108050000-TD8019-R00

Spallation Neutron Source

Ring DI Water System Controls Functional System Design (FSD)

February, 2003

APPROVED
BY: David Meyer
DATE: 3/10/03

J. E. Calaway 3/3/03
SNS Project Engineer

A U.S. Department of Energy Multilaboratory Project

SPALLATION NEUTRON SOURCE

Argonne National Laboratory • Brookhaven National Laboratory • Lawrence Berkeley National Laboratory • Los Alamos National Laboratory • Oak Ridge National Laboratory

Ring DI Water System Controls Description
TD8019 Rev 0

Operating Philosophy

Purpose:

The purpose of DI water system operation is to:

a) Maintain the DI water at an appropriate temperature setpoint.
b) Provide alarms if the resistivity in the circulating loop or polishing loop are abnormal

Assumptions: Running both pumps simultaneously is not acceptable.

Operator Controls and Operating Modes

1) OFF: Pumps are de-energized. Tower water return line control valve at 50% open.
2) PUMP A IS PRIMARY: Pump A is energized and pump B is de-energized.
3) PUMP B is PRIMARY: Pump B is energized and pump A is de-energized

OPERATOR INTERFACE DEFINITIONS

Local Hardware/Manual Operator Controls

1) Post heat exchanger DI water pressure *(PI 4600A, PI 4601A, PI 4602A, PI 4700A, PI 4400A, PI 4800A)*
2) Pre heat exchanger DI water pressure *(PI 4600B, PI 4601B, PI 4602B, PI 4700B, PI 4400B, PI 4800B)*
3) Filter skid DI water pressure #1 *(PI 4600E, PI 4601E, PI 4602E, PI 4700E, PI 4400E, PI 4800E)*
4) Filter skid DI water pressure #2 *(PI 4600F, PI 4601F, PI 4602F, PI 4700F, PI 4400F, PI 4800F)*
5) Filter skid DI water pressure #3 *(PI 4600G, PI 4601G, PI 4602G, PI 4700G, PI 4400G, PI 4800G)*
6) Post heat exchanger DI water temperature *(TI 4600A, TI 4601A, TI 4602A, TI 4700A, TI 4400A, TI 4800A)*
7) Pre heat exchanger DI water temperature *(TI 4600B, TI 4601B, TI 4602B, TI 4700B, TI 4400B, TI 4800B)*
8) Tower water supply temperature *(TI 4600C, TI 4601C, TI 4602C, TI 4700C, TI 4400C, TI 4800C)*
9) Tower water return temperature *(TI 4600D, TI 4601D, TI 4602D, TI 4700D, TI 4400D, TI 4800D)*
10) HOA switch for Pump A *(HS 4600A, HS 4601A, HS 4602A, HS 4700A, HS 4400A, HS 4800A)*
11) HOA switch for Pump B *(HS 4600B, HS 4601B, HS 4602B, HS 4700B, HS 4400B, HS 4800B)*
12) DI water pressure gauge isolation valves *(HV 4600A,B,E,F,G, HV 4601A,B,E,F,G HV 4602A,B,E,F,G, HV 4700A,B,E,F,G, HV 4400A,B,C,E,F,G, HV 4800A,B,C,E,F,G)*
13) DI water pumps isolation valves (*HV 4600W,X,Y,Z, HV 4601W,X,Y,Z, HV 4602W,X,Y,Z, HV 4700W,X,Y,Z, HV 4400W,X,Y,Z, HV 4800W,X,Y,Z)*

14) FAULT indicator light on MCC
15) READY indicator light on MCC
16) RUN indicator light on MCC

Software HMI/EPICS Digital Operator Controls

1) Primary Pump Mode
    a. OFF
    b. Pump A is primary
    c. Pump B is primary

Software HMI/EPICS Digital Displays

1) Primary Pump Mode switch status
    a. OFF
    b. Pump A is primary
    c. Pump B is primary
2) Pump that is running and the pump that is de-energized. *(PDIS 4600A,PDIS 4600B,PDIS 4601A, PDIS 4601B, PDIS 4602A, PDIS 4602B, PDIS 4700A, PDIS 4700B, PDIS 4400A, PDIS 4400B, PDIS 4800A, PDIS 4800B)*
3) Failed Primary Pump: Differential pressure across primary pump is low. Logic de-energizes primary pump and energizes backup pump.

