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INTERNAL TECHNICAL REPORT

Title: SOFTWARE REQUIREMENTS AND DESIGN GUIDE
FOR THE 5MW(e) RAFT RIVER PILOT PLANT

Organization: Mini Systems Division
Project Office

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MAY 15 1980

T. L. RASMUSSEN

Simmons, Patty

From: Dale J Claflin [Dale.Claflin@inl.gov]
Sent: Thursday, December 07, 2006 8:43 AM
To: Simmons, Patty
Cc: Claflin, Dale; Flynn, Vesta; Ponce, Linda
Subject: Re: EG&G Idaho Geothermal Reports
Attachments: EG&G Patent Docs.doc

Patty,

The 13 reports listed are all OK for unrestricted release. Please remove (cover up) the patent caution wording, as well as any other statements concerning restricted distribution. We don't have a concern with the "Internal Technical Report" words, but if you feel it would eliminate confusion by removing that term, please do so. Let me know if you need anything else.

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12/06/2006 12:34 PM

CC "Ponce, Linda" <poncel@osti.gov>, "Flynn, Vesta" <flynnv@osti.gov>
 Subject EG&G Idaho Geothermal Reports

Dale,

OSTI has been working on a project for the last year or so to collect geothermal documents. At the STIP meeting in April, I sent out a plea to the DOE labs to identify and send to OSTI any geothermal documents that we did not already have in our database. I have a problem with a group of reports from EG&G Idaho. I am not sure you are the person correct person to ask for help on this issue. If not, maybe you can direct me to the responsible individual.

Attached is a list of documents that were sent to OSTI as part of that special geothermal project. All of the documents in this list have a patent caution as well as 'Internal Technical Report' stamped on the front of the report. The date on each of the documents is well past the sunset date for patentable material. If there is no other reason for control, I would like permission to cover up the patent caution and release each as unlimited. Would we also need to cover 'Internal Technical Report'?

If you need me to, I will be happy to fax you a copy of the covers of the reports.

Please let me know if you can help me out with this problem, or advise if I should communicate with someone

12/7/2006

else - and who

Thanks ahead for your help,
Patty

Patty Simmons

U.S. DOE Office of Scientific and Technical Information

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865-576-1290

12/7/2006

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SOFTWARE REQUIREMENTS
AND
DESIGN GUIDE
FOR THE
5MW(e) RAFT RIVER
PILOT PLANT

PREPARED BY Carion Mettiff
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MSD PROJECT OFFICE F. S. MIYASAKI DATE 4/4/80

MECHANICAL DESIGN ENGINEER Roger Pissinatti DATE 4-7-80

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5MW(e) PROJECT MANAGER Leola Rasmussen DATE 5-12-80

SOFTWARE REQUIREMENTS AND DESIGN GUIDE
FOR THE RAFT RIVER 5MW(e) PILOT PLANT

1. SCOPE

This document defines the software requirements for the Raft River 5MW(e) Pilot Plant. It constitutes Part II of a three-part overall document which will contain the software requirements for the Supply and Injection Control System as Part I and the software requirements for the Data Processing System as Part III.

This document also provides a functional design guide for the required computer program modules. The design guide is intended to provide management with an overview of the form and function of the modules, and to be a working level outline for the software generation task.

Parts I and III of the overall documents will be issued at later date.

PART II

THE 5MW(e) PLANT

5. OVERVIEW

The 5MW(e) electrical generating plant is a demonstrational unit intended to provide engineering data basic to improvement of geothermal-electric technology. It is anticipated that the plant will operate on a production basis after initial testing, and that periodic re-testing will be done to measure the effects of fouling in heat exchanges and aging generally. The initial tests will confirm engineering estimates of performance, and will identify optimum feasible operating conditions and maximum power generating capacity. They will also identify any anomalous plant behavior not foreseen. Several tests will lead to quantification of constant and variable terms used in thermodynamic relationships descriptive of plant and subsystem behavior. Because the product of the testing will be confirmatory engineering data heretofore unavailable, the plant has been carefully instrumented, with either explicit or implicit instrumentation redundancy for most parameters to be measured. The 5MW(e) data system collects the data directly from the instrumentation. Enhancements such as on-line analytical routines may be added later, but initially, data capture shall be the sole activity of the data system.

The 5MW(e) plant converts the energy of geothermally heated water to electrical energy conforming to 60 Hz commercial power standards. The plant capacity is sufficiently large to be useful in a demonstrational sense, but is limited to a capacity conservative of the geothermal energy resource, which hasn't been fully explored. The 5MW(e) plant will continue on a regular production basis after completion of the testing. Additional production units may be added at a later time.

5.1 Geothermal Water Loop Overview

The supply of geothermally heated water has been discussed in PART 1. The geothermally heated water entering the plant is pressurized by pumps and may give up heat energy to the plant working fluid, isobutane, at two boilers and preheaters. The heated water flows thru the high pressure boiler, the high pressure preheater, the low pressure boiler, and the low pressure preheater. Each of the heat exchange elements in the cascade is engineered for successively lower temperature water input requirements for efficient use of the geothermal resource. After the usable heat energy has been extracted, the water is routed to the injection wells. The initial water temperature is 290°F. The temperature after the energy extraction is 140°F. Flow rate is 2250 gpm under normal operating conditions.

