

ANNEX B

Terms of Reference for Technical Specifications

Industrial Energy Efficiency in Key Sectors

GFIRA12001

Demonstration Project in Oil Refinery Sector

Abadan Oil Refining Company

1. General information

These Terms of Reference are designed for the international competitive bid for the supply of equipment and services required to “Replacement of barometric direct contact condensers of distillation unit 80 with Spiral Plate Heat Exchangers” at “ABADAN Oil Refining Company”, Oil Refinery Sector in Iran.

Beneficiary of this project is “Abadan Oil Refining Company”.

2. Objective of “Industrial Energy Efficiency in key Sectors” Project

The main objective of this program is to make a significant contribution towards Iran’s long-term energy efficiency (EE) strategy to produce a step-change in industry sector deliver a sustainable energy consumption pattern. It is aimed to accelerate the uptake of energy efficiency across five high energy intensive industrial sectors - Iron&Steel, Petrochemical, Refinery, Brick and Cement which comprise 71% of energy consumption of total industry. It is expected to reduce SEC across all industrial sectors by 20% by 2024/5 compared with 2008 as the base-year.

The Project encompasses five components as follows:

- Energy Agreements and other Legislation/ Drivers
- Sharing of Good EE practices
- Training, Benchmarking and other Events
- Direct support to Industry
- Financial Support

“Direct support to Industry” component is aimed to provide number of energy audits and benchmarking, promote M&T methods and equipment in order to identify energy efficiency technology option and accordingly have partial financial support of five selected energy efficiency demonstration projects in five key industrial sectors, Iron&Steel, Cement, Oil Refinery, Petrochemical and Brick.

The document addresses demonstration project in Oil Refinery Sector. The demonstration project for the oil refinery sector will be implemented at Abadan Oil Refining Company and requires co-financing from Abadan Oil Refining Company for a minimum of 50% of the investment costs and UNIDO financial contribution of maximum 50% of the project cost or US\$ 500,000 whichever is lower.

3. Spiral Plate Heat Exchangers

Existing barometric condensers are replaced with three Spiral Plate Heat Exchangers (SPHE) each, with 65% of total existing condensing duty (Attachment A). These SPHE, condense distillation tower overhead's (naphtha) vapor by clarified water as a cooling media (Attachment B - Data Sheets). Vendor should determine the condensing duty and flow rate of cooling water. These SPHE shall be installed on a platform at 13 meters height. The dimension of platform is 8.4 (m) x14.31 (m) (this area included operation and maintenance access walkway please see note 1) . The hereafter documents specified minimum requirements for the mechanical and process design, materials selection, fabrication, inspection, testing and preparation for shipment of SPHE.

Note 1: The area of the above mentioned platform includes all required area such as SPHE mounting area, walk ways, inspection and maintenance access area ; therefore, due to space limitations, SPHE need to be as much as possible compact to be fitted in this area(require small mounting area).

3.1. SCOPE OF SUPPLY AND TECHNICAL DESCRIPTION

The main parts of the scope of work include the following:

- Design (it should be based on Beneficiary process data sheet Equipment Supply, Annex B1)
- Inspection and Testing
- Supervision on installation and start-up and commissioning
- Spare parts Supply
- Training
- Measurement and Verification

Table 1: Scope of Supply

#	DESCRIPTION	Remarks
1	Spiral Plate Heat Exchanger	QUANTITY = 3
1.1	Spiral Plate Heat Exchanger Components (Figure 1)	
1.1.1	End Cover	
1.1.2	Cover Liner	
1.1.3	End Cover Gasket	
1.1.4	Spiral Plate	
1.1.5	Distribution Manifold	
1.1.6	Nozzle Flange	
1.1.7	Cover Bolting	
1.1.8	Flange Rings	
1.1.9	Shell Flange	
1.1.10	Center Core	
1.2	General Design and Requirements	
	The SPHE should be design for self-cleaning with minimum down time for maintenance and ensure that the reliable performance of efficient heat transfer is guaranteed. And also SPHE should be drained in	

