

|                                                                                                                                                                                                                                                                     |                     | API 661 Air-Cooled Heat Exchanger - Specification Sheet                                                                                                                                                                                                                                      |                      |                 |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------|---------------|
|                                                                                                                                                                                                                                                                     |                     | Job No.                                                                                                                                                                                                                                                                                      | Item No.             |                 | 2102 (winter) |
|                                                                                                                                                                                                                                                                     |                     | Page                                                                                                                                                                                                                                                                                         | By                   |                 |               |
|                                                                                                                                                                                                                                                                     |                     | Date                                                                                                                                                                                                                                                                                         | Revision             |                 | V05           |
|                                                                                                                                                                                                                                                                     |                     | Proposal No.                                                                                                                                                                                                                                                                                 | Contract No.         |                 |               |
|                                                                                                                                                                                                                                                                     |                     | Inquiry No.                                                                                                                                                                                                                                                                                  | Order No.            |                 |               |
| Manufacturer _____<br>Model no. _____<br>Customer <u>PEDCO/NISOC</u><br>Plant location <u>BINAK oilfield</u><br>Service <u>2st Stage Gas Compression Cool</u><br>Type draft <u>INDUCED</u><br>Bay size (WxL) (m) <u>2.172 x 3.900</u><br>No. of bays/items <u>1</u> |                     | Heat exchanged (MegaWatts) <u>0.4955</u><br>Surface/Item-Finned tube (m2) <u>1027</u><br>Bare tube (m2) <u>48.548</u><br>MTD, Eff. (Deg. C) <u>34.1</u><br>Transfer rate-Finned (W/m2-K) <u>16.86</u><br>Bare tube, service (W/m2-K) <u>356.65</u><br>Bare tube, clean (W/m2-K) <u>392.2</u> |                      |                 |               |
| Basic design data                                                                                                                                                                                                                                                   |                     |                                                                                                                                                                                                                                                                                              |                      |                 |               |
| Pressure design code _____                                                                                                                                                                                                                                          |                     | Structural code _____                                                                                                                                                                                                                                                                        |                      |                 |               |
| Tube bundle code stamped _____                                                                                                                                                                                                                                      |                     | Flammable service _____                                                                                                                                                                                                                                                                      |                      |                 |               |
| Heating coil code stamped _____                                                                                                                                                                                                                                     |                     | Lethal/toxic service _____                                                                                                                                                                                                                                                                   |                      |                 |               |
| Performance Data - Tube Side                                                                                                                                                                                                                                        |                     |                                                                                                                                                                                                                                                                                              |                      |                 |               |
| Fluid name <u>HYDROCARBON</u>                                                                                                                                                                                                                                       |                     | In                      Out                                                                                                                                                                                                                                                                  |                      |                 |               |
| Total fluid entering (kg/hr)                                                                                                                                                                                                                                        | <u>7585 X1.1</u>    | Total flow rate (Liq/Vap) (kg/hr)                                                                                                                                                                                                                                                            | <u>/ 8343.5</u>      | <u>/ 8343.5</u> |               |
| Dew/bubble point (Deg. C)                                                                                                                                                                                                                                           | <u>/</u>            | Water/Steam (kg/hr)                                                                                                                                                                                                                                                                          | <u>/</u>             | <u>/</u>        |               |
| (Deg. C)                                                                                                                                                                                                                                                            |                     | Noncondensables (kg/hr)                                                                                                                                                                                                                                                                      |                      |                 |               |
| Latent heat (kJ/kg)                                                                                                                                                                                                                                                 |                     | Molecular Wt. (Vap/Non-cond)                                                                                                                                                                                                                                                                 | <u>/</u>             | <u>/</u>        |               |
| Inlet pressure (barG)                                                                                                                                                                                                                                               | <u>54.8</u>         | Density (Liq/Vap) (kg/m3)                                                                                                                                                                                                                                                                    | <u>/ 36.175</u>      | <u>/ 50.059</u> |               |
| Pressure drop (All/Calc) (bar)                                                                                                                                                                                                                                      | <u>0.7 / 0.081</u>  | Specific heat (Liq/Vap) (kJ/kg-C)                                                                                                                                                                                                                                                            | <u>/ 2.4633</u>      | <u>/ 2.3853</u> |               |
| Velocity (Allow/Calc) (m/s)                                                                                                                                                                                                                                         | <u>/ 3.69</u>       | Thermal cond. (Liq/Vap) (W/m-K)                                                                                                                                                                                                                                                              | <u>/ 0.05</u>        | <u>/ 0.0387</u> |               |
| Inside fouling resistance (m2-K/W)                                                                                                                                                                                                                                  | <u>0.0002</u>       | Viscosity (Liq/Vap) (mN-s/m2)                                                                                                                                                                                                                                                                | <u>/ 0.0163</u>      | <u>/ 0.0139</u> |               |
|                                                                                                                                                                                                                                                                     | In      Out         |                                                                                                                                                                                                                                                                                              |                      |                 |               |
| Temperature (Deg. C)                                                                                                                                                                                                                                                | <u>149      60</u>  |                                                                                                                                                                                                                                                                                              |                      |                 |               |
| Performance Data - Air Side                                                                                                                                                                                                                                         |                     |                                                                                                                                                                                                                                                                                              |                      |                 |               |
| Air inlet temperature (Deg. C)                                                                                                                                                                                                                                      | <u>50.26</u>        | Face velocity (m/s)                                                                                                                                                                                                                                                                          | <u>3.27</u>          |                 |               |
