

Gardner

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|-----------------|-----------------------------|---------------------------------------|
| *Heating steam in/ drain outlet temperature | °F (°C) | 242/114 (116.7/45.6) | 177/172 (80.6/77.8) |
| *Feed water flow | lbs/h (kg/h) | 894,300 (405,654) | 1,117,700 (506,988) |
| *Manufacturer/erector | | Yuba Heat Transfer Corp. | Atlas - Mak Maschinenbau - GmbH |

No. 2 LP feed water heater

| | | | |
|---|-------------|---------------------------------------|--|
| *Type | | Horizontal U-tube L.P. size 32-319 | Vval 1.2.4/490, horizontal U- tube, 4-pass |
| *Heating surface area ft ² (m ²) | | 3,240 (301.0) | 4,850 (450.6) |
| *Number of heater | | 1 set | 1 set |
| *Material of heating tube | | Admiralty | S+ 35.8 Seamless steel |
| *Heating steam in/ drain outlet temperature | °F (°C) | 458/200 (236.7/93.3) | 275/172 (135.0/80.6) |
| *Feedwater in/outlet temperature | °F (°C) | 190/257 (87.94/125.0) | 167/208 (75.0/97.8) |
| *Feed water flow | lb/h (kg/h) | 896,510 (406,657) | 1,117,672 (506,976) |
| *Manufacturer/erector | | Yuba Heat Transfer Corp. | Atlas - Mak Maschinenbau - GmbH |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|--|---|
| <u>No. 3 LP Feed Water Heater</u> | | |
| *Type | Horizontal U-tube, L.P. size 30-298 | Vwal 12.4/580, horizontal U-tube 4-pass |
| *Heating surface area ft ² (m ²) & number of heater | 2,280 (211.8) 1 set | 5,814 (540.1) 1 set |
| *Material of heating tube | Admiralty | St. 35.8 Seamless Steel |
| *Heating steam in/ drain outlet temperature °F (°C) | 574/267 (301.1/130.5) | 502/218 (261.1/103.3) |
| *Feed water in/outlet °F (°C) temperature | 257/294 (125.0/145.5) | 208/289 (97.8/142.7) |
| *Feed water flow lbs/h (kg/h) | 896,510 (406,657) | 1,117,672 (506,976) |
| *Manufacturer/erector | Yuba Heat Transfer Corp. | Atlas - Mak Maschinenbau - GmbH |

Deaerator

| | | |
|--|---|---|
| *Type | Direct contact, spray tray mounted, on horizontal storage tank | Spray type, mounted on hori- zontal storage tank |
| *Deaerator Capacity lbs/h (kg/h) | | |
| *Condensate to deaerator lbs/h (kg/h) | | |

| <u>Gardner</u> | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|-----------------------------------|---|--|
| *Outlet feed water flow | lbs/h (kg/h) | 1,161,490 (526,852) | 1,494,270 (677,800) |
| *Storage tank capacity | ft ³ (m ³) | 5,620 (159.1) | 5,124 (145.1) |
| *Deaerator pressure | psig(kg/cm ² g) | 120 (8.44) | 142.3 (10.0) |
| *Manufacturer/erector | | Worthington Corp. | Atlas - Mak Maschinenbau - GmbH |
| *Heating steam inlet temperature | °F (°C) | - | 663 (350.5) |
| *Dissolved oxygen guarantee value | cc/l | 0.005 | 0.005 |
| <u>No. 5 HP feed water heater</u> | | | |
| *Type | | U-type multilok, Horizontal, HP size 34-274 | VU Way 95.2/400 horizontal U-tube 2-pass |
| *Heating surface area & number of heater | ft ² (m ²) | 3,350 (311.2) 1 set | 3,660 (340.0) 2 sets |
| *Material of heating tube | | 70-3-Cu-Ni (PHelps Dodge Cuffenloy 30) | St 35.8 Seamless Steel |
| *Heating steam in/ drain outlet temperature | °F (°C) | 830/356.8 (443.3/180.4) | 820/369 (437.8/187.2) |
| *Feed water in/outlet temperature | °F (°C) | 346.8/383.5 (174.9/195.3) | 359.4/408.7 (181.9/209.3) |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|--|--|
| *Feed water flow lbs/h (kg/h) | 1,055,930 (478,962.37) | 1,358,425 (616,181.6) |
| *Manufacturer/erector | Yuba Heat Transfer Corp. | Atlas - Mak Maschinenbau - GmbH |
| <u>No. 6 HP Feed water heater</u> | | |
| *Type | U-tube multi lok, horizontal, HP size 39-332 | VU Way 95.2/420 horizontal U-tube 2-pass |
| *Heating surface area °F (°C) & number of heater | 5,752 (534.4) 1 set | 3,770 (350.2) 2 sets |
| *Material of heating tube | 70-30 Cu-Ni (Phelps Dodge Cuffenloy 30) | St 45.8 III Seamless Steel |
| *Heating steam in/ drain outlet temperature | °F (°C) 650/393.4 (343.3/200.8) | 629/418.8 (331.7/214.9) |
| *Feed water in/outlet temperature | °F (°C) 383.5/457.9 (195.3/236.6) | 408.7/481.5 (209.3/249.7) |
| *Feed water flow lbs/h (kg/h) | 1,055,930 (478,961.4) | 1,358.425 (616,181.6) |
| *Manufacturer/erector | Yuba Heat Transfer Corporation | Atlas - Mak Maschinenbau - GmbH |

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| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|----------------------------|---|---------------------------------------|
| 2) <u>Turbine and Auxiliary</u> | | | |
| a. <u>Turbine</u> | | | |
| *Type | | Tanden-compound reheat, condensing unit | Tanden-compound single reheat |
| *Rating output | kW | 150,000 | 200,000 |
| *Throttle steam pressure at MSV inlet | psig(kg/cm ² g) | 1,804 (126.8) | 2,706 (190.2) |
| *Throttle steam temperature (main steam/hot reheat) | °F (°C) | 1,000/1,000 (537.8/537.8) | 1,000/1,000 (537.8/537.8) |
| *Exhaust vacuum | inHg (mmHg) | 3.5 (88.9) | 3.5 (88.9) |
| *Number of bled steam stages | | 6 | 6 |
| *Manufacturer/erector | | General Electric Company | Siemens |
| b. <u>Condenser</u> | | | |
| *Type | | 107E - RBT - 30 two-pass vertical- ly divided condenser with reflusing deaerating hotwell | Surface rectangu- lar single shell |
| *Circulating water | gal/m (m ³ /h) | - | - |
| *Tube cleanliness factor | % | - | - |
| *Condensate flow | lbs/h (t/h) | 820,000 (371.94) | 971,100 (440.48) |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|-----------------------------|-----------------------------|
| *Cooling water design °F (°C) temperature | 85 (29.4) | 85 (29.4) |
| *Cooling water outlet °F (°C) design temperature | - | - |
| *Design point tube ft (m/s) inside flow velocity | 7.0 (2.134) | 6.7 (2.042) |
| *Tube material of condensing zone | Arserical Admiralty | Admiralty |
| *Tube dimensions of condensing zone | 1" OD 18 BWG | 1" OD #18 |
| *Effective tube length | - | - |
| *Tube material of air cooling zone | - | - |
| *Cooling surface ft ² (m ²) | 115,060 (10,689) | 130,300 (12,150) |
| *Material of tube plate | Steel | Steel with taret coating |
| *Material of water box | Steel | Steel with taret coating |
| *Cathodic protection - system type | - | - |
| *Manufacturer/erector | Ingersoll - Rand Company | Siemens |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|----------------------------------|--|--|
| c. <u>Circulating Water Pump</u> | | |
| *Type | Vertical, single stage mixed flow size 40A PMA, non-pullout | Vertical shaft, mixed flow single stage with variable pitch propeller blades |
| *Capacity x head x number | 55,555 g/m x 30' (12,616 m ³ /h x 9.14 m) x 2 sets | 102,900 g/m x 25' (23,368 m ³ /h x 7.62 m x 2 sets |
| *Manufacturer/erector | Ingersoll - Rand Company | Siemens |
| *Driver - Type | | |
| - Capacity kW x rpm | 373 x 500 | 650 x 1,785 |
| d. <u>Air Ejector Equipment</u> | | |
| *Type | JS 200, twin element, two stage, steam hot with combined surface inter-after condenser | Roman 1/25, twin elements, two stage steam jet |
| *Capacity x number | - x 2 sets | 45 lbs/h (20.4 kg/h) x 2 sets |
| *Suction pressure inHg (mmHg) | 1.0 (25.4) | 2.5 (63.5) |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|--------------------------|-------------------|
| *Working steam consumption (in case of steam jet ejector) | lbs/h (kg/h) 827 (375.1) | 960 (435.5) |
| *Driver capacity kW x rpm (in case of mechanical ejector) | - | - |
| *Manufacturer/erector | Ingersoll - Rand Company | Siemens |