5.2 Isobutane Loop Overview

The plant working fluid, isobutane, is routed in essentially a closed loop. Within the loop liquid isobutane is pumped from a condensate storage tank to the low pressure preheater. The stream is divided, with part of the stream routed to the low pressure boiler, and part to the high pressure preheater. The stream through the high pressure preheater is routed to the high pressure boiler. The streams from the boilers consist of pressurized isobutane vapors, and the streams drive a turbine which has a high pressure and a low pressure stage. The vapors yield mechanical energy in the turbine, and the vapor exhaust of the two turbine stages is merged and routed to a condenser, where the isobutane gives up thermal energy and is condensed. The slightly subcooled liquid is returned to the condensate storage tank. Bypass paths around each of the preheaters help to regulate the input temperatures of the isobutane to the boilers. A water separator treatment element is also part of the isobutane loop.

5.3 Condenser Coolant Loop Overview

The condenser requires a cooled water stream, which picks up heat from the isobutane, and yields heat to ambient air by partial evaporation.

Water treated for mineral removal and for the prevention of scaling in the condenser is pumped to a tower for cooling by a dripping process that uses trays with holes to direct flow through a fan driven ambient air stream. The water losses by evaporation are replaced by a makeup stream from the treatment system. The water continually cycles gaining heat energy from the isobutane in the condenser and yielding heat to the environment in the cooling tower. The condenser function impacts overall plant efficiency, as it is the means of reducing backpressure at the turbine. Ambient air temperature and humidity content affect the water cooling function, which affects the condenser's heat transfer ability which in turn affects the turbine performance via the back pressure effects.

5.4 Turbine-Generator Overview

The turbine-generator unit is the electrical production element of the 5MW(e) plant. The instrumentation of this unit will be monitored by the data system for measurement of performance and general well-being. The turbine-generator combination is a conventional element of most thermal power generating plants. About 80 sensors measuring performance of the turbine generator will be assigned multiplexer connectors into the data system.

5.5 Data System Configuration Overview

The 5MW(e) data system consists of a DEC PDP 11/34 computer system having a VT100 CRT, and a controller for magnetic tape with one PERTEC drive, and two RL01 disks. Plant instrumentation is interfaced through an ANALOGIC analog and digital channel multiplexer. Exclusive of the turbine-generator unit instrumentation, about 130 analog signals are monitored by the data system.

5.6 Data System Function Overview

The 5MW(e) computer exercises no control functions, nor is there any initial requirement for calculational routines. The computer shall control

the sequence and rate of the analog and digital scanning. It will convert analog values to engineering units as necessary, and convert digital values to representations suitable for display. The data system shall exercise a data compression function to exclude redundant values from archive files. Periodic representations of single values, not more frequent than 10 minutes, shall be preserved in the steady state condition. Any significant changes occurring shall also be recorded. For archive purposes, each recorded value shall have either explicit or implicit identification, and shall have an accompanying time of acquisition to full resolution of the computer's time-of-day clock. The data system shall maintain a current value matrix containing the latest acquired value for each active signal on the data system. Upon operator demand, or as a timed function as appropriate, related subsets of the plant parameters shall be displayed on the CRT. A printed representation shall also be made, but only upon specific operator demand.

The data system shall permit transfer of the entire current value matrix to magnetic disk on operator command. This shall permit the preserving of all data system monitored values at a given instant. Space shall be allocated on the magnetic disk for up to 16 such "pictures" before overwrite occurs. This feature is intended to assist verification of steady state conditions. The representations shall be written to magnetic tape on operator command.

The data system archive function shall have enable and disable states under operator control to eliminate needless accumulation of unwanted data during intervals between tests. When the plant becomes fully operational, the disable feature may be removed.

6. GEOHERMAL WATER LOOP INSTRUMENTATION

Geothermal flow arriving from the S & I system at 290°F is regulated by valves. Three valves are used to control water temperature. Water in excess of the 5MW(e) plant needs may be directed into the 5MW(e) injection bypass line. (During normal operation no water bypasses the plant.) Downstream from the modulating valve, the temperature and flow rate are measured. A recirculation line has entry downstream from these two sensors. The next instrumentation downstream is a pressure sensor. Two pressurizing pumps operating in parallel are next. The pumps raise the pressure of the geothermal water by about 100 psig to near 180 psig during normal operations. The pressure is measured downstream of the pressurizing pumps. High pressure flow to the plant may be limited by a bypass. Additionally, some water may be valved to bypass the high pressure boiler and preheater.

Instruments for measuring the water properties ahead of the high pressure boiler include two for temperature, and one for pressure. Instruments immediately following likewise consist of one for pressure measurement, and two for temperatures. The instruments for each succeeding element in the cascade, namely the high pressure preheater, the low pressure boiler, and the low pressure preheater, are all similar to those for the high pressure boiler. The water is channeled through the tubes of each heat exchange element, with the isobutane routed through the shell. The geothermal water pressurization to near 180 psig ensures that the geothermal water will be in the liquid state uniformly as it cascades through the four heat exchanger elements. It also inhibits the precipitation of calcite.

Downstream of the heat exchangers flow is measured, a bypass line enters, and a re-circulation line exits. Flow is measured again downstream as the geothermal water at about 140°F is valved into the injection line. A three-way dump valve may direct the water to a pond if the rate of change in temperature is greater than the injection line can accommodate for any reason.

7. ISOBUTANE LOOP INSTRUMENTATION

Isobutane in the liquid state is held in a condensate storage tank at about 100°F. The tank is instrumented for level and temperature. The tank exit is instrumented for temperature. Two pumps in parallel pressurize the isobutane to about 430 psig, up from the tank pressure of about 66 psig. Pump work raises the temperature to about 105°F. Pressure is measured upstream and downstream of each pump. Additionally, temperature and flow downstream of each pump are measured. The density and flow rate of the isobutane stream are measured for the combined pump output. Partial flow may be valved to a water removal element. Flow through that element is measured, as is any flow valved back to the condensate storage tank.

