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Offer-No.: 184305.A

Project Recycled and polished lube oil refinery package

Dear Mr GHECHAM,

Further to our email exchange, it is my pleasure to offer you the following proposal.

Do note the scope of supply carefully as there are a number of items that are excluded and would need to be procured and installed locally.

This package will most certainly produce Group I oils and under certain circumstances Group II oils. There is an upgrade path via a solvent recovery system, which can be added in the future if required, that will give Group II oils without the need for a hydrotreater.

Please find our best quotation attached. The quotation is subject to the "General Conditions for Supply and Erection of Plant and Machinery for Import and Export 188A" of the ECE, Geneva, March 1957.

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Technical Proposal WORP-350 + RCPS-4X20

Waste Oil Refinery plus Reactivation Clay Polishing System for refined lube oil



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WORP-350 SPECIFICATION

1. GENERAL OUTLINE

The system will be designed and sized to process a nominal 350 litres per hour of used oil feed per 340-day year, on a continuous basis.

The unit is designed to separate water, aromatics, gasoline and kerosene and/or diesel fractions in a forced circulation flash evaporator feeding a packed column and recover two cuts of light and heavy lube product in a series of 2 Thin Wipe Film Evaporators, operating under high vacuum. Those lube cuts will be subsequently polished by a Reactivation Polishing System.

2. DESIGN SPECIFICATIONS

The plant will be designed based on the following typical feed characteristics

Input: 350 LPH of mixed hydrocarbons containing:

- ~ 5% water
- ~ 5 - 15% light ends [gasoline, aromatics]
- ~ 5 - 15% diesel, kerosene
- ~ 10 - 80% long-chain hydrocarbons
- ~ 5 - 30% residual solids and asphaltenes.

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Output specifications:

From Evap Skids:

- ~ 5% water containing traces [$< 2\%$] of hydrocarbons;
- ~ 10% - 35 % Lights [naphthalene, gasoline, kerosene, diesel]

From Skid WFE Skids:

- ~ 5% - 40% medium chain hydrocarbons (neutral 100 – 300)
- ~ 5% - 40% longer chain hydrocarbons (neutral 300 – 500)
- ~ 10% - 30% asphalt extender [containing solids and asphaltenes]

From Reactivation Clay Polishing System:

- ~ 96% of feed of medium chain hydrocarbons OR
- ~ 96% of feed of longer chain hydrocarbons
- ~ 4% mixed hydrocarbons for return to input feed

3. NOTES ON INPUT FEEDSTOCK

The product characteristics will completely depend on the feed properties. Thus, if the feed is predominantly long-chain hydrocarbons or lube oil of the heavier grade, such will be the product properties. In addition, the system will have the capability to accept a wide range of feed and can be adjusted to produce products having a wide range of viscosity, flash-points and boiling ranges. The water content in the feed is expected to be ~5%, and that water will be separated. The system will however have the ability to handle a feed that has up to 15% as water plus light ends which will be removed in the front-end Evap Skids. If, for instance, the feedstock has about 10% as water, 5% naphthalene and 10% of light fractions, all of these will be removed in the front-end Evap Skids and the hydrocarbon fraction can be used as a fuel for the thermic fluid heater, unblended or with slight blending for adjustments in viscosity, making the plant self-sufficient for heating energy.

4. PRODUCT SPECIFICATIONS

These specifications are achieved without post-treatment for colour in the optional adsorbent mineral polishing system. The viscosity of the first and the second cut can be adjusted to desired specification by controlling the first and second cut temperature and vacuum. The Viscosity Index of the lights can be controlled to be anywhere between 50 to 80 and the viscosity at 100°C will be between 2 and 7.5 cSt

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- Lights (mostly naphthalene, toluene, benzene, xylene, kerosene & diesel)

TEST AND METHODOLOGY	VALUE
Kinematic viscosity @ 40 °C - ASTM-D445	<3.3 cSt
Cetane	60 – 70
Flash Point - ASTM-D93	<10 °C
Calorific Value	>45 MJ/kg
Sulphur - ASTM-D1551	<0.5 % wt.
Water - ASTM-D95	<0.25 % vol.
Colour – ASTM-D1500	<4
Density@ 15 °C - ASTM-D1298	<0.869 kg/l
Carbon residue - ASTM-D189	<1.0 % wt.
Pour point - ASTM-D97	<15 °C
Lead	0 mg/kg
Calcium	0 mg/kg
Barium	0 mg/kg
Zinc	0 mg/kg
Iron	0 mg/kg
Phosphorus	0 mg/kg
Magnesium	0 mg/kg