e. Condensate Pump

| | | |
|----------------------------------|---|--|
| *Type | Vertical, 6 stages size 20 APKC - 6 | WKT 250 vertical 5 stage, 14"x12" ring sectional design with barrels |
| *Capacity gpm x head ft x number | 1850 gpm x 605 ft x 2 sets (420 m ³ /h) x (184.4 m) | 2880 gpm x 820 ft x 2 sets (654 m ³ /h) x (250 m) |
| *Manufacturer/erector | Ingersoll - Rand Company | Siemens |
| *Driver - Type | | |
| - Capacity kW x rpm | 298.4 x 1,180 (400 HP) | 610 x 1,180 |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|--|---|
| 3) <u>Generator and Auxiliary</u> | | |
| a. <u>Generator</u> | | |
| *Type | Totally enclosed hydrogen cooled GE Type ATB | Totally enclosed hydrogen cooled FTHD.540/62-2/60 |
| *Rating capacity kVA | 188,000 (30 psig) | 245,000 |
| *Power factor | 0.9 | 0.9 |
| *Voltage V | 18,000 | 14,400 |
| *Frequency Hz | 60 | 60 |
| *Revolution rpm | 3,600 | 3,600 |
| *Cooling type - Stator | Hydrogen cooled | Hydrogen cooled |
| - Rotor | | |
| *Hydrogen pressure psig(kg/cm ² g) | 30 (2.113) | 45 (3.164) |
| *Connection | Star | Double Star |
| *Exciting system | Static Type | Brushless Type |
| *Short circuit ration | 0.604 | 0.596 |
| *Neutral grounding system | Transformer 75 kVA 14,400/240 V, resistance, 0.63 ohm, 300A | Transformer 50kVA 10,000/220 V, resistance, 0.804 ohm, 220A |
| *Manufacturer/erector | General Electric | Siemens |
| b. <u>Exciter</u> | | |
| *Type | Static Type | 3 phase, 6 pole revolving arma- ture type with silicon rectifier |

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| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|-----|---|--------------------------------------|
| *Capacity | kW | Rectifier 846A DC 2 sets | 1,870 (main exciter) |
| | | C.T. 6,030A 3 phase 1ry P.T. 116 kVA | 940 (rectifier) 570(main exciter) |
| *Voltage | V | 18,000/120 V 2ry P.T. 340 kVA | |
| | | 18,000/256 V | 410 (rectifier) |
| *Revolution speed (if rotating type) | rpm | - | 3,600 |
| *Number | | 1 set | 1 set |
| *Manufacturer/erector | | General Electric | Siemens |
| *Kind of driver (if rotating type) | | - | Directly coupled to generator |

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| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---------------------------------------|-----|---|--|
| 4) <u>Transformers</u> | | | |
| a. <u>Main Transformer</u> | | | |
| *Type | | G.E. "Atmoseal" Oil-immersed(OA/FA) outdoor type | KFUM 1985N/130E Oil-immersed (FOD) outdoor type |
| *Capacity | kVA | 130,000 a 55°C Rise, OA 173,000 a 55°C Rise, FA 193,760 a 65°C CV Rise, FA | 232,000 |
| *Primary voltage | V | 17,500 | 14,400 |
| *Secondary voltage | V | 115,000 | 115,000 |
| *Phase | | 3 | 3 |
| *Impedance voltage | % | 7.13 | 10.7 |
| *Connection | | Delta - WYE | Delta - WYE |
| *Neutral (HV side) | | Solidly-grounded | Solidly-grounded |
| *Cooling system | | Air cooled | Forced oil cooled Forced air cooled |
| *Number | | 1 set | 1 set |
| *Manufacturer/erector | | General Electric | Siemens |
| b. <u>Station Service Transformer</u> | | | |
| *Type | | Oil immersed, seal- ed air, (OA) | KOUM, 1425 n/20 (OA) |
| *Capacity | kVA | 10,000 | 17,000 |
| *Primary voltage | V | 18,000 | 14,400 |
| *Secondary voltage | V | 4,160 | 4,160 |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------|---------------------|---------------------|
| *Phase | 3 | 3 |
| *Impedance voltage % | 5.5 | 9.9 |
| *Connection | Delta - WYE | Delta - WYE |
| *Neutral (L.V. side) | Solidly grounded | Solidly grounded |
| *Cooling system | Oil air self cooled | oil air self cooled |
| *Number | 1 set | 1 set |
| *Manufacturer/erector | General Electric | Siemens |

c. Emergency Station Service Transformer

| *Type | | <u>Common Use</u> |
|-----------------------|-----|-----------------------|
| | | Oil immersed (OA) |
| | | Out door, type |
| *Capacity | kVA | 12,000 |
| *Primary Voltage | V | 115,000 |
| *Secondary voltage | V | 4,160 |
| *Phase | | 3 |
| *Impedance voltage % | | 6.0 |
| *Connection | | Delta-Zigzag |
| *Neutral (L.V. side) | | Solidly grounded |
| *Cooling system | | Oil, air, self cooled |
| *Number | | 1 set |
| *Manufacturer/erector | | G.E. |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|-------------------|-------------------|
| 5) <u>Water Treatment System</u> | | |
| a. <u>Raw Water</u> | <u>Common Use</u> | |
| *Kind | Deepwell water | |
| *Total hardness (CaCO ₃) ppm | 95 | |
| *pH | 6.9 | |
| *Silica (SiO ₂) ppm | 70 | |
| *Turbidity degree | - | |
| b. <u>Raw Water Tank</u> | | |
| *Type | | |
| *Capacity m ³ x number | | |
| *Manufacturer/erector | | |
| c. <u>Sedimentation System</u> | | |
| *Type | | |
| *Applied chemical | | |
| *Manufacturer/erector | | |
| d. <u>Filtering System</u> | | |
| *Type | | |
| *Applied chemical | | |
| *Capacity t/day x number | | |
| *Manufacturer/erector | | |
| e. <u>Filtering System</u> | | |
| *Type | | |
| *Capacity t/day x number | | |
| *Type of reverse washing | | |
| *Filter material | | |
| *Manufacturer/erector | | |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|--------------------------------|-------------------------|
| f. <u>Water Dimineralizing Equipment</u> | | |
| *Type | Graver | |
| *Capacity GPM(m ³ /H) x number of train | 50 (11.4) x 3 | Mixed Bed 76 (17.3) x 2 |
| *Capacity per 1 cycle service gal(m ³) | Cation 90500 (286) | Anion 71000 (269) |
| | Mixed Bed 1,000,000 (3785) | |
| *Type of resin x resin filling capacity ft ³ | Cation RE-3 108 (3058) | |
| | Anion AE-61 96 (2718) | |
| | Mixed Bed Cation RE-6 17 (481) | |
| | Anion AE-61 11 (311) | |
| g. <u>Condensate Demineralizer</u> | | |
| *Pre-filter Type | None | None |
| *Condensate Demineralizer Capacity x number GPM(m ³ /H) | None | 1400 (318) x 3 |
| *Regeneration Equipment | | 2 sets in GSTP |