For isobutane entering the low pressure preheater, instruments include two temperature sensors, and sensors for pressure, flow, and density. Downstream of the low pressure preheater, two sensors measure temperature and one measures pressure. The instruments for the high pressure preheater have a similar configuration. Lines to the boilers have similar instrumentation as well. Instruments for each include those for determining density, flow, and temperature. Instruments immediately preceding the boilers include a sensor for pressure and two for temperature. Pressure and liquid level are sensed in the boilers. Downstream of the boilers, two sensors measure temperature, and flow and density of the isobutane are measured. Preceding the turbine stages temperature, pressure, and flow are measured, then temperature and pressure repeated immediately preceding turbine entry. Temperature of vapors emerging from the turbine is measured, and temperature and pressure of the merged vapor streams are measured. One additional temperature sensor is imposed in the line upstream of the condenser. Pressure and level within the condenser is measured, and a temperature sensor monitors the liquid flowing from the condenser to the storage tank. Bypass lines are instrumented for pressure, temperature, and differential pressure.

8. CONDENSER COOLANT LOOP INSTRUMENTATION

Upstream and downstream from the condenser two sensors measure temperature and one measures pressure. Instruments on lines exiting or entering through valves downstream of the condenser measure flow rate during blowdown, and the flow rate of makeup water. Pressure, temperature, and flow rate of the input stream to the cooling tower are monitored, and atmospheric pressure and wet and dry bulb temperature are measured for ambient air. Wet and dry bulb temperature instrumentation is also mounted in the cooling tower stack. The cooled water in the storage pond is measured for temperature and depth. After the cooling water is pressurized by pumping from the pond, the pressure and flow are measured upstream of the condenser.

9. TURBINE-GENERATOR INSTRUMENTATION

The turbine-generator combination is instrumented to measure working fluid parameters, performance, and operating condition. Instruments monitoring the operating condition or well-being of the turbine-generator unit in general have alarm setpoints. The two stage turbine is instrumented for flows, pressures, and temperatures of the isobutane vapors. The high pressure and low pressure stages of the turbine are supplied by separate headers. Each header has a throttle/stop valve for control of the flow rate, and flow is metered in each header. Pressure, temperature, and flow rate of both of the isobutane vapor streams are measured upstream of the throttle/stop valves, and pressure and temperature are measured downstream from the valves. At the impeller inlet and outlet, the isobutane pressure and temperature are measured. At the exhaust vanes, pressure and temperature are measured similarly. Temperature and pressure of the common exhaust are also measured. Temperature of the isobutane bypass at the balance piston is measured for each stage.

The generator performance instrumentation consists of devices to measure AC output volts, power, power factor, and volt-amperes reactive

(VARs). Measurement is also made of field current and voltage. Temperature of the stator is sensed by resistance temperature detectors at six points, with alarms activated on excessive temperature.

Instrumentation for monitoring vibration in the bearings of the generator, gear box, and turbine is switch selected manually from an Elliot panel. One of ten devices may be selected. The data system monitors the switch position. The devices actually measure proximity, deriving a frequency value for deviations that are cyclic. The signal level is a function of frequency.

The lubricating oil temperature and the temperature of the journal and thrust bearings is monitored with alarm functions. Bearings of the turbine, gear box, and generator are monitored. Oil temperature at the oil cooler outlet and for points downstream from each of the major bearings is measured.

10. DATA SYSTEM INSTRUMENTATION CONFIGURATION

The data system terminal assignments using the ANALOGIC instrumentation interface subsystem is contained in the following section, which provides the terminal assignment (MUX) the signal and transmitter identifications, and the primary and secondary instrumentation ranges. The information has been gathered from the P&IDs listed.

FSEC DRAWINGS:

699-0701-50-274, P-2, Rev-B
699-0701-50-274, P-3, Rev-B
699-0201-50-274, P-5, Rev-A
699-0201-50-274, P-6, Rev-C
699-0201-50-274, P-7, Rev-B
699-0201-50-274, P-8, Rev-A
699-0701-28-274, I-2, Rev-A
699-0701-28-274, I-3, Rev-A
699-0701-28-274, I-4, Rev-A
699-0701-28-274, I-5, Rev-A
699-0701-28-274, I-6, Rev-A
699-0701-28-274, I-7, Rev-A

ABBREVIATIONS

RBT	=	RESISTANCE BULB TRANSMITTER
SCT	=	SIGNAL CONVERTER TRANSMITTER
FDT	=	FREQUENCY TO D. C. TRANSMITTER
DCA	=	DIRECT CURRENT ALARM
DT	=	DENSITY TRANSMITTER
PT	=	PRESSURE TRANSMITTER
LT	=	LEVEL TRANSMITTER
ZT	=	POSITION TRANSMITTER
TE	=	TEMPERATURE ELEMENT
FT	=	FLOW TRANSMITTER
TDT	=	DIFFERENTIAL TEMP TRANSMITTER
PDT	=	DIFFERENT PRESSURE TRANSMITTER
MUX	=	MULTIPLEXOR
H.P.	=	HIGH PRESSURE
L.P.	=	LOW PRESSURE
TBV	=	TURBINE BYPASS VALVE
TBS	=	TO BE SPECIFIED

