DRESSER-RAND

PROPOSAL NO. 5/EA24/100-00
REFERENCE NO.

# MULTISTAGE CONDENSING STEAM TURBINE GENERATOR SET

DRESSER-RAND, Steam Turbine Division, proposes to furnish and deliver to the Purchaser, the Equipment described below FOB/Factories suitably prepared for domestic shipment.

One (1) DRESSER-RAND Steam Turbine/Generator Unit consisting of the following major components:

- One (1) 2500 KW, 6000 rpm, Multistage, Condensing Steam Turbine
- One (1) 2500 KW, 0.85 PF, 3 Phase, 60 Hertz, 4,160 Volts, 1800 RPM, Electric Generator and Exciter.
- One (1) Single Reduction Parallel Shaft Speed Reduction Gear with 1.3 Service Factor.
- One (1) Complete Lubrication System with Oil Reservoir Located in Baseplate.
- One (1) Electro-Pneumatic Control System.
- One (1) Local Turbine Gageboard.
- One (1) Baseplate Under Turbine, Gear, & Generator.
- One (1) High Speed Coupling & Guard for Connecting the Steam Turbine to the Reduction Gear.
- One (1) Low Speed Coupling & Guard for Connecting the Reduction Gear to the Generator.
- One (1) Generator Control & Switchgear Cubicle.
- One (1) Condenser & Accessories

DRESSER-RAND

PROPOSAL NO. 5/EA24/100-00
REFERENCE NO.

## PERFORMANCE DATA

| | Normal | Maximum | Minimum |
|---|---|---|---|
| Steam Inlet Pressure (PSIG) @ Turbine Inlet | 190 | 200 | 180 |
| Steam Inlet Temperature (°FTT) @ Turbine Inlet | 384 | 388 | 380 |
| Exhaust Pressure ("HGA) | 2.0 | 3.0 | 2.0 |
| Rated Output (KW at GENERATOR TERMINALS) | 890 | 2500 | 600 |
| Throttle Flow Required (LBS/HR) | 15,000 | 43,000 | 12,000 |
| Exhaust Enthalpy (BTU) | 995 | 986 | 975 |
| Speed (RPM) | 6000/1800 | 6000/1800 | 6000/1800 |

*GUARANTEE POINT = NORMAL CONDITION*

## TECHNICAL DATA

| | |
|---|---|
| Steam Inlet Flange | 6" - 600 lbs./RF - ASA |
| Steam Exhaust Flange | 30" - 125 lbs./FF - ASA |

Serial No.: D-4060

Turbine Frame: S-6

Gear Frame: Nuttall SD16-6L

Generator: Ideal Electric Generator

Turbine Rating: 3352 HP / 2500 KW at 6000 RPM

Rotation Viewed From Governor End of Turbine: Clockwise

Casing Material: Cast Steel Steam End / Cast Iron Exhaust End

Number of Turbine Stages: 1 Curtis and 6 Rateau

Shaft Packing, Labyrinth Rings: 6 at Steam End
3 at Exhaust End
1 in each Diaphragm between Stages

Sentinel Valve sounds a warning at 5 psig

Exhaust Relief Valve starts opening at 6 psig;
opens fully at 10 psig to pass 49172 LB\HR of steam

Oil: SAE 20

Bearing Lubrication: Pressured Lubed At 20 psig

| | Flow | Pressure | Driver |
|---|---|---|---|
| Main Oil Pump: | 38 GPM | 40 psig | Supplied By Nuttall Gear |
| Auxiliary Oil Pump: | 38 GPM | 40 psig | Motor |

Cooling Water Required
For Oil Cooler: 50 GPM at 85°F
For Gland Condenser: 22.2 GPM at 85°F

# SCOPE OF SUPPLY

## Turbine

One (1) Multistage, Frame "S", Single Valve, Steam Turbine, Rated for Continuous Duty up to 700 PSIG - 750°FTT, and Including the Following Accessories:

- 6" Cast Steel Inlet
- 30" Cast Iron Exhaust (UP or DOWN)
- 6" Trip & Throttle Valve w/Stainless Steel Removable Strainer, & Start-Up Strainer
- Hand Valves for Part Load Economy
- Tilt Pad Radial Bearings
- Tilt Pad Thrust Bearing
- Electronic Governor (Woodward 505 or Equal) w/Pneumatic Actuator & Dual Pickups
- Labyrinth End Glands & Interstage Glands Arranged for Automatic Gland Sealing
- Gland Condenser (Shipped Loose for Field Mounting)
- Insulation on Turbine Case & Steam Chest w/Sheet Metal Jacket
- Case Drains Piped & Valved to Edge of Base
- Performance Curves -Flow *vs.* Output
- Lateral Critical Speed Analysis - Dresser-Rand Standard
- Solenoid Trip Device
- Low Oil Pressure Trip Valve
- Trip Limit Switch
- Separate Gageboard - Floor Mounted
- Customer Test Points:
  - Case Hydro Test - Certified
  - Final Rotor Balance - Certified
  - One (1) Hour No-Load Run Test - Witnessed
- NEMA 1 - Electrical Equipment
- All Electrical Wired to Oversized Junction Boxes
- Turning Gear - AC Motor

## Gear

One (1) Lufkin or Nuttall Speed Decreasing Gear, Single Reduction, with:

- Ratio - 6000/1800
- AGMA Service Factor at 2500 KW - 1.3
- Fabricated or Cast Iron Housing
- Shaft Driven Main Oil Pump to Provide Lube Oil to Turbine, Gear, & Generator
- Sleeve Radial Bearings
- Thrust Collar

# SCOPE OF SUPPLY

**Fabricated Steel Baseplate** - Under Turbine, Gear, and Generator

**High and Low Speed Couplings with Guards** - Spacer Type

**Lubrication System**

One (1) Lubrication System for Turbine, Gear, and Generator including:

- Carbon Steel Reservoir Built into Baseplate
- Open Drip-Proof Motor Driven Auxiliary Oil Pumps - AC & DC (MOP Mounted on Gear)
- Dual Filters w/25 Micron Filtration Design
- Dual Coolers - 3/8" Tubes, 85°F Cooling Water Design
- Three (3) Way Transfer Valve
- Pressure Gages for Filter Inlet & Discharge
- Air Vent
- Lube Oil Control Valve
- Auxiliary Oil Pump Start Pressure Switch
- Auxiliary Oil Pump Bypass Relief Valve
- Low Oil Pressure Switch
- High Oil Temeprature Switch
- Dial Thermometers - In/Out of Cooler
- Flanged & Welded Carbon Steel Piping Throughout
- Sight Flow Indicators in Each Bearing Drain Line (5 Total)
- Reservoir Heater
- Differential Pressure Switch for Filters
- Oil Level Switch
- Customer Connection for Oil Separation System

**Generator**

One (1) Synchronous Generator (Ideal Model SAB or Equal) - Brushless Design, Rated 2941 KVA, 2500 KW, at 0.85 Power Factor, 1800 RPM, 3 Phase/60 HZ/4160 Volt, WYE Connected, 6 Leads, 105°C Rise By Resistance Above a 40°C Ambient, Class F Insulation, Continuous Duty Design including:

Electrical Features:

- Damper Windings
- Insulation System to be VPI-Complete Stator
- Field Suitable for Excitation from Brushless Exciter
- Capable of Operating at Rated KVA &Rated Temperature Rise at Altitudes of 3300 Feet Above Sea Level

# SCOPE OF SUPPLY

## Generator

Electrical Features (Continued)

- Efficiency Guaranteed at Loads:
  - 4/4 - 96.2
  - 3/4 - 96.1
  - 1/2 - 95.4
- Six (6) Leads for Differential Protection
- Short Circuit Ratio Not Less Than 0.6

Mechanical Features

- Two (2) Sleeve Bearings, Bracket Mounted, Suitable for Forced Feed Lubrication from System Furnished by Customer. Ideal will provide Oil In & Oil Out Connections at Bearing Housings Only. No piping is included.
- One (1) Bearing is to be Insulated to Prevent Shaft Currents
- Mechanical Balance per NEMA Standard
- Open Drip-Proof Enclosure with Filters
- Unit to be Capable of 125% Overspeed without Mechanical Injury

Accessories

- Bearing Temperature Detectors - One (1) per Bearing, RTD Type, 120 Ohm Nickle
- Two (2) Grounding Pads on Frame to be Located Diagonally Opposite of Each Other
- Space Heaters
- Six (6) Stator Temperature Detectors, RTD Type, 120 Ohm Copper
- Main Terminal Box Including:
  - Lightning Arrestors
  - Surge Capacitor
  - Oversized to Accomodate Stress Cones Furnished by Others
  - 3 Cts for Differential Protection
  - 3 Cts for Metering
- Brushless Exciter
- Permanent Magnet Alternators (PMA)
- One (1) RTD in Inlet Air Path
- Furnish & Mount B-N Vibration Equipment - Two (2) Probes per Bearing

# SCOPE OF SUPPLY

## Generator Auxiliary Equipment

One (1) Static Voltage Regulator System Including:

- Two (2) Static Voltage Regulators, ± 1/2% with Single Phase Sensing, Parallel Circuit
- Dual Voltage Adjusting Rheostat - Single Motor Operated
- Underfrequency Protection
- Var/PF Controller
- Manual Voltage Control Module with Selector Switch
- Exciter Diode Failure Monitor
- Minimum/Maximum Excitation Limiter

One (1) Neutral Grounding Resistor Rated 400 AMPS, 10 Seconds, 2400 Volt L/N with Safety Enclosure and CT.

IDEAL ELECTRIC CO.
330 EAST FIRST STREET • MANSFIELD, OHIO 44901 • USA
TELEPHONE (419) 522-3611 • FAX (419) 522-3568

# SYNCHRONOUS GENERATOR DATA

| | | | | | | |
|---|---|---|---|---|---|---|
| | KW | 2500 | KVA | 2941 | P.F. | 0.85 |
| 105 °C RISE | VOLTS | 4160 | AMPS | 408 | RPM | 1800 |

## REACTANCES

PER UNIT ON 2941 kVA BASE

| | | | |
|---|---|---|---|
| Direct Axis Synchronous | (Unsaturated) | Xd | 1.729 |
| Direct Axis Transient | (Rated Voltage) | X'd | 0.239 |
| Direct Axis Subtransient | (Rated Voltage) | X"d | 0.167 |
| Quadrature Axis Synchronous | (Unsaturated) | Xq | 0.899 |
| Quadrature Axis Subtransient | (Rated Voltage) | X"q | 0.163 |
| Negative Sequence | (Rated Voltage) | X2 | 0.170 |
| Zero Sequence | (Rated Voltage) | Xo | 0.065 |
| Short Circuit Ratio | | SCR | 0.750 |

## TIME CONSTANTS

| | | |
|---|---|---|
| Direct Axis Open Circuit Transient | T'do | 3.710 Sec. |
| Direct Axis Short Circuit Transient | T'd | 0.512 Sec. |
| Direct Axis Short Circuit Subtransient | T"d | 0.030 Sec. |
| Short Circuit Armature | Ta | 0.041 Sec. |

## RESISTANCES

| | | |
|---|---|---|
| Armature | (per phase at 25°C) | 0.04495 Ohms |
| Field | (at 25°C) | 0.484 Ohms |
| Rotor Inertia | | 2200 Lb-Ft² |

## EFFICIENCY

| Load | Eff. at 0.85 P.F. |
|---|---|
| 4/4 | 96.2% |
| 3/4 | 96.1% |
| 1/2 | 95.4% |

DATE 10/09/95

Ref: 2112018

# SCOPE OF SUPPLY

## Generator Control & Switchgear Cubicle

One (1) Generator Control & Switchgear Cubicle, 2500 KW, 0.85 PF, 4160V, 3P, 4W, 60 Hz, ANSC 37, Indoor Construction with Approximate Dimensions of 94"H, 72"W, 90"D to include:

- Generator CB, Vacuum, 4160V, 3P, 1200A, EO, DO, 350MVA
- Surge Protection Arrestor, 4160V, 3P
- AC Instrumentation: Electronic Multimeter to Include AM, VM, FM, KW, KVAR, KWH, KVARH, PF, 1% Class - Utility Grade
- RTD Monitor Relay - Two (2) Channel with Temperature Meter & Channel Selector Switch
- Control & Synchronizing Panel to include:
  - Annunciator, 12 Point, with Ringback Control Logic, Reset, PB, Silence PB, Lamp Test PB, & Horn
  - Sync Scope
  - Sync Lights
  - Sync Switch
  - Voltage Adjust Potentiometer
  - Speed Adjust Up/Down Switch
  - Mode Control Switches
- Device 15V - Electronic Synchronizer with 5% Voltage Match, SPMA
- Device 90PF - VAR-Power Factor Controller, Type SCP250
- Device 51V - Phase Overcurrent Relay with Voltage Restraint
- Device 51N - Ground Overcurrent Relay
- Device 87 - Phase Differential Current Relay with Six (6) Cts
- Device 86 - Lockout Relay
- Device 32 - Reverse Power Relay
- Device 40 - Reverse VAR, Loss of Excitation Relay
- Device 46 - Negative Sequence Current Relay, 3P
- Circuit Breaker Control Switch with R/G Indicating Lights
- Two (2) Sets of Potential Transformers with Fusing
- Three (3) Sets of Current Transformers with Shorting Blocks
- Mount/Wire Speed Governor Equipment Furnished by Customer
- Mount/Wire Voltage Regulating Equipment Furnished by Customer
- Transition Section for Connection to Bus Bar
- Station Battery & Charger, 48VDC, Powered from Separate 120 Volt Source Provided by Others
- Space Heater & Humistat Control Powered from Separate 120 Volt Source Provided by Others

## Condenser

One (1) Graham or Equal Condenser System in accordance with the Attached Seven (7) Vendor Information Sheets.

graham
Vacuum and Heat Transfer

| | | | |
|---|---|---|---|
| Customer | : Dresser-Rand | Ref.No. | : 81BAT95 |
| Customer Ref | : RRF Expansion | Date | : 10/09/95 |
| Location | : Harrisonburg,VA | Engineer | : KGG |
| Item | : T/G | Page | : 1 |

## SCOPE OF SUPPLY

Vendors and model numbers are listed to illustrate construction features. Graham reserves the right to substitute equipment of an equal type and quality by other vendors. Any items omitted from this scope of supply list are excluded from this quotationat this time and will not be furnished.

