery storage and the hydraulic oil tanks.

2.2.2 Power Plant

2.2.2.1
A Diesel Engine with direct fuel injection shall be provided. Preferably, the engine shall not be turbo-charged. The Bidder shall offer two alternative makes of engines with full technical details.

2.2.2.2 Engine Power

The engine power shall be	minimum	100 kW
	maximum	120 kW

2.2.2.3 Engine-Cooling System

The engine-cooling system shall be designed to work in a tropical climate.

2.2.2.4 Engine Air Inlet

The engine air inlet system shall be of Donaldson type or equivalent, cyclonic pre-cleaner and double-stage-dry paper element type with air-restriction indicator. Air inlets shall be at least 2000 mm above ground level.

2.2.2.5 Silencer
Required is a heavy-duty type, mounted in an upswept position.

2.2.2.6 Engine Oil Filter
Full-flow heavy-duty engine oil filters with a replaceable filter element shall be supplied.

2.2.2.7 Engine Protection System
An automatic engine shut-off protection system shall be provided:

The system shall monitor:
- low engine oil pressure
- high engine oil pressure
- high coolant temperature
- high transmission oil temperature

2.2.2.8 Fuel Systems
Fuel tank capacity shall be 120 - 150 litres. Water separator and dual fuel filter with replaceable elements shall be provided.

2.2.3 Transmission

2.2.3.1
A power shift transmission incorporating a torque converter, with multiple stages for forward and reverse, shall be provided. Pressure-testing connections on the gearbox and power take-offs for the hydraulic pump shall be provided.

2.2.3.2 Transmission Oil System
The transmission oil system shall have a separate oil cooler and a full-flow heavy-duty oil filter with a replaceable element. The system shall be capable of tropical zone operations with a temperature range of -20 ° - +45 °C and 100% humidity.

2.2.4 Travel Gear

2.2.4.1 Drive Axle
The drive axle shall be fixed and be of heavy-duty type with planetary axle and hub reduction.

2.2.4.2 Steering Axle
The power steering axle shall be of heavy-duty type with a single double-acting hydraulic cylinder.

2.2.4.3 Tires
Tires shall be of pneumatic type. The twin tires on the drive axle and the two tires on the steering axle shall be of the same size.

Size: Front 12.00 x 20 - 18 PR
Rear 12.00 x 20 - 18 PR

All tires shall be filled up with tirefill.

2.2.5 Brakes

2.2.5.1 Service Brakes
The service brakes shall either be two hydraulically-operated disk brakes or wet disc brakes.

2.2.5.2 Parking Brake
The parking brake shall be spring-actuated and mechanically operated.

2.2.6 Hydraulic System

2.2.6.1
The hydraulic system shall preferably be powered by gear-type hydraulic pumps, driven by power take-offs mounted on the torque converter.

Independent lines shall be provided for

- steering
- piloting
- lifting
- tilting
- side-shifting
- swivelling

2.2.6.2
The hydraulic system shall be protected against pump failures due to contamination by high-pressure cartridge-type filters fitted on the delivery lines.

In addition, in the return line, full flow, replaceable cartridge-type filters shall be provided. These filters shall have a bypass protection and a clogged condition indicator. The preferable filter micron rating shall be 10 microns.

2.2.6.3
A full flow fin and tube-type, oil to air hydraulic fluid cooler shall be provided in the hydraulic system to maintain safe operating temperatures.

2.2.6.4
The hydraulic oil tank drain plug shall be of magnetic type.

2.2.6.5
The main valve of the mast-lowering brake shall be installed in or directly mounted to the lifting cylinder.

2.2.6.6
Quickly-detachable hose couplings for spreader operation shall be provided on the truck.

2.2.7 Driver's Cabin

An elevated cabin for increased visibility and improved safety and productivity shall be offered. The driver's eye-level should be at least 4,000 mm.

The driver's cabin shall be of the single-man-type, mounted on anti-vibration rubber mountings. Door locks (keys) on all lift trucks shall be provided. The cabin shall be provided with sound insulation. Driver's seat shall be fully suspended. The left and right hand cabin windows shall be installed in a way that opening for ventilation is possible. Tinted safety glass for all windows shall be provided with windscreen wipers fitted at the front and at the rear window.

The cabin shall meet FOPS criteria ISO 3449 and FEM.

A heating system shall be installed.

2.2.7.1 Operator's Console

The operator's console shall include all necessary controls for the Forklift Truck's normal operations. All control wiring shall end on terminal blocks appropriately marked with corresponding wire numbers. All console control equipment shall be dimensioned for heavy-duty continuous operations.

The following instruments shall be provided:

- Hour meter
- Fuel gauge
- Engine coolant temperature gauge
- Engine oil pressure warning light and buzzer
- Torque converter oil-temperature gauge
- Torque converter oil-pressure light
- Alternator control lamp
- Dual air pressure gauge, if applicable
- Parking brake indicator light
- Twistlocks indicator lights
- Ammeter charging

2.2.8 Electrical System

The systems voltage shall be 24 V.

Two batteries of 12 V, alt least 130 Ah at 20-hr-rate, maintenance free and with a battery main isolating switch shall be supplied. The battery compartment must be lockable.

Lighting:
- Head lights, well protected
- Stop/tail lights, well protected
- Direction indicator front rear, well protected
- Floodlight mounted to rear of cab
- Four working lights on the mast

A central fuse box is required, inline fuses are not permitted.

2.2.9 Fork Attachment

The forklift truck shall be equipped with a side-shifting fork positioner and with a telescopic 20' and a 40' side frame spreader for ISO containers.

2.2.10 Surface Protection

All structural parts shall be blasted to DIN 55928 SA 2.5 standard and painted with a high-built paint system according to the manufacturers standard preferably it shall be a solvent and heavy-metal-free paint (acrylic water-based paint) with not less than four (4) coats of paint:

- paint specifications shall be attached to the tender
- primer
- two (2) coats of intermediate layers
- top coat

Total dry film thickness shall be not less than 180 microns.

Paint	Shade to	RAL 2009 Traffic Orange
	or	RAL 1023 Traffic Yellow

Mast, carriage and forks RAL 9005 Flat Black.

Danger stripes in black paint across the counter-weight are required.

This colour scheme may be altered by the Purchaser.

2.2.10.1 Purchaser's Logo

The Purchaser's logo shall be prominently displayed on the outside of the truck in positions indicated by the Purchaser. Exterior finishing paints, according to manufacturers standard, shall be used.

2.3 Design Criteria

2.3.1 General Design

The general design and the stability design of the forklift truck shall conform to the requirements of

- DIN 15138
- FEM Section III
- ISO
- BS 5750 Part 1.

The Bidder shall state the standards used in its design.

2.3.2 Mechanical Design

2.3.2.1 General
The mechanical design of load-carrying parts shall be calculated to FEM Section III A, DIN 15173. Any pinch and shear points on the upright and carriage shall be avoided.

All fasteners or parts likely to become loose by vibration shall be secured by approved devices.

All parts shall be designed to ensure easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance.

2.3.2.2 Bearings
Bearings on the forklift truck shall be of the anti-friction type.

2.3.2.3 Lubrication
Lubrication of all mechanical operating parts shall be provided in accordance with manufacturers' instructions. Oil-type lubrication shall be provided for speed reducer and other major components where lubrication is needed. Lubrication of other mechanical parts shall be effected by means of high-pressure grease introduced through industrial button-type fittings. All pedal shafts, steering axles and lift cylinder mountings shall be greasable. The oil for lubrication shall be of the type and make as used in Georgia.

2.3.3 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the forklift truck's design, whenever practical.

2.3.3.1
Diagnostic ("trouble-shooting") techniques, procedures and test-equipment shall be developed for rapid location of a fault in order to achieve an overall reduction of systems down time. The Bidder shall list in its proposal systems for which such diagnostic procedures will be supplied.

2.3.3.2 Accessibility
Restricted accessibility of modules, assemblies and other items is a large contributor to the extension of repair time. Configuration of the hardware and its layout in the forklift truck shall allow free and easy access for maintenance personnel and for tools and equipment which are required to perform the repair task.

2.3.4 Electrical Design

2.3.4.1 General
All electrical equipment, materials and workmanship shall conform to the applicable current standards of BS, ASA, VDE or their equivalents. All equipment and materials furnished shall be suitable for operations in a humid, marine atmosphere up to 40 degrees centigrade of ambient temperature. Nameplates shall be engraved on phenolic plastic, attached to the equipment with corrosion-resistant rivets.