TAG NUMBER IDENTIFICATION

The digits following the sensor abbreviation identify the subsystem where the measurement is located. For example: TE 127 is a temperature measurement located in the Isobutane Condensate Sybsystem. For the thermal loop the following number blocks identify the subsystems shown:

<u>Number Block</u>	<u>Subsystem</u>
100	Isobutane Condensate
200	Isobutane Fluid
300	Isobutane Vapor
800	Geothermal Fluid
900	Cooling Water

MUX CHANNEL	DESCRIPTION	TAG NO.
1.	Pressure H. P. Preheater Outlet	(PT-259)
2.	Temperature H. P. Preheater Discharge	(TE-256)
3.	Temperature H. P. Preheater Discharge	(TE-203A)
4.	Temperature H. P. Preheater Suction	(TE-251)
5.	Flow Differential Isobutane to H. P. Preheater	(FDT-255)
6.	Pressure H. P. Preheater Inlet	(PT-249)
7.	Temperature L. P. Preheater Discharge	(TE-265)
8.	Pressure L. P. Preheater Outlet	(PT-267)
9.	Temperature L. P. Preheater Discharge	(TE-262A)
10.	Temperature L. P. Preheater Suction	(TE-253)
11.	Flow Differential Isobutane to L. P. Preheater	(FDT-264)
12.	Pressure L. P. Preheater Inlet	(PT-250)
13.	Temperature L. P. Boiler Discharge	(TE-271A)
14.	LEVEL Isobutane L. P. Boiler	(LT-208)
15.	Temperature L. P. Boiler Discharge	(TE-287)
16.	Pressure L. P. Boiler	(PT-289)
17.	Temperature L. P. Boiler Suction	(TE-290)
18.	Pressure L. P. Boiler Inlet	(PT-293)
19.	Position Isobutane L. P. Boiler Valve	(ZT-208)
20.	Flow Isobutane to L. P. Boiler	(FDT-294)
21.	Differential Pressure P across WA 208	(PDT-254)
22.	Temperature H. P. Boiler Discharge	(TE-248)
23.	Temperature H. P. Boiler Suction	(TE-263B)
24.	Level Isobutane H. P. Boiler	(LT-213)
25.	Temperature H. P. Boiler Suction	(TE-298)
26.	Pressure H. P. Boiler Inlet	(PT-214)
27.	Position Isobutane H. P. Boiler	(ZT-213)
28.	Differential Pressure P across WA 213	(PDT-297)

MUX CHANNEL	DESCRIPTION	TAG NO.
29.	Flow Isobutane to L. P. Boiler	(FDT-296)
30.	Pressure L. P. T.S.V. Inlet	(PT-284)
31.	Flow Isobutane Vapor to H. P.	(FT-153)
32.	Temperature L. P. T.S.V. Inlet	(TE-154)
33.	Differential Pressure Across L. P. T.S.V.	(PDT-156)
34.	Position Isobutane L. P Turbine Valve	(ZT-303)
35.	Temperature L. P. T.S.V. Outlet	(TE-158)
36.	Pressure H. P. T.S.V. Inlet	(PT-263)
37.	Flow Isobutane Vapor to L. P. Turbine	(FDT-150)
38.	Differential Pressure (P across H. P. T.S.V.)	(PDT-148)
39.	Position Isobutane H. P. Turbine Valve	(ZT-304)
40.	Temperature (H. P. T.S.V. Outlet)	(TE-152)
41.	Temperature Condensor Inlet	(TE-146)
42.	Temperature Condensate Storage Tank	(TE-144)
43.	Level Condensate TK101	(LT-145)
44.	Level TK101 and HX101	(LT-162)
45.	Position Pump Bypass Flow Control	(ZT-278)
46.	Flow Differential Turbine to Bypass Condensor Storage	(FDT-160)
47.	Temperature Condensor Outlet	(TE-143)
48.	Pressure Condensor HX-102	(PT-141)
49.	Pressure Pump 101 Suction	(PT-159)
50.	Temperature Pump 101 Discharge	(TE-135)
51.	Pressure Pump 101 Discharge	(PT-139)
52.	Temperature H. P. Boiler Discharge	(TE-263A)
53.	Flow Pump 101 Discharge	(FT-134)
54.	Flow Pump 102 Discharge	(FT-133)
55.	Flow Pump 101 and 102 Discharge	(FT-278)
56.	Pressure Pump 102 Discharge	(PT-131)

MUX	DESCRIPTION	TAG NO.
CHANNEL		
57.	Temperature Discharge From Pump 102	(TE-127)
58.	Pressure Pump 102 Suction	(PT-129)
59.	Pressure H. P. Boiler Inlet	(PT-878)
60.	Temperature H. P. Boiler Suction	(TE-898)
61.	Temperature H. P. Boiler Suction	(TE-840A)
62.	Temperature H. P. Boiler Discharge	(TE-899)
63.	Pressure H. P. Boiler Outlet	(PT-829)
64.	Pressure H. P. Preheater Inlet	(PT-875)
65.	Temperature H. P. Preheater Suction	(TE-839A)
66.	Temperature H. P. Preheater Discharge	(TE-897)
67.	Pressure H. P. Preheater Outlet	(PT-828)
68.	Pressure L. P. Boiler Inlet	(PT-872)
69.	Temperature L. P. Boiler Suction	(TE-838A)
70.	Temperature L. P. Boiler Discharge	(TE-895)
71.	Pressure L. P. Boiler Outlet	(PT-827)
72.	Pressure L. P. Preheater Inlet	(PT-870)
73.	Temperature L. P. Preheater Suction	(TE-837A)
74.	Pressure L. P. Preheater Outlet	(PT-826)
75.	Temperature L. P. Preheater Discharge	(TE-896)
76.	Pressure Combined Pump Discharge	(PT-882)
77.	Flow Differential at 10" Turbine	(FDT-887)
78.	Pressure Differential Across Pump 802	(PDT-886)
79.	Temperature L. P. Boiler Suction	(TE-271B)
80.	Pressure Differential Across Pump 801	(PDT-885)
81.	Pressure Geothermal Fluid Filter Outlet	(PT-889)
82.	Vacant	
83.	Temperature Geothermal Fluid Inlet	(TE-891)
84.	Flow From Geothermal Wells	(FT-892)
85.	Vacant	