SURFACE CONDENSER TUBED IN SHOP
(1 ) Model 38 51 / 17.00 TALTD — DrawingA81BAT95-1

STEAM JET AIR REMOVAL PACKAGE
(1 ) Model 1-32-088-2 — Drawing A81BAT95-2

LIQUID RING VACUUM PUMP AIR REMOVAL PACKAGE
(1 ) Model 1PV62160/12 — Drawing A81BAT95-3

ATMOSPHERIC RELIEF VALVE
(1 ) Viking 24" Vertical Carbon Steel

HOGGING EJECTOR
(1 ) Graham, 2H Cast Iron
Silencer, Maxim,Model 2" FP Crb.Stl,Internals, Flg./w F.G. Pack

HOTWELL GAUGE GLASS
(1 ) Consolidated #20-207, Bronze tubular

VACUUM GAUGE(S)
(1 ) U.S. Gauge #1981, 4-1/2", 316SS tube, PET case, 316SS Lower stem

PRESSURE GAUGE(S)
(1 ) U.S. Gauge #1981, 4-1/2", 316SS tube, PET case, 316SS Lower stem
(1 ) Pigtail Syphon, U.S. Gauge, 517H 1/2" Carbon Steel

TEMPERATURE INDICATORS
(2 ) U.S. Gauge 65300674 5" Dial Every angle 304SS case
(2 ) U.S. Gauge Thermowell No. 3/4"-2605-U4.5-304SS, 3/4" NPT, 304SS

AIR LEAKAGE METER
(1 ) Graham, Calibrated Orfice with gauge, 0 - 40 PPH

INTERCONDENSER CONDENSATE TRAP
(1 ) Sarco ASTM A126, Type-FA30, 1"

AFTERCONDENSER CONDENSATE TRAP
(1 ) Sarco ASTM A126, Type-FA30, 1"

Graham Manufacturing Co., Inc., P.O. Box 719, Batavia, NY 14021-0719
Corporate and Sales Headquarters: 20 Florence Avenue, Batavia, NY 14020
Tel. (716) 343-2216 Telex: (71) 6854142 Fax No. (716) 343-1097

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Vacuum and Heat Transfer

# SURFACE CONDENSER SPECIFICATIONS

Customer : Dresser-Rand
Cust.Ref.: RRF Expansion
Location : Harrisonburg,VA
Quantity : one

Ref.No. : 81BAT95
Date : 10/09/95
Item : Peak design
Engineer : KGG/BAT81

## PERFORMANCE

| | |
|---|---|
| Absolute Pressure @ Steam Inlet (in.HgA) | 3.00 |
| Steam Condensed (lb./hr.) | 43000. |
| Heat Rejected (Btu/hr.) | 38829000. |
| Circulating Water (gpm) | 3883. |
| Water Inlet / Outlet (deg.F) | 85.00 / 105.00 |
| Water Pressure Loss : (ft.Water / psi) | 15.0 / 6.5 |
| Percent Clean | 85. |
| Tube Velocity (fps) | 7.63 |

## DESIGN

| | | |
|---|---|---|
| MODEL : | | 38 51 / 17.00 TALTD |
| Surface Area (sq.ft.) Total / Effective | | 3271. / 3208. |
| Number of Water Passes | | 2. |
| Number of Tubes | | 980. |
| Outside Tube Diameter (in.) - BWG | | 0.7500 - 18 AW |
| Total Tube Length (ft.) | | 17.00 |
| Design / Test Pressure (psig) : | Shell.....FV& | 15.0 /Flooded |
| | Tubes | 125.0 / 187.5 |
| Design Temperature (deg.F) : | Shell | 250.0 |
| | Tubes | 125.0 |
| Hotwell : cylindrical ...supply (gal.) | | 220. |
| Steam Inlet Diameter (in.) (FF) | | 40. |
| Water Connections (in.) | | 2. - 20. |
| Condensate Outlet (in.) | | 1. - 6.0 |

## MATERIALS

| | | |
|---|---|---|
| Shell | (SA-516-70) | Carbon Steel |
| Water Boxes | (SA-516-70) | Carbon Steel |
| Water Box Covers | (SA-516-70) | Carbon Steel |
| Baffles | (SA-516-70) | Carbon Steel |
| Tube Support Plates | (SA-36) | Carbon Steel |
| Tubes | (SB-111-443) | Admiralty |
| Tube Sheets | (SB-171-464) | Naval Rolled Brass |

Remarks : Design per HEI, Ninth Edition
Construction and Stamp per ASME Section VIII , Div. 1 , Tube Side Only
Steam Inlet Impingement Protection Included
Water Boxes and Covers to be Coal Tar Epoxy Coated
Ejector Package Mounted on the Main Condenser

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graham
Vacuum and Heat Transfer

Customer : Dresser-Rand
Customer Ref: RRF Expansion
Location : Harrisonburg,VA

Ref.No. :81BAT95
Date :10/09/95
Item :
Engineer:KGG

## STEAM JET EJECTOR PERFORMANCE:

| | |
|---|---|
| Pressure maintained (inches HgA)* | 1.0 |
| Total Fluid Evacuated (lbs/hr) | 43.2 |
| Dry air evacuated (lbs/hr) | 13.5 |
| Motive steam required per element (lbs/hr) | 195.0 |
| Operating steam pressure (psig) | 175.0 |
| Operating steam temperature (deg.F) | 377.0 |
| Inter condenser cooling water temp. (deg.F) | 85.0 |
| Inter condenser cooling water required (gpm) | 59.3 |
| Cooling water pressure drop thru I/A condenser (psi) | 0.7 |

## STEAM JET EJECTOR DESIGN:

| | | | |
|---|---|---|---|
| Model designation | | | 1-32-088-2/2H |
| Number of stages | | | TWO |
| Number of elements for parallel operation | | | ONE |
| Material of diffuser and suction chamber | | | SA-278-35 |
| Material of steam nozzles | | | 416SS |
| Type of inter and after condenser | | | IN-LINE |
| Material of inter and after condenser shell | | | SA-53-B |
| Tube sheets | | | SA-516-70 |
| Tubes | 0.7500 - 18 BWG AW | | SB-111-443 |
| M.A.W.P/ Test Pressure (psig) | : | Shell | 20 / 30 |
| | | Tubes | 125 / 188 |
| Design Temperature (deg.F) | : | Shell | 250 |
| | | Tubes | 125 |

## APPURTENANCES INCLUDED:

| | |
|---|---|
| Steam strainer | Included |
| Interconnecting steam piping | Included |
| Air leakage meter | Included |
| Priming ejector - Size | 2H(7C) |
| Steam consumption (lbs/hr) | 375.0 |
| Drainers or traps | Included |
| Design per HEI Construction of I/AC per ASME Sec. VIII Div I | |
| Isolation valve(s) at 1st stage discharge | Included |
| Isolation valve at hogger suction | Included |
| Suction Manifold | Included |
| Hogging Ejector silencer | Included |
| Motive steam stop valve for each jet | Included |

Measured at condenser inlet.