All electrical equipment furnished shall resist deterioration from corrosion when exposed to severe moisture conditions near salt water.

As far as practicable, all screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastenings and fittings shall be of corrosion-resistant material or shall be treated or plated in a manner to render them resistant to corrosion.

2.3.4.2 Wiring

Electrical wiring throughout the forklift truck shall be dimensioned in accordance with the circuit's current-carrying requirements.

Wiring shall be of PVC or neoprene insulation with approved flexible-type switchboard wiring, for control panels to minimise vibration damage.

2.3.5 Quality Control

Quality control shall be employed to assume a vital role in establishing and maintaining a high-quality product. Detailed inspections and controls shall be made and data shall be gathered for analysis and evaluation to ensure that the required quality standards are met.

The Contractor shall be responsible for providing inspection methods, maintaining surveillance and control over all testing and special processes, checking manufacturing methods, materials and bought-in supplied items, for compliance with the applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspections reports shall be furnished for:

(a) Engine
(b) Transmission
(c) Hydraulic pumps and cylinders
(d) Steel used in load bearing structural frame members
(e) Brakes
(f) Welders' certifications
(g) Safety devices
(h) Attachments
(i) Chain certificate
(j) Capacity certificate

The Purchaser shall submit a certificate of his quality control system according to ISO 9000-9004.

2.4 Final Adjustment and Testing

After the forklift truck has been erected, adjusted, lubricated and otherwise made ready for operations, it shall be tested to demonstrate conformity to all requirements defined in these Specifications.

The Contractor shall submit to the Purchaser for approval the full testing program, including the contents of tests, methods of conducting, control and measuring, required instruments, equipment and power.

The Purchaser will provide the operator and the necessary loads.

Final testing process shall consist of the following main stages:

(a) Static test
(b) Dynamic test
(c) Testing of safety devices
(d) Testing of speeds
(e) Operations test

These tests shall prove that all indicated data are in conformity with the Contractor's specifications.

2.5 Safety Arrangements

2.5.1

General assembly and detail design of the forklift truck shall conform to the safety regulations and codes listed in Clause 2.2 of the Special Conditions of Contract added by the following:

2.5.2

All nuts connecting the moving and rotating parts shall be of the self-locking type to prevent their loosening due to vibration.

2.5.3

All rotating parts shall be provided with rigid safety guards.

2.5.4

The Contractor shall install one (1) 3-kg powder fire extinguisher in the cab.

2.5.5

Unavoidable hazardous points shall be marked with a special warning paint (yellow/orange and black stripes).

2.5.6

Walk ways shall be covered with anti-slip coat.

2.5.7

Automatic reversing lights with acoustic warning signal.

2.6 General Instructions

2.6.1 Bidder-Supplied Information

The Bidder shall submit with its proposal detailed specifications for all listed items, a list of all standard equipment and a price list of all available options which were not included in the basic prices.

The Bidder shall offer its standard equipment as close as possible to the given technical specifications. Special design and prototypes will not be accepted.

The offered type of equipment must have been manufactured for at least one year and shall be from the same production lot.

3. Data Sheet

3.1

The Bidder shall enclose with its proposal the following data sheet according to DIN 15140 specification.

3.2

Additionally, the following shall be provided with the data sheet:

3.2.1

Data sheets on all main components such as engine, transmission and hydraulic components.

3.2.2

Dimensional drawing of the forklift truck.

3.2.3

Load diagram for standard fork operations.

3.2.4

Load diagram for container-handling operations.

3.2.5

Statement-indicating maximum ground pressure.

3.2.6

Paint specification

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 14: Wheel Loader/ Bobcat

Table of Contents

1. General Description

These Specifications describe a wheel loader (similar to Bobcat) which shall be purchased by the Beneficiary, and which shall be used for bulk handling inside ships.

2. Operating Characteristics

2.1 Operations Characteristics

2.1.1 Lifting Capacity

2.1.1.1
Basic capacity at load centre of 500 mm shall be: 600 kg

2.1.1.2
Lifting height with standard bucket, minimum 3,000 mm

2.1.1.3
Lifting construction shall be of the free-view-type.

2.1.1.4 Bucket Size
Standard bucket width, minimum 1,600 mm
Standard bucket capacity (driven), minimum 600 kg

2.1.2 Speeds

2.1.2.1 Driving speed forward 10 km/h - 15 km/h

2.1.2.2 Driving speed backward 10 km/h - 15 km/h

2.1.3 Major Dimensions

2.1.3.1 Overall length incl. bucket, maximum 3,500 mm

2.1.3.2 Overall width, maximum 1,900 mm

2.1.3.3 Height, mast lowered, maximum 2,150 mm

2.1.3.4 Turning radius, maximum 2,000 mm

2.1.4 Protective Devices

2.1.4.1
Safety hydraulic lock valves shall be provided on all load-bearing hydraulic cylinders.

2.1.4.2
Hydraulic counterbalance valves shall be provided on load-lowering motions.

2.2 Main Technical and Design Demands

2.2.1 Main Frame Construction

The main frame shall be an all-welded, torsion-resistant frame, utilising the most modern design techniques to provide an attractive structure with a minimum of maintenance. The design shall avoid pockets where water may collect.

The frame structure shall provide efficient protection for all internal parts, especially for the fuel and hydraulic oil tanks.

Sling eyes shall be provided on the frame structure and counterweight to enable the lifting of the truck by crane.

The Bidder shall indicate the length of the lifting ropes required.

2.2.2 Power Plant

2.2.2.1
A Diesel Engine with direct fuel injection shall be provided. Preferably, the engine shall not be turbo-charged. The Bidder shall offer two alternative makes of engines with full technical details.

2.2.2.2

The engine power shall be	minimum	35 kW
	maximum	50 kW

(rating according to DIN 6271).

2.2.2.3 Engine-Cooling System
The engine-cooling system shall be designed to work in a tropical climate and inside ships.

2.2.2.4 Engine Air Inlet
The engine air inlet system shall be of Donaldson type or equivalent, cyclonic pre-cleaner and double-stage dry paper element type with air-restriction indicator.

2.2.2.5 Silencer
Required is a heavy-duty anti-sparking type, mounted in an upswept position.

2.2.2.6 Engine Oil Filter
Full-flow heavy-duty engine oil filters with a replaceable filter element shall be supplied.

2.2.2.7 Engine Protection System

An automatic engine shut-off protection system, which shall be electrically operated via solenoid valve at the injection pump, shall be provided.

The system shall monitor:

- low engine oil pressure
- high engine oil temperature
- high coolant temperature
- high transmission oil temperature

2.2.2.8 Fuel System

Fuel tank capacity shall be 40 - 60 litres. Water separator and dual fuel filter with replaceable elements shall be provided.

2.2.3 Transmission

2.2.3.1

A hydrostatic transmission working on all four wheels for forward and reverse shall be provided. Pressure-testing connections on the gearbox and power take-offs for the hydraulic pump shall be provided.

2.2.3.2 Transmission Oil System

The transmission oil system shall have a separate oil cooler and a full-flow heavy-duty oil filter with a replaceable element. The system shall be capable of tropical zone operations.

2.2.4 Travel Gear

2.2.4.1 Front and Rear Axle

The axle shall be fixed and be of heavy-duty type.

2.2.4.2 Tyres

Tyres shall be of superelastic type or pneumatic with tyrefill, and be of the same size.

2.2.5 Brakes

2.2.5.1 Service Brakes

The service brakes shall be hydraulically-operated disk brakes on the axle.

2.2.5.2 Parking Brake

The parking brake shall be spring-actuated and mechanically operated.

2.2.6 Hydraulic System

2.2.6.1
The hydraulic system shall preferably be powered by gear-type hydraulic pumps, driven by power take-offs mounted on the torque converter.

Independent lines shall be provided for
- steering
- piloting
- lifting

2.2.6.2
The hydraulic system shall be protected against pump failures due to contamination by high-pressure cartridge-type filters fitted on the delivery lines.

In addition, in the return line, full flow, replaceable cartridge-type filters shall be provided. These filters shall have a bypass protection and a clogged condition indicator. The preferable filter micron rating shall be 10 microns.