5.1.2 Snyder Power Plant Equipment1) Boilera. Boiler Proper

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|-----------------------------------|-----------------------------------|--------------------------------------|
| <u>Type</u> | | Meander Waterwall radiant type | Meander Waterwall radiant type |
| <u>Steam Pressure at 100% load</u> | | | |
| *Design pressure | psig(kg/cm ² g) | 3,425 (240.8) | 3,425 (240.8) |
| *Final superheater outlet | psig(kg/cm ² g) | 2,770 (194.76) | 2,770 (194.76) |
| *Reheater outlet | psig(kg/cm ² g) | 544.3 (38.27) | 544.3 (38.27) |
| <u>Steam temperature at 100 % load</u> | | | |
| *Rating temperature | °F (°C) | 1,005 (540.5) | 1,005 (540.5) |
| Economizer inlet | °F (°C) | 481 (249.4) | 481 (249.4) |
| Reheater inlet | °F (°C) | - | 627 (330.5) |
| Reheater outlet | °F (°C) | 1,005 (540.5) | 1,005 (540.5) |
| Superheater outlet | °F (°C) | 1,005 (540.5) | 1,005 (540.5) |
| <u>Evaporation</u> | | | |
| *Boiler MCR | lbs/h (t/h) | 1,675,485 (760) | 2,274,227 (1,031.6) |
| *Unit 4/4 load | lbs/h (t/h) | 1,494,270 (677.8) | 2,028,507 (920.1) |
| <u>Superheater</u> | | | |
| *Primary superheater | | | |
| Type | | horizontal conti- nuous tube | horizontal conti- nuous tube type |
| Heating surface | ft ² (m ²) | (S.H. Total) 57,360 (5328.9) | 52,560 (4,883) |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|------------------------|-----------------------------------|----------------------------------|-----------------------------------|
| *Top and Roof SH | | | |
| Type | | Tangent type | Tangent type |
| Heating surface | ft ² (m ²) | | 9,860 (916) |
| *Secondary Superheater | | | |
| Type | | | Pendant conti- nuous tube type |
| Heating surface | ft ² (m ²) | | 26,570 (2,468.4) |
| Superheater materials | | STPT-49 STBA-12, 22, 23, 24 - | |

Reheater

| | | | |
|------------------|-----------------------------------|--|--|
| *Type | | Horizontal & pen- dant continuous tube | Horizontal & pen- dant continuous tube |
| *Heating surface | ft ² (m ²) | 44,810 (4163.0) | 41,900 (3,985.5) |
| *Materials | | STBA-12,22,24 STB-34 SUS-27 HTB | STBA-12,23,24, STB-35 |

Economizer

| | | | |
|--------------------------|-----------------------------------|---------------------------|--------------------------|
| *Material | | STB 42 (ASTM A210 A-1) | STB 42 |
| *heating surface | ft ² (m ²) | 30,200 (2,805.7) | 54,600 (5,072.5) |
| *In/outlet temperatue | °F (°C) | 481/545 (249.4/285.0) | 481/564 (249.4/295.5) |

Furnace

| | | | |
|---------|-----------------------------------|------------------|-----------------|
| *Volume | ft ³ (m ³) | 79,750 (2,258.2) | 120,000 (3,398) |
|---------|-----------------------------------|------------------|-----------------|

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------------|--------------------|----------------------|
| *Construction of water wall | Horizontal meander | Meander construction |
| *Manufacturer/erector | Babcock - Hitachi | Babcock - Hitachi |

b. Air PreheaterRegenerative air heater

| | | |
|----------------------------|-----------------------------------|---|
| *Type | Horizontal regenerative type | Ljungstrom horizontal regenerative type |
| *Heating area | ft ² (m ²) | 98,070 (9,111)/ heater (149,210 (13,862) |
| *In/outlet air temperature | °F (°C) | 160/555 (71.1/290.5) 137/559 (58.3/292.8) |
| *Manufacturer/erector | Ljungstrom Gadelius | Ljungstrom Gadelius |

Steam air heater

| | | |
|----------------------------|-------------------------------------|---|
| *Type | 21-450M4V-ETI-FE 31 | 21-530H5V-ETI-FE 41 |
| *Heating area | ft ² (m ²) | 18,510 (1,719.6) 27,835 (2,586) |
| *In/outlet air temperature | °F (°C) | 136/160 (57.8/71.1) 100/134 (37.8/56.7) |
| *Manufacturer/erector | GEA Luftkunkler-gesellschaft Bothum | GEA Luftkunkler-gesellschaft Bothum |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------|-----------------------------------|---|
| c. <u>Sootblower</u> | | |
| *Type/units number | RSB-53A Retractable rack 22 units | RSB-53A retractable rack type 18 sets swing type 2 sets |
| *Manufacturer/erector | Babcock - Hitachi | Babcock - Hitachi |

d. Boiler Automatic ControlCombustion control

| | | |
|-----------------------|------------|------------|
| *Type | Electronic | Electronic |
| *Manufacturer/erector | Siemens | Siemens |

Temperature control

| | | |
|-----------------------|------------------|------------------|
| *Type | Electropneumatic | Electropneumatic |
| *Manufacturer/erector | Bailey & Siemens | Bailey & Siemens |

Feed water control

| | | |
|-----------------------|------------|------------|
| *Type | Electronic | Electronic |
| *Manufacturer/erector | Siemens | Siemens |

e. Fuel Supply & Firing SystemHeavy oil storage tank

| | | |
|-----------------------------------|--------------------|----------------------|
| *Type | Floating roof type | |
| *Capacity m ³ x number | Tank No. 1 | 8752 m ³ |
| | Tank No. 2 | 8752 m ³ |
| | Tank No. 3 | 23550 m ³ |
| | Tank No. 4 | 23550 m ³ |
| *Manufacturer/erector | | |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|---|--|
| <u>Light oil tank</u> | | |
| *Type | Common use for G1, G2, S1 and S2 | |
| *Capacity x number gal. (m ³) | 11,720 (44.36) x 1 set | |
| *Manufacturer/erector | | |
| <u>Heavy oil service tank</u> | | |
| *Type | None | none |
| *Capacity, Number of tank | | |
| *Manufacturer/erector | | |
| <u>Heavy oil burner</u> | | |
| *Type | Wide range mecha- nical atomizing | Mechanical ato- mizing type |
| *Capacity, Number of g/h (l/h) burner | 1,280 (4,845) x 18 | 972 (3,679) x 24 |
| *Manufacturer/erector | Babcock & Wilcox | Babcock & Wilcox |
| <u>Light oil burner</u> | | |
| *Type | B & W standard pressure and ato- mizing | B & W standard pressure and ato- mizing with re- placeable sprayer plate |
| *Capacity, number of lb/h (kg/h) burner | 440 (199.6)/18 pcs | /24 pcs |
| *Manufacturer/erector | Babcock & Wilcox | Babcock & Wilcox |

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| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|----------------------------|--------------------------------|--|
| <u>Main fuel oil pump</u> | | | |
| *Type | | IMO-Saren type spindle pump | IMO-Screw type ALG-110-4B spindle pump |
| *Discharge pressure, | psig(kg/cm ² g) | 720 (50.6) | 900 (63.3) |
| capacity & number of pump | g/m (m ³ /h) | 330 (74.9) 2 sets | 380 (86.3) x 2 sets |
| *Manufacturer/erector | | Siemens | Steinmeller |
| *Driver - Type | | - | 1MJ5428 - 4F |
| - Capacity | kW | 250 | 250 |
| <u>Constant differential fuel oil pump</u> | | | |
| *Type | | | 81, HSZ-5321 |
| *Capacity | g/m (m ³ /h) | | 430 (97.7) |
| *Suction pressure | psig(kg/cm ² g) | | 730 (51.3) |
| *Discharge pressure | psig(kg/cm ² g) | | 900 (63.3) |
| <u>Light fuel oil pump</u> | | | |
| *Type | | De Laval - IMO | 4800-Gear pump |
| *Discharge pressure | psig(kg/cm ² g) | | 250 (17.6) |
| Capacity & number of pump | g/m (m ³ /h) | 2 sets | 86 (19.5) x 1 set |
| *Manufacturer/erector | | | The Engineering Co. |
| *Driver - Type | | AC motor | AC motor |
| - Capacity | HP (kW) | 7.5 (5.6) | 25 (18.65) |
| *Manufacturer/erector | | General Electric | Westing House |