MUX CHANNEL	DESCRIPTION	TAG NO.
86.	Position Geothermal Fluid Temperature Control	(ZT-805)
87.	Flow Bypass	(FT 880A)
88.	Flow To Injection	(FT 865)
89.	Position Geothermal Fluid Reinjection Control	(ZT-821)
90.	Temperature Cooling Tower Outlet	(TE-941)
91.	Temperature Cooling Tower Outlet	(TE-942)
92.	Temperature Cooling Tower Inlet	(TE-963)
93.	Flow Cooling Tower Inlet	(FT-959)
94.	Temperature Cooling Tower Inlet-Dry Bulb	(TE-938)
95.	Pressure Atmospheric At Cooling Tower Inlet	(PT-939)
96.	Temperature Cooling Tower Inlet Wet Bulb	(TE-940)
97.	Flow Make Up Water Pretreatment Plant	(FT-933)
98.	Flow Combined Pump Discharge	(FT-956)
99.	Pressure Cooling Water Sump Outlet	(PT-957)
100.	Temperature Cooling Water Sump	(TE-955)
101.	Flow Blow Down Treatment Plant	(FT-930)
102.	Temperature Difference Condensate Storage Tank Inlet-Outlet	(TDT-934)
103.	Pressure Condensor HX101 Outlet	(PT-926)
104.	Temperature Condensate Storage Tank Outlet	(TE-928)
105.	Temperature Condensate Storage Tank Inlet	(TE-929)
106.	Pressure Condensor HX102 Inlet	(PT-932)
107.		
108.		
109.		
110.		
111.	Pressure H. P. Boiler	(PT-299)
112.	Temperature Isobutane Liquid	(TE-279)
113.	Temperature H. P. Boiler Discharge	(TE-840B)
114.	Temperature H. P. Preheater Discharge	(TE-839B)
115.	Temperature Isobutane Vapor	(TE-151)

MUX CHANNEL	DESCRIPTION	TAG NO.
116.		(TE-155)
117.	Flow Bypass	(FT 880B)
118.	Temperature L. P. Boiler Inlet	(TE-280)
119.	Temperature H. P. Boiler Inlet	(TE-281)
120.	Temperature Condensate Storage Discharge	(TE-128)
121.	Temperature L. P. Boiler Discharge	(TE-838B)
122.	Temperature L. P. Preheater Discharge	(TE-837B)
123.	Temperature H. P. Preheater Suction	(TE-203B)
124.	Temperature L. P. Preheater Suction	(TE-262B)
125.	Temperature Geo. Water to S&I Dump Valve	(TE-10-207)
126.	Temperature Geo. Water to Injection System	(TE-10-208)
127.	S&I Bypass Flow	(FT-306)
128.	Pressure S&I Supply Water	(PT-10-115)
129.	Pressure S&I Injection System	(PT-10-128)
130.	Turbine/Generator Measurements (To be included in Revision-1)	
213.		

Equipment	Description	Destination	Units
TE 127	Temperature (dis- charge from Pump 102)-	1. Data array 2. Video display on demand 3. Archived to tape (on demand)	1-5 V D.C. Range 50-150°F
RBT 127			
SCT 127			
MUX 57			
TE 128	Temperature (con- densate storage discharge)	as above	4-20 MA out of SCT 128 50-150°F
RBT 128			
SCT 128			
MUX 120			
PT 129	Pressure (Pump 102 Suction)	as above except no video display	4-20 MA out of SCT 129 50-150 PSIG
SCT 129			
MUX 58			
PT 131			
SCT 131	Pressure (Pump 102 discharge)	as above except no video display	1-5 V D.C. 0-800 PSIG
MUX 56			
FT 133	Flow (Pump 102 discharge)	as above	1-5 V D.C. Range (Set 0-50") (Adj. 0-150")
SCT 133			
MUX 54			
FT 134	Flow (Pump 101 discharge)	As above except no video display	1-5 V D.C. Range (Set 0-50") (Adj. 0-150")
SCT 134			
MUX 53			

Equipment	Description	Destination	Units
TE 135	Temperature (Pump 101 discharge)	As above	1-5 V D.C. Range 50-150°F
RBT 135			
SCT 135			
MUX 50			
PT 139	Pressure (Pump 101 discharge)	As above except no video display	1-5 V D.C. Range 0-800 PSIG
SCT 139			
MUX 51			
PT 141	Pressure (condenser HX-102)	As above except no video display	4-20 MA Range 0-200 PSIG
SCT 141			
MUX 48			
TE 143	Temperature (condenser outlet)	As above	1-5 V D.C. Range 50-150°F
RBT 143			
SCT 143			
MUX 47			
TE 144	Temperature (condensate storage tank)	As above	1-5 V D.C. Range 50-150°F
RBT 144			
SCT 144			
MUX 42			
TE 146	Temperature (condenser inlet)	As above except no video display	4-20 mA Range 125-200°F
RBT 146			
SCT 146			
MUX 41			