| Air flow rate/item (m3/s)                                                                                                                                                                                                                                           | <u>5      31.18</u> | Minimum design ambient temp. (Deg. C)                                                                                                                                                                                                                                                        | <u>5</u>             |                 |               |
| Mass velocity (kg/s-m2)                                                                                                                                                                                                                                             |                     | Altitude (m)                                                                                                                                                                                                                                                                                 | <u>12.5</u>          |                 |               |
| Air outlet temperature (Deg. C)                                                                                                                                                                                                                                     | <u>65.43</u>        | Static pressure (Pa)                                                                                                                                                                                                                                                                         | <u>167.92</u>        |                 |               |
| Air flow rate/fan (m3/s)                                                                                                                                                                                                                                            | <u>15.59</u>        |                                                                                                                                                                                                                                                                                              |                      |                 |               |
| Design, Material, and Construction                                                                                                                                                                                                                                  |                     |                                                                                                                                                                                                                                                                                              |                      |                 |               |
| Design pressure (barG)                                                                                                                                                                                                                                              | <u>62</u>           | Heating Coil                      NO                                                                                                                                                                                                                                                         |                      |                 |               |
| Test pressure (barG)                                                                                                                                                                                                                                                | <u>80.6</u>         | No. of tubes                                                                                                                                                                                                                                                                                 | _____                |                 |               |
| Design temperature (Deg. C)                                                                                                                                                                                                                                         | <u>175</u>          | Tube outside diameter (mm)                                                                                                                                                                                                                                                                   | _____                |                 |               |
| Min. design metal temp. (Deg. C)                                                                                                                                                                                                                                    |                     | Tube material                                                                                                                                                                                                                                                                                | _____                |                 |               |
| Tube bundle                                                                                                                                                                                                                                                         |                     | Fin material and type                                                                                                                                                                                                                                                                        | _____                |                 |               |
| Size (WxL) (m)                                                                                                                                                                                                                                                      | <u>2.116 X 3.9</u>  | Fin thickness (mm)                                                                                                                                                                                                                                                                           | _____                |                 |               |
| No./Bay                                                                                                                                                                                                                                                             | <u>1</u>            | ASME Code, Sec. VIII, Div. 1                                                                                                                                                                                                                                                                 | _____                |                 |               |
| Number of tube rows                                                                                                                                                                                                                                                 | <u>6</u>            | Heating fluid                                                                                                                                                                                                                                                                                | _____                |                 |               |
| Bundles in parallel                                                                                                                                                                                                                                                 | <u>1</u>            | Heating fluid flow rate (kg/hr)                                                                                                                                                                                                                                                              | _____                |                 |               |
| Bundles in series                                                                                                                                                                                                                                                   |                     | Temperature (In/Out) (Deg. C)                                                                                                                                                                                                                                                                | <u>/</u>             |                 |               |
| Structure mounting                                                                                                                                                                                                                                                  |                     | Inlet pressure (barG)                                                                                                                                                                                                                                                                        | _____                |                 |               |
| Pipe rack beams                                                                                                                                                                                                                                                     |                     | Pressure drop (All/Calc) (kPa)                                                                                                                                                                                                                                                               | <u>/</u>             |                 |               |
| Ladders, walkways, platforms                                                                                                                                                                                                                                        |                     | Design temperature (Deg. C)                                                                                                                                                                                                                                                                  | _____                |                 |               |
| Structure surface prep.                                                                                                                                                                                                                                             |                     | Design pressure (barG)                                                                                                                                                                                                                                                                       | _____                |                 |               |
| Header surface prep.                                                                                                                                                                                                                                                |                     | Inlet/Outlet nozzle                                                                                                                                                                                                                                                                          | <u>/</u>             |                 |               |
| Louver                                                                                                                                                                                                                                                              |                     | Header                                                                                                                                                                                                                                                                                       |                      |                 |               |
| Material                                                                                                                                                                                                                                                            | <u>YES</u>          | Type                                                                                                                                                                                                                                                                                         | <u>PLUG</u>          |                 |               |
| Action control                                                                                                                                                                                                                                                      | <u>Manual</u>       | Material                                                                                                                                                                                                                                                                                     | <u>SA-240 TP316L</u> |                 |               |
| Action type                                                                                                                                                                                                                                                         |                     | Corrosion Allowance (mm)                                                                                                                                                                                                                                                                     | <u>0</u>             |                 |               |
|                                                                                                                                                                                                                                                                     |                     | No. of passes                                                                                                                                                                                                                                                                                | <u>4</u>             |                 |               |