Software HMI/EPICS Analog Operator Controls

1) DI water temperature

Software HMI/EPICS Analog Displays

1) DI water supply temperature *(TT 4600A, TT 4601A, TT4602A, TT4700A, TT4400A, TT4800A)*
2) Tower water return line controller output *(IP 4600A/TCV 4600A, IP 4601A/TCV 4601A, IP 4602A/TCV 4602A, IP 4700A/TCV 4700A, IP 4400A/TCV 4400A, IP 4800A/TCV 4800A)*
3) Resistivity of circulating loop *(AIT 4600A, AIT 4601A, AIT 4602A, AIT 4700A, AIT 4400A, AIT 4800A)*
4) Resistivity of polishing loop *(AIT 4600B, AIT 4601B, AIT 4602B, AIT 4700B, AIT 4400B, AIT 4800B)*

Software HMI/EPICS Alarms (via EPICS Alarm Handler)

1) Supply temperature high and low
2) Tower water differential pressure high and low
3) Circulating loop resistivity low
4) Polishing loop resistivity low
5) Primary pump failed, backup pump running (differential pressure is normal)
6) No flow (low differential pressure on both pumps)

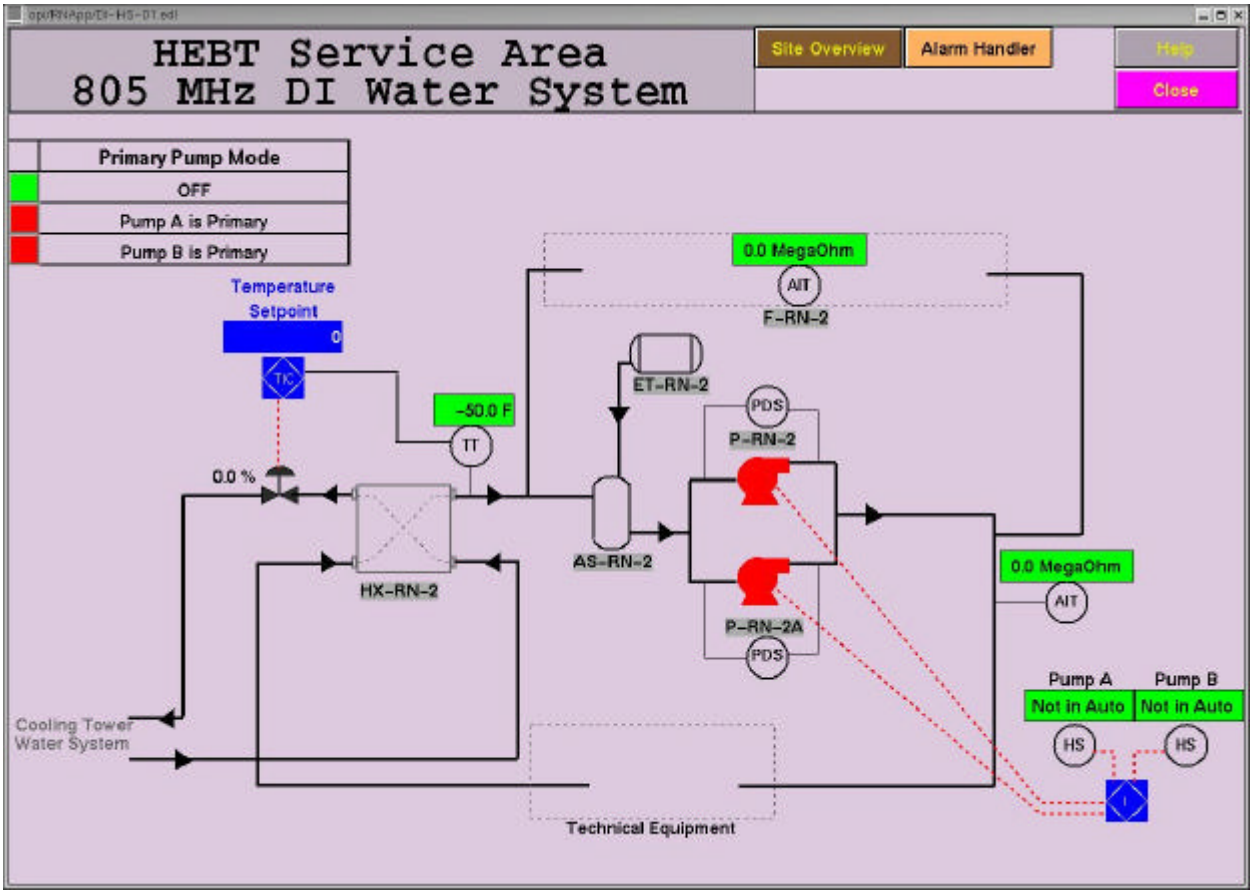
Control Logic Description

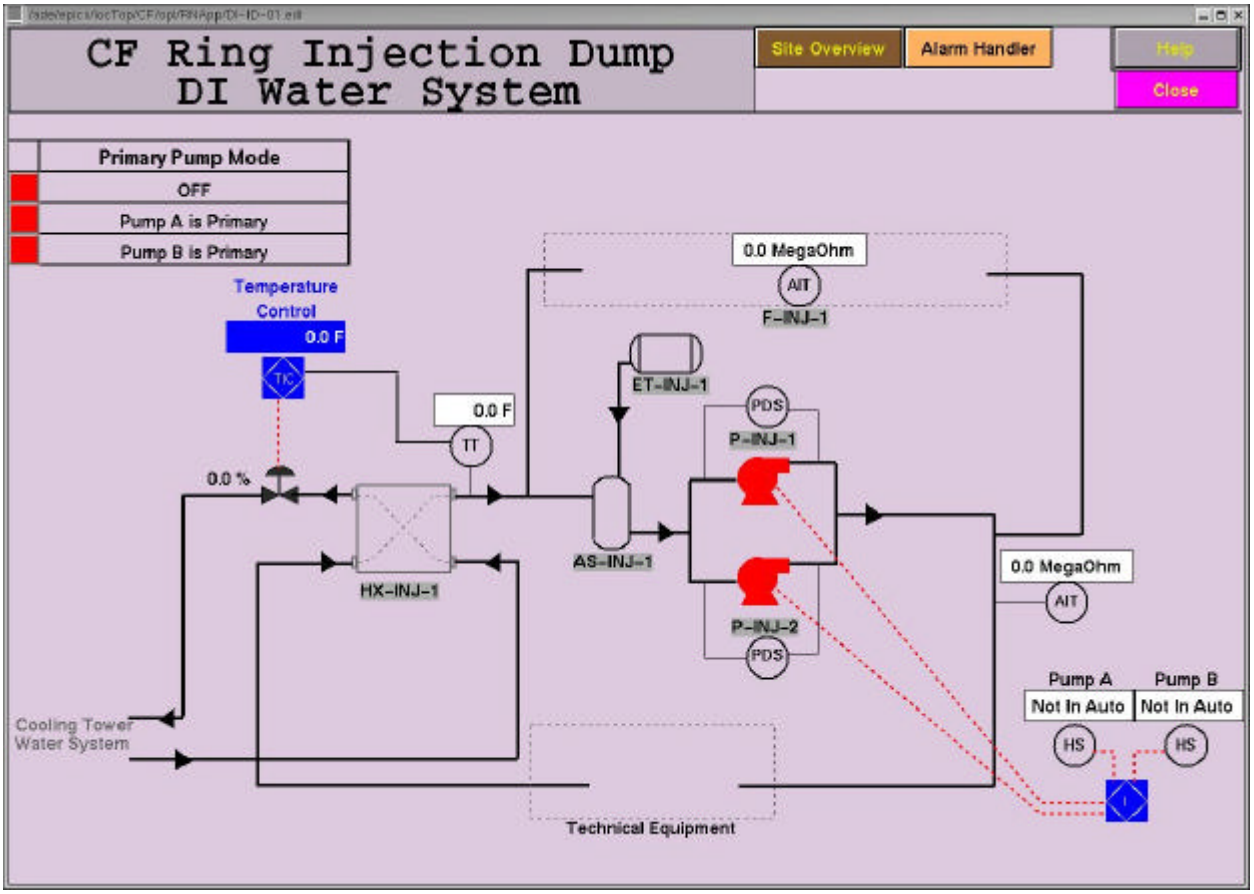
In the OFF mode, the primary and backup pump will be de-energized .