2.2.6.3
A full flow fin and tube-type, oil to air hydraulic fluid cooler shall be provided in the hydraulic system to maintain safe operating temperatures.

2.2.6.4
The hydraulic oil tank drain plug shall be of magnetic type.

2.2.6.5
The main valve of the mast-lowering brake shall be installed in or directly mounted to the lifting cylinder.

2.2.6.6
The truck shall be equipped with a 4-way hydraulic valve.

2.2.6.7
Quick detachable hose couplings for attachments shall be provided on the truck.

2.2.7 Operator's Compartment and Overhead Guard

The driver's seat shall be of the full suspension type. Compartment and overhead guard shall meet FOPS criteria ISO 3449, FEM and ROPS.

The driver's overhead guard shall be covered with a suitable transparent plastic, fastened in a noise-reducing manner.

The driver's seat shall be protected from the sides and the rear by mashed window girders.

2.2.7.1 Operator's Console

The operator's console shall include all necessary controls for the wheel loader's normal operations. All control wiring shall end on terminal blocks appropriately marked with corresponding wire numbers. All console control equipment shall be dimensioned for heavy-duty continuous operations.

The following instruments shall be provided:

- Hour meter
- Fuel gauge
- Engine coolant temperature gauge
- Engine oil-pressure warning light and buzzer
- Torque converter oil-temperature gauge
- Torque converter oil-pressure light
- Alternator control lamp
- Parking brake indicator light
- Ammeter charging

2.2.8 Electrical System

The systems voltage shall be 12 V.

One battery of 12 V, at least 90 Ah at 20-hr.-rate, maintenance free and suitable for tropical conditions with a battery main isolating switch shall be supplied.

Lighting:

- Head lights, well protected
- Floodlight mounted to rear of cab
- Indoor light

A central fuse box is required, inline fuses are not permitted.

2.2.9 Attachment

The wheel loader shall be equipped with a bucket of at least 600 kg capacity.

2.2.10 Surface Protection

All structural parts shall be blasted to DIN 55928 SA 2.5 standard and painted with a paint system according to the manufacturer's standard, preferably a solvent and heavy-metal-free (acrylic water based paint), with not less than four (4) coats of paint:

- primer
- two (2) coats of intermediate layers
- top coat

Total dry film thickness shall be not less than 240 microns.

Paint shade to	RAL 2009 Traffic Orange
or	RAL 1023 Traffic Yellow

Danger stripes in black paint across the counter-weight are required.

This colour scheme may be altered by the Purchaser.

2.2.10.1 Purchaser's Logo
The Purchaser's logo shall be prominently displayed on the outside of the truck in positions indicated by the Purchaser.

2.3 Design Criteria

2.3.1 General Design

The general design and the stability design of the wheel loader shall conform to the requirements of

DIN 15138
FEM Section III
ISO
BS 5750 Part 1.

The Bidder shall state the standards used in its design.

2.3.2 Mechanical Design

2.3.2.1 General
The mechanical design of load-carrying parts shall be calculated to FEM Section III A, DIN 15173. Any pinch and shear points on the upright and carriage shall be avoided.

All fasteners or parts likely to become loose by vibration shall be secured by approved devices.

All parts shall be designed to ensure easy assembly, adjustment, removal for replacement and accessibility for lubrication, inspection and maintenance.

2.3.2.2 Bearings
Bearings on the wheel loader shall be of the anti-friction type.

2.3.2.3 Lubrication
Lubrication of all mechanical operating parts shall be provided in accordance with manufacturers' instructions. Oil-type lubrication shall be provided for speed reducer and other major components where lubrication is needed. Lubrication of other mechanical parts shall be effected by means of high-pressure grease introduced through industrial button-type fittings. All pedal shafts, steering axles and lift cylinder mountings shall be greasable. The oil for lubrication shall be of the type and make as used in the Beneficiary's country.

2.3.3 Maintainability Design Factors

To reduce maintenance down time and cost, maintainability factors should be introduced into the wheel loader's design, whenever practical.

2.3.3.1
Diagnostic ("trouble-shooting") techniques, procedures and test-equipment shall be developed for rapid location of a fault in order to achieve an overall reduction of systems down time. The Bidder shall list in its proposal systems for which such diagnostic procedures will be supplied.

2.3.3.2 Accessibility
Restricted accessibility of modules, assemblies and other items is a large contributor to the extension of repair time. Configuration of the hardware and its layout in the wheel loader shall allow free and easy access for maintenance personnel and for tools and equipment which are required to perform the repair task.

2.3.4 Electrical Design

2.3.4.1 General
All electrical equipment, materials and workmanship shall conform to the applicable current standards of BS, ASA, VDE or their equivalents. All equipment and materials furnished shall be suitable for operations in a humid, marine atmosphere up to 50 degrees centigrade of ambient temperature. Nameplates shall be engraved on phenolic plastic, attached to the equipment with corrosion-resistant rivets.

All electrical equipment furnished shall resist deterioration from corrosion when exposed to severe moisture conditions near salt water.

As far as practicable, all screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastenings and fittings shall be of corrosion-resistant material or shall be treated or plated in a manner to render them resistant to corrosion.

2.3.4.2 Wiring
Electrical wiring throughout the wheel loader shall be dimensioned in accordance with the circuit's current-carrying requirements.

Wiring shall be of PVC or neoprene insulation with approved flexible-type switchboard wiring, for control panels to minimise vibration damage.

2.3.5 Quality Control

Quality control shall be employed to assume a vital role in establishing and maintaining a high-quality product. Detailed inspections and controls shall be made and data shall be gathered for analysis and evaluation to ensure that the required quality standards are met.

The Contractor shall be responsible for providing inspection methods, maintaining surveillance and control over all testing and special processes, checking manufacturing methods, materials and bought-in supplied items, for compliance with the applicable specifications, making reports of inspections and tests to be provided to the Purchaser as will be outlined in the final contract agreement. Test and inspections reports shall be furnished for:

(a) Engine
(b) Transmission
(c) Hydraulic pumps and cylinders
(d) Steel used in load bearing structural frame members
(e) Brakes

(f) Welders' certifications
(g) Safety devices
(h) Attachments
(i) Capacity certificate

2.4 Final Adjustment and Testing

After the wheel loader has been erected, adjusted, lubricated and otherwise made ready for operations, it shall be tested to demonstrate conformity to all requirements defined in these Specifications.

The Contractor shall submit to the Purchaser for approval the full testing programme, including the contents of tests, methods of conducting, control and measuring, required instruments and equipment.

The Purchaser will provide the operator and the necessary loads.

Final testing process shall consist of the following main stages:

(a) Static test
(b) Dynamic test
(c) Testing of safety devices
(d) Testing of speeds
(e) Operations test

These tests shall prove that all indicated data are in conformity with the Contractor's specifications.

2.5 Safety Arrangements

2.5.1

General assembly and detail design of the wheel loader shall conform to the safety regulations and codes listed in the Contract added by the following:

2.5.2

All nuts connecting the moving and rotating parts shall be of the self-locking type to prevent their loosening due to vibration.

2.5.3

All rotating parts shall be provided with rigid safety guards.

2.5.4

Unavoidable hazardous points shall be marked with a special warning paint (yellow/orange and black stripes).

2.6 General Instructions

2.6.1 Bidder-Supplied Information

The Bidder shall submit with its proposal detailed specifications for all listed items, a list of all standard equipment and a price list of all available options which were not included in the basic prices.

The Bidder shall offer its standard equipment as close as possible to the given technical specifications. Special design and prototypes will not be accepted.
The offered type of equipment must have been manufactured for at least one year and shall be from the same production lot.

3. Data Sheet

3.1

The Bidder shall enclose with its proposal a data sheet according to DIN 15140 specification.

3.2

Additionally, the following shall be provided with the data sheet:

3.2.1

Data sheets on all main components such as engine, transmission and hydraulic components.

3.2.2

Dimensional drawing of the wheel loader.

3.2.3

Load diagram for standard bucket operations.

3.2.4

Statement-indicating maximum ground pressure.

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 15: "HANSE" Pallet

Table of Contents

1. General Description

These Specifications describe a "HANSE"-Pallet which will be purchased by the Beneficiary, and which shall be used for general cargo handling.

2. Operations Characteristics

2.1 Capacity

Load carrying capacity: (for crane and forklift operation)	2,000 kg

2.2 Dimensions

Width:	1,150 mm
Length:	1,800 mm

2.3 Main Technical and Design Demands

Construction to be according to drawing No. G 540 a and following specification.