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Vacuum and Heat Transfer

# LIQUID RING PUMP SPECIFICATION SHEET

1 CUSTOMER: Dresser-Rand
2 USER : Harrisonburg,VA
3 PLANT LOCATION :
4 SERVICE OF UNIT:

EG NO : 81BAT95
JOB NO :
CUST NO :
DATE : 10/09/95
Engineer: KGG

## PERFORMANCE REQUIREMENTS

5 GAS HANDLED: AIR/WATER VAPOR
6 SUCTION PRESSURE: 50.0 mmHgA SUCTION TEMPERATURE: 93.6 F
7 SEALANT FLUID: WATER SEALANT TEMPERATURE: 80.0 F
8 COOLING WATER TEMP: N.A. F SOURCE:
9 ELECTRIC SUPPLY: VOLTS: 230/460 PHASE: 3 CYCLE: 60

## PUMP SELECTION

10 MODEL NO: 1PV62160/12
11 STAGES: two SHAFT SEAL: packing glands
12 MAT'L OF CONSTR: cast iron case, ductile iron rotors, SS shaft
13 SPEED: 1750 RPM DISCHARGE PRESS: 14.7 psia
14 CAPACITY: 330.7 ACFM AT SUCTION PRESSURE OF: 50.0 mmHgA
15 HORSEPOWER-AT OPERATING POINT: 26.4 bhp MAXIMUM:
16 SEAL LIQUID: WATER QUANTITY: 20.0 GPM TEMP: 80.0 F
17 FLOW: once through

## MOTOR DETAILS

18 HORSEPOWER: 40 hp SPEED: 1750 rpm
19 ELECTRIC SUPPLY: VOLTS: 230/460 PHASE: 3 CYCLE: 60
20 ENCLOSURE: ODP
21 MAKE: Reliance or Equal
22 SPECIAL FEATURES:

## OPTIONAL ACCESSORIES

23 BASEPLATE: included for LRVP and motor only
24 COUPLING & GUARD: included, T.B. Woods or equal
25 DISCHARGE SEPARATOR: included, steel
26 SEAL WATER REGULATING VALVE: included, bronze
27 SEAL WATER PRESSURE GAUGE: included
28 SEAL WATER SOLENOID VALVE: included, brass
29 VACUUM GAUGE: included
30 VACUUM RELIEF VALVE: included, aluminum
31 SEAL WATER STRAINER: included, cast iron
32 SEAL WATER SHUTOFF VALVE: included, brass
33 INLET CHECK VALVE: included, bronze
34 RECIRCULATION PUMP: none
35 HEAT EXCHANGER: none
36 INTERCONNECTING PIPING: included
37 MANUAL DRAIN AND FILL VALVES: included
38 GAUGE GLASS: included Bronze 3/4" glass diam
39 COMMENTS: Performance tolerance per HEI.
40
41
42
43
44

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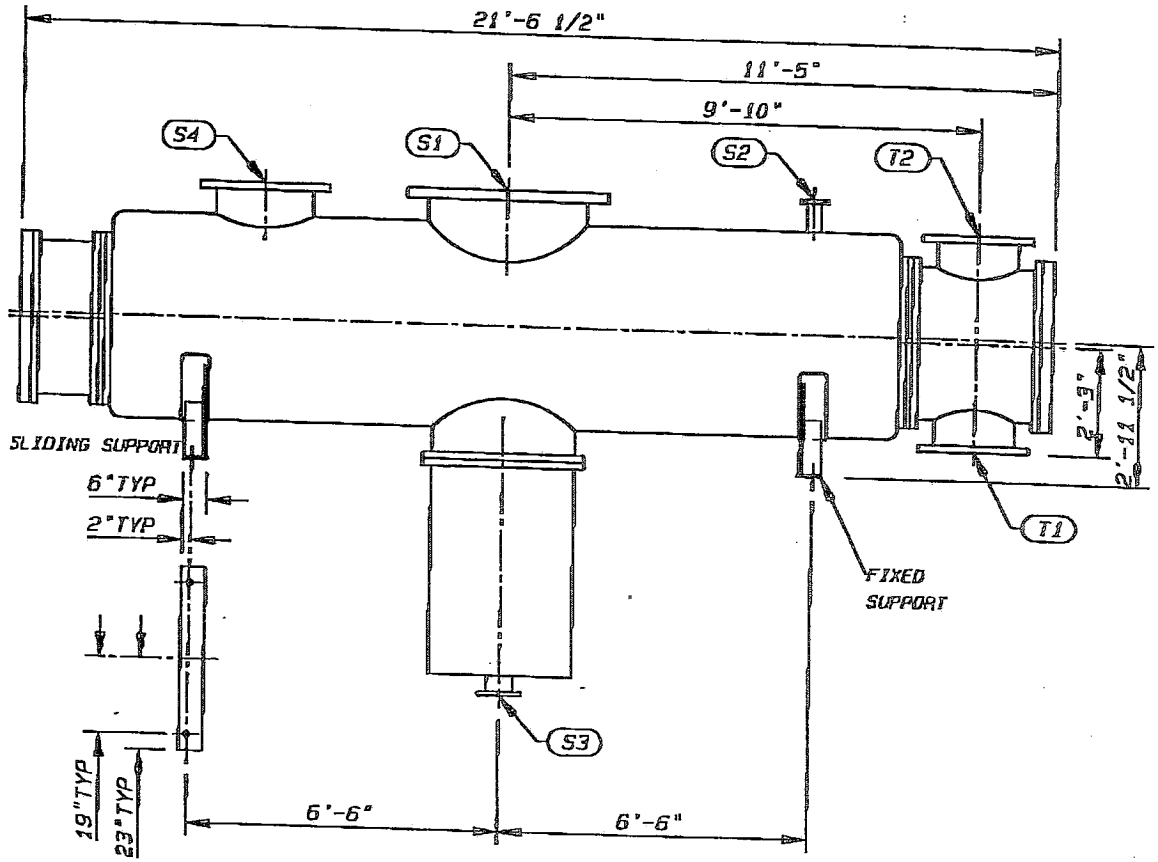
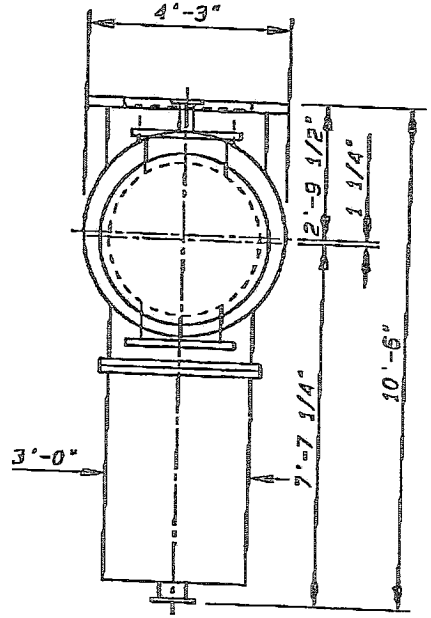
*** PRELIMINARY DRAWING NOT CERTIFIED FOR CONSTRUCTION ***