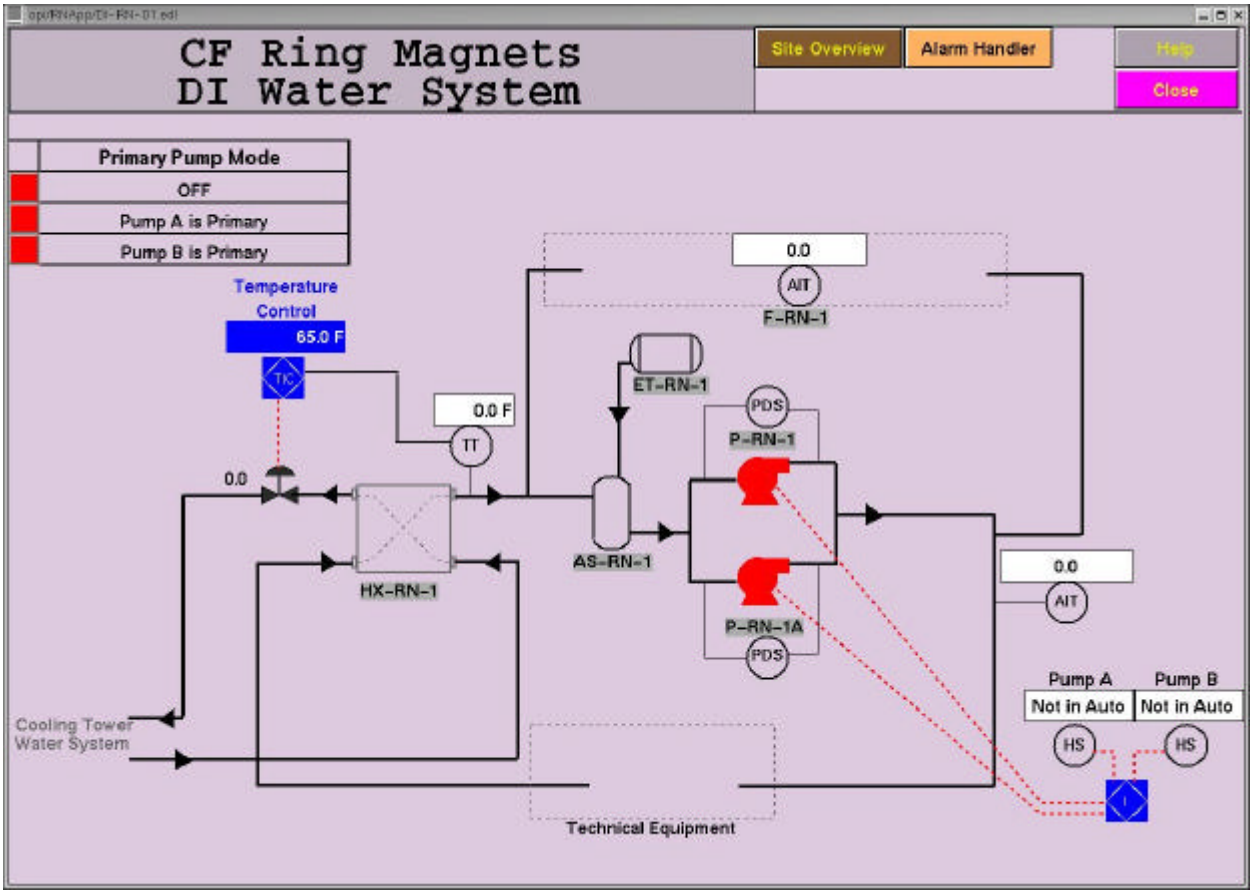
In the PUMP A IS PRIMARY mode, the Pump A will be energized and the Pump B will be de-energized. After a delay period, the Pump A will be periodically checked for low flow. If low flow is detected, Pump A will be de-energized and Pump B will be energized. An alarm will be generated to the operator. After a delay period, the Pump B will be periodically checked for low flow. If low flow is detected, Pump B will be de-energized and a "No Flow" alarm will be generated to the operator.