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| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---------------------------------|---|--|
| <u>Main fuel oil heater</u> | | |
| *Type | MESCO 2 EV 13 - 1625 | MESCO 2 EU15-168-F Triplex fuel oil heater |
| *Capacity & number of heater | g/m ³ /h 135 (30.7) x 3 sets | 190 (43.2) x 3 sets |
| *Manufacturer/erector | The Engineering Co. | The Engineering Co. |

f. Boiler Draughting EquipmentForced Draught Fan

| | | |
|------------------------|---|-------------------------------------|
| *Type | Axial Flow, 2 stage Model FAF 22.4/ horizontal, with 12.5-2 axial flow oil hydraulic rotor 2 stage horizon- blade adjustment tal, with oil hydraulic rotor blade | |
| *Capacity & number | ft ³ /min (m ³ /min) | 232 lb/sec (105.2 kg/sec) |
| *Pressure | inwg (mmwg) | 45 (1,143) |
| *Revolution speed | rpm | 1,750 |
| (Manufacturer/erector) | Dingler | Dingler |
| *Driver - Type | AC motor squirrel cage, horizontal | AC motor 1, RN3, 352-LHE- 90Z |
| - Capacity HP(KW) | | 2,250 (1,680) x 3,300 (2, |
| x number | 2 sets | 2 sets |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|------------------------------|---|
| - Manufacturer/ erector | Siemens | Siemens |
| <u>Gas Recirculation Fan</u> | | |
| *Type | 6600 POT - CH | Double suction turbo fan NV - 1CO #16 -1/2 |
| *Capacity & number ft ³ (m ³ /min) | 250,800 (7,101.6) x 1 set | 416,400 (11,790.8) x 1 set |
| *Pressure inwg (mmwg) | - | 12.2 (309.9) |
| *Revolution speed rpm | 900 | 870 |
| *Manufacturer/erector | - | - |
| *Driver - Type | AC motor | AC motor ETA-KK weather protected NEMA type II |
| - Capacity KW x number | 475 x 1 set | 930 x 1 set |
| - Manufacturer/ erector | - | - |

Stack - handles flue gas fromS1 and S2

| | |
|------------------------------|---|
| *Construction | Welded steel plate and gunitelined with 2.5" thick mixture of sand |
| *Top inside diameter m | 17'6" (5.34m) |
| *Height m | 284' (86.6m) |
| *Number | One stack for S1 and S2 |
| *Manufacturer/erector | Pacific Engineering |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---------------------------------------|-------------|--|---|
| g. <u>Boiler Feed Water Pump</u> | | | |
| <u>Turbine driven feed water pump</u> | | | |
| *Type & number of stage | | HDGR 75, 7 stage centrifugal | HDR8S, 6 stage centrifugal |
| *Capacity | lbs/h (t/h) | 1,863,000 (845) | 2,600,000 (1,179.4) |
| & number of pump | | x 1 set | x 1 set |
| *Total head | psi (m)/rpm | 3,545 (2492.5)/ | 3,804 (2,674.6)/ |
| & revolution | | 4600 | 5000 |
| *Manufacturer/erector | | KSB | KSB |
| <u>Turbine for BFP</u> | | | |
| *Type | | Axial reaction single cylinder condensing type | Axial reaction single cylinder, condensing type |
| *Capacity & number | kW | 14,200 x 1 set | 12,214 x 1 set |
| of turbine | | | |
| *Manufacturer/erector | | Siemens | Siemens |
| <u>T-BFP booster pump</u> | | | |
| *Type | | YNK N 400/300, double suction, single stage | YNKN 400/300, double suction single stage |
| *Capacity & number | lbs/h (t/h) | 1,863,000 (845.0) x 1 set | 2,600,000 (1,179.4) x 1 set |
| *Total head & | psi m/rpm | 96 (67.5)/1,500 | 96 (67.5)/1,630 |
| revolution | | | |
| *Driver (pump input) | kW | 200 | 420 |
| *Manufacturer/erector | | KSB | KSB |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-------------------------------------|-------------|--|---|
| <u>Motor driven feed water pump</u> | | | |
| *Type & number of stage | | HDGr 555/7 stage centrifugal, motor driven | HDG 55n, 11 stage centrifugal, motor driven |
| *Capacity & number of pump | lbs/h (t/h) | 706,470 (320.4) x 2 sets | 760,000 (344.7) x 1 set |
| *Total head & revolution | psi (m) rpm | 3,585 (2,520)/4870 | 2,950 (2,074.1)/ 3,570 |
| *Manufacturer/erector | | KSB | KSB |
| *Driver - Type | | Totally enclosed fan cooled | ITC 2929-3 EPOI-Z |
| - Capacity kW & number of motor | | 4,400 x 1 set | 3,120 x 1 set |
| - Manufacturer/ erector | | Siemens | Siemens |

h. Feed Water Heaters EquipmentNo. 1 LP feed water heater

| | | | |
|--|-----------------------------------|--|---|
| *Type | | Vwak1 115.4/470 horizontal U-tube 4 pass | Vwak1 115.2/750, horizontal U-tube 2 pass low pres- sure, 4 separate drain cooler |
| *Heating surface & number of heater | ft ² (m ²) | 4,740 (440.3) 1 set | 7,410 (688.4) 1 set |
| *Material of heating tube | | St 35.8 seamless steel | St 35.8 |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|---|--|
| *Heating steam in/ °F (°C) | 177/172 | 182.5/176.5 |
| drain outlet temperature | (80.6/77.8) | (83.6/80.3) |
| *Feed water in/outlet °F (°C) | 112/167 | 113.4/170.1 |
| temperature | (44.4/75.0) | (45.2/76.7) |
| *Feed water flow lbs/h (kg/h) | 1,117,690 | 1,863,526 |
| | (506,975) | (845,295) |
| *Manufacturer/erector | Atlas - Mak | Atlas - Mak |
| | Maschinenbau GmbH | Maschinenbau - GmbH |
| <u>No. 2 LP feed water heater</u> | | |
| *Type | Vwak1 12.4/490 horizontal U-tube 4 pass | Vwak1 115.2/750, horizontal U-tube design, 2 pass low press. with internal drain cooler |
| *Heating surface ft ² (m ²) | 4,850 (450.6) | 7,410 (688.4) |
| & number of heater | 1 set | 1 set |
| *Material of heating tube | St 35.8 | St 35.8 |
| *Heating steam in/ °F (°C) | 275/172 | 266.6/182.5 |
| drain outlet temperature | (135/80.6) | (130.3/83.6) |
| *Feed water in/outlet °F (°C) | 167/208 | 170.1/214 |
| temperature | (75.0/97.8) | (76.7/101.1) |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|-----------------------------------|---|--|
| *Feed water flow | lbs/h (kg/h) | 1,117,672 (506,976) | 1,863,526 (845,295) |
| *Manufacturer/erector | | Atlas-Mak Mas- chinenbau - GmbH | Atlas-Mak Mas- chinenbau - GmbH |
| <u>No. 3 LP feed water heater</u> | | | |
| *Type | | Vwak1-12.4/580 horizontal U-tube 4 pass | Vwak1 125.2/900 horizontal U-tube 2 pass low press. and with inter- nal drain cooler |
| *Heating surface & number of heater | ft ² (m ²) | 5,814 (540.1) 1 set | 8,880 (825.0) 1 set |
| *Material of heating tube | | St 35.8 seamless steel | St 35.8 |
| *Heating steam in/ drain outlet temperature | °F (°C) | 502/218 (261.1/103.3) | 499/226.6 (259.4/108.1) |
| *Feed water in/outlet temperature | °F (°C) | 208/289 (97.8/142.7) | 214/299.3 (101.1/148.5) |
| *Feedwater flow | lbs/h (kg/h) | 1,117,672 (506,976) | 1,863,526 (845,295) |
| *Manufacturer/erector | | Atlas-Mak Mas- chinenbau GmbH | Atlas-Mak Mas- chinenbau GmbH |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--------------------------------------|----------------------------|---|--|
| <u>Deaerator</u> | | | |
| *Type | | Spray type mounted on horizontal storage tank | spray deaerator mounted on hori- zontal storage tank |
| *Deaerating capacity | lbs/h (kg/h) - | | 2,425,600 (1,100,252) |
| *Condensate to deaerator | lbs/h (kg/h) - | | 1,674,262 (759,445) |
| *Outlet feed water flow | lbs/h (kg/h) | 1,494,270 (677,800) | 2,028,507 (920,130.8) |
| *Heating steam inlet temperature | °F (°C) | 663 (350.5) | 642 (338.9) |
| *Storage tank capacity | Cu.ft.(m ³) | 5,124 (145.1) | 6,762.8 (191.5) |
| *Design pressure | psig(kg/cm ² g) | 142.3 (10.0) | 171 (12.0) |
| *Dissolved oxygen guarantee value | cc/l | 0.005 | 0.005 |
| *Manufacturer/erector | | Atlas-Mak Mas- chinenbau GmbH | Atlas-Mak Mas- chinenbau GmbH |
| <u>No. 5 HP feed water heater</u> | | | |
| *Type | | VU way 95.2/400 horizontal U-tube 2 pass | VU way 110.2/530 horizontal U-tube 2 pass high pres- sure with inter- nal drain cooler |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|----------------------------------|----------------------------------|
| *Heating surface ft ² (m ²) | 3,660 (340.0) x | 4,990 (463.6) x |
| & number of heater | 2 sets | 2 sets |
| *Material of heating tube | St 35.8 seamless steel | 15 M03 |
| *Heating steam in/ °F (°C) | 820/369 | 432.9/375 |
| drain outlet | (437.8/187.2) | (222.7/190.5) |
| temperature | | |
| *Feed water in/outlet °F (°C) | 359.4/408.7 | (362.7/420 |
| temperature | (181.9/209.3) | (183.7/215.5) |
| *Feed water flow lbs/h (kg/h) | 1,358,448 | 2,274,199 |
| (both heaters) | (616,181.6) | (1,031,559.3) |
| *Manufacturer/erector | Atlas-Mak Mas- chinenbau GmbH | Atlas-Mak Mas- chinenbau GmbH |