All wooden parts have to be of beech-wood.

Grain nearly straight grown.

Following imperfections of the wood are not permitted:

- heavily twisted growth
- putrefaction and stained by damp
- worm-eaten or fungoid
- lose knots; grown in knots on both sides are permitted up to a size of 40 mm by 70 mm, if there is a minimum distance between each knot of 100 mm and not more than 4 knot at each board. Grown in knots with a diameter less than 20 mm are allowed.
- cracks; straight cracks with a length less than the width of the board are permitted.
- tree edges; tree edges up to a width of 20 mm (measured on the surface) are permitted.

All screws, nails, nuts and washers to be hot galvanised.

- screws: oval head hot zinc galvanised steel carriage screws 8 mm x 160 mm; DIN 603
- nuts: hexagon hot zinc galvanised nut, 8 mm, DIN 555
- washers: hot zinc galvanised washers, 28 mm x 9.5 mm x 2 mm, DIN 440
- nails: hot zinc galvanised convex ring nails, Form K, 4.2 mm x 90 mm according to DIN 68163
  or
  hot zinc galvanised anti-split screw nails, Form A, 5.2 mm x 90 mm according to DIN 68163

All positions of screws and nails to be according to drawing No. G 540a. All nail holes to be pre-drilled, depth 55 mm.

If anti-crack-screw-nails are used, pre-drilling is not necessary.

All holes for the screws to be countersunk, at least all screws and nuts are not less than 2 mm below the surface of the wood.

All measurements have to be adhered to the drawing, deviations are not acceptable. Wood drying tolerances (shrinkage) according to drawing have to be taken into consideration by cutting fresh wood.

2.4 Marking of Pallet

Coating: outside of the cross beams to be coated with 1 thick layer of traffic yellow, RAL 1023. However, colour may be altered on demand and without additional cost.

Branding: outside of one cross beam the port logo, 2 t and year of manufacturing to be branded not less than 2 mm deep. Type of letters to be according DIN 15146, part 2.

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 16: Over-Height Gear, 40' and 20'

Table of Contents

1. General Description

These Specifications describe fully-automatic Over-Height Gear, 40' and 20', which shall be purchased by the Beneficiary and which shall be used for handling of over-height containers.

The Over-Height Gear shall be used without alterations on the spreader and without additional power supply. A hydraulic mechanism shall allow quick and simple handling without additional operators. The construction shall come up to the latest safety requirements, be easy to handle, sturdy, and highly suitable for port operations.

The Over-Height Gear shall be locked/unlocked to the spreader like an ordinary container. During this procedure, the twist-locks of the gear shall not turn. The locking of the gear's twist-locks shall only be possible when all four safety pins are fully adjusted and when the spreader's twist-locks are turned to the lock position. The unlocking of the spreader's twist-locks shall not cause the gear's twist-locks to lock/unlock. The position of the gear's twist-locks shall be visually indicated.

2. Operating Characteristics

2.1 Operational Requirements

The Over-Height Gear shall meet the following requirements:

- maximum of time saving during loading and unloading of over-height cargo
- minimum loss of time for connecting the gear to the spreader
- easy to handle by the operator/driver
- automatic lashing between the gear and the container
- no need for connecting/disconnecting electrical cables and hydraulic pipes/hoses
- compatibility to 40'-spreaders in use
- compatibility to 20'-spreaders in use
- easy exchange of all moving parts subject to wear and tear
- low maintenance and repair costs

2.1.1 Dimensions

Minimum over-height, net: 2,100 mm

2.1.2 Lifting Capacity

- lifting capacity (tested at 25% overload): 40 tons
- load eccentricity: ± 10%

2.1.3 Twist-Lock Turning

The turning speed shall be the same as the respective spreader's twist-lock turning speed.

2.1.4 Hydraulic System

Operational pressure: 20 bar

The required power is produced by the turning of the spreader's twist-lock.

2.1.5 Surface Protection

- sand-blasted
- 2 layers of primer
- 2 top layers (Synthal-KH, RAL 2000)
- minimum total thickness: 200 µm

2.1.6 Material

- frame: St 52/3
- twist-locks (ISO 1161): 42 Cr Mo 4

2.1.7 Additional Supply

- operation manual
- workshop manual
- spare part manual
- emergency key
- lever for manual operation and special socket for torque wrench

2.2 Technical Aspects

- manual emergency handling
- fully functional for both left- and right-turning (clockwise or anti-clockwise) spreader twist-locks
- fully functional even with minor damages on containers
- hydraulic and mechanical systems to be resistant to sea water and salty atmosphere
- simple and sturdy construction allowing easy operation and maintenance

All relevant operations (power supply for contacts, security mechanisms, visual indications) are solely effected by the turning of the spreader's twist-locks.

The gear shall operate at the following spreader twist-lock tolerances:

• maximum diagonal	13 mm	or 19 mm (ISO 668)
• maximum height	80 mm	
• maximum width	60 mm	
• minimum width	50 mm	

All twist-lock movements shall be fully synchronised.

2.3 Safety Aspects

The Over-Height Gear shall fulfil the following safety aspects:

- clearly-marked position of the twist-locks in any operational position
- visually-indicated twist-lock position for easy identification
- security against accidental turning of twist-locks caused by stress both with and without locked container
- automatic security check controls if all four corners are in correct position, thus preventing a misplaced container from being locked
- open design to ensure that the crane driver has a free view
- uncontrolled locking operations to be prevented

2.4 Design Standards

2.4.1 Applied Rules

- EC Machine Rules (89/392/EWG) dated 22/07/1993
- EN 292-1
- EN 292-2
- UVV 18/VBG 9a

2.4.2 Applied DIN-Standards

-	steel construction:	DIN 15018 + DIN 18800
-	materials:	DIN 17100
-	stability:	DIN 4114

2.4.3 Technical Security Data

-	lifting capacity:	400 KN
-	state of loading:	H 2
-	class of utilisation:	B 5
-	maximum brake speed:	4.9 m/secl

Technical Specifications for Port Handling Equipment for the Ports of Poti and Batumi

Item 17: Workshop Equipment

Table of Contents

1. General Description

These Specifications describe Workshop Equipment grouped into Electrical Workshop Machinery and Electric Measuring and Other Devices, which shall be purchased by the Beneficiary as stipulated in the Bill of Quantities.

2. Equipment Specifications

2.1 Electrical Workshop Machinery

2.1.1 Electric Hand Drilling Machine

- supply voltage: 240V, 50Hz
- electric motor: 0.6 kW
- hammering
- speed: 400-800min^{-1}
- capacity in steel: 18mm
- capacity in concrete: 25mm
- including metal transportation box
- drill chuck for hammering
- 10 pcs of masonry drills: 10-20mm
- 2 sets, HSS drills 1-13mm, 0.5mm steps

2.1.2 Electric Hand Drilling Machine

- supply voltage: 240V, 50Hz
- power consumption: 701/380W
- electronic control
- hammering
- left and right rotation
- capacity in steel: 13mm
- rated speed: 0-650min^{-1}
  0-2,000min^{-1}
- drill chuck: up to 13mm
- according to VDE
- including: metal transportation box

2.1.3 Electric Hand Drilling Machine

- supply voltage: 240V, 50Hz
- power consumption: 1,150/670W
- electronic control
- hammering
- left and right rotation
- capacity in steel: 16mm
- rated speed: 0-700min^{-1}
  0-2100min^{-1}
- drill chuck: up to 13mm
- according to VDE
- including metal transportation box

2.1.4 Cable Reel, Steel

25 m cable reel, 3 x 1.5 mml, with 3 sockets

2.1.5 Electric Angle Grinder

- supply voltage: 240V, 50Hz
- power consumption: 1,900/1,350W
- speed: 8,500min-1
- wheel diameter: up to 180mm
- grinding chuck: M14
- according to VDE
- including metal transportation box

2.1.6 Electric One-Hand Angle Grinder

- supply voltage: 240V, 50Hz
- power consumption: 800/480W
- electronic speed control
- speed: 2,700-10,000min-1
- wheel diameter: up to 115mm
- grinding chuck: M14
- according to VDE
- including metal transportation box

2.1.7 Bench Grinding Machine

- supply voltage: 240V, 50Hz
- power consumption: 280/180W
- speed: 3,000min-1
- size of grinding wheels: 175x20mm