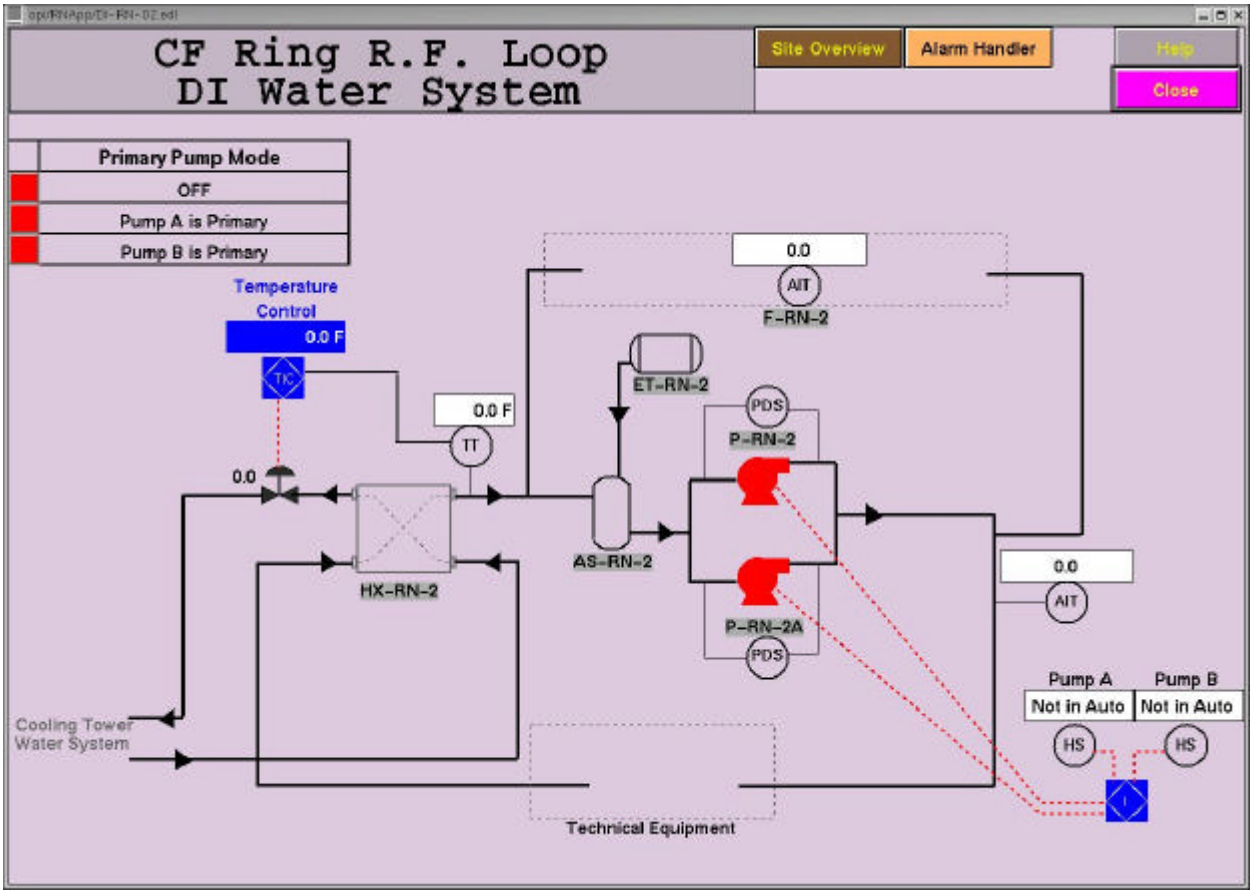
In the PUMP B IS PRIMARY mode, the Pump B will be energized and the Pump A will be de-energized. After a delay period, the Pump B will be periodically checked for low flow. If low flow is detected, Pump B will be de-energized and Pump A will be energized. An alarm will be generated to the operator. After a delay period, the Pump A will be periodically checked for low flow. If low flow is detected, Pump A will be de-energized and a "No Flow" alarm will be generated to the operator.

