108050000-TD0024-R00

Spallation Neutron Source

CUB Heating Water System Controls Functional System Design (FSD)

January, 2003

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SNS Project Engineer

CUB Heating Water System Controls Description
TD80024 Rev 0, January 14, 2003

Operating Philosophy

Purpose:

The purpose of heating water system operation is to:

a) Maintain the heating water at an appropriate temperature setpoint based on the outside temperature. If the outside temperature is below 65 DegF, then the temperature setpoint will be 200 DegF. If the outside temperature is above 70 DegF, then the temperature setpoint will be 160 DegF.
b) Provide heating water flow to the CUB unit heaters if the outside temperature is below 60 DegF.
c) Open boiler isolation valves when boilers are started.

Assumptions: Running both pumps simultaneously is not acceptable.

Operator Controls and Operating Modes

1) OFF: Pumps are de-energized. Supply heating water valve will be closed and the return heating water valve will be 100 % 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) Hot water boiler 1 water temperature *(TI4101)*
2) Hot water boiler 2 water temperature *(TI4103)*
3) Hot water circulating pump A inlet pressure *(PI4121)*
4) Hot water circulating pump B inlet pressure *(PI4128)*
5) Hot water circulating pump A pressure isolation valves *(HV4121, HV4122)*
6) Hot water circulating pump B pressure isolation valves *(HV4128, HV4129)*
7) Hot water circulating pump A differential pressure *(PDIS4022)*
8) Hot water circulating pump B differential pressure *(PDIS4023)*
9) Hot water circulating pump A differential pressure isolation valves *(HV4119, HV4120)*
10) Hot water circulating pump B differential pressure isolation valves *(HV4126, HV4127)*
11) HOA switch for Pump A *(HS4022)*
12) HOA switch for Pump B *(HS4023)*
13) Chemical feeder outlet pressure *(PI4132)*
14) Chemical feeder inlet pressure *(PI4134)*
15) Chemical feeder isolation valves (*HV4132, HV4134)*
16) FAULT indicator lights on MCC

17) READY indicator lights on MCC
18) RUN indicator lights 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. *(PDIS4022, PDIS4023)*
3) Boilers status *(YI4021, YI4022)*
4) 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

None

Software HMI/EPICS Analog Displays

1) Outside temperature *(TT4015)*
2) Heating water supply temperature *(TT4021)*
3) Hot water boiler 1 output temperature *(TT4023)*
4) Hot water boiler 2 output temperature *(TT4024)*
5) Hot water boilers supply valve *(IP4021A)*
6) Hot water return valve *(IP4021B)*
7) Heating water return temperature *(TT4022)*

Software HMI/EPICS Alarms (via EPICS Alarm Handler)

1) Primary pump failed, backup pump running (differential pressure is normal)
2) No flow (low differential pressure on both pumps)
3) Boiler alarm *(YA4021, YA4022)*

Control Logic Description

In the OFF mode, the primary and backup pump will be de-energized . The return heating water valve (IP4021B) is set to 100 % open and the supply heating water valve (IP4021A) is closed.