No. 6 HP feed water heater

| | | |
|---|--|--|
| *Type | VU way 95.2/420 horizontal U-tube 2 pass | VU way 110.2/560 horizontal U-tube 2 pass, high press. with internal drain cooler |
| *Heating surface ft ² (m ²) | 3,770 (350.2) x | 5,280 (490.5) x |
| & number of heater | 2 sets | 2 sets |
| *Material of heating tube | St 45.8 III seamless steel | 13 CrMo44 |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-------------------------------|-------------------|-------------------|
| *Heating steam in/ °F (°C) | 629/418.8 | 647/432.9 |
| drain outlet | (331.7/214.9) | (341.7/222.7) |
| temperature | | |
| *Feed water in/outlet °F (°C) | 408.7/481.5 | 420.3/492.3 |
| temperature | (209.3/249.7) | (215.7/255.7) |
| *Feed water flow lbs/h (kg/h) | 1,358,448 | 2,274,199 |
| (both heaters) | (616,181.6) | (1,031,559.3) |
| *Manufacturer/erector | Atlas-Mak Mas- | Atlas-Mak Mas- |
| | chinenbau GmbH | chinenbau GmbH |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|-----------------------------|-----------------------------------|---|
| 2) <u>Turbine and Auxiliary</u> | | | |
| a. <u>Turbine</u> | | | |
| *Type | | Tanden compound single reheat | Tanden compound reheat retraction condensing type |
| *Rating output | kW | 200,000 | 300,000 |
| *Throttle steam pressure at MSV inlet | psig(kg/cm ² g) | 2,706 (190.2) | 2,700 (189.8) |
| *Throttle steam temperature (main steam/hot reheat) | °F (°C) | 1,000/1,000 (537.8/537.8) | 1,000/1,000 (537.8/537.8) |
| *Exhaust vacuum | inHg (mmHg) | 3.5 (88.9) | 3.5 (88.9) |
| *Number of bled steam stages | | 6 | 6 |
| *Manufacturer/erector | | Siemens | siemens |
| b. <u>Condenser</u> | | | |
| *Type | | Surface, rectangular single shell | Surface rectangular single shell |
| *Circulating water | gal/min (m ³ /h) | | 222,200 (50,462) |
| *Tube cleanliness factor | % | - | 85 |
| *Condensate flow | lbs/h (t/h) | 971,100 (440.48) | 1,335,893 (605.95) |
| *Cooling water design temperature | °F (°C) | 85 (29.4) | 85 (29.4) |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|------------------------------|-----------------------------------|
| *Cooling water outlet °F (°C) design temperature | | |
| *Design point tube ft/s (m/s) inside flow velocity | 6.8 (2.072) | 6.4 (1.95) |
| *Tube material of condensing zone | Admiralty metal | SOMS, 76 (AL- Bross) |
| *Tube dimensions of condensing zone | 1' OD #18 | 1"OD 25' |
| *Effective tube length | | 25', 11-3/64" (7,900.6 m/m) |
| *Tube material of air cooling zone | | 90 - 10 Cu - Ni |
| *Cooling surface ft ² (m ²) | 130,300 (12,105) | 236,000 (21,925) |
| *Material of tube plate | Steel with tarset coating | Steel with epoxy coating |
| *Material of water box | Steel with tarset coating | Steel with tarset coating |
| *Chathodic protection system type | - | - |
| *Manufacturer/erector | Siemens | Kraftwerke Union, West Germany |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|----------------------------------|--|---|
| c. <u>Circulating water pump</u> | | |
| *Type | Vertical shaft, mixed flow, single case with variable pitch propeller blades | PEZ-1600, vertical shaft mixed flow single phase with variable pitch propeller blade |
| *Capacity x head x number | 102,900 g/m x 25' (23,368 m ³ /h x 7.62 m) x 2 sets | 128,480 g/m x 30.1 ft (29,178 m ³ /h x 9.17 m) x 2 sets |
| *Manufacturer/erector | Siemens | Pump KSB Drive-draftwerke Union (Siemens) |
| *Driver - Type | Siemens | |
| - Capacity kW x rpm | 650 x 1,785 | 1,100 x 1,190 |
| d. <u>Air ejector equipment</u> | | |
| *Type | Roman I/2E, twin element, two stage steam jet | Roman I/2E, twin element, two stage steam jet with combined surface inter and after condenser |
| *Capacity (dry air) x number | 45 lbs/h(20.4 kg/h) x 2 sets | 33 lbs/h(15 kg/h) x 2 sets |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|----------------------------|-----------------------------------|--|---|
| *Suction pressure | inHg (mmHg) | 2.5 (63.5) | 2 (50.8) |
| *Working steam consumption | lbs/h (kg/h) | 960 (435.4) | 868 (393.7) |
| *Inter Condenser surface | ft ² (m ²) | - | 77.5 (7.2) |
| *After condenser surface | ft ² (m ²) | | 50.6 (4.7) |
| *Manufacturer/erector | | Siemens | Siemens |
| e. <u>Condensate pump</u> | | | |
| *Type | | WKT-250 vertical 5 stage 14" x 12" ring sectional design with barrels | WKT-300 vertical 4 stage, 16" x 14" ring section- al design with barrels equipped with radial im- pellers |
| *Capacity x head x number | | 2880 gpm x 820 ft x 2 sets (654.0 m ³ /h) x (250 m) | 2,100,000 lb/h x 355 psi x 2 sets (952.56 t/h x (24.96 kg/m ²)) |
| *Manufacturer/erector | | Siemens | Pump - KSB Drive - Kraft- werte Union |
| *Driver - Type | | | |
| - Capacity kW x rpm | | 610 x 1,180 | 900 x 1,180 |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------------------|----------------------------|--|--|
| 3) <u>Generator and Auxiliary</u> | | | |
| a. <u>Generator</u> | | | |
| *Type | | Totally enclosed Hydrogen cooled | Totally enclosed hydrogen cooled FTHDD 540/66-2/60 |
| *Rating capacity | kVA | 245,000 | 370,000 (45 psig Hz) |
| *Power factor | | 0.9 | 0.9 |
| *Voltage | V | 14,400 | 21,000 |
| *Frequency | Hz | 60 | 60 |
| *Revolution | rpm | 3,600 | 3,600 |
| *Cooling type - Stator | | Hydrogen cooled | Direct cooling |
| - Rotor | | Hydrogen cooled | Direct cooling |
| *Hydrogen pressure | psig(kg/cm ² g) | 45 (3.164) | 45 (3.164) 60 (4.219) |
| *Connection | | Double Star | Double Star |
| *Exciting system | | Brushless type | Brushless type |
| *Short circuit ration | | 0.596 | 0.62 |
| *Neutral grounding system | | Transformer 50 kVA 10,000/220 V Resistance 0.804ohm 220 A | Transformer 175 kBS 21,000/240 V, 0.198 ohm 730 A SLIV-CC |
| *Manufacturer/erector | | Siemens | Siemens |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------|--|---|
| b. <u>Exciter</u> | | |
| *Type | 3 phase, 6 pole revolving arm type with silicon rec- tifier | 3 phase, 6 pole revolving arma- ture type F 340 - 32 - 6 |
| *Capacity | kW | |
| Main Exciter | 1,870 | 1,880 |
| Rectifier | 940 | 1,665 |
| *Voltage | V | |
| Main exciter | 570 | 415 |
| Rectifier | 410 | 520 |
| *Revolution speed | rpm | |
| (if rotating type) | 3,600 | 3,600 |
| *Number | 1 set | 1 set |
| *Manufacturer/erector | Siemens | Siemens |
| *Kind of driver | Directly coupled | Directly coupled |
| (if rotating type) | with generator shaft | with generator shaft |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|----------------------------|-----|---|--|
| 4) <u>Transformers</u> | | | |
| a. <u>Main Transformer</u> | | | |
| *Type | | Oil immersed (FOA) outdoor type | AFOC - 3NY5CP, oil immersed, (FOA) outdoor type |
| *Capacity | kVA | 232,000 | 370,000 |
| *Primary voltage | V | 14,400 | 21,000 |
| *Secondary voltage | V | 115,000 | 115,000 |
| *Phase | | 3 phase | 3 phase |
| *Impedance voltage | % | 11.0 | 14.97 |
| *Connection | | Delta - WYE | Delta - WYE |
| *Neutral (HV side) | | Solidly grounded | Solidly grounded |
| *Cooling system | | Forced oil cooled forced air cooled (FOA) | Forced oil, forced air cooled (FOA) |
| *Number | | 1 set | 1 set |
| *Manufacturer/erector | | Siemens | Hitachi Ltd. |