Additional supply:

- pedestal: height: 880mm
  weight: 27 kg

2.1.8 Electric Soldering Tool

- power supply: 240V, 50Hz
- power consumption: 50W
- soldering temperature: 400°C

Additional supply:

- 1 spare 45 soldering tip

2.1.9 Electric Soldering Tool

- power supply: 240V, 50Hz
- power consumption: 150W
- soldering temperature: 450°C

Additional supply:

- 2 spare soldering tips

2.1.10 Air Compressor, mobile

- 240V, 50Hz, IP44
- motor and thermal motor protection against overload
- fully-automatic operation via pressure switch, automatic pressure unloader and safety valve
- suction rate: 310ltr/min.
- tank capacity: 40ltr
- motor power: 1.5kW
- max. pressure: 10bar

Additional supply:
- 30m reinforced PVC-hose, inside diameter 13mm
- 2 air cleaner guns
- 1 spray gun with 1.6mm nozzle
- 50 hose clamps 12-20 mm
- 1 air pressure regulator with filter and water separator
- set of quick connections:
  8 pcs with outside threads
  8 pcs with inside threads
  8 pcs with hose connection
- 1 tyre inflator gauge 1-10 bar range

2.1.11 Steam-Cleaning Machine

Mobile high pressure cleaner, oil-heated and pump-driven, 415V, 50Hz, 5.8 kW
- hot water delivery: 430-850 ltr/h
- operating pressure: 30-170 bar
- temperature: 30-155°C
- tank capacity fuel: 25 ltr
- tank capacity chemicals: 20 ltr
- 3 rubber tyres, one or two of to be of swivel and brake type.

The supply shall include:
- 1 hand spray gun
- 1 jet pipe, length: 1m
- 4 HP-hoses, length: 10m
- 2 nozzle mouth pieces

2.2 Electric Measuring and Other Devices

2.2.1 Digital Multimeter

The digital display is integrated in the handle, according to VDE
- power supply: 9V
- AC/DC range: 0-1,000V
- S-range: 0-20K S
- accuracy: $\leq$ 0.5% ± 1 digit

Additional supply:
- transportation bag

2.2.2 Voltage Tester (Duspol)

- display range: 6-750V AC/DC
- LED display
- in leather case
- according to VDE

2.2.3 Multi-Tester

- AVO-meter AC/DC volt/ohm/ammeter
- fuse protected test leads
- alligator clips
- leather case
- according to VDE
- power supply: 1.5 V
- AC/DC range: 0-600V
- S-range: 0-10K S
- A-range: 0-3A

Additional supply:

- 1 set of test leads and tips

2.2.4 Battery Charger

- 240V, 50Hz, 20A
- charging current, capacity: 440VA
- switchover plug: 12V to 24V
- ampere-meter
- cut-out relay
- assisted take off 100A
- voltage display with a quick-charge device according to VDE

2.2.5 Battery Quick Charger

- charging voltage: 6, 12, 24, 36, 48V according to VDE
- charging current average:
  - 6V 50/75 A
  - 12V 100/150 A
  - 24V 75/122 A
  - 36V 50/75 A
  - 48V 35/52 A
- starting aid, average
  - 6V 320/480 A
  - 12V 380/570 A
  - 24V 330/500 A

Additional supply:
- ammeter
- change over switch charging voltage
- change over switch 0 - normal - rapid
- charging cables approx. 3m length including clips
- remote starting cable, approx. 4m length including push button tool tray with electric outlet socket

2.2.6 Car Light Tester

- light tester: 6-24V
- reversible blade with alligator clamp
- length: 33mm
- width: 3.5mm
- overall length: 125mm
- cable length: 750mm
- blade: chrome vanadium

2.2.7 Portable Engine Tester

Portable engine tester with analogue display suitable for two- and four-stroke engines with coil ignition systems, suitable for testing of speed, dwell angle and voltage, according to VDE.

- speed: 0-2,000 rpm
  0-10,000rpm
- dwell angle: 0-90
- resistance: 0-20 m Ohm
- no. of cylinders: 8
- test cable: 1.6m

Additional supply:
- leather bag

2.2.8 Portable Engine Tester

The portable and battery-operated combi-tester allows the principal engine function to be tested on conventional coil, breaker-triggered or breaker-less systems, allowing checks of engine speed, dwell angle, voltage and distance, according to VDE.

- measuring ranges:
  0-72° for 4-cylinder engines
  0-48° for 6-cylinder engines
  0-36° for 8-cylinder engines
- speed 0-1600 rev/min
  0-8000 rev/min
- resistance: 0-100 K-Ohm
- connecting cables

Additional supply:
- 1 dry battery 9V, type IEC GF 22

2.2.9 Timing Light Control

Timing light with analogue display scale of advance angle-meter and non-directional inductive pick-up, which controls the flash through the ignition spark of the first cylinder.

The timing light has a xenon lamp ensuring a highly visible flash even in a well-lighted room. The flash sequence is adjusted by a thumb wheel control in the handle until the moving firing point mark coincides with the fixed mark, simultaneously setting the pointer of the meter scale to show the advance angle in degrees.

The timing light allows for tests of the basic setting of the ignition distributor and the advance angle, centrifugal advance/retard, and vacuum advance/retard.

- according to VDE
- measuring scale: 0-60°

Additional supply:
- inductive pick-up clamp with connecting cable
- pair of connection cable with connecting clip

2.2.10 Compression Tester for Petrol Engine

- with shockproof manometer
- recording of up to 8 test results on a diagram sheet
- recording range: 3.5 - 17 bar
- no. of tests per card: 8

Additional supply:
- compression tester with recorder
- pair of connection cables
- extension hose with spark plug adapter
- 100 recording cards
- 3 replacement rubber adapters plus 3 extensions
- plastic box

2.2.11 Compression Tester for Diesel Engine

- with shockproof manometer
- recording of up to 8 test results on one diagram sheet
- recording range: 10 - 40 bar
- no. of tests per card: 8
- compression tester with recorder
- pair of connection cables
- 100 recording cards
- 3 different adapters
- plastic box

2.2.12 Small Parts Cleaner

- to be mounted directly on the container of the liquid
- working surface in one part
- grating of galvanised steel sheet
- operated by foot pedal with on/off switch
- cleaning brush
- operating height: 950 mm
- working space: 800 x 550 mm
- voltage: 240V

Additional supply:
- drum with 200 ltr rapid cold
- cleaner, odourless

2.2.13 Battery Service Kit

Battery service kit, in handy steel case with plastic insert, containing:
- 1 small metal saw
- 1 terminal brush
- 1 battery cell tester, 10-0-12V and 6-0-6V
- 1 cleaning brush
- 1 bulb filter
- 1 acid tester with float
- 1 spanner, 10 x 13 mm
- 1 water pump plier, length 250mm, capacity 40mm
- 1 screwdriver, flat, 150 x 6.5 mm
- 1 cleaning brush with plastic bristles
- 1 terminal puller
- 1 terminal reamer
- 1 battery carrying strap
- 1 plastic bottle with one rubber poorer, 2 ltr
- 1 cable cutting knife

2.2.14 Thickness Gauge

Set of 20 metal-feeler gauge sheets from 0.1 mm up to 2 mm in steps of 0.1 mm
- -length of sheet: 100 mm
- width of sheet: 13 mm

2.2.15 Thickness Gauge

Set of 20 metal-feeler gauge sheets from 0.1 mm up to 2 mm in steps of 0.1 mm
- length of sheet: 300 mm
- width of sheet: 13 mm

2.2.16 Speedometer

Mechanical speedometer set in a leather bag
- range of measuring: 0-10,000 1/min
- range of linear measuring: 0-1,000 m/min
- accuracy: ± 2 ‰

2.2.17 Thread Cam

Set of thread cams for inside and outside threads for ISO and Whitworth threads, DIN 13, 11, consisting of 52 pcs.

