108050000-TD8004-R00

Spallation Neutron Source

Klystron DI Water Systems Functional System Design (FSD)

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APPROVED
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SPALLATION NEUTRON SOURCE

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

DI Water System Controls Description
TD8004 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

a. Post heat exchanger DI water pressure *(PI 4300A, PI 4302A, PI 4303A, PI 4306A)*
b. Pre heat exchanger DI water pressure *(PI 4300B, PI 4302B, PI 4303B, PI 4306B)*
c. Filter skid DI water pressure #1 *(PI 4300E, PI 4302E, PI 4303E, PI 4306E)*
d. Filter skid DI water pressure #2 *(PI 4300F, PI 4302F, PI 4303F, PI 4306F)*
e. Filter skid DI water pressure #3 *(PI 4300G, PI 4302G, PI 4303G, PI 4306G)*
f. Post heat exchanger DI water temperature *(TI 4300A, TI 4302A, TI 4303A, TI 4306A)*
g. Pre heat exchanger DI water temperature *(TI 4300B, TI 4302B, TI 4303B, TI 4306B)*
h. Tower water supply temperature *(TI 4300C, TI 4302C, TI 4303C, TI 4306C)*
i. Tower water return temperature *(TI 4300D, TI 4302D, TI 4303D, TI 4306D)*
j. HOA switch for Pump A *(HS 4300A, HS 4302A, HS 4303A, HS 4306A)*
k. HOA switch for Pump B *(HS 4300B, HS 4302B, HS 4303B, HS 4306B)*
l. DI water pressure gauge isolation valves *(HV 4300A,B,E,F,G, HV 4302A,B,E,F,G HV 4303A,B,E,F,G, HV 4306A,B,E,F,G)*
m. DI water pumps isolation valves (*HV 4300W,X,Y,Z, HV 4302W,X,Y,Z, HV 4303W,X,Y,Z, HV 4306W,X,Y,Z)*
n. FAULT indicator light on MCC
o. READY indicator light on MCC
p. 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 4300A,PDIS 4300B,PDIS 4302A, PDIS 4302B, PDIS 4303A, PDIS 4303B, PDIS 4306A, PDIS 4306B)*
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 4300A, TT 4302A, TT4303A, TT4306A)*
2) Tower water return line controller output *(IP 4300A/TCV 4300A, IP 4302A/TCV 4302A, IP 4303A/TCV 4303A, IP 4306A/TCV 4306A)*
3) Tower water differential pressure *(PDT 4300, PDT 4302)*
4) Resistivity of circulating loop *(AIT 4300A, AIT 4302A, AIT 4303A, AIT 4306A)*
5) Resistivity of polishing loop *(AIT 4300B, AIT 4302B, AIT 4303B, AIT 4306B)*