NOTE:
CONNECTION FLANGES ARE ANSI STANDARD DRILLING AND THICKNESS UNLESS OTHERWISE NOTED.
CUSTOMER TO SPECIFY COOLING WATER NOZZLE ARRANGEMENT.
STEAM INLET FLANGE THICKNESS PER HEI.
SLIDING SUPPORT: (2) 1 1/8" x 1 1/2" SLOTTED HOLES.
FIXED SUPPORT: (2) 1-1/8" DIA. HOLES.

| | | |
|---|---|---|
| T1 | 20" | 150# RF COOLING WATER INLET |
| T2 | 20" | 150# RF COOLING WATER OUTLET |
| S1 | 40" | FF STEAM INLET |
| S2 | 3" | 150# RF AIR OFF TAKE |
| S3 | 6" | 150# RF CONDENSATE OUTLET |
| S4 | 24" | 150# RF RELIEF VALVE |

| | | | |
|---|---|---|---|
| CUSTOMER | Dresser-Rand | | |
| CUSTOMER REF. | ARF Expansion | | |
| MODEL | 3851/17.00TALTD | | |
| | M.A.W.P. | TEST PRESS. | DESIGN TEMP |
| SHELL SIDE | FV 15 PSIG | 23 PSIG | 250 °F |
| TUBE SIDE | 125 PSIG | 188 PSIG | 125 °F |

GRAHAM MANUFACTURING CO., INC.
20 FLORENCE AVE. BATAVIA N.Y.

PRELIMINARY SURFACE CONDENSER DRAWING

| SCALE | MADE | CHKD | APPD | DATE | DWG. NO. | REV. |
|---|---|---|---|---|---|---|
| 1/48 | KGG | | | 10/9/95 | ABIBAT95-1 | |

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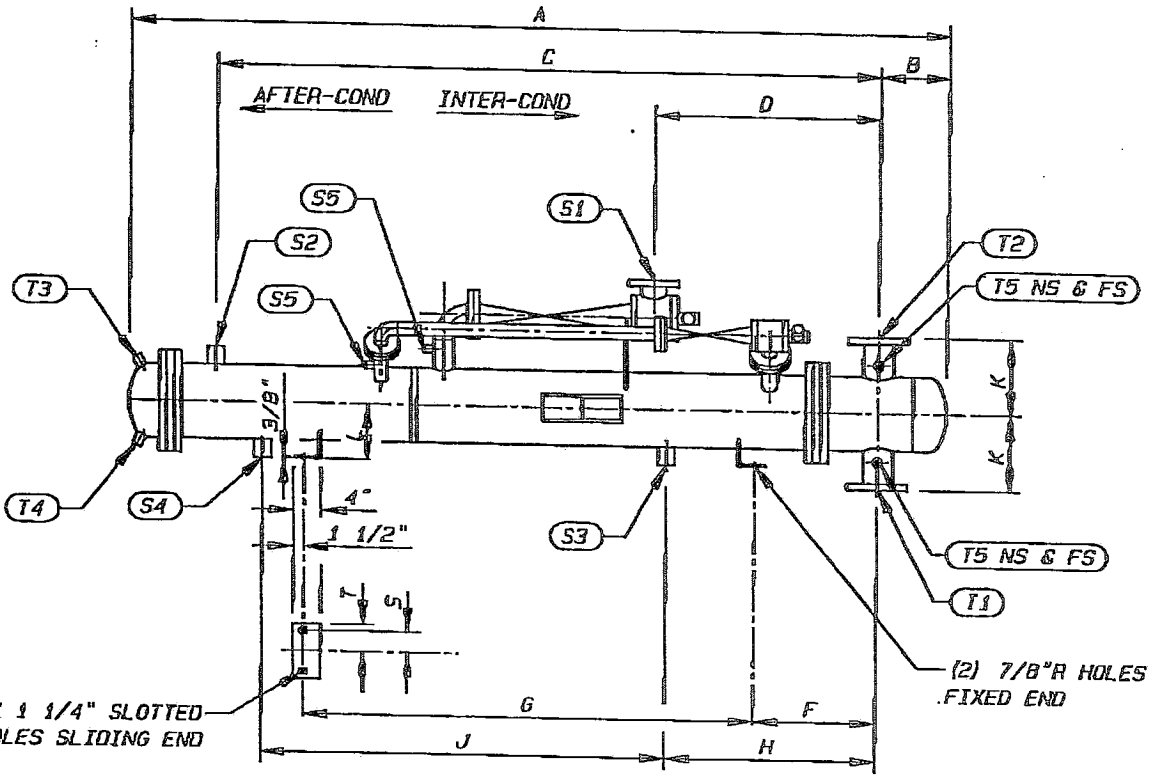
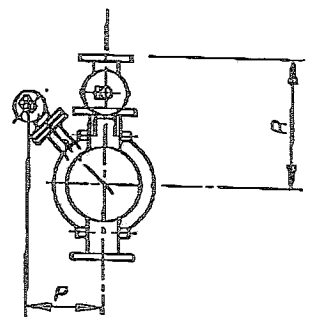



NOTE:
CONNECTION FLANGES ARE ANSI STANDARD DRILLING AND THICKNESS UNLESS OTHERWISE NOTED.

| | |
|---|---|
| CUSTOMER | Dresser-Rand |
| CUSTOMER REF. | RRF Expansion |
| MODEL | 1-32-088-2 |

| CONNECTION SCHEDULE S=SHELL SIDE T=TUBE SIDE | | | |
|---|---|---|---|
| SYMBOL | SIZE | TYPE | SERVICE |
| S1 | 3" | 150# ANSI (FF) | VAPOR INLET |
| S2 | 1 1/2" | NPT | VAPOR OUTLET |
| S3 | 1 1/2" | NPT | CONDENSATE OUTLET |
| S4 | 1 1/2" | NPT | CONDENSATE OUTLET |
| S5 | 1/2" | NPT | TEST CONN. |
| T1 | 3" | 150# ANSI (RF) | WATER INLET |
| T2 | 3" | 150# ANSI (RF) | WATER OUTLET |
| T3 | 3/4" | NPT | VENT |
| T4 | 3/4" | NPT | DRAIN |
| T5 | 3/4" | NPT | TEST CONN. |

| DIMENSIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | B | C | D | F | G | H | J |
| 9'-8" | 8 3/16" | 8'-0" | 2'-8" | 17" | 5'-5" | 2'-6" | 4'-11" |
| K | L | P | Q | R | S | T | |
| 10" | 7" | 10 5/16" | | 18 9/16" | 2" | 3" | |

| | SHELL SIDE | TUBE SIDE |
|---|---|---|
| M.A.W.P (PSIG) | 20 | 125 |
| TEST PRESS (PSIG) | 30 | 188 |
| DESIGN TEMP (°F) | 250 | 125 |

GRAHAM MANUFACTURING CO., INC.
20 FLORENCE AVE. BATAVIA N.Y.