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

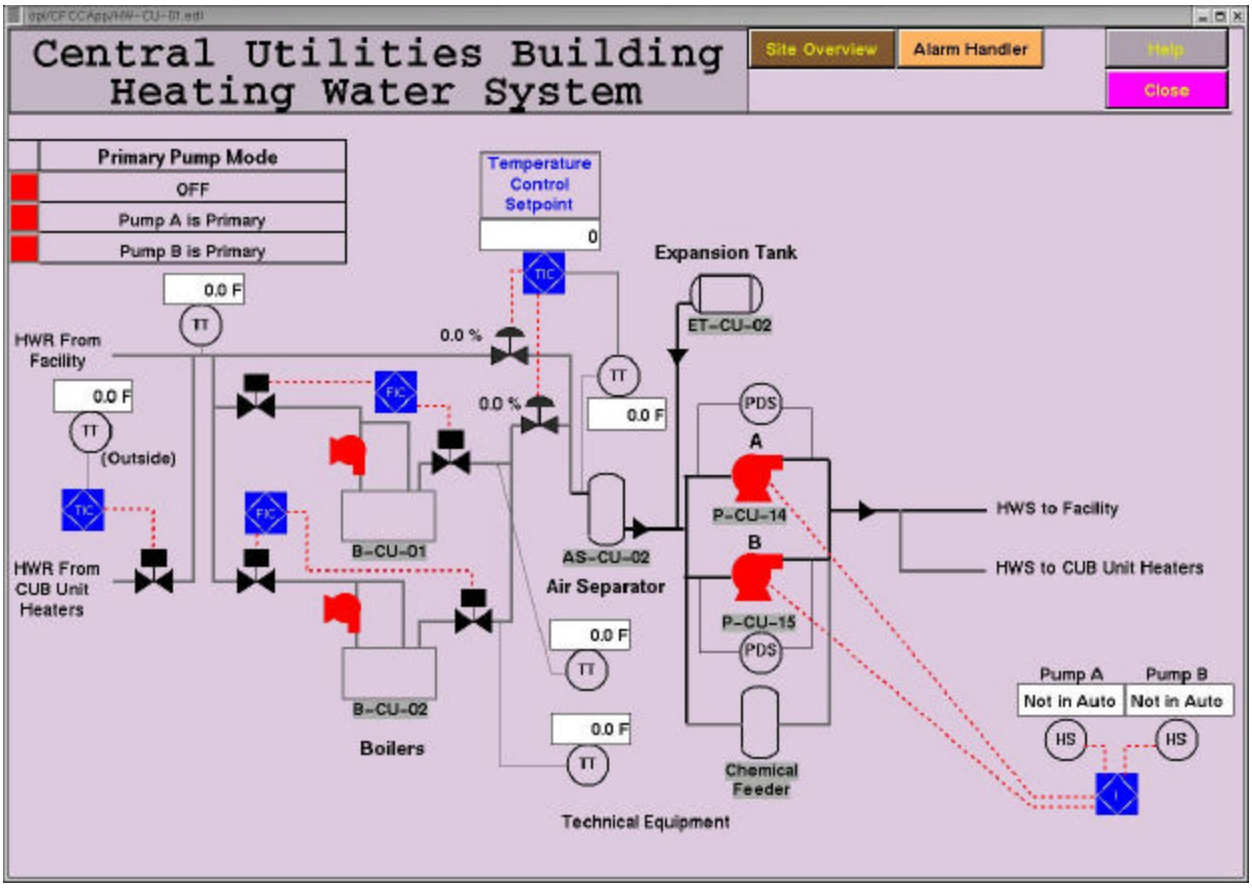
flow (PDIS4022) is detected, Pump A will be de-energized and Pump B will be energized. An alarm will be generated to the operator. After a delay period, the Pump B will be periodically checked for low flow. If low flow (PDIS4023) is detected, Pump B will be de-energized and a "No Flow" alarm will be 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 (PDIS4023) 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 (PDIS4022) 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 Water Temperature Control Valves (IP4021A and IP4021B) are modulated inversely to each other by a PID algorithm to maintain the Heating Water Temperature Setpoint. For example, if the Supply Heating Water Valve is at 30 %, the Return Heating Water Valve is set to 70%. The Heating Water Temperature Setpoint will be 200 DegF if the outside temperature is below 65 DegF, and 160 DegF if the outside temperature is above 70 DegF. The default Heating Water Temperature Setpoint will be 200 DegF should the heating water system be started when the outside temperature is between 65 and 70 DegF.

If the outside temperature falls below 60 DegF, the CUB unit heaters isolation valve (SOV4025) will be opened.

When a boiler is started, its associated isolation valve (SOV4021 and SOV4022, or SOV4023 and SOV4024) will be opened.


Central Utilities Building
Heating Water System
Site Overview
Alarm Handler
Help
Close
Primary Pump Mode
OFF
Pump A is Primary
Pump B is Primary
Temperature Control Setpoint
0
TIC
Expansion Tank
ET-CU-02
0.0 F
TT
HWR From Facility
0.0 %
0.0 F
TT
(Outside)
TIC
FIC
0.0 %
TT
0.0 F
PDS
A
P-CU-14
B
P-CU-15
PDS
HWS to Facility
HWS to CUB Unit Heaters
HWR From CUB Unit Heaters
B-CU-01
AS-CU-02
Air Separator
B-CU-02
Boilers
0.0 F
TT
0.0 F
TT
Chemical Feeder
Technical Equipment
Pump A
Pump B
Not in Auto
Not in Auto
HS
HS