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

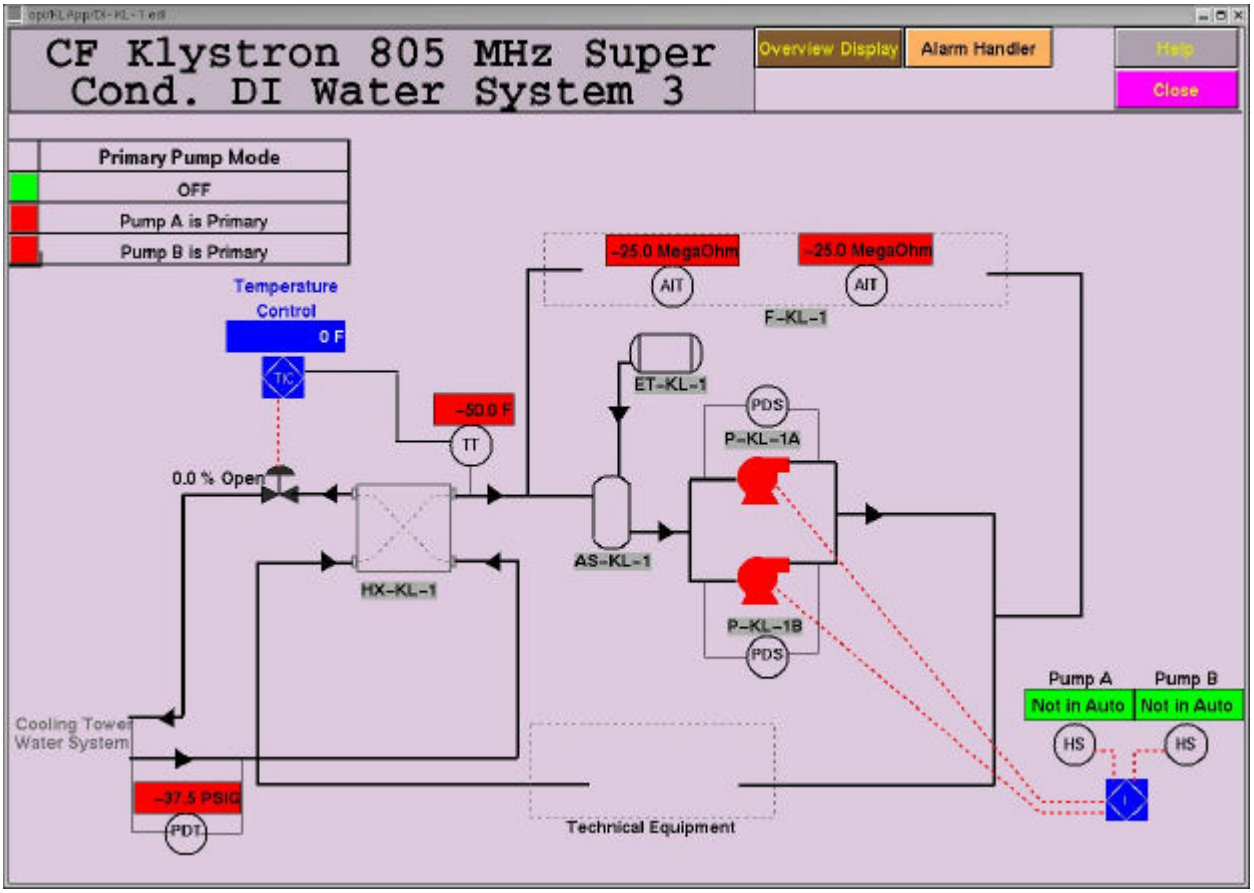
In the OFF mode, the primary and backup pump will be de-energized .