- Medium-chain hydrocarbons (light lube) or 1st cut

TEST AND METHODOLOGY	VALUE
Ash - ASTM-D482	0.01 % wt.
Density @ 15 °C – ASTM-D4052	~ 0.80 kg/l
Water content – ASTM-D95	0.02 % vol.
Pour point – ASTM-D97	- 38 °C
Colour – ASTM-D1500	<3
Carbon Conradson Residue – ASTM-D189	<0.5 % wt.
Kinematic viscosity @ 40 °C – ASTM-D445	~34.0 cSt
Sodium	<1 mg/kg
Iron	<1 mg/kg
Chromium	<0.1 mg/kg
Nickel	<0.1 mg/kg
Silicon	<0.1 mg/kg
Aluminium	<0.1 mg/kg
Lead	<0.1 mg/kg
Silver	0 mg/kg

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Copper	<0.1 mg/kg
Zinc	<0.1 mg/kg
Barium	<0.1 mg/kg
Tin	<0.1 mg/kg
Sulphur – ASTM-D4294	<0.2 % wt.
Calorific value, Gross	45 MJ/kg
Calorific Value, Net	43 MJ/kg
Flash Point – closed cup	>180 °C
Asphaltenes Content	< 0.5%

- Long Chain Hydrocarbon Distillate (heavy lube) or 2nd cut

TEST AND METHODOLOGY	VALUE
Ash - ASTM-D482	0.01 % wt.
Density @ 15 °C – ASTM-D4052	~ 0.88 kg/l
Water content – ASTM-D95	0.01 % vol.
Pour point – ASTM-D97	- 30 °C
Colour – ASTM-D1500	<3
Carbon Conradson Residue – ASTM-D189	<0.5 % wt.
Kinematic viscosity @ 40 °C – ASTM-D445	~44.0 cSt
Sodium	<1 mg/kg
Iron	<1 mg/kg
Chromium	<0.1 mg/kg
Nickel	<0.1 mg/kg
Silicon	<0.1 mg/kg
Aluminium	<0.1 mg/kg
Lead	<0.1 mg/kg
Silver	0 mg/kg
Copper	<0.1 mg/kg
Zinc	<0.1 mg/kg
Barium	<0.1 mg/kg
Tin	<0.1 mg/kg
Sulphur – ASTM-D4294	<0.5 % wt.
Calorific value, Gross	45 MJ/kg
Calorific Value, Net	43 MJ/kg
Flash Point – closed cup	>230 °C
Asphaltenes Content	<0.5%

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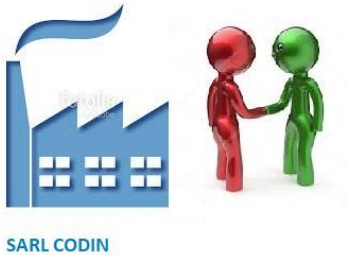
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- #6 Industrial Boiler Fuel or Asphalt extender

TEST AND METHODOLOGY	VALUE
Kinematic viscosity @ 40 °C - ASTM-D445	<95 cSt
Flash Point - ASTM-D93	>70 °C
Calorific Value	>43 MJ/kg
Sulphur - ASTM-D1551	Variable
Water - ASTM-D95	<0.1 % vol.
Colour	Black
Density@ 15 °C - ASTM-D1298	<0.98 kg/l
Carbon residue - ASTM-D4530	<12.0 % wt.
Pour point - ASTM-D97	<18 °C
Total acid number – ASTM-D974	0.00
Lead	10 mg - 120 g/kg
Calcium	6 – 38 g/kg
Barium	20 mg – 16 g/kg
Zinc	6 – 15 g/kg
Iron	100 mg – 6 g/kg
Phosphorus	1 - 6 g/kg
Magnesium	350 mg – 5 g/kg
Copper	10 mg – 1 g/kg

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5. SYSTEM PROCESS DESCRIPTION

The inlet pump will pump the used oil feedstock into the forced circulation evaporator. A circulation pump will circulate the dirty oil from the flash tank through the reboiler, back to the flash tank. The evaporator will have hot oil circulating on the shell side, and will be temperature controlled. In the flash tank the water, aromatics and diesel fractions will evaporate. This vapour will exit the flash tank and enter the fractionation column where the water and aromatics will be separated from the diesel fraction. The water and aromatics vapour will exit the top of the column, condense in the light ends condenser, and drop into the decanting light ends receiver. From here some water fraction will be pumped back to the column as reflux by the distillate pump, the rest to storage. The naphtha will be pumped to storage via a differential density level controller. The diesel fractions will condense in the column and migrate to the bottom, from where they will be heated via a thermo-siphon reboiler, and pumped to diesel storage.

