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|   <br><b>SAZEH</b><br><small>ENGINEERS &amp; CONSULTANTS</small><br>شرکت مهندسی و ساختمان نفت<br>OIL DESIGN & CONSTRUCTION CO.<br><b>中国石化工程建设公司</b><br><small>SINOPEC ENGINEERING INCORPORATION</small> | <b>Shazand Arak Refinery Expansion and Upgrading Project</b>                                                                   |  | <br><b>NIOEC</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Process Data Sheet</b><br><b>For E-3113</b><br><b>(Crude Column OVHD Condenser)</b><br><b>No. 2 Crude Distillation Unit</b> |  |                                                                                                     |
| <b>Originator Project No.:</b> 8350                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                |  | <b>Project No. :</b> 2260                                                                           |
| <b>Document No. : DS-44-31-024-2</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                |  | <b>Page 1 of 4</b>                                                                                  |

## Process Data Sheet

### For E-3113

### (Crude Column OVHD Condenser)

### No. 2 Crude Distillation Unit

| 02  | Revised as per VENDOR information              | 6-Feb-2013            | H.H      | G.M.     | SH.P./ N.SH. |     |
|-----|------------------------------------------------|-----------------------|----------|----------|--------------|-----|
| 01  | Revised as Indicated as per VENDOR information | 28-Jan-2012           | H.H      | G.M.     | SH.P/N.SH    |     |
| 00  | Issued for Approval                            | 29-Nov-2006           | SH.A.    | G.M.     | R.M./M.F.    |     |
| Rev | Description                                    | Date                  | Prepared | Checked  | Approved     | AC  |
|     |                                                | 8350-U31-FSD-DAS-0040 | POD: EX  | POI: IFE | Status:      | IFA |

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|   <br>SAZEH<br>شرکت طراحی و ساختمان نفت<br>中国石化工程建设公司<br>SINOPEC ENGINEERING INCORPORATION<br>OIL DESIGN & CONSTRUCTION CO. |  | <b>Shazand Arak Refinery Expansion and Upgrading Project</b> |  | <br>NIOEC |                     |
| <b>Process Data Sheet For E-3113</b><br><b>(Crude Column OVHD Condenser)</b><br><b>No. 2 Crude Distillation Unit</b>                                                                                                                                                                                                                                                           |  | <b>Project No. : 2260</b>                                    |  |                                                                                              |                     |
| <b>Originator Project No. : 8350</b>                                                                                                                                                                                                                                                                                                                                           |  | <b>Document No. : DS-44-31-024-2</b>                         |  | <b>Rev. : 02</b>                                                                             | <b>Page: 2 of 4</b> |