b. Station Service Transformer

| | | | |
|------------------|-----|-----------------------------------|--|
| *Type | | Oil immersed (OA) outdoor type | Oil immersed (OA/ FA) outdoor type having 2 LV wind- ings |
| *Capacity | kVA | 17,000 | HV-18,750/25,000 LV-9,375/12,500 |
| *Primary voltage | V | 14,400 | 21,000 |

Snyder

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------|---|----------------------|--|
| *Secondary voltage | V | 4,160 | 4,160/4,160 |
| *Phase | | 3 phase | 3 phase |
| *Impedance voltage | % | 9.7 | HV-LV ₁ 8.59 HV-LV ₂ 8.67 LV ₁ -LV ₂ 16.04 12.5 MVA, Base |
| *Connection | | Delta - WYE | Delta - WYE |
| *Neutral (LV side) | | Solidly grounded | 249 ohm, 10 A, grounding resistor |
| *Cooling system | | Oil, air self cooled | Oil, air, self cooled |
| *Number | | 1 set | 1 set |
| *Manufacturer/erector | | Siemens | Hitachi |

c. Emergency station service transformer

| | | <u>Common Use</u> |
|--------------------|-----|---|
| *Type | | Oil immersed (OA) outdoor type |
| *Capacity | kVA | 30,000 - 15,000/15,000 |
| *Primary voltage | V | 34,500 |
| *Secondary voltage | V | 4,160/4,160 |
| *Phase | | 3 phase |
| *Impedance voltage | % | HV-LV ₁ 7.63 HV-LV ₂ 7.19 HV-LV ₂ 16.63 15 MVA base |

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------|-------------------|-------------------|
| *Connection | Delta - WYE | |
| *Cooling system | Self cooled | |
| *Number | 1 set | |
| *Manufacturer/erector | Mitsubishi | |

SnyderUnit No. 1Unit No. 25) Water Treatment Systema. Raw water

*Kind Deepwell water

*Total hardness ppm 95

(CaCO₃)

*pH 6.9

Silica (SiO₃) ppm 70

*Turbidity degree -

b. Raw water tank

*Type Cylindrical

*Capacity x number gal (m³) 300,000 (1,135.5) x 1

(Manufacturer/erector

c. Sedimentation system

*Type

*Applied chemical

*Capacity t/day x number

*Manufacturer/erector

d. Filtering system

*Type Reverse Osmosis

*Capacity t/day x number 5167/cycle (cation)

*Type of reverse washing

*Filter material

*Manufacturer/erector

Snyder

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|----------------------------------|-------------------|
| e. <u>Water Demineralizing Equipment</u> | | |
| *Type | Permutit | |
| *Capacity GPM (m ³ /h) | 100 (22.7) x 2 | |
| x number of train | Mixed Bed 100 (22.7) x 2 | |
| *Capacity per 1 cycle | Cation 136400 (516) | |
| service gal. (m ³) | Anion 125,600 (475) | |
| | Mixed Bed 514000 (1946) | |
| *Type of resin x resin | Cation IR-120 172 | |
| filling capacity ft ³ (l) | Anion IRA-402 102 (2888) | |
| | Mixed Bed Cation IR-120 28 (793) | |
| | Anion IRA-402 24 (679) | |
| f. <u>Condensate Demineralizer</u> | | |
| *Pre-filter type | None | None |
| *Condensate demineralizer | 1400 (318) x 3 | 1400 (318) x 4 |
| capacity x number GPM (m ³ /H) | | |
| *Regeneration Equipment | 2 sets in GSTP | |

5.1.3 Malaya Power Plant Equipment

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---------------------------------------|-----------------------------------|-----------------------------------|--|
| 1) <u>Boiler Equipment</u> | | | |
| a. <u>Boiler Proper</u> | | | |
| *Type | | Meander Waterwall radiant type | Single drum, EI pass, radiant type |
| <u>Steam Pressure at 100 % load</u> | | | |
| *Design pressure | psig(kg/cm ²) | 3,425 (240.8) | 2,910 (204.6) |
| *Final superheater outlet | psig(kg/cm ²) | 2,770 (194.76) | 2,471 (173.8) |
| *Reheater outlet | psig(kg/cm ²) | 544.3 (38.27) | 465 (32.7) |
| <u>Steam temperature at 100% load</u> | | | |
| *Rating temperature | °F (°C) | 1,005 (540.5) | 1,005 (541) |
| *Economizer inlet | °F (°C) | 481 (249.4) | 518.4 (270.2) |
| *Reheater inlet | °F (°C) | 627 (330.5) | 606 (318.9) |
| *Reheater outlet | °F (°C) | 1,005 (540.5) | 1,005 (541) |
| *Final superheater outlet | °F (°C) | 1,005 (540.5) | 1,005 (541) |
| <u>Evaporation</u> | | | |
| *Boiler MCR | lbs/h (t/h) | 2,278,780 (1,033.636) | 2,657,500 (1,305.423) |
| *Unit 4/4 load | t/h | - | - |
| <u>Heating surface area</u> | | | |
| *Contact heat transfer area | ft ² (m ²) | 186,600 (17,335) | 321,850 (29,900) |
| *Radiant heat transfer area | ft ² (m ²) | 11,330 (1,052.5) | 17,300 (1,610) |