The dehydrated residual hydrocarbons will be pumped through a flow indicating controller, into the first wiped film evaporator. The medium-chain hydrocarbons will vaporize in the wiped film evaporator, and will exit through an inbuilt condenser to a product receiver. From this receiver it will be pumped to storage. The residual from this stage will be pumped as feed to the second wiped film evaporator where the heavier hydrocarbon fractions will evaporate and exit through the inbuilt condenser into a receiver. From the receiver this fraction will be pumped to storage. The residual fraction from this stage, which contains the solids and tars, flows by gravity out of the bottom of the evaporator to a positive displacement gear pump, from where it will be pumped to storage.

Note that the medium and long hydrocarbon chains can be pumped directly to the inlet of an adsorbent mineral polishing filter stabilising the oil and preventing oxidation, decreasing sulphur content and improving odour.

The system will include temperature, pressure, flow and level indicators, controls, and alarms. All the electrical and electronic components on the skid will be flame-proof, suitable for gases in Groups II A & B. Included will also be two non-explosion-proof electrical and process control panels containing all the necessary thermal overloads and control modules, all for remote location installation [more than 15m from the skid]. All the wetted surfaces will be carbon steel (boiler quality). All piping connections will be welded and flanged. The system will come fully assembled, mounted on several painted carbon steel skids, and come ready to hook up to the infrastructure of hot oil, cooling water, electricity, instrument air, and storage tanks. The system can be located under a roof and side cover for protection from winds and storms.

Two Roots boosters and an oil sealed vacuum pump will supply vacuum to the different stages of the system.

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The source of process heat will be a thermic fluid heater capable of supplying 345°C hot oil.

Instrument air will be supplied by an air compressor and air dryer.

An evaporative cooling tower will supply cooling water.

The system offered is complete with a thermal oxidation system for treating the VOC emissions from the plant.

6. SCOPE OF SUPPLY - HERING

- System engineering diagrams, including PF diagrams, P & I diagram, electrical and utility lists and diagrams, component specifications and operation and maintenance manual
- All equipment specified on P & I drawing and within the battery limits of the supply;
- Forced circulation evaporator, fractionation columns & related equipment;
- Two thin film evaporators with all related equipment;
- Positive displacement gear pumps & centrifugal pumps, with flameproof motors with high temperature packing;
- Oil sealed vacuum system;
- Positive displacement vacuum boosters.
- Pipe and fittings;
- Level, flow, pressure and temperature monitors, controllers & alarms;
- Motor control panel;
- PLC inclusive of the computer;
- Valves and control valves, with high temperature packing and seals;
- All flame proof electrical components, (magnetic starters and controllers will be non-flame proof for remote location);
- Metal skids;
- Pressure test the system before shipment;
- Insulation of the system with high temperature insulation (may be done in the field after erection);
- Thermic fluid heating system complete with expansion tank & circulation pump;
- Thermal oxidation system for treating VOC emissions from the plant;
- Carbon filtration system for treating VOC emissions,
- Evaporative cooling tower, with its circulation pump;
- Air compressor and instrument air dryer, 30 m³/h capacity at 700 kPa pressure;

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- Site presence for 1 week during final stages of hook up to supervise that the hook up between utilities and system (yard piping and field electrical) is completed per specification;
- Two weeks start-up assistance by an engineer or technician and an additional 3 weeks operational assistance;