	<p>position such that, without any need to disconnect pipe work or to open the units.</p> <p>The pressure design code should be agreed by beneficiary. Pressure components shall comply with the pressure design code and the supplemental requirements in this document.</p>	
1.3	Spiral Plate Heat Exchanger System	
1.3.1	The shell of SPHE should be Carbon steel (ASME SA-516 Gr. 60/70) unless otherwise approved by the Abadan Refinery.	
1.3.2	Non-pressure parts (such as lifting lugs, clips, and supports) that are welded directly to pressure parts shall be weld able mild carbon steel (ASME SA-283 or SA-36) or any steel permitted for pressure parts.	
1.3.3	All nameplates shall be austenitic (300 series) stainless steel.	
1.3.4	All bolts shall be ASME SA-193 Gr B7 and nuts shall be ASME SA-194 Gr 2H.	
1.3.5	The projection of flanged connections shall be of sufficient length to allow installation and removal of the flange bolts from either side of the flange.	
1.3.6	Vendor shall provide estimates of actual pressure drop (nozzle to nozzle) for each side.	
1.3.7	The velocities in the port shall be limited to 15 ft/s (4.6 m/s).	
1.3.8	Studded and/or flanged connections shall be in accordance with ASME B16.5.	
1.3.9	<p>Plates shall conform to the following:</p> <p>a. The plates shall be fully welded.</p> <p>b. The materials of plate should be Duplex Stainless Steels (the type of Duplex Stainless Steels should be approved by beneficiary before any fabrication).</p> <p>c. Stainless Steels and All materials in contact with the process fluid shall meet the requirements of the applicable standard to mitigate potential for sulfide stress cracking (SSC) and chloride stress corrosion cracking (SCC).</p> <p>NOTE: For the purpose of this provision, NACE MR0175 is equivalent to ISO 15156 (all parts).</p>	
1.3.10	<p>Spiral Plate</p> <p>The plate thicknesses and stud density (pitch) shall be designed for the higher design temperature of either side.</p> <p>The plate thicknesses and stud density on each side shall take account of the design pressure (or vacuum) on the other side. The stud density may be different on each side.</p> <p>Spiral plate nominal thickness shall not be less than for stainless steels, high alloys: 2 mm (14 US gauge).</p> <p>The port area of plates shall be design to meet the design conditions without the need of stiffeners.</p> <p>The wetted areas of fabricated pass support plates and guided bar shall be the similar material to the plates.</p> <p>Vendor quotes shall include at least one day of orientation at site by Vendor representative on assembly and cleaning Procedures and maintenance requirements.</p>	
2	<p>Drawings and Other Data Requirements</p> <p>(Note: The vendor shall submit, for review by the purchaser, outline</p>	

	drawings for each heat exchanger unit.) The drawings shall include the following information:	
2.1	Service, item number, project name and location, purchaser's order number, vendor's shop order number and other special identification numbers;	
2.2	Design pressure, test pressure, design temperature, minimum design metal temperature for each side, and any restrictions on testing or operation of the heat exchanger;	
2.3	Maximum allowable working pressure (MAWP) in the corroded condition and at the design temperature for the hot side and cold side;	
2.4	Materials specifications and grades for all components;	
2.5	Where the heat exchanger is integral with or mounted on a pressure vessel, all mating dimensions, weld preparation details, including connection to the center core and flange dimensions, gasket and bolting details;	
2.6	Connection sizes, location, orientation, projection, direction of flow and, if flanged, the rating and facing;	
2.7	Coupling sizes, rating and orientation;	
2.8	Dimensions, orientation and location of supports, including bolt holes and slots;	
2.9	Overall dimensions of the heat exchanger;	
2.10	Detailed information of the heat exchanger, including outer shell thickness, channel width, center core type, channel spacing and channel closure type (hot and cold sides), channel plate thickness (hot and cold sides), spacer stud diameter and layout, end cover dimensions, shell flange dimensions, distribution manifolds dimensions, cover bolting details, space required for removable components.	
2.11	Mass of the heat exchanger, empty and full of water, and of removable components with a mass greater than 25 kg (60 lb), e.g. end covers.	
2.12	Maximum allowable forces and moments on each connection.	
2.13	Specified corrosion allowance for each side of the heat exchanger.	
2.14	References to the applicable code, standards, and the purchaser's specification.	
2.15	Requirements for post weld heat treatment.	
2.16	Requirements for nondestructive examination (NDE).	
2.17	Requirements for surface preparation and painting.	
2.18	Gasket materials.	
2.19	Location and orientation of nameplates, lifting lugs, grounding clips or other attachments.	
2.20	Location of the center of gravity of the empty exchanger. For units with hinged covers, the center of gravity shall be shown for one or both covers open. The review of engineering documents by the purchaser shall not relieve the vendor of the responsibility of meeting the requirements of the purchase order.	