Equipment	Description	Destination	Units
LT 145 SCT 145 MUX 43	Level (condensate TK-101)	As above except no video display	1-5 V D.C. Range
PDT 148 SCT 148 MUX 38	Pressure (P across H.P. T.B.V.)	As above	1-5 V D.C. Range 0-500 PSID
FDT 150 SCT 150 MUX 37	Flow (turbine vapor)	As above except no video display	4-20 MA Range: TBS
TE 151 SCT 150 MUX 115	Temperature Isobutane vapors	As above	1-5 V D.C. Range TBS
TE 152 RBT 152 SCT 152 MUX 40	Temperature (H.P. T.B.V.)	As above	1-5 V D.C. Range 50-200°F
FT 153 FDT 153 SCT 153 MUX 31	Flow (isobutane vapor to H.P.)	As above except no video display	4-20 MA Range TBS

Equipment	Description	Destination	Units
TE 155 SCT MUX 116	Temperature isobutane vapors	As above	1-5 V D.C. Range TBS
TE 154 RBT 154 SCT 154 MUX 32	Temperature (L.P. T.B.V.) Inlet	As above	1-5 V D.C. Range 125-200°F
PDT 156 SCT 156 MUX 33	Differential pressure (across L.P. T.B.V.)	As above	1-5 V D.C. Range (Set 0 - 250 PSID)
TE 158 RBT 158 SCT 158 MUX 35	Temperature (L.P. T.B.V.)	As above	1-5 V D.C. Range 50-200°F
PT 159 SCT 159 MUX 49	Pressure (Pump 101 suction)	As above except no video display	4-20 MA Range (Set 0 - 150 PSIG)
FDT 160 SCT 160 MUX 46	Flow (differential) Turbine to bypass condenser storage	As above	4-20 MA Range TBS

Equipment	Description	Destination	Units
LT 162 SCT 162 MUX 44	Level cond. storage tank	As above	4-20 MA Range (Set 0 - 240")
FT 278 SCT 278 MUX 55	Flow pump 101 & 102 discharge	As above except no video display	4-20 MA Range (Set 0 - 100", Adj. 0 - 150")
ZT 278 SCT 278 MUX 45	Pump bypass flow control	As above	4-20 MA Range TBS
TE 279 SCT MUX 112	Temperature isobutane liquid	As above	1-5 V D.C. Range TBS
PT 263 SCT 263 MUX 36	Pressure H.P. T.B.V. inlet	As above	1-5 V D.C. Range (Set 0 - 750 PSIG)
PT 284 SCT 284 MUX 30	Pressure L.P. T.B.V. inlet	As above	1-5 V D.C. Range (Set 0 - 750 PSIG)

Equipment	Description	Destination	Units
TE 280	Temperature low pressure boiler inlet	As above	4-20 MA Range 50-200°F
RBT 280			
SCT 280			
MUX 118			
TE 281	Temperature HP boiler inlet	As above	4-20 MA Range 50-250°F
RBT 281			
SCT 281			
MUX 119			
MUX 110	Vacant		
FDT 296	Flow isobutane to LP boiler (10" Turbine meter)	As above	4-20 MA Range TBS
SCT 296			
MUX 29			
MUX 109	Vacant		
FDT 294	Flow isobutane to LP boiler (8" Turbine meter)	As above	4-20 MA Range TBS
SCT 294			
MUX 20			

Equipment	Description	Destination	Units
TE 248 RBT 248 SCT 248 MUX 22	Temperature HP boiler discharge	As above	4-20 MA Range 125-300°F
TE 290 RBT 290 SCT 290 MUX 17	Temperature LP boiler suction	As above	4-20 MA Range 125-200°F
PT 293 SCT 293 MUX 18	Pressure LP boiler inlet	As above	4-20 MA Range (Set 0 - 750 PSIG)
TE 287 RBT 287 SCT 287 MUX 15	Temperature LP boiler discharge	As above	4-20 MA Range 125-200°F
LT 213 SCT 213 MUX 24	Level isobutane HP boiler	As above	4-20 MA Range TBS
ZT 213 SCT 213 MUX 27	Position isobutane HP boiler	As above	4-20 MA Range TBS

Equipment	Description	Destination	Units
PDT 254 SCT 254 MUX 21	Differential pressure P across WA 208	As above	4-20 MA Range (Set 0 - 250 PSIG)
PDT 297 SCT 297 MUX 28	Differential pressure P across WA 213	As above	4-20 MA Range (Set 0 - 50 PSIG)
LT 208 SCT 208 MUX 14	Level isobutane LP boiler	As above	4-20 MA Range TBS
ZT 208 SCT 208 MUX 19	Position isobutane LP boiler	As above	4-20 MA Range TBS
PT 289 SCT 289 MUX 16	Pressure LP boiler	As above	4-20 MA Range (Set 0 - 1000 PSIG)
PT 299 SCT 299 MUX 111	Pressure HP boiler	As above	4-20 MA Range (Set 0 - 1000 PSIG)
TE 262A RBT 262A SCT 262A MUX 9	Temperature preheater discharge	As above	1-5 V D.C. Range 130-190°F