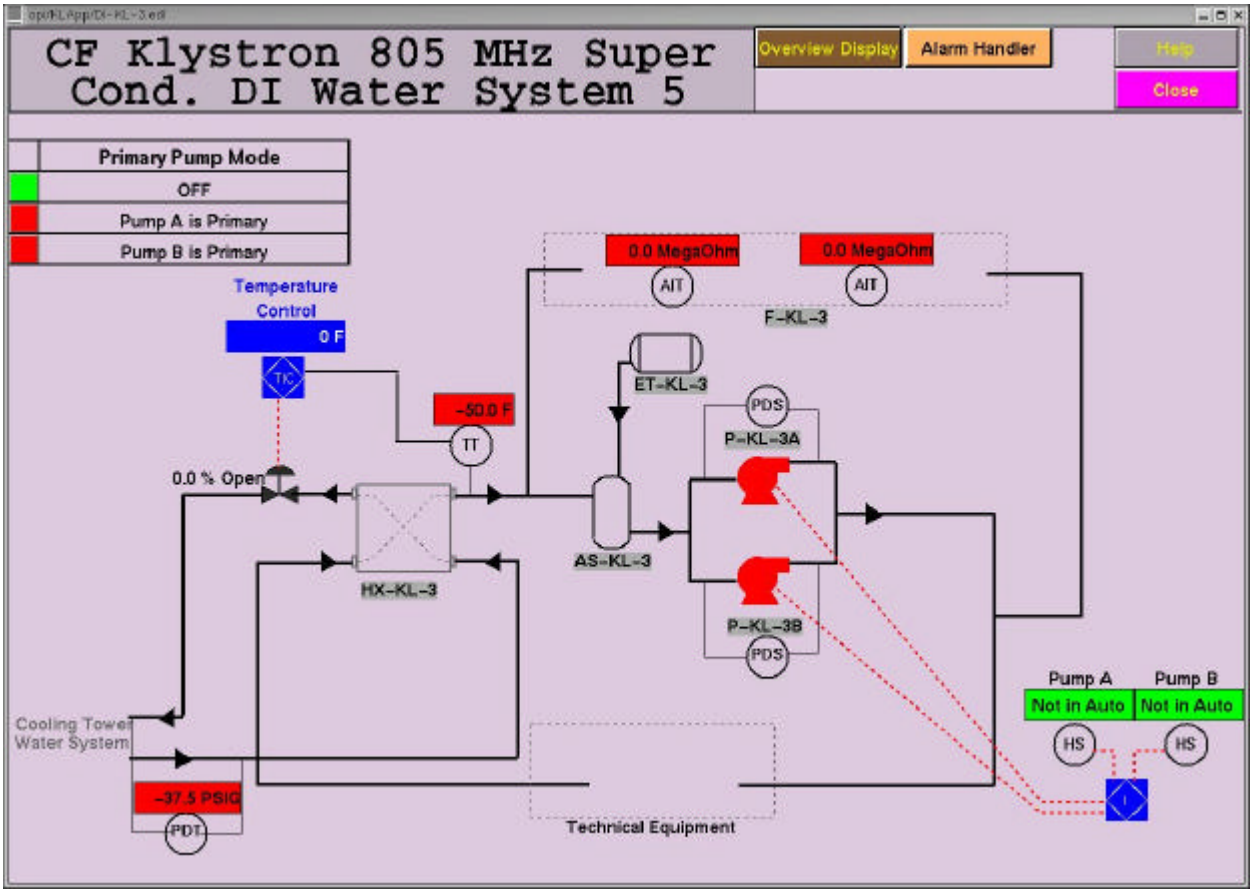
In the PUMP A IS PRIMARY mode, the Pump A will be energized and the Pump B will be de-energized. After a delay period, the Pump A will be periodically checked for low flow. If low flow is detected, Pump A will be de-energized and Pump B will be energized. An alarm will be generated to the operator. After a delay period, the Pump B will be periodically checked for low