2.2.18 Thread Cam

A DIN-sheet for all theoretical measurements of ISO and Whitworth threads, DIN 13, 259, 103

2.3 Mechanical Tools

2.3.1 Drill Set

- HSS drill set, right hand cutting, according to DIN 338
- size: from 1 to 5 mm in 0.1 mm steps, 41 pcs

Additional supply:
- one metal box

2.3.2 Drill Set

- HSS drill set
- right-hand cutting
- according to DIN 338
- size: from 5.1 to 10 mm in 0.1 mm steps, 50 pcs

Additional supply:
- one metal box

2.3.3 Drill Set

- HSS drill set
- right-hand cutting
- according to DIN 338
- in metal box
- size: from 1-13 mm in 0.5 mm steps, 25 pcs

2.3.3a Drill Set

- HSSE drill set
- right-hand cutting
- according to DIN 338
- in a metal box
- size: from 1-13 mm, in 0.5 mm steps, 25 pcs

2.3.4 Counter Sink

- set of HSS
- TIN coated
- 90° counter-sink with cylindrical shaft
- in metal box
- sizes: 8, 10, 11.5, 15 mm

2.3.5 Reamer

- set of quick adjustment reamers, HSS
- hardened (Cr) cutting edges
- 11 pcs in wooden box
- size: 8 - 31.5 m

2.3.6 Reamer

- set of quick adjustment reamers, HSS
- hardened (Cr) cutting edges
- 13 pcs in wooden box
- size: 8 - 45 mm

2.3.7 Threading Tool Set, Taps and Dies

- set of HSSE ERGO dies for stainless steel
- ISO threads according to DIN 13
- size: M3 - M20; 3/3.5/4/5/6/8/10/12/14/16/18/20

Additional supply:
- wooden box
- cutting dies
- screw taps
- twisting pliers

2.3.8 Machine Taps

- set of heavy-duty machine taps, DIN 2182, HSS-E
- set of 14 pcs UNC taps with threads of 1-64 to 12-24 and 1/4"-20 to 1/2"-13
- set of 33 pcs UNF taps with threads of 0-80 to 12-28 and 1/4"-28 to 7/8"-14

2.3.9 Machine Taps

- set of 17 pcs of heavy-duty machine taps, DIN 376, HSS-E, Metric ISO, right hand cutting, from M3 to M33

2.3.10 Hydraulic Press

Hydraulic press with welded steel frame and electric driven pump unit, 415V, 50Hz, working platform adjustable, remote control unit

- overall height: 2,005 mm
- overall width: 1,180 mm
- depth: 1,000 mm
- max. pressure: 100 t
- lifting capacity: 150 mm

Additional supply:
- 4 different matrix tools

2.3.11 Chain Hoist

- chain of the hoist to be of Gall-type
- with automatic brake
- security hook not to break under over-tension (opening!)
- hand-lever operated
- capacity: 1,500 kg
- lifting height: 1,500 mm
- length of lever: 440 mm
- weight: 16 kg

2.3.12 Bench Vice

- front movable jaw
- unbreakable forged steel
- surface hardened
- painted in blue
- jaw width: 160 mm
- opening: 225 mm
- weight: 25 kg

2.3.13 Work Bench

- standard work bench
- with wood surface
- thickness: 50 mm
- base frame made of steel sheets
- 1 compartment
- 3 lockable metal drawers
- colour: RAL 6011
- length: 1,500 mm
- width: 700 mm
- height: 850 mm

2.3.14 Tool Box

Tool box of rigid steel sheet construction with different compartments

- length: 430 mm
- width: 200 mm
- height: 200 mm

2.3.15 Tool Cabinet

Steel cabinet with 3 drawers and 2 lockable doors, with tool holders

- height: 970 mm
- width: 650 mm
- depth: 250 mm

2.3.16 Steel Cabinet

- with 2 main doors, 3 inlet floors and 2 drawers
- height: 1,000 mm
- width: 1,000 mm
- depth: 500 mm
- colour: RAL 6011

2.3.17 Steel Cabinet

Cabinet with lockable sliding doors and 4 adjustable floors

- height: 1,950 mm
- width: 1,550 mm
- depth: 565 mm
- colour: RAL 7032

2.3.18 Hammer Set

- engineer's hammer
- German form
- ashwood handle
- work surfaces polished with safety claw wedge
- according to DIN 1041
- consisting of:

5 pcs	100 gr
5 pcs	300 gr
22 pcs	500 gr
5 pcs	1000 gr

2.3.19 Hammer Set

- sledge hammer
- German type
- ashwood handle
- according to DIN 1042
- consisting of:

2 pcs	3,000 gr
2 pcs	5,000 gr
2 pcs	8,000 gr

2.3.20 Mallets

- black mallets
- German type
- varnished hickory handle
- work surfaces polished
- according to DIN 6475
- consisting of:

2 pcs	1,000 gr
2 pcs	1,500 gr

2.3.21 Rubber Mallets

- barrel shape
- with ashwood handle
- hard quality
- approx. 90 shore A
- according to DIN 5128
- consisting of:

2 pcs	220 gr
2 pcs	590 gr

2.3.22 Chisel Set

- special Cr/Mo steel
- tempered head
- lacquered shank
- 1 octagonal flat chisel of 150x12x14 mm and 120x10x12mm each
- 1 octagonal cape chisel of 120x10x4 mm
- 1 drift punch of 150x12x4 and 120x10x3 mm each
- 1 centre punch of 120x10 mm
- 1 metal box with holders

2.3.23 Hand Scriber

- with exchangable, hardened tips of CrVa-steel
- with knurled handle
- size: 250 x 8 mm

2.3.24 File Set

Warding file set in metal box consisting of 6 pcs:

- 1 flat
- 1 half-round
- 1 round
- 1 square
- 1 three-square
- 1 barrette

Length of cut: 100 mm

2.3.25 File and Rasp Set

File and rasp set in plastic bag consisting of 5 pcs:
- 1 flat
- 1 half-round
- 1 round
- 1 three-square
- 1 half-round

Length of cut: 200 mm

2.3.26 Hand Hacksaw

- metal saw frame
- with adjustable handle
- similar to DIN 6473
- for saw blade length of 300 mm

2.3.27 Hacksaw Blades

- HSS-Bi-metal
- flexible blade
- length: 300 mm
- width: 13 mm
- pcs: 24

2.3.28 Double Ended Spanner Set

- open jawed spanners
- chrome-vanadium steel
- metric size
- 12 pcs of 6-32 mm
- according to DIN 3110

2.3.29 Double Ended Spanner Set

- open jawed spanners
- chrome-vanadium steel
- BS-size
- 12 pcs of 1/4 - 1.1/8"
- according to DIN 3110

2.3.30 Combination Spanner Set

- chrome-vanadium steel
- metric size
- 15 pcs of 6-32 mm
- according to DIN 3113B

2.3.31 Combination Spanner Set

- chrome-vanadium steel
- BS-size
- 20 pcs of 1/4 - 1.1/4"
- according to DIN 3113

2.3.32 Ring Spanner Set

- heavy-duty ring spanners with extension
- chrome-vanadium steel
- drop forged
- on blue metal display board with hooks
- 19 pcs of 24-85 mm
- extension 0, 1, 2, 3

2.3.33 Double Ring Spanner Set

- chrome-alloy steel
- deep offset
- chrome-plated
- double-hexagon
- according to DIN 838
- 12 pcs of 6-32 mm

2.3.33a Adjustable Wrench

- DIN 3117 B
- length 160 mm, 18 mm
- length 260 mm, 28 mm

2.3.34 Double Ring Spanner Set

- chrome-alloy steel
- deep offset
- chrome-plated
- double-hexagon
- according to DIN 838
- 10 pcs of 1/4 - 15/16"

2.3.35 Allen Key Set

- short-form Allen keys in a plastic wallet
- chrome-vanadium steel
- hardened nickel plated
- according to DIN 911
- 10 pcs of 2-14 mm

2.3.36 Strap Wrench

- with extra-long, non-slipping strap
- chrome-vanadium steel
- chrome plated
- range: 200 mm
- length: 285 mm

2.3.37 Nut Driver Set

- nut driver in chrome-vanadium steel
- hardened
- chrome-plated
- with exchangable T-handle
- 12 pcs of 4-13 mm
- length: 140 mm
- in plastic wallet

2.3.38 Torque Wrench Set

- with automatic release
- setting of torque by turning handle end
- direct reading on scale
- 1 range from 8-40 Nm in 5N steps
- 1 range from 40-200 Nm in 5N steps
- 1 range from 140-760 Nm in 10N steps