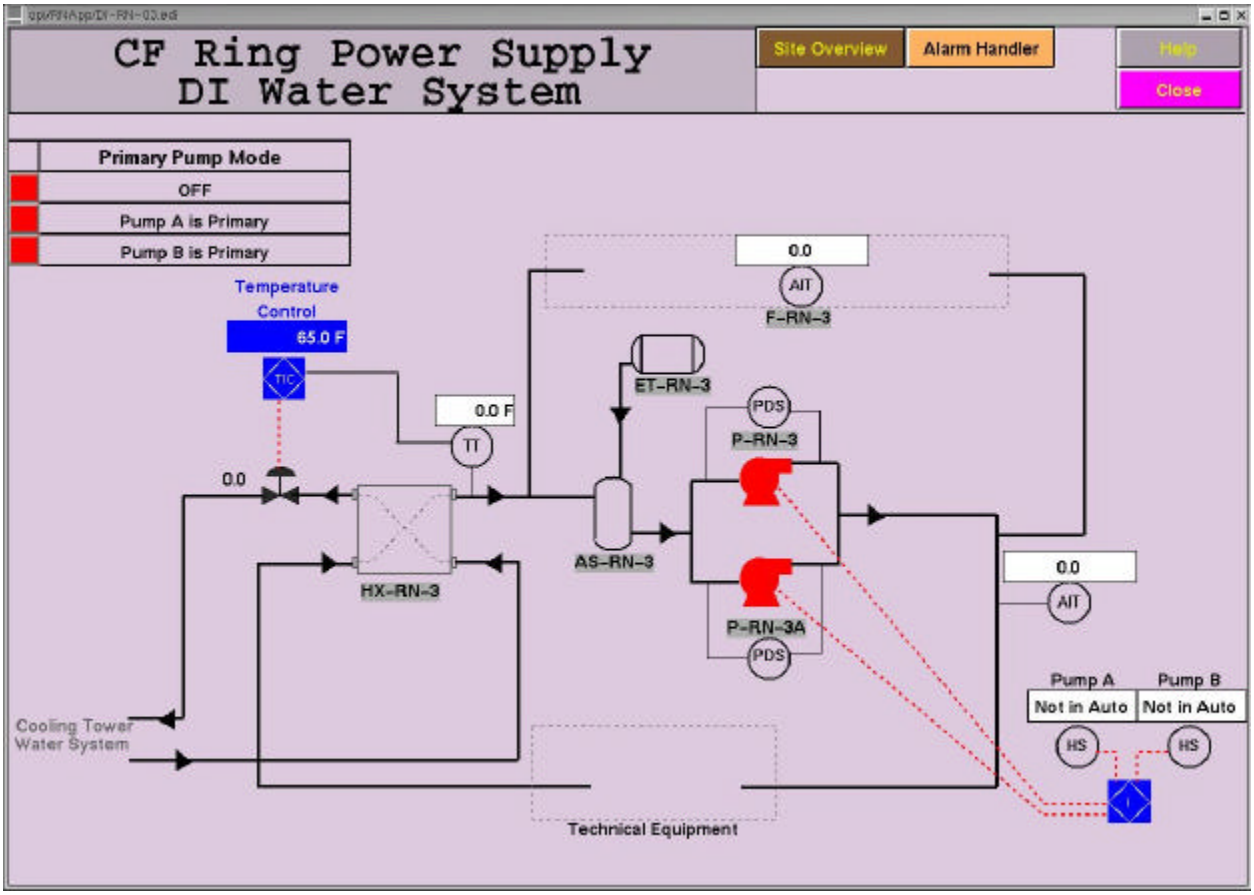
For both the PUMP A IS PRIMARY and PUMP B IS PRIMARY modes, the Tower Water Return Line Control Valve is modulated by a PID algorithm to maintain the DI Water Temperature Setpoint.