7. SCOPE OF SUPPLY – CLIENT

- Concrete slabs and buildings as necessary;
- Ancillaries: Tank farm with all necessary tanks, pumps, field instruments, interconnecting piping; 3 phase electrical switch gear; water sump/tank;
- Firefighting system per local regulations;
- Erection of the system at site as per instruction manuals;
- All hook-ups between the skids and the infrastructure. This includes the thermic fluid heater, cooling tower, instrument air, electricity and storage tanks as well as the connections between the remote starter and control panel and the skid (field wiring);
- Piping between the front-end skids will be shop fabricated. Other interconnecting piping between skids as well as between utilities and skids will have to be done at site by client;
- Hook-up between the thermal oxidation system and the emission points;
- Thermic Fluid;
- Water for cooling;
- Feed oil, fuel;
- Chimney for the plant;
- First fill of lubricants and greases for the gearboxes/bearings;
- All applicable taxes, duties, and permits

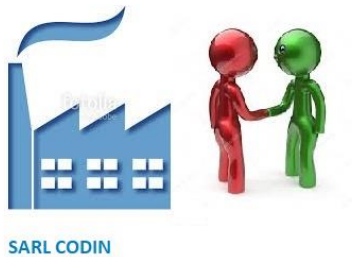
8. ENVIRONMENTAL LOADING

These fall broadly into 3 categories, liquid, gas and noise

Liquid – Approximately 20 litres per hour water (recovered from the feed oil) containing trace (<2%) hydrocarbons should be routed to a waste water storage and/or treatment system – this wastewater treatment system is outside the Hering scope of supply.

Gas – The emissions from the thermic fluid boilers will consist of the usual emissions from any boiler burning diesel fuel at the required rate to produce the BTU/HR heat required from the process. The emissions from the vacuum pump vent will consist of VOC's and some sulphur compounds. The total amount is very low [60 m³/h), and will depend somewhat on the types of oil being processed, those are controlled via a thermal oxidation system and carbon filter. The last source is from the storage tanks and this will be similar to the emissions from the vacuum pump vent. A vapour recovery system is

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installed when the tanks are installed, and the common vent from this source is also tied into the system treating the emissions from the vacuum pump vent. This vapour recovery system is piping from the tank top and connected by means of a common header to the thermal oxidation system and carbon filter. This piping is primarily part of tank farm piping and yard piping and is in the client's scope.

Noise – vacuum pump set is ~85 dBA, air compressor is ~85 dBA.

9. UTILITY REQUIREMENTS

Electrical

The connected electric load for the WORP-350 as proposed will be 200 kW, 3 phase, 380 volt, 50 Hz. Other voltages available.

Process Heat

The system will require one or two thermic fluid heaters that will deliver heat at 345°C. The quantity of thermic fluid required for the system and to be provided by client one time will be approximately 1000 litres.

Fuel requirement for the thermic fluid heaters

LDO at approximately 30 litres per hour – can be obtained from the light ends of the process.

Cooling water

The system will require cooling as water at 30 °C maximum.

Instrument air

The system will require 30 m³/h of dry clean air at 700 kPa.

Dimensions

The plant will consist of the following packages:

4 x Process plant skids each measuring 2.5m x 2.5m x 12 m

1 x Vacuum pump skid measuring 2.5m x 3m x 3m

1 x Thermic fluid heater package that would require a space of 2m x 2m x 8.5m

Thermal oxidation system that would require a space of 2m x 4m x 5m high

Cooling water system that would require a space of 4m x 5.5m x 2.5m high

Air compressor and dryer that would require a closed room area of 1.5m x 3m x 3m

Control room of suitable size to accommodate the control panels and PLC, air-conditioned, at a distance of >15m from the plant.

Excludes the tank farm and other building dimensions.

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REACTIVATION CLAY POLISHING SYSTEM SPECIFICATION

1. GENERAL

The scope of supply of this specification shall include the design, fabrication, factory testing, delivery and commissioning of one (1) Hering Model Number RCPS-4X20 Adsorbent Mineral Polishing System and shall consist of the equipment and components as subsequently described.

The system, when received by the purchaser, shall provide a fully workable unit and shall perform in accordance with this specification.

The RCPS-4X20 operates in two phases:

1) Processing Phase:

In this process, the oil is polished by forced percolation through adsorptive media columns. After polishing, the oil is pumped through a 25-micron rated filter before the oil is discharged through a flow meter. The system comprises of four banks of columns. Three banks of columns are processing oil at any one time.

2) Reactivation Phase:

After having processed a pre-determined quantity of oil, the media beds saturate, and their efficiency drops off sufficiently to justify reactivation. The media is reactivated in the columns and a quantity is collected in a holding tank before being pumped for reprocessing. One bank of columns is reactivated while three are processing oil.