2.3.39 Tool Set for Mechanics

Tool set in plastic case, tools in chrome-vanadium steel, consisting of:
- combined ring and open jawed spanner set 7-19mm, 9 pcs
- one rim wrench, 17 x 19 mm
- combination plier, 165 mm length
- engineer's hammer, 300 gr
- chisel flat, length 150 mm
- 3 screw drivers:
  - 8 x 175 mm
  - 6 x 100 mm
  - 5.5 x 40 mm
- 2 cross slot screw drivers
  - PH 02
  - PH 2
- 2 small part containers
- 5 angled allen keys 3, 4, 5, 6, 8 mm
- 1 light tester 6-24 V
- 1 adjustable wrench, length 205 mm
- 1 adjustable tube wrench, length 200 mm
- 1 socket for spark plugs
- 1 sliding T-bar
- 1 universal joint, 73 mm
- 2 extensions 125 mm, 250 mm
- 1 reversible ratchet, length 265 mm
- 9 hexagonal sockets with 1/2" drive 10, 11, 12, 13, 14, 15, 17, 19, 22 mm

2.3.40 Screw Driver Set

- with hexagon collar
- chrome-vanadium steel

consisting of:
- 7 pcs slot screw driver 3.5, 4.5, 5.5, 7, 8, 10, 12 mm
- 6 pcs slot screw driver 4.5, 5.5, 7, 8 mm, cross slot screw driver, Ph1, Ph2

2.3.41 Plier Set

- pliers made of special tool steel, oil-hardened
- induction-hardened cutting edges
- PVC-coated handle
- according to DIN 5244

consisting of:
- combination plier, 180 mm
- side cutting plier, 160 mm
- telephone plier, 200 mm
- plastic case

2.3.42 Side Cutting Plier

- made of chrome-vanadium steel, oil-hardened
- induction-hardened cutting edges
- chrome plated
- according to DIN5238A
- length: 140 mm

2.3.43 Combination Plier

- for hard wires class H
- special vanadium steel
- chrome plated and polished
- according to DIN 5244
- length: 160 mm

2.3.44 Water Pump Plier

- plier made of chrome-vanadium steel
- painted red with sliding joint
- head polished
- according to DIN 5231D
- length: 240 mm

2.3.45 Vice Grip Wrench

- plier made of chrome-vanadium steel
- nickel plated
- length: 175mm/280 mm/240 mm
- opening: 25 mm/45 mm/32 mm

2.3.46 Crimping Terminal Assortment Set

Terminal assortments in metal box with crimping pliers for cutting and stripping.
- diameter gauge positioning, squeezing the insulation sleeve.
- one size of assortment: 3,750 pcs H0.5 - H4.0
- one size of assortment: 700 pcs H6.0 - H16

2.3.47 Cable Knife

- handle insulated up to 1,000V
- according to VDE
- with protection cap
- each one cutting length: 50 mm
- each one cutting length: curved 35 mm

2.3.48 Three Square Scraper

- chrome-vanadium steel
- with wooden handle
- according to DIN 8350 C
- length: 150 mm
- width: 10 mm

2.3.49 Square Scraper

- chrome-vanadium steel
- with wooden handle
- according to DIN 8350 A
- length: 150 mm
- width: 15 mm

2.3.50 Curved Scraper

- chrome-vanadium steel
- with wooden handle
- length: 200 mm
- width: 80 x 16

2.3.51 Hole Punch

- made of special tool steel, forged
- according to DIN 7200A
- in plastic wallet
- 12 pcs of 3, 5, 6, 8, 10, 12, 13, 14, 16, 19, 22, 25 mm

2.3.52 Stud Remover Set

- remover made of chrome-vanadium steel
- with left-hand thread for right-hand screws
- for screw diameters from 1.4 mm - 24 mm
- 8 pcs in plastic box

2.3.53 Extractor

Small extractor, 2 arms
- each one range up to: 60mm/80mm
- clamping depth: 50mm/80mm

2.3.54 Extractor

- with two sliding arms
- special tool steel, drop forged
- each one range up to: 120, 200, 350, 750mm
- clamping depth: 100, 150, 200, 400 - 700mm

2.3.55 Internal Ball-Bearing Extractor

- bearing inside puller set with two arms
- special tool steel, drop forged
- range of inside diameter: 12-70 mm
- set of 10 pcs in metal box

2.3.56 Separating and Pulling Device Set

- special tool steel
- 1 separator
- 1 pulling device
- 1 extension pair
- sheet metal case
- each one range up to: 60 mm/115 mm

2.3.57 Working Gloves for Welders

- 3 fingers
- leather
- according to DIN 4871

2.3.58 Rubber Gloves

- 5 fingers
- reinforced
- with cotton inlet
- according to DIN 4841

2.3.59 Safety Goggles

- full sight protection goggles for workers who wear spectacles
- according to K-DIN 234

2.3.60 Safety Welding Goggles

- with removable iternal glasses
- according to K-DIN 27

2.3.61 Pump Oiler

- with double-action pump and hostalen container
- size: 300 ml
- length of tube: 140 mm

2.3.62 High Pressure Grease Gun

- grease container mounted on a rubber-tired trolley
- foot lever-operated
- max. pressure: 400 bar
- content: 8 kg
- size: 810 x 250 x 400 mm (h, w, d)
- cmi per stroke: 2 cmi

Additional supply:
- 2.2 m high pressure hose
- high pressure handle
- nozzle tube
- set of nozzles and grease nipples in metal box

2.3.63 Barrel Pump

- hand-lever operated for oil and gasoline
- pump for standing barrels
- capacity: 30 ltr/min
- including hose set

2.3.64 Brush Set

Brush set with wooden handle consisting of:
- flat bush: 20, 25, 35, 50 mm
- round brush: size 2, 4, 6
- finish brush: size 10, 12, 16

2.3.65 Wire Brush

Steel wire brush, three rows
- length: 290 mm
- width: 30 mm

2.3.66 Wire Brush

Spark plug wire brush, four rows, wire made of brass
- length: 200 mm

2.3.67 Number Punch Set

Set of 10 punches in plastic box
- length of shank: 64 mm
- height of number: 3 mm, 0-9

2.3.68 Letter Punch Set

Set of 27 punches in plastic box
- length of shank: 72 mm
- height of alpha: 6 mm

2.3.69 Bumping Tool Set

In sheet metal box, consisting of:
- 2 different hammers
- 1 plastic hammer
- 4 bumping weights
- 1 flat chisel
- bending iron bar
- bending plier

2.3.70 Ratchet Wrench Set

- chrome-vanadium steel 31CrV3
- according to DIN 12,5/3120
- 19 sockets: 10-32 mm
- 1/2" ratchet
- extensions: 125mm, 250 mm
- universal joint
- sliding T-bar
- lever
- sheet metal box

2.3.71 Ratchet Wrench Set

- chrome-vanadium steel 31CrV3
- according to DIN 3120
- 19 sockets: 1/4" - 1.1/4"
- 1/2" ratchet
- extensions: 125mm, 250 mm
- universal joint
- sliding T-bar
- lever
- sheet metal box

2.3.72 Ratchet Wrench Set

- chrome-vanadium steel 31CrV3
- chrome plated
- according to 25 DIN 3120
- 1" ratchet
- extensions: 205mm, 405 mm
- sliding T-bar: 640 mm
- 10 pcs: 36 - 80 mm
- sheet metal box

2.3.73 Ratchet Wrench Set

- chrome-vanadium steel 31CrV3
- according to 25 DIN 3120
- 1" ratchet
- extensions: 205mm, 405 mm
- sliding T-bar: 640 mm
- 10 pcs: 1.1/2" - 3"

2.3.74 Cutting Wheels

For metal and stone, cold pressed, open structure
- max. speed: 80 m/s, medium hard wheel, straight version
- diameter: 125, 180 mm
- thickness: 3, 3 mm
- bore: 22, 22 mm
- max. speed: 12,000, 8,500 min-1

2.3.75 External Circlip Pliers

- set according to DIN 5254 B
- angled tips
- chrome-vanadium
- size: A01, A11, A31 and A41

2.3.76 External Circlip Pliers

- set according to DIN 5254 B
- straight tips
- chrome-vanadium
- size: A0, A1, A2 and A4

2.3.77 Internal Circlip Pliers

- set according to DIN 5256 C
- straight tips
- chrome-vanadium
- size: J1, J2, J3 and J4

2.3.78 Internal Circlip Pliers

- set according to DIN 5256 D
- angled tips
- chrome-vanadium
- size: J11, J21, J31 and J41