3	Inspection and Testing	
3.1	<p>Quality Assurance</p> <p>The purchaser shall specify if the vendor shall supply information about its quality control system and shall supply a quality control plan.</p>	
3.2	<p>Quality Control</p> <p>For pressure-containing welds, inspection shall be performed in accordance with the pressure design code. The following additional requirements apply to external pressure-retaining welds.</p> <ol style="list-style-type: none"> 1. All accessible butt welds shall have at least one spot-radiograph. The spot radiographs shall be at least 250 mm (10 in.) long or shall be full length if the weld is less than 250 mm (10 in.) long. Weld porosity limits for spot radiographs shall be as stated in the pressure design code for fully radiographed joints. 2. 100 % radiographic examination shall be performed on any accessible butt welded seam in any component that has been subjected to severe working (ratio of thickness to local radius greater than 5 %) after welding. 3. On pressure parts, all attachment welds (structural attachment, lug, etc.) with a throat greater than 6 mm (1/4 in.) shall be examined and evaluated by the liquid penetrates method in accordance with the pressure design code. Any surface irregularities that interfere with the examination shall be removed by grinding or machining. 	
	<p>Production hardness testing of pressure-retaining welds shall be in accordance with the pressure design code, or the following requirements, whichever is the more stringent.</p> <ol style="list-style-type: none"> 1. Welds in components made of a carbon, Cr-Mo, 11/13/17 % chromium, and duplex stainless steels shall be hardness tested. Hardness testing of the heat-affected zone shall be conducted, 2. If post weld heat treatment is required, the examination shall be made after the post weld heat treatment is completed. 3. One longitudinal weld, one circumferential weld and each connection-to-component weld if the connection is DN 50 (NPS 2) or larger shall be tested. 4. Hardness test results and locations shall be recorded. 	
	<p>All materials and work shall be subject to inspection by a representative of the Beneficiary who shall have free access to the Vendor and his Sub-Contractor plant at all times when work on the order is being undertaken.</p> <p>Any rejections made by him will be final. Inspection and/or witnessing of tests shall in no way release the Vendor from guarantees of performance, materials, workmanship, dimensional accuracy and full compliance with the terms of the order. Waiver in any phase of inspection must be obtained in writing from the Purchaser. Unless otherwise specified, inspection, testing and preparation for shipment shall be in accordance with ISO 10438, Part1.</p> <p>The living expense of the beneficiary's representative (2 persons (each for 3 man- days (totally 6 man-days) during inspection period at vendor (supplier) cost, should be considered in supplier financial proposal.</p>	

	<p>Inspection shall be made in accordance with procedures agreed upon. Vendor shall accordingly carry out inspection of all equipment and materials in his scope of work or their sub-suppliers, prior to shipment to site, and shall ensure that all equipment and materials fully comply with the purchase order.</p> <p>The requirements for non-destructive testing shall be in accordance with The Code and any specified requirements bellow: Welded attachments shall be inspected and dye penetrates tested in accordance with The Code.</p> <ul style="list-style-type: none"> • The hydrostatic test in accordance with The Code shall be performed in the presence of an inspector representing the Abadan Refinery. • The hydrostatic test shall be separately applied to the hot side and to the cold side with no pressure to the other side, and with both sides pressurized simultaneously. • The hydrostatic test pressure for each test shall be held for a sufficient time to permit a thorough inspection and detection of small seepage leaks, or for not less than 30 minutes. After completion of the test the plate heat exchanger shall be drained. • For each hydrostatic test, two indicating gauges (or, one indicating gauge and one recording gauge) shall be attached to the plate heat exchanger. • The chloride content of water used for hydrostatic testing of pressure parts of solid austenitic stainless steel materials or austenitic stainless steel lined parts shall not exceed 50 parts per million. 	
4	Other Required Information	
4.1	<p>Proposal Information Required</p> <p>The vendor's proposal shall include completed datasheets such as those given in API std.664.</p> <p>For components, the vendor shall describe the details of construction and assembly.</p> <p>A proposal drawing shall be furnished that shows the major dimensions in plan and elevation, including the nozzle sizes and their orientations along with those for venting and draining, and approximate mass full of water.</p> <p>The vendor's proposal shall include details of the channel closure construction.</p> <p>The vendor's proposal shall include the type of supports.</p> <p>The vendor shall supply a recommended spare parts list for each spiral plate heat exchanger.</p>	
4.2	<p>Information Required After Outline Drawings Are Reviewed.</p> <p>Gasket details, including type and material, shall be provided. Details of any gasket jointing shall be included. This information shall not be marked with any restrictions for use.</p> <p>Upon receipt of the purchaser's review comments on the outline drawings, the vendor shall submit copies of all detailed (nonproprietary) drawings. These shall fully describe the heat exchanger and shall include at least the following information:</p> <p>a) Full views and cross-sectional views with all dimensions and materials sufficient for mechanical design calculations for each part;</p>	