2. SCOPE

Hering shall supply all necessary physical arrangements, mechanical, electrical connection, piping schematic and all necessary data for use in the operation and maintenance of this system. Hering shall provide two (2) hard copies of the instruction manual and one (1) soft copy on DVD. This manual shall contain:

- Operating Instructions
- Maintenance Information

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- Equipment Drawings
- Spare Parts List

3. CAPACITY

The RCPS-4X20 will process light or medium lube oil, typically 100N - 500N, and will improve the color from L=5.0 to L<2.5. Odour is reduced to non-detectable/barely-detectable. Sulfur is reduced from 2000 PPM to < 300PPM. All specifications are input oil dependent and may require more than a single pass to achieve. The RCPS is capable of a throughput of 300 litres per hour on a continuous basis, 355 days per year.

4. POWER AND UTILITY REQUIREMENTS

1. 380 Volts, 3 Phase, 50 Hertz plus ground wire (no neutral required), 300A supply. All global voltages supported, specify on order.
2. Cooling water for heat exchangers, 300 LPM at 30°C..
3. 600 kPa dry, compressed air for valve operation, minimum 10 m³/h compressor required, outside Hering scope.

5. DIMENSIONS AND WEIGHTS

The RCPS-4X20 system shall be supplied on 6 skids. 4 skids will contain columns and 2 skids will contain the rotating equipment and reactivation sub-assembly. Each column skid (skids 1 – 4) will be 6.0m long, 2.4m wide and 2.5m high. Skids 5 and 6 will be 4.5m long, 2.4m wide and 2.5m high. Skids 1 through 4 will weigh approximately 4500 kg each, skids 5 and 6 will weigh approximately 3000 kg each.

The complete RCPS system footprint requires an area of approximately 25m x 25m for full access.

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6. DESCRIPTION OF COMPONENTS

The system shall be fully assembled on heavy duty steel bases, which shall be sufficiently braced to minimize vibration. A drip lip shall be provided on the base of each skid to collect spillage. The system shall consist of the following components. Unless otherwise noted all pneumatic-control valves will be single-acting, spring return ball valves or angle-seat valves and require 600 kPa air pressure to open.

- One (1) System Inlet Ball Valve, pneumatic, double-acting, 40mm nominal diameter, flanged.
- Two (2) Oil Inlet Ball Valve, pneumatic.
- One (1) Inlet Strainer.
- One (1) Inlet Strainer isolation valve.
- One (1) Inlet Flow Sight Indicator.
- One (1) Positive Displacement Inlet Pump, Viking Gear pump or equivalent. The pump shall be rated at nominally 300 LPH at 50Hz rotation speed. It shall be direct driven by a 1.5 kW electric motor.
- One (1) Inlet Pump Relief Valve, internal, set at 460 kPa.
- One (1) 16 kW Electric Inlet Oil Heater. The heater shall contain 1 off 16 kW heater elements, which shall have a watt density not greater than 2 W/cm²
- Seven (7) Thermocouples for monitoring and control.
- One (1) Heated oil relief valve, set to 250 kPa, for system protection in the event of an uncontrolled shutdown of the system.
- One (1) Flow Switch, which shall be interlocked with the heater and shall require flow prior to energizing heaters.

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- Two (2) Pressure Gauges, which are used to monitor pressure drop across the elements, thus showing the need to replace the elements.
- One (1) Discharge Pump. The pump shall have a rating of 300 LPH at 50 Hz rotational speed and shall be direct driven by a 1.5 kW electric motor, Viking gear pump or equivalent. Pump will be controlled by a VFD.
- One (1) Discharge Pump Relief Valve, set at 200 kPa.
- Two (2) Sampling Cocks shall be provided on the rotating equipment skid, one for the incoming oil and one for processed oil.
- One (1) Outlet Flow Sight Indicator
- Two (2) Discharge Ball Valve, pneumatic, 40mm nominal diameter, flanged.
- One (1) System Relief Valve, set at 300 kPa. Dumps oil into TK-3 internal tank in the event of system blockage.
- One (1) Oil Filter to be installed after the outlet pump. The after-filter is furnished with replaceable pleated paper elements with a nominal micron selectivity of 25-micron.
- One (1) in-line pulse flow transmitter.
- Four (4) banks of 20 mild steel columns are filled with Phönix™ activated bauxite and bed support media. Banks are piped to allow sequential rotating operation of 3 banks for oil processing and one bank for reactivation. Total Phönix™ activated bauxite weight supplied is approximately 8,000 kg.
- One (1) Hering Colour Sensor, connected to the PLC to indicate when the banks are saturated and either prompt the operator to switch banks or automatically perform the operation.
- Four (4) Steel tanks, rectangular configuration for intermediate storage of oil during operation and reactivation of the activated clay.