2.3.79 Tool Box for Electricians

- according to VDE
- including leather bag

  consisting of:
- Allen key set, 2 - 10 mm according to DIN911
- tip snip
- electrician's pocket knife
- cable cutter up to cable diameter of 10 mm
- hack saw, blade 140 mm
- phase tester 220-250 V
- engineer's hammer, 300 gr, according to DIN1041
- screw driver for cross slot screws according to DIN 5256
  - 2 x 100 mm: 2 pcs
  - 1 x 80mm: 2 pcs

- screw driver for slot screws, according to DIN 5265
  - 150 x 8.0 x 1.2 mm
  - 150 x 5.0 x 1 mm
  - 150 x 3.0 mm
  - 125 x 6.5 x 1.2 mm
  - 125 x 4.0 x 0.8 mm
  - 100 x 5.5 x 1.0 mm
  - 100 x 4.0 x 0.8 mm
  - 75 x 3.0 x 0.5 mm
- double-ended offset screw driver according to DIN 5200
  - for slot screws 100 x 4 mm
  - for cross screws 100 x 5 mm
- nut driver according to DIN 3125
  - 125 x 5.5 mm
  - 125 x 7.0 mm
  - 125 x 8.0 mm
  - 125 x 10.0 mm
- cable stripper
- folding rule 2.00 m
- cable strip plier according to VDE up to 1,000 V
- side cutting plier, length 160 mm, according to VDE up to 1,000 V
- telephone plier, length 210 mm, according to VDE up to 1,000 V
- telephone plier, length 160 mm, according to VDE up to 1,000 V
- combi plier, length 190 mm, according to DIN 5244 and VDE up to 1,000 V
- water pump plier, length 250 mm, according to DIN 3117 and VDE up to 1,000 V
- square blades awl, length 180 mm
- socket set, with hexagon sockets in painted steel box with 3/8" ratchet, sockets from universal joints, 2 extensions, tommy bar with sliding "T" according to DIN 3122/23
- multimeter AC/DC, A, V, , range: up to 1,000 V, aligator clips, leather case, fuse proof a shock-proof housing, transistor tester included, digital display, up to 20 A and 10 M..... supply 9 V, according to VDE

3. Bill of Quantities

Item	Description	Unit	Qty	Unit Cost	Total Cost
2.1	Electrical Workshop Machinery				
2.1.1	Electric Hand Drilling Machine	Pc	1		
2.1.2	Electric Hand Drilling Machine	Pc	2		
2.1.3	Electric Hand Drilling Machine	Pc	1		
2.1.4	Cable Reel, Steel	Pc	4		
2.1.5	Electric Angle Grinder	Pc	2		
2.1.6	Electric One-Hand Angle Grinder	Pc	2		
2.1.7	Bench Grinding Machine	Set	1		
2.1.8	Electric Soldering Tool	Set	1		
2.1.9	Electric Soldering Tool	Pc	1		
2.1.10	Air Compressor, mobile	Set	1		
2.1.11	Steam-Cleaning Machine	Set	1		
2.2	Electric Measuring and Other Devices				
2.2.1	Digital Multimeter	set	2		
2.2.2	Voltage Tester (Duspol)	set	3		
2.2.3	Multi-Tester	set	1		
2.2.4	Battery Charger	pc	3		
2.2.5	Battery Quick Charger	set	2		
2.2.6	Car Light Tester	pc	5		
2.2.7	Portable Engine Tester	set	2		
2.2.8	Portable Engine Tester	set	1		
2.2.9	Timing Light Control	set	1		
2.2.10	Compression Tester for Petrol Engine	set	1		
2.2.11	Compression Tester for Diesel	set	1		
2.2.12	Small Parts Cleaner	pc	1		
2.2.13	Battery Service Kit	set	2		
2.2.14	Thickness Gauge	pc	2		
2.2.15	Thickness Gauge	pc	2		
2.2.16	Speedometer	set	1		
2.2.17	Thread Cam	set	2		

Item	Description	Unit	Qty	Unit Cost	Total Cost
2.2.18	Thread Cam	set	2		
2.3	Mechanical Tools				
2.3.1	Drill Set	set	1		
2.3.2	Drill Set	set	1		
2.3.3	Drill Set	set	1		
2.3.3a	Drill Set	set	1		
2.3.4	Counter Sink	set	1		
2.3.5	Reamer	pc	1		
2.3.6	Reamer	set	1		
2.3.7	Threading Tool Set, Taps and Dies	set	1		
2.3.8	Machine Taps	set	1		
2.3.9	Machine Taps	set	1		
2.3.10	Hydraulic Press	set	1		
2.3.11	Chain Hoist	pc	2		
2.3.12	Bench Vice	pc	6		
2.3.13	Work Bench	pc	6		
2.3.14	Tool Box	pc	20		
2.3.15	Tool Cabinet	pc	1		
2.3.16	Steel Cabinet	pc	2		
2.3.17	Steel Cabinet	pc	2		
2.3.18	Hammer Set	set	1		
2.3.19	Hammer Set	set	1		
2.3.20	Mallets	set	1		
2.3.21	Rubber Mallets	set	1		
2.3.22	Chisel Set	set	5		
2.3.23	Hand Scriber	pc	5		
2.3.24	File Set	set	2		
2.3.25	File and Rasp Set	set	5		
2.3.26	Hand Hacksaw	pc	5		
2.3.27	Hacksaw Blades	pc	500		
2.3.28	Double Ended Spanner Set	set	5		
2.3.29	Double Ended Spanner Set	set	5		
2.3.30	Combination Spanner Set	set	5		

Item	Description	Unit	Qty	Unit Cost	Total Cost
2.3.31	Combination Spanner Set	set	5		
2.3.32	Ring Spanner Set	set	2		
2.3.33	Double Ring Spanner Set	set	2		
2.3.33a	Adjustable Wrench	set	3		
2.3.34	Double Ring Spanner Set	set	2		
2.3.35	Allen Key Set	set	5		
2.3.36	Strap Wrench	pc	2		
2.3.37	Nut Driver Set	pc	2		
2.3.38	Torque Wrench Set	set	1		
2.3.39	Tool Set for Mechanics	set	5		
2.3.40	Screw Driver Set	set	5		
2.3.41	Plier Set	set	5		
2.3.42	Side Cutting Plier	pc	5		
2.3.43	Combination Plier	pc	5		
2.3.44	Water Pump Plier	pc	5		
2.3.45	Vice Grip Wrench	set	4		
2.3.46	Crimping Terminal Assortment Set	set	2		
2.3.47	Cable Knife	set	5		
2.3.48	Three Square Scraper	pc	5		
2.3.49	Square Scraper	pc	5		
2.3.50	Curved Scraper	pc	5		
2.3.51	Hole Punch	set	1		
2.3.52	Stud Remover Set	set	1		
2.3.53	Extractor	set	2		
2.3.54	Extractor	set	2		
2.3.55	Internal Ball-Bearing Extractor	set	1		
2.3.56	Separating and Pulling Device Set	set	1		
2.3.57	Working Gloves for Welders	pair	20		
2.3.58	Rubber Gloves	pair	10		
2.3.59	Safety Goggles	pc	20		
2.3.60	Safety Welding Goggles	pc	20		
2.3.61	Pump Oiler	pc	5		
2.3.62	High Pressure Grease Gun	set	1		

Item	Description	Unit	Qty	Unit Cost	Total Cost
2.3.63	Barrel Pump	set	1		
2.3.64	Brush Set	set	5		
2.3.65	Wire Brush	pc	10		
2.3.66	Wire Brush	pc	5		
2.3.67	Number Punch Set	set	1		
2.3.68	Letter Punch Set	set	1		
2.3.69	Bumping Tool Set	set	1		
2.3.70	Ratchet Wrench Set	set	4		
2.3.71	Ratchet Wrench Set	set	1		
2.3.72	Ratchet Wrench Set	set	1		
2.3.73	Ratchet Wrench Set	set	1		
2.3.74	Cutting Wheels	set	50		
2.3.75	External Circlip Pliers	set	2		
2.3.76	External Circlip Pliers	set	2		
2.3.77	Internal Circlip Pliers	set	2		
2.3.78	Internal Circlip Pliers	set	2		
2.3.79	Tool Box for Electricians	set	4		
Total, FOB					
Sea freight to Poti					
Insurance to Poti					
Total, CIF Poti					

Delivery Period to Poti ..... weeks