	<p>b) Details of each pressure-retaining weld, including weld material, weld nominal thickness, weld location and applicable nondestructive examination method;</p> <p>c) Details of each weld and weld nominal thickness for non-pressure attachments;</p> <p>d) Complete bills of materials, including the material specification;</p> <p>e) Details of cladding and weld overlay;</p> <p>f) flange-face finish;</p> <p>g) Installation, operation and maintenance instructions (manual), including lifting and handling.</p> <p>The vendor shall furnish for the purchaser's review or record the following documentation:</p> <p>a) Mechanical design calculations for all the heat exchanger pressure-retaining components. If calculations are made using computer software, all input and output data shall be detailed so as to facilitate an understanding of the calculation procedures. The equations in the applicable sections of the pressure design code shall be referenced;</p> <p>b) Mechanical calculations shall be provided for deflection of the end covers;</p> <p>c) Design calculations based on seismic, wind, transportation and/or piping loads, if these loads are provided by the purchaser;</p> <p>d) Recommended tools and proposed procedures for assembly of flanged joints, if controlled bolt tightening procedures (such as hydraulic torque wrenches or hydraulic tensioning devices) are used. Any required lubricants shall be stated;</p> <p>e) Design calculations for loads imposed on nozzles of heat exchangers attached to a vertical vessel.</p> <p>After final review, the vendor shall revise all the required drawings and welding procedures and submit each with the following text marked on every sheet separately and dated: "CERTIFIED FOR CONSTRUCTION".</p>	
5	<p>Reports and Records</p> <p>After the heat exchanger is completed, the vendor shall furnish the purchaser with the following documents in the format and quantities specified by the purchaser:</p> <p>a) "as-built" datasheet;</p> <p>b) All outline and detail drawings, marked "CERTIFIED AS-BUILT";</p> <p>c) Certified record of all impact tests performed;</p> <p>d) Certified mill test reports for all pressure parts, including channel plates (each material test report shall be identified by a part number);</p> <p>e) Complete certified bill of materials suitable for obtaining all replacement parts, including quantity, description, material specification and identification of each part;</p> <p>f) Temperature charts of all post-weld heat treatments;</p> <p>g) Completed manufacturer's data report in accordance with the pressure design code;</p> <p>h) Nameplate rubbing or a facsimile;</p> <p>i) All mechanical design calculations, marked "CERTIFIED AS-BUILT";</p> <p>j) Nondestructive examination (NDE) map;</p> <p>k) All associated NDE reports, including radiographic, magnetic-particle, liquid-penetrant, ultrasonic, hardness, impact, positive material identification (PMI) and any other reports as applicable;</p>	