**API 661 Air-Cooled Heat Exchanger - Specification Sheet**

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**Design, Material, and Construction (continued)****Header (continued)**

|                 |                 |
|-----------------|-----------------|
| Slope           | 1% ON LAST PASS |
| Plug material   | SA-182 F316 L   |
| Gasket material | Solid METAL     |

| Nozzle            | No. | Size, (in) | Rating/Facing |
|-------------------|-----|------------|---------------|
| Inlet             | 1   | 4          | 600 RF        |
| Outlet            | 1   | 4          | 600 RF        |
| Vent              | 1   | 2          | 600 RF        |
| Drain             | 1   | 2          | 600 RF        |
| Chemical Cleaning |     |            |               |
| Min. Wall Thk.    |     |            |               |

**Tube**

|                       |                               |
|-----------------------|-------------------------------|
| Material              | SA-213 TP316L Tube (S) S31603 |
| Tube outside diameter | (mm) 25.4                     |
| wall thickness        | (mm) 1.651                    |

|            |            |
|------------|------------|
| No./Bundle | 156        |
| Length     | (m) 3.9    |
| Pitch      | (mm) 70.5  |
| Layout     | Triangular |

**Fin**

|                              |                         |
|------------------------------|-------------------------|
| Type                         | Extruded                |
| Material                     | Aluminum Alloy 1060 - O |
| Thickness                    | (mm) 0.48               |
| Selection temp.              | (C)                     |
| Outside diameter             | (mm) 57.15              |
| Fin density                  | (fin/meter) 400         |
| ASME Code, Sec. VIII, Div. 1 |                         |
| Customer Specifications      |                         |

**Mechanical Equipment****Fan**

|                    |                   |
|--------------------|-------------------|
| Manufacturer       |                   |
| No./Bay            | 2                 |
| RPM                | (Revs/min.) 645.4 |
| Diameter           | (mm) 1450         |
| No. of blades      | 4                 |
| Angle              | (degrees)         |
| Pitch adjustment   | 50% Auto          |
| Blade material     | Al                |
| Hub material       | steel/Alu         |
| @design temp       | 4.8               |
| @min. ambient temp | 6.6               |
| Tip speed          |                   |

**Driver**

|              |          |
|--------------|----------|
| Type         |          |
| Manufacturer |          |
| No./Bay      | 2        |
| Driver       | (kW) 7.5 |

|                 |                           |
|-----------------|---------------------------|
| RPM             | 1500                      |
| Service factor  | 1                         |
| Enclosure       | YES,EEExd, IIB T3 (IP 55) |
| Voltage         | 400                       |
| Phase           | 3                         |
| Cycle           | 50                        |
| Fan noise level | (dB) <85                  |

**Speed Reducer**

|                |                           |
|----------------|---------------------------|
| Type           | V-Belt                    |
| Manufacturer   |                           |
| No./Bay        | 2                         |
| Service factor | 1.8                       |
| Speed ratio    | 2.28                      |
| Support        |                           |
| Vib. switch    | YES,EEExd, IIB T3 (IP 65) |
| Enclosure      |                           |

**Controls - Air Side**

|                                        |    |
|----------------------------------------|----|
| Air recirculation                      | NO |
| Degree control of outlet process temp. |    |
| (Max. Cooling),+/-                     | /  |
| Action on control signal failure       |    |
| Fan pitch                              |    |
| Louvers                                |    |
| Actuator air supply                    |    |
| Fan                                    |    |

|                            |    |
|----------------------------|----|
| Louvers                    |    |
| Positioner                 |    |
| Signal air pressure (barG) |    |
| From                       | To |
| From                       | To |
| Supply air pressure (barG) |    |
| From                       | To |
| From                       | To |

**Shipping**

|                        |                   |
|------------------------|-------------------|
| Plot area (WxL)        | (m) 2.172 x 3.900 |
| Bundle weight (Note 4) | (kg) 3217.6       |
| Bay                    | (kg)              |

|          |            |
|----------|------------|
| Total    | (kg) 10514 |
| Shipping | (kg)       |

Note: 1-Reported duty and flow rates include a user-specified multiplier of 1.10

2-Maximum allowable nozzle load = 3 x API.

3-Material will be meet requirements of NACE MR0175/ISO1516 and specification for material requirments in sour service (BK-GNRL-PEDCO-000-PI-SP-0008)

4- HTRI Weights are reported