Malaya

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---------------------------|-----------------------------------|--------------------------------------|---|
| <u>Superheater</u> | | | |
| *Primary superheater | | | |
| Type | | Horizontal continuous tube type | Horizontal continuous multi-loop tube, drainable type |
| Heating surface | ft ² (m ²) | 52,560 (4,883.0) | 107,700 (10,010) |
| *Top and Roof Superheater | | | |
| Type | | Tangent type | - |
| Heating surface | ft ² (m ²) | 9,860 (916.0) | - |
| *Secondary Superheater | | | |
| Type | | Pendant continuous tube type | Horizontal continuous multi-loop type, drainable type |
| Heating surface | ft ² (m ²) | 26,570 (2,468.4) | 25,530 (2,370) |
| *Materials | | | |
| | | Austenitic Alloy | STBA 12, 22, 24 |
| | | Steel tubes | SUS 321 HTB |
| <u>Reheater</u> | | | |
| *Type | | Horizontal & pendant continuous tube | Continuous multi-drop drainable type |
| *Heating surface | ft ² (m ²) | 42,900 (3,985.5) | 36,330 (3,380) |
| *Materials | | | |
| | | STBA 35, 123, 23, | STB 35 |
| | | 24 | |
| | | SUS 27 HTB | |

Malaya

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------------|-----------------------------------|----------------------|
| <u>Economizer</u> | | |
| *Material | STB 42 | STB 42 |
| *Heating surface | ft ² (m ²) | 54,600 (5,072.5) |
| | | 44,550 (4,140) |
| <u>Furnace</u> | | |
| *Volume | ft ³ (m ³) | 116,400 (3,295.9) |
| | | 148,700 (4,210.6) |
| *Construction of water wall | Horizontal meander | Ribbed membrane wall |
| *Manufacturer/erector | Babcock - Hitachi | Babcock - HITACHI |

b. Air PreheaterRegenerative air heater

| | Horizontal | Vertical |
|----------------------------|-----------------------------------|-------------------------|
| *Type | Horizontal | Vertical |
| *Heating area | ft ² (m ²) | 149,210 (13,862) |
| | | 172,000 (15,990) |
| *In/outlet air temperature | °F (°C) | 137/559 |
| | | (58.3/292.8) |
| | | 137/560 |
| | | (58/293) |
| *Manufacturer/erector | Ljungstrom/ Gadelius | Ljungstrom/ Gadelius |

Steam air heater

| | Finned | Helically fined double U-tube |
|----------------------------|-----------------------------------|----------------------------------|
| *Type | Finned | Helically fined double U-tube |
| *Heating area | ft ² (m ²) | 27,835 (2,586) |
| | | 24,335 (2260.7) |
| *In/outlet air temperature | °F (°C) | 100/134 |
| | | (37.8/56.7) |
| | | 80/201 |
| | | (26.7/93.9) |
| *Manufacturer/erector | GEA Luftkunklekgesellschaft | |

c. Sootblower

| | KK Type RSB | Single nozzle swing type/20 |
|--------------------|-------------|--------------------------------|
| *Type/units number | KK Type RSB | Single nozzle swing type/20 |
| | 53A/18 | |

Malaya

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------|-------------------|-------------------|
| *Manufacturer/erector | Babcock - Hitachi | Babcock - Hitachi |

d. Boiler Automatic ControlCombustion control

| | | |
|-----------------------|------------|-----------|
| *Type | Electronic | Pneumatic |
| *Manufacturer/erector | Siemens | Bailey |

Temperature control

| | | |
|-----------------------|-----------|--------------------------|
| *Type | Pneumatic | Pneumatic/ electronic |
| *Manufacturer/erector | Hitachi | Bailey |

Feedwater control

| | | |
|-----------------------|------------|--------------------------|
| *Type | Electronic | Pneumatic/ electronic |
| *Manufacturer/erector | Siemens | Bailey |

e. Fuel Supply & Firing SystemHeavy oil storage tank

| | |
|--|-------------------------------|
| *Type | Pontoon type Floating roof |
| *Capacity, bbl, (m ³) x number | 193,400 (30,750) x 3 sets |
| *Manufacturer/erector | ECCO - ASIA |

Light oil tank

| | |
|-----------------------------------|-----------------|
| *Type | Fixed cone roof |
| *Capacity m ³ x number | |
| *Manufacturer/erector | ECCO - ASIA |

Heavy oil service tank

| | | |
|-------|------|------|
| *Type | None | None |
|-------|------|------|

Malaya

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|----------------------------|---|---|
| *Capacity, number of m ³ tank | | | |
| *Manufacturer/erector | | | |
| <u>Heavy oil burner</u> | | | |
| *Type | | Baw Return flow atomizer | Baw return flow atomizer |
| *Capacity, lb/h (kg/h) | | 7,300 (3,310) | 8,500 (3,855) |
| number of burner | | 24 | (24 nozzles) |
| *Manufacturer/erector | | Babcock, Hitachi | Babcock, Hitachi |
| <u>Light oil burner</u> | | | |
| *Type | | Band w/air ope- equipped with ele- ctrode for sparked ignition | Band w/oil fired electrically ignited lighter |
| *Capacity, g/h (1/h) | | 1,585 (6,000) x 24 | 400 lbs/h (181.4 kg/h) x 12 sets |
| number of burner | | | |
| *Manufacturer/erector | | Babcock, Hitachi | Babcock, Hitachi |
| <u>Main fuel oil pump</u> | | | |
| *Type | | Screw 1 | Screw-rotary |
| *Discharge pressure | psig(kg/cm ² g) | 765 (53.87) | 821 (57.7) |
| Capacity | g/m (m ³ /g) | 395 (89.7) x 2 sets | 436 (99.03) x 2 |
| & number of pump | | | |
| *Manufacturer/erector | | De Laval IMO | Sier - Bath |
| *Driver - Type | | TEFC - XP | Explosion - Proof |
| - Capacity HP (kW) | | 300 (223.8) | 350 (261.1) |

Malaya

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|--|--|--------------------------------------|
| <u>Light fuel oil pump</u> | | |
| *Type | Gear | Same as M1 |
| *In/outlet pressure | psig(kg/cm ² g) 0/230 (0/16.2) | |
| Capacity & number of pump | g/m (m ³ /h) 50 (11.4) x 2 sets | |
| *Manufacturer/erector | Northern Ord | |
| *Driver - Type | AC motor (TEFC _ XP) | |
| - Capacity HP (kW) | 15 (11.19) | |
| *Manufacturer/erector | Westinghouse | |
| <u>Constant Differential fuel oil pump</u> | | |
| *Type | Horizontal SVC type | Horizontal type, centrifugal pump |
| *Capacity | g/m (m ³ /h) 400 (90.8) | 480 (109.02) |
| *Suction pressure | psig(kg/cm ² g) 755 (53.1) | 725 (50.97) |
| *Discharge pressure | psig(kg/cm ² g) 925 (65.0) | 901 (53.35) |
| <u>Heavy oil heater</u> | | |
| *Type | Horizontal | Horizontal |
| *Capacity & number of heater | g/m (m ³ /h) 195 (44.3) x 3 sets | 205 (46.5) x 3 sets |
| *Manufacturer/erector | MESCO | WELDON |

f. Boiler Draughting Equipment

Malaya

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|----------------------------|--|--------------------------------|-----------------------------------|
| <u>Forced Draught Fan</u> | | | |
| *Type | | Axial flow, 2 state horizontal | Horizontal centrifugal type |
| | | | F-29B, 80-75, A ₃ |
| | | | DWDI BX-VIV |
| *Capacity & number | ft ³ /m (m ³ /m) | 380,000 (10,760) | 394,000 (11,160) |
| | | x 2 sets | x 2 sets |
| *Pressure | inwg (mmwg) | 43 (1,092.2) | 53.5 (1,105) |
| *Revolution speed | rpm | 1,150 | 1,183 |
| *Manufacturer/erector | | KWU | Honden Parson/ Babcock-Hitachi |
| *Driver - Type | | AC motor | AC motor |
| | | Siemens RN5 634- 6HE90-X | |
| - Capacity kW x number | | 2,460 x 2 sets | 2,600 x 2 sets |
| - Manufacturer/ erector | | Siemens | Babcock - Hitachi |