	<p>l) Hydrostatic test records in the form of a chart or certification.</p> <ol style="list-style-type: none"> 1. The SPHE shall be hydro tested independently at 1.3 times the design pressure. 2. All materials in contact with the hot and cold fluids shall be (316ss, or titanium). 3. All connections 2 inch and larger shall be studded port and designed for connection to a 300 lb flange. 4. All surfaces should be blasted using abrasives to Sa 2 ½ (SSPC-SP10), near-white blast cleaning. Primer Coat: Zinc Rich Epoxy min. 70µ DFT. Intermediate Coat: MIO High Build Cured Epoxy Polyamide min. 100µ DFT. Top Coat: Polyurethane min. 80µ DFT (white, RAL 9010, semi-gloss) 5. The material of panel cover (Side, Bottom and top) shall be fabricated of SA-516 Gr. 60/70 carbon steel and have sufficient thickness to meet ASME requirements without the use of welded stiffeners. 	
6	<p>Nameplates and Stampings</p> <p>As a minimum, the following data shall be clearly stamped or engraved on SPHE nameplate:</p> <ol style="list-style-type: none"> 1. A stainless steel nameplate shall be permanently attached to the plate heat exchanger. 2. Nameplate data shall include: <ol style="list-style-type: none"> a. Manufacturer's name and plate heat exchanger serial number. b. User's equipment number. c. User's order number. d. Year built. e. Code symbol. f. Design temperature and minimum design metal temperature. g. Maximum allowable working pressure. h. Hydrostatic test pressure. i. Weight (empty). j. Post weld heat treatment, if performed. <p>A nameplate shall be securely attached at a readily visible location on the equipment.</p>	
7	<p>Safety System</p> <p>All safety standard and regulation related to the construction / installation and operation of this equipment should be considered by the vendor.</p>	
8	<p>Civil works</p> <p>Civil work will be done by the beneficiary.</p> <p>Note: For designing of foundation and civil structure, the dimension (width, length and height) and weight of the equipment(s) should be sent to the beneficiary as soon as possible.</p>	
9	<p>Installation, commissioning ,start up and training</p> <p>Installation, commissioning and start-up of the three supplied plate heat exchangers will be done by beneficiary under the supervision of the supplier specialist.</p> <p>The supplier has to provide :</p> <ul style="list-style-type: none"> -The complete system (Three plate heat exchangers, mixing equipment, feeding equipment, and safety system. - Technical assistance for start-up and on-site training (if it is 	

	necessary) for the operation and maintenance of the complete system, individually for beneficiary.	
10	Technical assistance	
	The supplier needs to have technical assistance and on-site training infrastructure and after sale service. Please provide description of the technical assistance and after sale service including number and location of the servicing centres, profile of the technical staff and contact details of the responsible person, and any other information that can validate the reliability and effectiveness of the service, such as spare part warehouse, number of technicians, etc. The information provided will be verified by the UNIDO's field office in Iran.	
11	Spare Part	
	The supplier has to provide a detailed list and quotation of spare parts required for the proper functioning of the complete system at least for five (5) years.	
12	Guarantee	
	The supplier has to guarantee all equipments and components for 12 months after equipment commissioning, and free of charge assistance, excluding consumables.	
13	On-site inspection	
	The supplier has to carry out an on-site inspection, at its own cost, at the plant (if it is necessary).	
14	Delivering	
	Delivering all the equipment shall be done by supplier in CIF to Bandar Imam port.	

4. Guarantee Parameters

Table 2: Guarantee Parameters

Parameters	Unit	Guarantee
Pressure drop (Max. allowable) Hot Side	psi	0.7
Pressure drop (Max. allowable) Cold Side	psi	29
Temperature drop (Hot Side)	°F	80
Temperature drop (Cold Side)	°F	30
Total Duty	MMBTU/hr	>=165
Cooling Water Flow Rate	Lb./hr	The amount will be set during engineering and will be guaranteed by the supplier.

5. Good Performance Guarantee

This guarantee will be released after issuance of final acceptance by UNIDO and IFCO, six months after commissioning and the results from M&V¹.

Note: 10 % of the contract cost will be released after good performance guarantee.

6. Financial offer

The quotation must be in US\$ for all items.

For items procured in Iran, the quotation must be in US\$. However, payments for goods procured in Iran will be in Rials, at the UN exchange rate.

7. Beneficiary

Name of the Company: Abadan Oil Refining Company

Contact Details:

Contact Person: Mr. Habibollah Abolhoseini

Tel: +98 631-2225180

Fax: +98 916-1184621

Address: P.O. Box 555, Abadan Oil Refining Company, Abadan, Iran

8. Evaluation Criteria

Obtaining of at least 80 score from the following table.