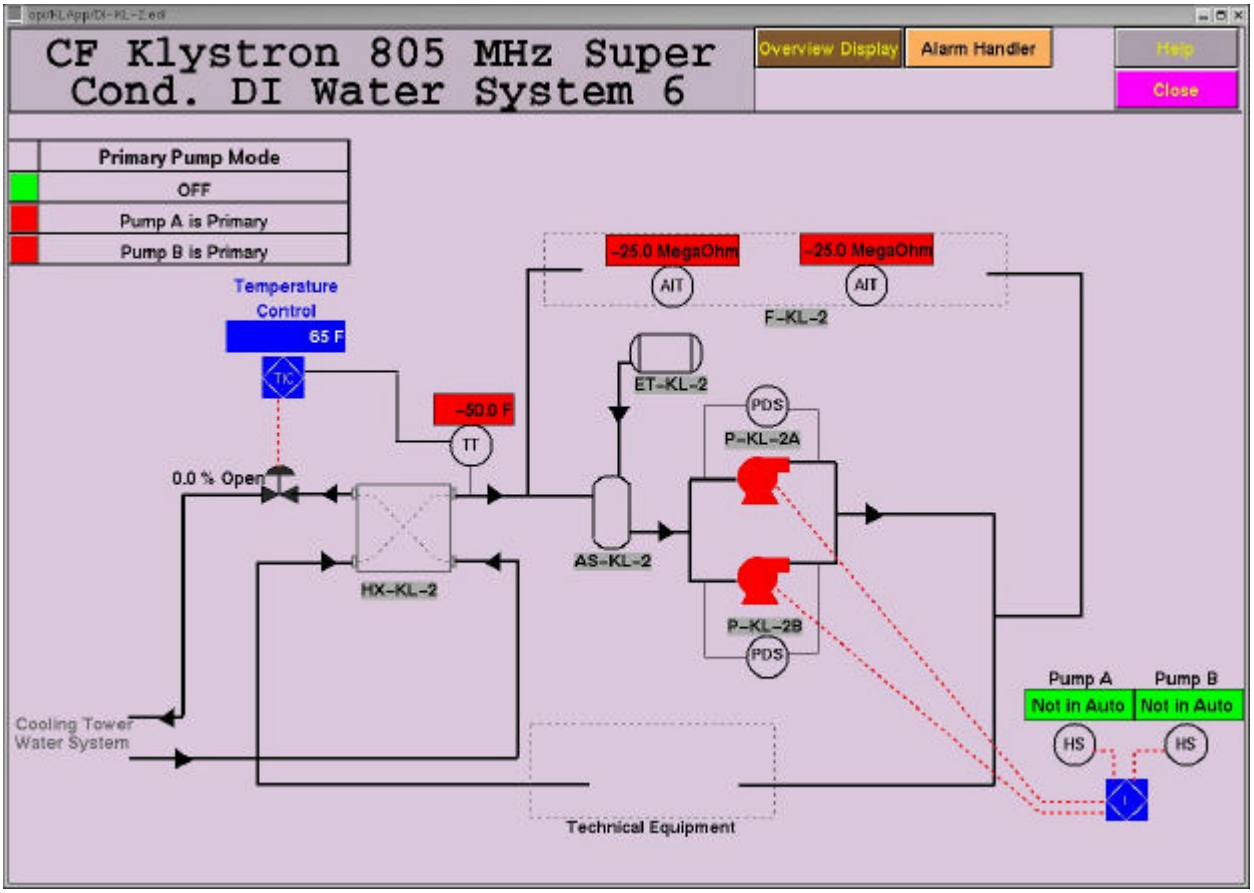
flow. If low flow is detected, Pump B will be de-energized and a “No Flow” alarm will be generated to the operator.