Gas recirculation

| | | | |
|--------------------|--|---------------------------------|--|
| *Type | | Double suction turbo-fan NVICD, | Double suction with backward-curved air foil type blades |
| | | 16-1/2 | |
| *Capacity x number | ft ³ /m (m ³ /m) | 416,400 (11,790.8) | 464,600 (13,160) |
| | | x 1 set | x 1 set |
| *Pressure | inwg (mmwg) | 12.2 (309.9) | 11.8 (300) |
| *Revolution speed | rpm | 870 | 1,180 |

Malaya

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|----------------------------|---------------------------------|-----------------------------------|
| *Manufacturer/erector | Nakashima | Howder Parson/ BC Hitachi K.K. |
| *Driver - Type | AC Motor EFA-KK NEMA type II | AC motor |
| - Capacity kW x number | 930 x 1 set | 930 x 1 set |
| - Manufacturer/ erector | | Babcock - Hitachi |

Stack

| | | |
|----------------------------------|--|---|
| *Construction | Tower supported structure anchored on a girder | Consists of 2 sections const- ructed one on top of the other |
| *Top inside diameter ft (m) | 15 (4.57) | 17'-3/12" (5.25) |
| *Height ft (m) | 220 (67.06) | 220 (67.06) |
| (Base of stuck elevation ft (m)) | | |
| *Number | one | one |
| *Manufacturer/erector | Pacific Engineering/ PECCO | ECCO ASIA |

g. Boiler Feed Water PumpTurbine driven feed water pump

| | | |
|-------------------------|-------------------------------|--|
| *Type & number of stage | HDR8S, centrifugal 6 stage | Impulse type single flow con- densing turbine 5 stage |
|-------------------------|-------------------------------|--|

Malaya

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|----------------------------|----------------------------|--------------------------|-------------------------------------|
| *Capacity & number of pump | lbs/m (m ³ /hr) | 2,600,000 (1,179.4) | 6,850 g/m |
| | | x 1 set | (1,555.64m ³ /h) x 1 set |
| *Total head & revolution | psig(m) rpm | 3,804 (1,674.6) 5,000 | 3,260 *2,292.1) 5,060 |
| *Manufacturer/erector | | Siemens | Hitachi |

Turbine for BFP

| | | |
|-------------------------------|----|---|
| *Type | | Axial, reaction, single cylinder, condensing type |
| *Capacity & number of turbine | kW | 12,214 x 1 set |
| *Manufacturer/erector | | Siemens |

T-BFP booster pump

| | | | |
|----------------------------|----------------|--|-------------------------------------|
| *Type | | YNKN 400/300 double suction single stage | Horizontal type |
| *Capacity & number of pump | lbs/m (t/h) | 2,600,000 (1,179.4) | 6,850 g/m |
| | | x 1 set | (1,555.64)m ³ /h x 1 set |
| *Total head & revolution | psig(m) rpm | 96 (67.5) 1630 | 125.2 (88) 1,765 |
| *Driver | kW | 420 | 505 |
| *Manufacturer/erector | | KSB | Hitachi |

Motor driven feed water pump

| | | | |
|-------------------------|--|---------------|------------|
| *Type & number of stage | | HDG h/11 - 11 | Horizontal |
|-------------------------|--|---------------|------------|

Malaya

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|------------------------------------|----------------|---------------------------------------|--|
| *Capacity & Number of pump | lbs/h (t/h) | 760,000 (344.7) x 1 set | 3,425 g/m (777.8 m ³ /h) x 2 sets |
| *Total head & revolution | psi (m) rpm | 2,950 (2,074.1) 3,570 | 3,220 (2,264) 5,300 |
| *Manufacturer/erector | | Kelin, Achanzlin & Becker Hitachi Ltd | |
| *Driver - Type | | Motor driven | Motor driven |
| - Capacity & kW number of motor | | 3,120 x 1 set | 3,050 x 2 sets |
| - Manufacturer/ erector | | Siemens | Hitachi, Ltd. |

M-BFP booster pump

| | | | |
|-------------------------------|---------------------|------|---------------------------|
| *Type | | None | Horizontal type |
| *Capacity & Number of pump | g/m ³ /h | | 3,425 (777.8) x 2 sets |
| *Total head & revolution | psig (m)/rpm | | 100 (70.3)/1800 |
| *Manufacturer/erector | | | Hitachi, Ltd. |
| *Drive - Type | | | FWP, Direct |

h. Feed Water Heaters EquipmentNo. 1 LP Feed water heater

| | | | |
|--|-----------------------------------|--------------------------|----------------------------|
| *Type | | Horizontal U-tube | Horizontal U-tube |
| *Heating surface are & number of heater | ft ² (m ²) | 7,410 (688.4) x 1 set | 5,597 (519.98) x 2 sets |
| *Material of heating tube | | St 35.8 | SUS 304 TB |

Malaya

| | | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|-----------------------|--------------|-------------------|-------------------|
| *Heating steam in/ | °F (°C) | 182.5/176.5 | 193.9/177.4 |
| drain outlet | | (83.6/80.3) | (89.94/80.8) |
| temperature | | | |
| *Condensate in/ | °F (°C) | 113.4/170.1 | 117.9/172.4 |
| outlet temperature | | (45.2/76.7) | (47.72/78.0) |
| *Condensate flow | lbs/h (kg/h) | 1,863,520 | 1,859,101 |
| | | (845,295) | (845,045.9) |
| *Manufacturer/erector | | Atlas-Mak Mas- | Hitachi, Ltd. |
| | | chinenbau GmbH | |

No. 2 LP feed water heater

| | | | |
|---|--------------|-------------------|-------------------|
| *Type | | Vwak1 115.2/750 | Horizontal U-tube |
| | | Horizontal U-tube | 2 pass |
| | | 2 pass low pres- | |
| | | sure | |
| *Heating surface area ft ² (m ²) | | 6,954 (646.0) | 8,810 (818.5) |
| & number of heater | | x 1 set | x 1 set |
| *Material of heating tube | | St 35.8 | 0.5 M. Cs |
| | | | STBA 12 |
| *Heating steam in/ | °F (°C) | 266.6/182.5 | 382.5/182.4 |
| drain outlet | | (130.3/83.6) | (194.7/83.5) |
| temperature | | | |
| *Condensate in/outlet | °F (°C) | 170.1/214 | 172.4/238.1 |
| temperature | | (76.7/101.1) | (78/114.5) |
| *Condensate flow | lbs/m (kg/h) | 1,863,520 | 1,859,101 |
| | | (845,295) | (845,045.9) |

Malaya

| | <u>Unit No. 1</u> | <u>Unit No. 2</u> |
|---|--|------------------------------|
| *Manufacturer/erector | Atlas-Mas Mas chinenbau GmbH | Hitachi, Ltd. |
| <u>No. 3 LP feed water heater</u> | | |
| *Type | Vwak1 125.2/900 Horizontal U-tube Horizontal U-tube 2 pass low pressure | Horizontal U-tube |
| *Heating surface area ft ² (m ²) & number of heater | 8,880 (825.0) x 1 set | 5,904 (548.5) x 1 set |
| *Material of heating tube | S. 35.8 | 0.5 M. CS STBA 12 |
| *Heating steam in/ drain outlet temperature °F (°C) | 499/226.6 (259.44/108.1) | 485/248.1 (251.7/120.1) |
| *Condensate in/outlet temperature °F (°C) | 214/299.3 (101.1/148.5) | 238.1/270.8 (114.5/132.7) |
| *Condensate flow lbs/m (kg/h) | 1,863,526 (845,295) | 1,859,101 (845,045.9) |
| *Manufacturer, erector | Atlas-Mak Maschi- nenbau GmbH | Hitachi, Ltd. |
| <u>Deaerator</u> | | |
| *Type | Spray, deaerator mounted on hori- zontal storage tank | Spray deaerator |
| *Outlet feed water flow lbs/h (t/h) | 2,279,000 (1,033.7) | 2,421,957 (1,100.9) |