Table of technical-commercial evaluation for tender offers

No.	Criteria	Weight Factor or Grade factor
1	Coverage of all technical terms of this document	3
2	Thermal performance of the SPHE	8
3	Over design duty and capacity of the SPHE	8
4	Dimensions and Weight of the SPHE	12
5	Range of operating pressure and temperature of the SPHE	8
6	Pressure drop across the SPHE (both sides especially hydrocarbon side)	12
7	Fluid flow capacity of the SPHE (both sides)	8
8	Use higher corrosion resistible material for construction of the SPHE	8
9	Easy access and repair / trouble-free inspection and repair	8
10	Ability and ease of future expansion	3
11	Lower operating and maintenance cost	5
12	Proposed Schedule/ Delivery time of equipment	5

¹ Measurement & Verification

13	The duration of guarantee	4
14	Submit maintenance and operation training plan	3
15	Having references in similar projects(at least 3 projects)	5
Total		100

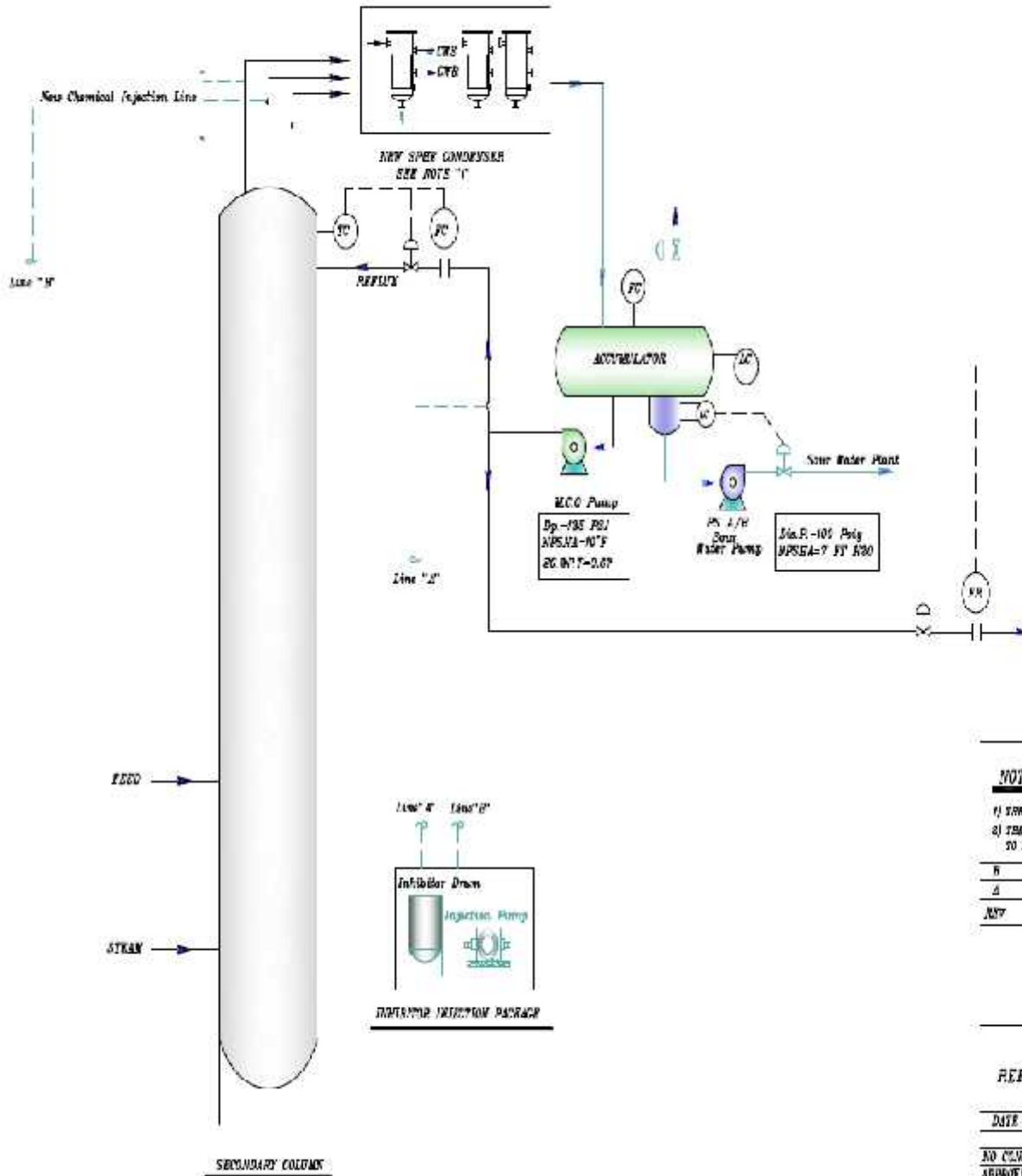
9- Hydrocarbon (Over Head Vapour) Specification