PRELIMINARY EJECTOR PACKAGE

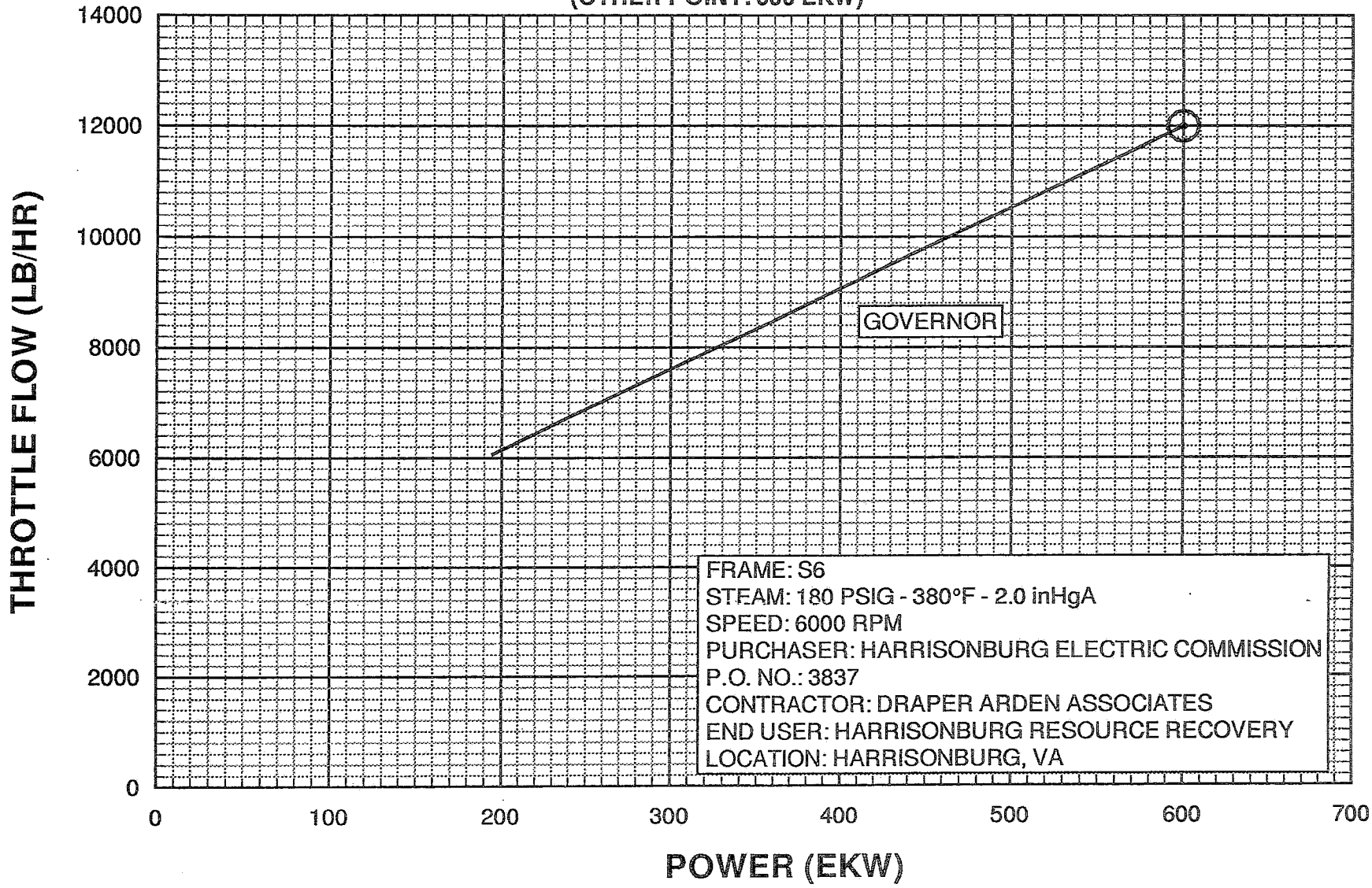
| SCALE | MADE | CHKD | APPD | DATE | DWG. NO. | REV. |
|---|---|---|---|---|---|---|
| NONE | KGG | | | 10/09/95 | A81BAT95-2 | |

10/10/95 13:45

0 of 1

# TURBINE PERFORMANCE

(OTHER POINT: 600 EKW)



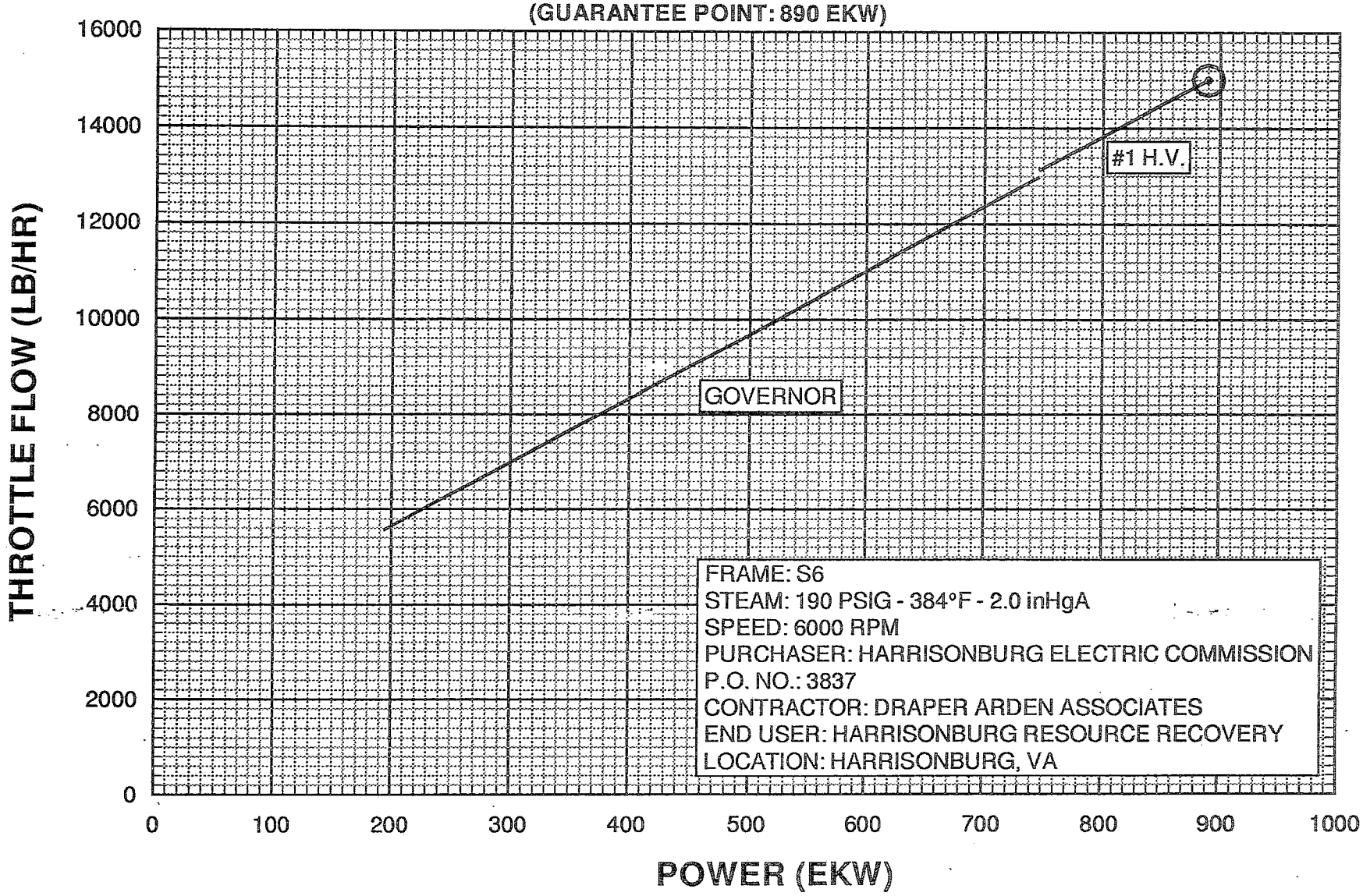

Drawn By: TDJ
Feb 28 1996

DRESSER-RAND Steam Turbine Division
Wellsville,NY 14895 USA

U26361-1A
S/N: D4060

# TURBINE PERFORMANCE

(GUARANTEE POINT: 890 EKW)