Equipment	Description	Destination	Units
TE 262B RBT 262B SCT 262B MUX 124	Temperature preheater suction	As above	1-5 V D.C. Range 60-110°F
TE 203A RBT 203A SCT 203A MUX 3	Temperature HP preheater discharge	As above	1-5 V D.C. Range 200-250°F
TE 203B RBT 203B SCT 203B MUX 123	Temperature HP preheater suction	As above	1-5 V D.C. Range 120-180°F
PT 250 SCT 250 MUX 12	Pressure LP preheater inlet	As above except no video display	1-5 V D.C. Range (Set 0 - 750 PSIG)
PT 259 SCT 259 MUX 1	Pressure HP preheater outlet	As above except no video display	1-5 V D.C. Range (Set 0 - 750 PSIG)
PT 267 SCT 267 MUX 8	Pressure LP preheater outlet	As above except no video display	1-5 V D.C. Range (Set 0 - 750 PSIG)

Equipment	Description	Destination	Units
PT 249	Pressure HP preheater inlet	As above except no video display	1-5 V D.C. Range (Set 0 - 750 PSIG)
SCT 249			
MUX 6			
TE 265	Temperature LP preheater discharge	As above	1-5 V D.C. Range 125-200°F
RBT 265			
SCT 265			
MUX 7			
TE 251	Temperature HP preheater suction	As above except no video display	4-20 MA Range 50-200°F
RBT 251			
SCT 251			
MUX 4			
TE 253	Temperature LP preheater inlet	As above except no video display	4-20 MA Range 50-150°F TBS
RBT 253			
SCT 253			
MUX 10			
MUX 107	Vacant		
FDT 255	Flow isobutane to HP preheater	As above	1-5 V D.C. Range TBS
SCT 255			
MUX 5			

Equipment	Description	Destination	Units
FDT 264	Flow isobutane to LP preheater	As above	1-5 V D.C. Range TBS
SCT 264			
MUX 11			
MUX 108	Vacant		
TE 263A	Temperature HP boiler discharge	As above	1-5 V D.C. Range 200-260°F
RBT 263A			
SCT 263A			
MUX 52			
TE 263B	Temperature HP boiler suction	As above	1-5 V D.C. Range 200-250°F
RBT 263B			
SCT 263B			
MUX 23			
TE 271A	Temperature LP boiler discharge	As above	1-5 V D.C. Range 130-190°F
RBT 271A			
SCT 271A			
MUX 13			
TE 271B	Temperature LP boiler suction	As above	1-5 V D.C. Range 120-180°F
RBT 271B			
SCT 271B			
MUX 79			

Equipment	Description	Destination	Units
PT 214 SCT 214 MUX 26	Pressure HP boiler inlet	As above	4-20 MA Range (Set 0 - 750 PSIG)
TE 298 RBT 298 SCT 298 MUX 25	Temperature HP boiler suction	As above	4-20 MA Range 125-250°F
ZT 303 SCT 303 MUX 34	Position isobutane LP turbine valve	As above	4-20 MA Range TBS
ZT 304 SCT 304 MUX 39	Position isobutane HP turbine valve	As above	4-20 MA Range TBS
ZT 805 SCT 805 MUX 86	Position geothermal fluid temperature control	As above	4-20 MA Range TBS
TE 838A RBT 838A SCT 838A MUX 69	Temperature LP boiler suction	As above	1-5 V D.C. Range 175-225°F

Equipment	Description	Destination	Units
TE 838B	Temperature LP boiler discharge	As above	1-5 V D.C. Range 130-190°F
RBT 838B			
SCT 838B			
MUX 121			
TE 839A	Temperature HP preheater suction	As above	1-5 V D.C. Range 210-260°F
RBT 839A			
SCT 839A			
MUX 65			
TE 839B	Temperature HP preheater discharge	As above	1-5 V D.C. Range 175-225°F
RBT 839B			
SCT 839B			
MUX 114			
TE 837A	Temperature LP preheater suction	As above	1-5 V D.C. Range 130-190°F
RBT 837A			
SCT 837A			
MUX 73			
TE 837B	Temperature LP preheater discharge	As above	1-5 V D.C. Range 90-160°F
RBT 837B			
SCT 837B			
MUX 122			

Equipment	Description	Destination	Units
TE 840A	Temperature HP boiler suction	As above	1-5 V D.C. Range 250-300°F
RBT 840A			
SCT 840A			
MUX 61			
TE 840B	Temperature HP boiler discharge	As above	1-5 V D.C. Range 210-260°F
RBT 840B			
SCT 840B			
MUX 113			
TE 891	Temperature geo- fluid inlet	As above	1-5 V D.C. Range 25-300°F
RBT 891			
SCT 891			
MUX 83			
PT 889	Pressure geo- fluid filter outlet	As above except no video display	1-5 V D.C. Range (Set 0 - 300 PSIG)
SCT 889			
MUX 81			
PT 882	Pressure combined pump discharge	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)
SCT 882			
MUX 76			
PT 878	Pressure HP boiler inlet	As above except no video display	1-5 V D.C. Range (Set 0 - 300 PSIG)
SCT 878			
MUX 59			

Equipment	Description	Destination	Units
PT 829 SCT 829 MUX 63	Pressure HP boiler outlet	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)
PT 875 SCT 875 MUX 64	Pressure HP preheater inlet	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)
PT 828 SCT 828 MUX 67	Pressure HP preheater outlet	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)
PT 872 SCT 872 MUX 68	Pressure LP boiler inlet	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)
PT 827 SCT 827 MUX 71	Pressure LP boiler outlet	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)
PT 870 SCT 870 MUX 72	Pressure LP preheater inlet	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)
PT 826 SCT 826 MUX 74	Pressure LP preheater outlet	As above	1-5 V D.C. Range (Set 0 - 300 PSIG)