See Annex B1

10- Cooling Water Specification

	Min.	Normal	Max.
TDS (ppm) :	3000	5000	10000
TH (ppm as caco3) :	100	200	1200
Temperature CWS :	90 °F		
Temperature CWR :	120 °F		
Pressure CWS :	73 Psig		
Pressure CWR :	44 Psig		
PH (CWS & R) :	7.5		

Attachment 1: Drawing



NOTE

- 1) THREE NEW SMALL PLATE HEAT EXCHANGER CONDENSER
- 2) THE EXISTING BAROMETRIC CONDENSERS SHOWN BY DASHED TO ATTENUATOR SHOWN AS SHOWN

REV	DESCRIPTION	BY	DATE	APP'D
001				

AORC

UNIT 80

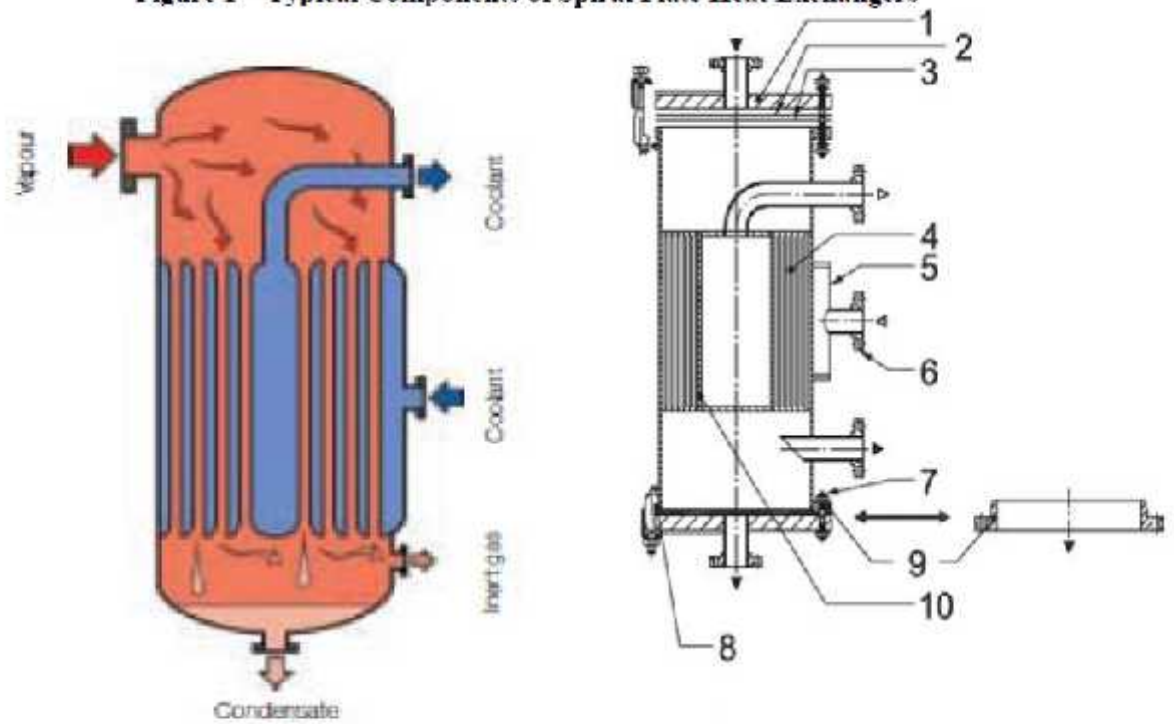
REPLACEMENT BAROMETRIC CONDENSER

DATE	SCALE	DRAWN BY	CHECKED BY	PROJ. LEAD

NO CONSTRUCTION PERMITTED UNLESS DRAWING APPROVED
 APPROVED FOR CONSTRUCTION BY: DATE:
 PROJECT NO. SIZE CLASS SERIAL NUMBER SHEET NUMBER
 ADD 00/000 R2 L 1/1

Attachment 2:

Figure 1—Typical Components of Spiral Plate Heat Exchangers
 Figure 1—Typical Components of Spiral Plate Heat Exchangers



K:

- 1 Key
- 2 1 end cover
- 3 2 cover liner
- 3 end cover gasket

- 4 spiral plate
- 5 distribution manifold
- 6 nozzle flange

- 7 cover bolting
- 8 flange ring
- 9 shell flange

- 10 center core