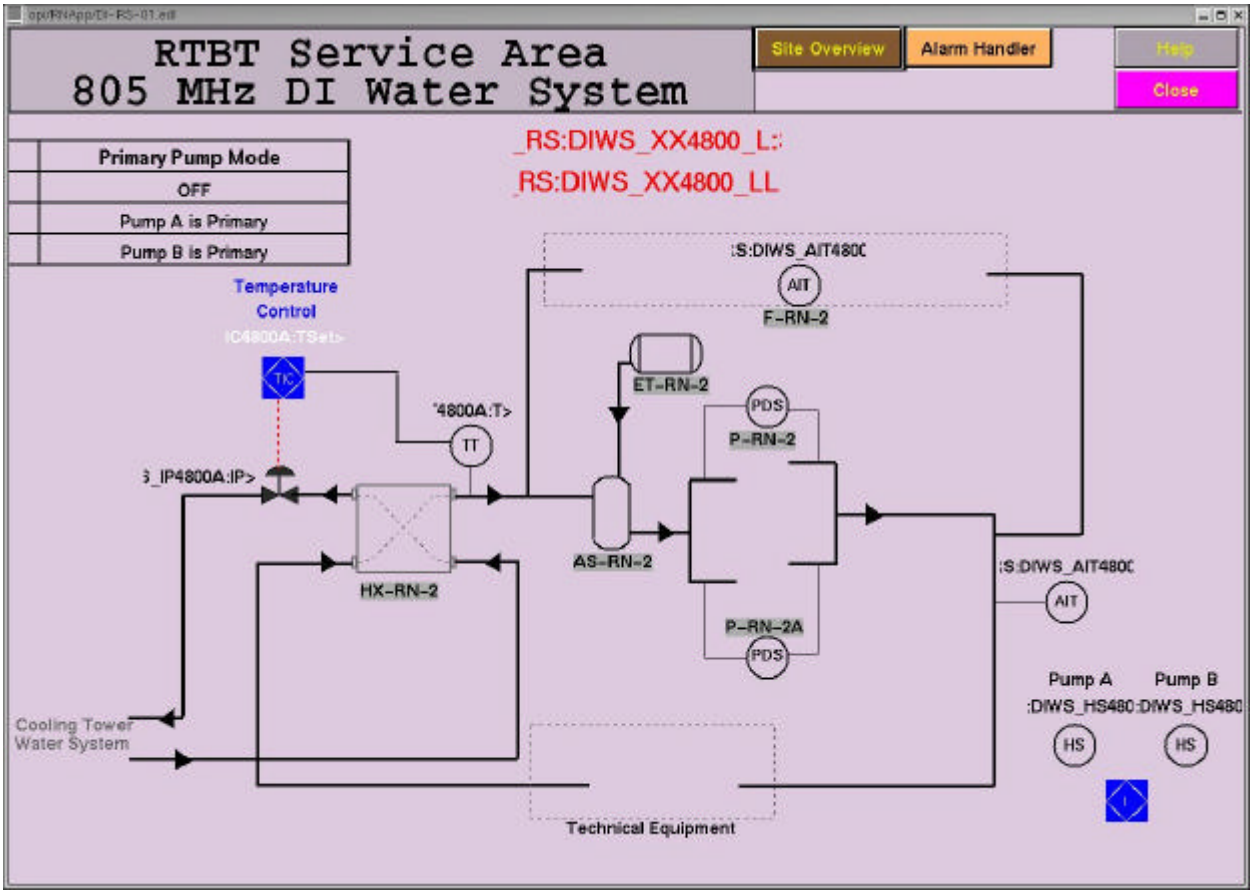

HEBT Service Area
805 MHz DI Water System
Site Overview
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature
Setpoint
0
TC
-50.0 F
TT
0.0 %
HX-RN-2
0.0 MegaOhm
AIT
F-RN-2
ET-RN-2
PDS
P-RN-2
AS-RN-2
P-RN-2A
PDS
0.0 MegaOhm
AIT
Pump A
Pump B
Not In Auto
Not In Auto
HS
HS
Cooling Tower
Water System
Technical Equipment


CF Ring Injection Dump
DI Water System
Site Overview
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature
Control
0.0 F
TC
0.0 F
TT
0.0 %
HX-INJ-1
0.0 MegaOhm
AIT
F-INJ-1
ET-INJ-1
PDS
P-INJ-1
AS-INJ-1
P-INJ-2
PDS
0.0 MegaOhm
AIT
Pump A
Pump B
Not In Auto
Not In Auto
HS
HS
Cooling Tower
Water System
Technical Equipment


CF Ring Magnets
DI Water System
Site Overview
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
65.0 F
TC
0.0
TT
0.0 F
HX-RN-1
AS-RN-1
ET-RN-1
PDS
P-RN-1
P-RN-1A
0.0
AIT
F-RN-1
0.0
AIT
Pump A
Not in Auto
Pump B
Not in Auto
HS
HS
Cooling Tower