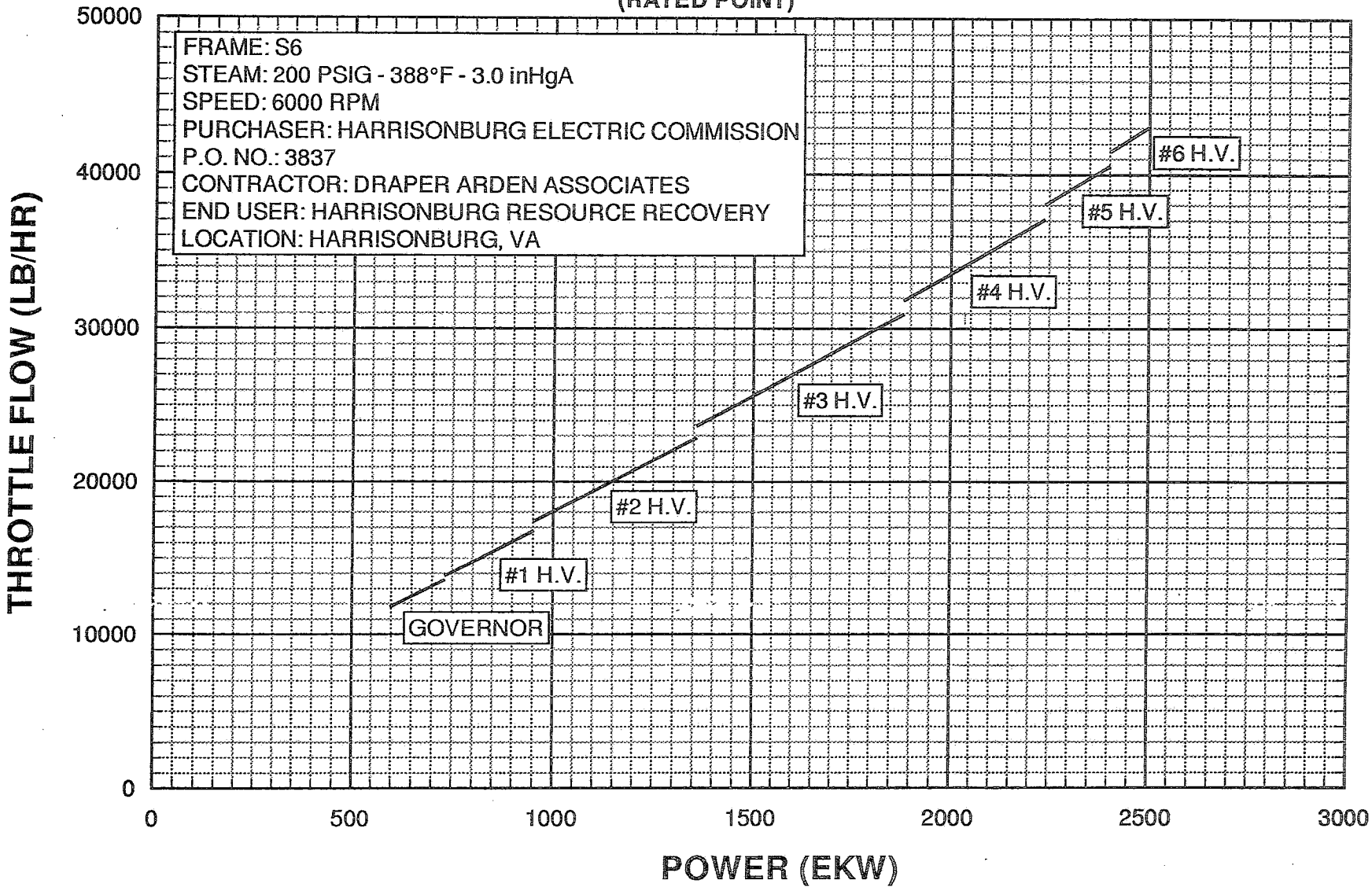

Drawn By: TDJ
Feb 28 1996

DRESSER-RAND
Steam Turbine Division
Wellsville,NY 14895 USA

U26361-1B
S/N: D4060

# TURBINE PERFORMANCE

(RATED POINT)




Drawn By: TDJ
Feb 28 1996

DRESSER-RAND Steam Turbine Division
Wellsville,NY 14895 USA

U26361-1C
S/N: D4060

Nuttall Gear Corporation
2221 Niagara Falls Blvd., P.O. Box 1032, Niagara Falls, N.Y. 14302
716/731-5180 FAX 716/731-9329

CUSTOMER - DRESSER RAND

| | |
|---|---|
| UNIT SIZE | SD 16-6L |
| ASSEMBLY POSITION | R.H. |
| CUSTOMER P.O. # | T-26361-5 |
| GENERAL ORDER # | NC-2368 |
| SHOP ORDER # | 96R60785 |
| HORESEPOWER | 2500 KW |
| SERVICE FACTOR | 1.3 |
| RATIO | 3.3261:1 |
| INPUT RPM | 5987 |
| OUTPUT RPM | 1800 |
| GEAR DRIVE EFFICIENCY | 98.6% |

# DRESSER - RAND
## STEAM TURBINE DIVISION

### MAJOR STEAM CONNECTIONS

| REV. | CONN. | FLANGE | SIZE | ANSI | O.D. | B.C. | NO. HOLES | DIA. HOLES | MIN. FLG. THICKNESS | RAISED FACE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | TURBINE INLET | 6" | 600# | 14.00 | 11.50 | 12 | 1.12 | 1.88 | .25 x 8.50 | RIGHT SIDE |
| | B | TURBINE EXHAUST | 30" | 125# | 38.75 | 36.00 | 28 | 1.38 | 2.12 | F.F. | UP |

### AUXILIARY CONNECTIONS

| REV. | | CONNECTION | NO. | SIZE & TYPE CONNECTION | VALVE REQUIRED | VALVE SUPPLIED BY | CONNECT TO | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | C | INLET VALVE ABOVE SEAT DRAIN | 1 | 3/4" 600# ANSI R.F. | YES | D-R | OPEN DRAIN | |
| | D | INLET VALVE BELOW SEAT DRAIN | 1 | 3/4" 600# ANSI R.F. | YES | D-R | OPEN DRAIN | |
| | E | INLET T&T VALVE STEM LEAKOFF | 1 | 3/4" FNPT | NO | ---- | OPEN DRAIN | |
| | F | GOVERNOR VALVE STEM LEAKOFF | 1 | 3/4" FNPT | NO | ---- | OPEN DRAIN | |
| A | G | NOZZLE BOWL DRAIN | 1 | 3/4" 600# ANSI R.F. | YES | D-R | OPEN DRAIN | |
| A | H | FIRST STAGE DRAIN | 1 | 3/4" 300# ANSI R.F. | YES | D-R | OPEN DRAIN | |
| | J | EXHAUST DRAIN | 1 | 3/4" 150# ANSI R.F. | YES | D-R | OPEN DRAIN | |

## 7.0 DATA SHEETS

### 7.1 GENERAL

All data requested hereinafter shall be supplied with each proposal and will be used by the Engineer for evaluation purposes.