Equipment	Description	Destination	Units
PDT 886	Pressure differential across Pump 802	As above	1-5 V D.C. Range 0-150 PSI
SCT 886			
MUX 78			
PDT 885	Pressure differential across Pump 801	As above	1-5 V D.C. Range 0-150 PSI
SCT 885			
MUX 80			
TE 899	Temperature HP boiler discharge	As above except no video display	4-20 MA Range 125-275°F
RBT 899			
SCT 899			
MUX 62			
TE 897	Temperature HP preheater discharge	As above except no video display	4-20 MA Range 125-275°F
RBT 897			
SCT 897			
MUX 66			
TE 895	Temperature LP boiler discharge	As above except no video display	4-20 MA Range 125-200°F
RBT 895			
SCT 895			
MUX 70			
TE 896	Temperature LP preheater discharge	As above except no video display	4-20 MA Range 25-175°F
RBT 896			
SCT 896			
MUX 75			

Equipment	Description	Destination	Units
TE 898	Temperature HP boiler suction	As above	4-20 MA Range 125-300°F
RBT 898		except no	
SCT 898		video display	
MUX 60			
ZT 821	Position geo-thermal fluid injection control	As above	1-5 V D.C. Range TBS
SCT 821			
MUX 89			
FDT 887	Flow 10" turbine meter	As above	4-20 MA Range TBS
SCT 887		except no	
MUX 77		video display	
FT 880A	Flow (bypass)	As above	4-20 MA Range (Set 0 - 100") (Adj 0 - 150")
SCT 880A			
MUX 87			
FT 880B	Flow (bypass)	As above	4-20 MA Range (Set 0 - 50") (Adj 0 - 150")
SCT 880B			
MUX 117			
FT 892	Flow from wells	As above	1-5 V D.C. Range (Set 0 - 100") (Adj 0 - 150")
SCT 892			
MUX 84			

Equipment	Description	Destination	Units
FT 865	Flow to injection	As above	1-5 V D.C.
SCT 865			Range
			(Set 0 - 100")
MUX 88			(Adj 0 - 150")
TE 940	Temperature cooling tower inlet wet bulb	As above	1-5 V D.C.
RBT 940			Range
SCT 940			+32°F
MUX 96			to 150°F
PT 957	Pressure cooling water sump outlet	As above	1-5 V D.C.
SCT 957			Range (Set 0 - 150 PSIG)
MUX 99			
PT 939	Pressure atmospheric at cooling tower inlet	As above	1-5 V D.C.
SCT 939			Range (Set 0 - 15 PSIA barometric)
MUX 95			
TE 938	Temperature cooling tower inlet dry bulb	As above	1-5 V D.C.
RBT 938			Range -30 to 150°F
SCT 938			
MUX 94			
TE 942	Temperature cooling tower outlet	As above	4-20 MA
RBT 942			Range
SCT 942			TBS
MUX 91			

Equipment	Description	Destination	Units
TE 941	Temperature cooling tower outlet	As above	4-20 MA Range -30 to 150°F
RBT 941			
SCT 941			
MUX 90			
TE 929	Temperature condenser inlet	As above except no video display	4-20 MA Range 25-100°F
RBT 929			
SCT 929			
MUX 105			
TE 928	Temperature condenser outlet	As above except no video display	4-20 MA Range 25-100°F
RBT 928			
SCT 928			
MUX 104			
TE 955	Temperature cooling water sump	As above	1-5 V D.C. Range 25-100°F
RBT 955			
SCT 955			
MUX 100			
PT 932	Pressure condenser HX 101 inlet	As above except no video display	1-5 V D.C. Range (Set 0 - 150 PSIG)
SCT 932			
MUX 106			

Equipment	Description	Destination	Units
PT 926	Pressure condenser HX 101 outlet	As above except no video display	1-5 V D.C. Range (Set 0 - 150 PSIG)
SCT 926			
MUX 103			
TE 934A TE 934B	Temperature difference con- densate storage tank inlet-outlet	As above	1-5 V D.C. Range 0-150°F
TDT 934			
SCT 934			
MUX 102			
FT 930	Flow blowdown treatment plant	As above	1-5 V D.C. Range (Set 0 - 50") (Adj 0 - 150")
SCT 930			
MUX 101			
FT 956	Flow combined pump discharge	As above	4-20 MA Range (Set 0 - 300") (Adj 0 - 750")
SCT 956			
MUX 98			
FT 933	Flow make up water pretreatment plant	As above except no video display	1-5 V D.C. Range (Set 0 - 100") (Adj 0 - 150")
SCT 933			
MUX 97			
FT 959	Flow cooling tower inlet	As above	1-5 V D.C. Range (Set 0 - 300") (Adj 0 - 750")
SCT 959			
MUX 93			

Equipment	Description	Destination	Units
TE 963	Temperature cooling tower inlet	As above	1-5 V D.C. Range +30 -150°F
RBT 963			
SCT 963			
MUX 92			
TE 256	Temperature HP Preheater	As above	1-5 V D.C. Range 125-250°F
RBT 256	discharge		
SCT 256			
MUX 2			

- NOTE:
1. Turbine/Generator measurements will be included in Revision-1.
 2. MUX channels 125 through 129 will be included in Revision-1.