Water System
Technical Equipment


CF Ring R.F. Loop
DI Water System
Site Overview
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
0.0 F
TC
0.0
TT
0.0 F
HX-RN-2
AS-RN-2
ET-RN-2
PDS
P-RN-2
P-RN-2A
0.0
AIT
F-RN-2
0.0
AIT
Pump A
Not in Auto
Pump B
Not in Auto
HS
HS
Cooling Tower
Water System
Technical Equipment


CF Ring Power Supply
DI Water System
Site Overview
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
65.0 F
TIC
0.0
0.0 F
TT
HX-RN-3
ET-RN-3
PDS
P-RN-3
AS-RN-3
P-RN-3A
PDS
0.0
AIT
F-RN-3
0.0
AIT
Pump A
Not in Auto
Pump B
Not in Auto
HS
HS
Cooling Tower
Water System
Technical Equipment


RTBT Service Area
805 MHz DI Water System
Site Overview
Alarm Handler
Help
Close
_RS:DIWS_XX4800_L:
_RS:DIWS_XX4800_LL
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
TIC
TT
HX-RN-2
ET-RN-2
PDS
P-RN-2
AS-RN-2
P-RN-2A
PDS
:S:DIWS_AIT480(
AIT
F-RN-2
:S:DIWS_AIT480(
AIT
Pump A
Pump B
HS
HS
Cooling Tower
Water System
Technical Equipment