|                                                       |                                  |                           |                              |                            |                             |
|-------------------------------------------------------|----------------------------------|---------------------------|------------------------------|----------------------------|-----------------------------|
| Services : Crude Column OVHD Condenser                |                                  |                           |                              |                            |                             |
| Item No. : E-3113                                     |                                  | No. of Bays per item : 4  |                              | No. of Bundles per Bay : 2 |                             |
| Type: Forced                                          |                                  |                           |                              |                            |                             |
| Code / Regulaion : ASME Sect. VIII Div. 1.API 661     |                                  |                           |                              |                            |                             |
| Specification : -                                     |                                  |                           |                              |                            |                             |
| Heat Exchanged Duty ( x Factor) : 18.77 x 1.1 MW MTD: |                                  |                           |                              |                            |                             |
| Operating Data                                        |                                  |                           |                              |                            |                             |
| Fluid Circulated                                      | Sp.Gr<br>(15 / 15 deg C)         | MW                        | Density<br>kg/m3             | Viscosity<br>cp            | Flow Rate x Factor<br>kg/hr |
| Inlet : at 103 °C Total                               |                                  |                           |                              |                            | 110915 x 1.1                |
| Vapor                                                 |                                  | 49.5                      | 3.18                         | 0.01                       | 76160 x 1.1                 |
| Liquid                                                |                                  | 119                       | 684                          | 0.29                       | 28798 x 1.1                 |
| Steam                                                 |                                  |                           |                              |                            |                             |
| Water                                                 |                                  | 18.0                      | 956                          | 0.27                       | 5957 x 1.1                  |
| Noncondensables                                       |                                  |                           |                              |                            |                             |
| Outlet : at 55°C Total                                |                                  |                           |                              |                            |                             |
| Vapor                                                 |                                  | 54.5                      | 3.38                         | 0.01                       | 1578 x 1.1                  |
| Liquid                                                |                                  | 100                       | 684                          | 0.3                        | 87716 x 1.1                 |
| Steam                                                 |                                  |                           |                              |                            |                             |
| Water                                                 |                                  | 18.0                      | 986                          | 0.5                        | 21621 x 1.1                 |
| Noncondensables                                       |                                  |                           |                              |                            |                             |
| Specific Heat Vapor                                   | 1.93 at inlet condition          | 1.80 at inlet condition   | kJ/(kg.°C)                   |                            |                             |
| Liquid                                                | 2.67 at inlet condition          | 2.61 at inlet condition   | kJ/(kg.°C)                   |                            |                             |
| Thermal Conductivity Vapor                            | 0.0224 at inlet condition        | 0.0196 at inlet condition | W/(m°C)                      |                            |                             |
| Liquid                                                | 0.116 at inlet condition         | 0.131 at inlet condition  | W/(m°C)                      |                            |                             |
| Pour Point                                            | - °C                             | Steam Coil : No           |                              |                            |                             |
| Dew Point                                             | - °C                             |                           |                              |                            |                             |
| Bobble Point                                          | - °C                             |                           |                              |                            |                             |
| Condensing Data                                       | Attached                         |                           |                              |                            |                             |
| Operating pressure (Inlet/Outlet)                     | 1.14 / -                         |                           |                              |                            | bar(g)                      |
| Pressure drop allowance                               | 0.3                              |                           |                              |                            | bar                         |
| Max. allowable Velocity                               |                                  |                           |                              |                            | m/s                         |
| Fouling Factor (tube / Air)                           | 0.264 / 0.352                    |                           |                              |                            | m2 °C/kw                    |
| Design pressure (Max. / Min)                          | 3.5 / HV(0.41 bara) @103°C       |                           |                              |                            | bar(g)/bara                 |
| Design Temperature (Max./Min)                         | 155/-                            |                           |                              |                            | °C                          |
| MDMT                                                  | -28                              |                           |                              |                            | °C                          |
| Ambient Conditions                                    |                                  |                           |                              |                            |                             |
| Design Ambient Temperature                            | 43 °C                            |                           | Min. Ambient Temp. -25 °C    |                            |                             |
| Design Atmospheric Pressure                           | 0.82 bar(a)                      |                           | Min. Ambient Press. - bar(a) |                            |                             |
| Noise Control                                         | Yes 85 dB at 1m beside equipment |                           |                              |                            |                             |
| Type of Temperature Controller                        |                                  |                           |                              |                            |                             |
| Louvers(Yes or No / Control)                          | No /                             |                           |                              |                            |                             |
| Fan Pitch(Yes or No / Control)                        | Yes / Autovvariable Note-2       |                           |                              |                            |                             |
| Control Action on Air-Failure                         | Fan Pitch : Maximum              |                           | Louver :                     |                            |                             |

Notes: 1-Short term design condition for steam purge 3.5 barg at 150°C  
 2-50% fan pitch control  
 3-Normal duty is 18.77 MW

|                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                |                                                                                              |
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|                                                                                                                                                                                                                                                                                                                                                                                           | <b>Process Data Sheet</b><br><b>For E-3113</b><br><b>(Crude Column OVHD Condenser)</b><br><b>No. 2 Crude Distillation Unit</b> |                                                                                              |
| <b>Originator Project No. : 8350</b>                                                                                                                                                                                                                                                                                                                                                      | <b>Document No. : DS-44-31-024-2</b>                                                                                           |                                                                                              |
| <b>Rev. : 02</b>                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                | <b>Page: 3 of 4</b>                                                                          |

|                                       |                            |                 |           |
|---------------------------------------|----------------------------|-----------------|-----------|
| Service: Crude Column OVHD Condenser  |                            | Item No. E-3113 |           |
| MECHANICAL DATA                       |                            |                 |           |
| Header                                |                            |                 |           |
| Type                                  | PT-plug type               |                 |           |
| Material                              | CS                         |                 |           |
| Plug Material                         | CS                         |                 |           |
| Gasket Material                       | Soft Iron (90HB max.)      |                 |           |
| Corrosion Allowance                   | 3 mm                       |                 |           |
| Connection Inlet                      | Size: 2 x 6"               | Rating:150      | Facing:RF |
| Outlet                                | Size: 2 X 3"               | Rating:150      | Facing:RF |
| Special Nozzle                        | Size:                      | Rating:         | Facing:   |
| Tube                                  |                            |                 |           |
| Material                              | CS                         |                 |           |
| ASTM/ASME/JIS                         | Seamless                   |                 |           |
| OD x Min.Thickness                    | 25.4 x 2.77 mm             |                 |           |
| Max. Length                           | 9.144 m                    |                 |           |
| Fin                                   |                            |                 |           |
| Type                                  | Extruded                   |                 |           |
| Material                              | Aluminium                  |                 |           |
| Miscellaneous                         |                            |                 |           |
| Structure Mounting                    | Pipe rack                  |                 |           |
| Surface Preparation                   | -                          |                 |           |
| Vibration Switch                      | Yes                        |                 |           |
| Mechanical Equipment                  |                            |                 |           |
| Fan Material                          | AL                         |                 |           |
| Driver Type                           | Motor                      |                 |           |
| Enclosure                             | Ex e II T3 / IP55          |                 |           |
| Electrica Power<br>(Volt/Phase/Cycle) | 400 V / Three phase / 50HZ |                 |           |
| Speed Reducer Type                    |                            |                 |           |

