

108050000-TD0004-R00

# Spallation Neutron Source

## Klystron DI Water Systems Functional System Design (FSD)

June, 2002

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SNS Project Engineer



A U . S . D e p a r t m e n t o f E n e r g y M u l t i l a b o r a t o r y P r o j e c t

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**

### **TD80004 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.