The Bidder shall answer all questions as briefly as possible. Where space does not permit sufficient description, the Bidder shall provide additional information such as drawings, cuts or typewritten descriptions.

Name of turbine manufacturer. DRESSER RAND

Name of generator manufacturer. IDEAL OR =

Name of excitation system manufacturer. IDEAL OR =

Name of governor manufacturer. WOODWARD OR =

Overall length. OUTLINE CE 213231 APPROX 295 INCHES

Overall width. " " " 125 INCHES

Overall height. " " " 110 INCHES

## 7.2 TURBINE/GENERATOR FEATURES

Type of turbine blades

Impulse (stage numbers) (7) SEVEN

Reaction (stage numbers) _____

With the governing valves wide open at design steam conditions, the turbine is expected to pass a throttle flow of 45000 lbs./hr.

Maximum continuous operating pressure 700 PSIG

Maximum continuous operating temperature 750 °F

### 7.2.1 Turbine Components:

Casing Material INLET & BARREL A216 GR WCB

Type of Support CENTERLINE

Type of Exhaust Flow (UP OR DOWN) CAST IRON A278, CL40

Rotor Material WHEELS A294 - FORGED
SHAFT 4140 CL BC

Blade Design and Material 403 SS

Blade Shroud Design and Material 403 SS

Nozzle Rings Material 416 SS

Bearings Design and Material JOURNAL - TILT PAD
THRUST - TILT PAD

Seals Design and Material LABY - NI RESIST

Inlet Steam Chest Design and Material A216 GR WCB CAST STEEL

Inlet Steam Valve Design and Material A 351, GD 4205S

7.2.2 Governor:

| | |
|---|---|
| Type and Design (include catalog cuts or drawings) | WOODWARD ELECTRONIC |
| Oil System Design | NONE REQ'D |
| Pump Design | NONE REQ'D |
| Accuracy (furnish complete details) | CLASS D |

7.2.3 Trip and Throttle Valve:

| | |
|---|---|
| Design and Material | 700PSIG 750°F |
| Integral Strainer Design and Material | ST. ST. |

| | |
|---|---|
| 7.2.4 Rotor Balance (Tolerance) | PER NEMA |
| 7.2.5 Lubrication System: | PRESSURE LUBE |
| Type and Design | INTEGRAL |
| Main Oil Pump Design | POSITIVE DISPLACEMENT |
| A.C. Auxiliary Pump Design | " " |
| D. C. Auxiliary Pump Design | " " |
| Location | IN CASE |
| Sump Tank Design and Capacity | LATER |

Sump Tank Accessories:

| | |
|---|---|
| PER SPEC | |
| | |
| | |

Air/Vapor Removal System — BLOWER

Heaters (Design) — INCLUDED

Lube Oil Control System (Furnish Drawings, Catalog Cuts, Etc.) — SEE TYPICAL DRG # CE 213444

7.2.6 Shaft Sealing System:

Type and Design — LABYRINTH / AUTOMATIC SYSTEM

Equipment Furnished (Manufacturer, Size, Flow, Materials of Construction, Etc.): — LATER

Steam Jet Ejector Design — "

Ejector - Steam Condenser Design — "

Cooling Water Flow — "

7.2.7 Turbine Gauge Board, Generator/Synchronozing Panel & Switchgear:

Describe Type, Design and Proposed Location — PER SPEC

7.2.8 Generator: — SEE SEPERATE GENERATOR SHEETS

Rated KVA capability

Generator Reactances

Zero sequence at rated current $X_0$

Negative sequence at rated voltage $X_2$

Subtransient at rated voltage X'd

Transient at rated current X'd

Synchronous at rated current X'd _____

SCR at rated KVA _____

Generator efficiency at rated kVA and rated power factor _____ %

Generator regulation at rated power factor 75% kVA _____ ,

100% rated kVA _____ , and 110% rated kVA _____.

7.2.9 Excitation System:

Excitation, voltage _____ , Amperes _____ .

Type of excitation System:

static _____

brushless alternator _____

Can field temperature, voltage and current be measured directly? (Yes or No) _____

If so, how? _____

Electrically-operated field breaker? (Yes or No) _____

Transformer: KVA _____ Primary Volts _____ Secondary Volts _____.

Type insulation? Oil _____ Dry _____ .

Approximate weight? _____ .

Electrically-operated Primary Air Circuit Breaker? Yes _____ No _____.

I. C. MVA _____

F. L. Amperes _____

Brushless Alternator: KVA _____ Volts _____

Rectifier: Rotating _____ Stationary _____

Diodes Accessible During Operation? YES _____ No _____

Voltage Regulator

Manufacturer _____

Type _____ Model _____

7.2.10 Neutral Grounding Provision

Reactor _____ Resistor _____.

OHM rating _____ Ampere rating _____.

7.2.11 Structural Requirements:

Total Weight (lbs) ~ 60,000 SEE OUTLINE CE 213231 TURBINE/GEAR/GEN./BASE/LUBE

Weight of Individual Components (List):

| Component | (lbs) |
|---|---|
| TURBINE | 12000 |
| GEAR | 4000 |
| GENERATOR | 22000 |
| BASEPLATE | 18000 |
| ACCESSORIES | 2000 |
| CONDENSER | 30000 |
| SWITCHGEAR | 4000 |
| | |

7.2.12 Speed Reducing Gear (If not Direct Coupled)

Manufacturer NUTALL OR LUFKIN

Type and Design SINGLE REDUCTION

Rated Horsepower and Service Factor 2500 KW 1.3

Input Shaft Speed 6000

Output Shaft Speed 1800

Horsepower Losses at 100% INCLUDED and 50% of rated power

Cooling Design and Requirements PART OF LUBE SYSTEM

Lubrication Design PRESSURE LUBE

.2.13 Turbine-Generator Performance SEE PROPOSAL SHEET

| Throttle Flow lb/hr (@ 190 PSIG & 384°F) | 50,000 | 40,000 | 25,000 | Max | Min |
|---|---|---|---|---|---|
| Exhaust Enthalpy Btu/lb | | | | | |
| Generator Output (KVA) | | | | | |
| Steam Rate (lb/kwh) | | | | | |

CONDENSER SEE PROPOSAL SHEETS

.1 Manufacturer:

Name: GRAHAM

Location: BATAVIA NY

2 Condenser surface area (total effective): _____ sq. ft.