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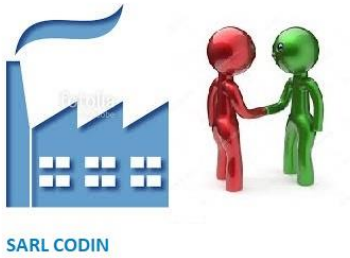
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- One (1) Exhaust gas purification system is provided to ensure that the RCPS-4X20 does not generate any obnoxious odour. This uses an activated charcoal scrubber, supplied as part of skid 6. The system is provided with one full charge of activated carbon. Usually the exhaust gas flow can be piped to the existing boiler on the front-end processing system.
- One (1) Scrubber bypass valve. This allows for direction of the reactivation exhaust gases to the external thermal oxidiser.
- One (1) Reactivation sub-assembly including Roots blower with 15 kW motor, VFD controlled.
- Two (2) water-to-oil high-efficiency heat exchangers, Thermal Transfer or equivalent.
- IP66 Control Cabinets shall be provided, which shall contain all necessary control items required for the system. All motors shall be provided with magnetic starters for full voltage, across-the-line starting. Each motor shall have sufficient overload protection. Circuit breakers shall be provided with each motor starter.
- *Electrical System*
All components shall be suitable for 380 Volt, 3 Phase, 50 Hertz power supply (other voltages available). One (1) dry-type transformer shall be supplied for control circuits. The system will be Siemens PLC controlled and include a 15" touchscreen for local control. The system can be integrated with a front-end wipe-film evaporator providing 'go'/'no go' i/o. The system will have an Ethernet connection to allow for remote control and monitoring. It is recommended that an IP address be assigned to the RCPS that will allow Hering access for technical support.
- *Piping and valving*
All piping shall be either carbon steel, sized for the designed flow, braced and supported to prevent vibration or stainless steel where required by process parameters. Piping will be welded construction when possible, to minimize leaks. Pipe flanges shall be provided to allow removal of components for maintenance, when necessary. Wherever possible, manual isolation ball valves will be provided to allow easy draining of strainers and filters. Columns will be fitted with manual

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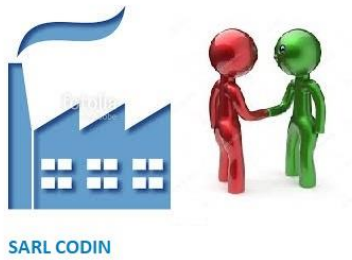
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ball valves for individual column isolation and as safety backup to prevent inadvertent oil feeding to reactivating columns. Each column will be provided with a Phönix™ top-up valve.

- Miscellaneous gauges, transducers and switches will be provided for control and monitoring purposes.
- Miscellaneous pumps will be provided for waste control purposes.

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7. COMMERCIAL

Complete Oil Refinery - WORP and RCPS - as above

The price for the equipment, ex works, unpacked, amounts to:

Price for Plant **1.800.000 EUR**

Delivery, Packing

The refinery will ship in 10 x 40' high cube shipping containers.

Estimated shipping to Port Algeria from factory is:

30.000 EUR

(Valid shipping quote can be provided upon request)

Delivery Schedule

Approximately 10 months after order placement, clarification of all technical and commercial details and receipt of down-payment.

Payment Conditions

100 % against letter of credit, payable:

- 50% down-payment with order
- 45% against B/L
- 5% against commissioning

Warranty

The warranty lasts 12 months from date of shipment. Excluded from the warranty are consumables and seals. Technical changes to the machine without EQUIPMENT BUILDERwritten approval automatically void the warranty.

Validity

This offer is valid for three months from the date of offer.

Conditions of Sale

This offer is subject to the "General Conditions for Supply and Erection of Plant and Machinery for Import and Export 188A" of the ECE, Geneva, March 1957.

Technical Improvements

EQUIPMENT BUILDERreserves the right to improve the technical data mentioned in this proposal to the latest standards during engineering.

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