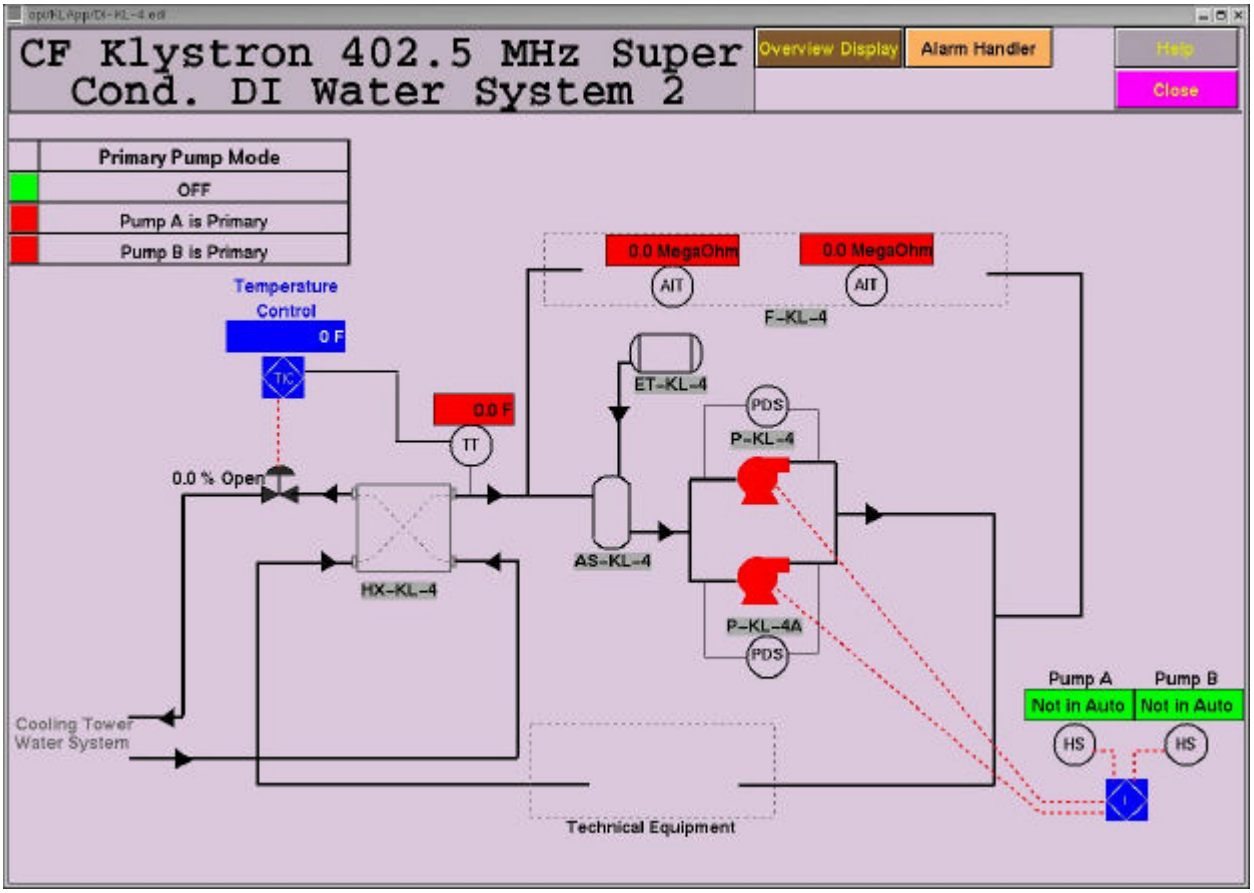
In the PUMP B IS PRIMARY mode, the Pump B will be energized and the Pump A will be de-energized. After a delay period, the Pump B will be periodically checked for low flow. If low flow is detected, Pump B will be de-energized and Pump A will be energized. An alarm will be generated to the operator. After 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.


CF Klystron 805 MHz Super Cond. DI Water System 3
Overview Display
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
0 F
TC
-50.0 F
TT
0.0 % Open
HX-KL-1
AS-KL-1
ET-KL-1
-25.0 MegaOhm
-25.0 MegaOhm
AIT
AIT
F-KL-1
PDS
P-KL-1A
P-KL-1B
PDS
Pump A
Pump B
Not In Auto
Not In Auto
HS
HS
Cooling Tower Water System
-37.5 PSIG
PDT
Technical Equipment


CF Klystron 805 MHz Super Cond. DI Water System 5
Overview Display
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
0 F
TC
-50.0 F
TT
0.0 % Open
HX-KL-3
AS-KL-3
ET-KL-3
0.0 MegaOhm
0.0 MegaOhm
AIT
AIT
F-KL-3
PDS
P-KL-3A
P-KL-3B
PDS
Pump A
Pump B
Not In Auto
Not In Auto
HS
HS
Cooling Tower Water System
-37.5 PSIG
PDT
Technical Equipment


CF Klystron 805 MHz Super Cond. DI Water System 6
Overview Display
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
65 F
TC
-50.0 F
TT
0.0 % Open
HX-KL-2
-25.0 MegaOhm
-25.0 MegaOhm
AIT
AIT
F-KL-2
ET-KL-2
PDS
P-KL-2A
P-KL-2B
PDS
AS-KL-2
Pump A
Pump B
Not In Auto
Not In Auto
HS
HS
Cooling Tower Water System
Technical Equipment


CF Klystron 402.5 MHz Super Cond. DI Water System 2
Overview Display
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control
0 F
TC
0.0 F
TT
0.0 % Open
HX-KL-4
0.0 MegaOhm
0.0 MegaOhm
AIT
AIT
F-KL-4
ET-KL-4
PDS
P-KL-4
P-KL-4A
PDS
AS-KL-4
Pump A
Pump B
Not In Auto
Not In Auto
HS
HS
Cooling Tower Water System
Technical Equipment