Note

|                                                                                                                                                                                                                                                       |  |                                                                                                                                |  |                                                                                     |  |
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|    |  | <b>Shazand Arak Refinery Expansion and Upgrading Project</b>                                                                   |  |  |  |
|                                                                                                                                                                                                                                                       |  | <b>Process Data Sheet</b><br><b>For E-3113</b><br><b>(Crude Column OVHD Condenser)</b><br><b>No. 2 Crude Distillation Unit</b> |  |                                                                                     |  |
| <b>Originator Project No.</b> : 8350                                                                                                                                                                                                                  |  |                                                                                                                                |  | <b>Project No.</b> : 2260                                                           |  |
| <b>Document No.</b> : DS-44-31-024-2                                                                                                                                                                                                                  |  | <b>Rev.</b> : 02                                                                                                               |  | <b>Page:</b> 4 of 4                                                                 |  |

|                                         |         |        |       |       |       |       |                 |       |       |       |       |        |
|-----------------------------------------|---------|--------|-------|-------|-------|-------|-----------------|-------|-------|-------|-------|--------|
| Service: Crude Column OVHD Condenser    |         |        |       |       |       |       | Item No.:E-3113 |       |       |       |       |        |
| Heat Exchanged 18.77 MW                 |         |        |       |       |       |       |                 |       |       |       |       |        |
| Enthalpy-Temperature profile Non linear |         |        |       |       |       |       |                 |       |       |       |       |        |
| Hot side properties                     |         |        | 1     | 2     | 3     | 4     | 5               | 6     | 7     | 8     | 9     | 10     |
|                                         |         | Inlet  |       |       |       |       |                 |       |       |       |       | Outlet |
| Temperature                             | °C      | 102.87 | 97.55 | 92.23 | 86.91 | 81.59 | 76.27           | 70.96 | 65.64 | 60.32 | 55    |        |
| Vapor weight fraction                   |         | 0.69   | 0.46  | 0.31  | 0.22  | 0.15  | 0.1             | 0.07  | 0.05  | 0.03  | 0.01  |        |
| Enthalpy                                | MW      | 23.21  | 16.63 | 12.79 | 10.35 | 8.67  | 7.44            | 6.48  | 5.68  | 5.01  | 4.41  |        |
| Latent Heat                             | kJ/kg   | 954.7  | 811.7 | 712.3 | 638.9 | 581.2 | 534.4           | 495.8 | 463.9 | 437.9 | 416.7 |        |
|                                         |         |        |       |       |       |       |                 |       |       |       |       |        |
| Vapor density                           | kg/m3   | 3.18   | 3.41  | 3.55  | 3.64  | 3.67  | 3.66            | 3.63  | 3.56  | 3.48  | 3.38  |        |
| Vapor viscosity                         | cP      | 0.01   | 0.01  | 0.01  | 0.01  | 0.01  | 0.01            | 0.01  | 0.01  | 0.01  | 0.01  |        |
| Vapor theramal conductivity             | w/m°C   | 0.022  | 0.022 | 0.022 | 0.021 | 0.021 | 0.02            | 0.02  | 0.02  | 0.02  | 0.02  |        |
| Vapor specific Heat                     | kJ/kg°C | 1.93   | 1.93  | 1.92  | 1.91  | 1.9   | 1.88            | 1.86  | 1.85  | 1.83  | 1.8   |        |
|                                         |         |        |       |       |       |       |                 |       |       |       |       |        |
| Total liquid density                    | kg/m3   | 719    | 727   | 726   | 724   | 723   | 723             | 723   | 724   | 726   | 728   |        |
| Total liquid viscosity                  | cP      | 0.28   | 0.28  | 0.29  | 0.3   | 0.32  | 0.33            | 0.35  | 0.36  | 0.38  | 0.41  |        |
| Total liquid thermal conductivity       | w/m°C   | 0.116  | 0.121 | 0.123 | 0.124 | 0.125 | 0.126           | 0.127 | 0.128 | 0.13  | 0.131 |        |
| Total liquid specific heat              | kJ/kg°C | 2.67   | 2.77  | 2.77  | 2.74  | 2.72  | 2.7             | 2.68  | 2.66  | 2.64  | 2.61  |        |
| Total liquid surface tension            | dyne/cm | 40.9   | 44.4  | 44.8  | 45    | 45    | 45.2            | 45.4  | 45.7  | 46    | 46.4  |        |
| Total liquid critical pressure          | bar(a)  | 138.6  | 152.2 | 151.6 | 149.5 | 147.3 | 145.4           | 143.7 | 142.3 | 141.2 | 140.2 |        |
| Total liquid critical temperature       | °K      | 622.6  | 623.1 | 620   | 616.8 | 613.8 | 611.1           | 608.7 | 606.5 | 604.6 | 603   |        |