

108050000-TD0026-R01

Spallation Neutron Source

Central Exhaust Controls Functional System Design (FSD)

February, 2003

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

Central Exhaust Controls Description
TD80026 Rev 1, February 18, 2003

Operating Philosophy

Purpose:

- 1) Provide air exhaust capability for the Ring Injection Dump, RTBT tunnel, Target PCE, Target SCE, and Target HOG buildings.
- 2) Modulate exhaust fan speed to control to the exhaust flow setpoint.
- 3) Provide high and low alarms for exhaust flow and pressure.
- 4) Provide operator indication that fans/dampers are operating and that dampers are in the proper position.
- 5) Provide interlocking capabilities between the SCE and PCE systems and between the SCE and Target Building make-up air systems.
- 6) Provide a manual means of pressure control for the SCE and PCE systems.
- 7) Provide operator indication of Central Exhaust Building Temperature and Power Automatic Transfer Switch position.
- 8) Provide operator indication of exhaust stack air quality.

Assumptions:

- 1) Running both pumps simultaneously is not acceptable.
- 2) Automatic transfer switch automatically switches from normal power to backup power on power loss detection.
- 3) Stack monitor not currently available.
- 4) No automatic change of tunnel exhaust flow is provided. Thus, unless the exhaust flow setpoint is lowered manually, the flow from each tunnel will be greater when one tunnel is ventilation and one is not then when both are in ventilation.

Operator Controls and Operating Modes

- 1) OFF: All fans de-energized, all dampers closed
- 1) FAN A IS PRIMARY: Fan A is energized and fan B is de-energized.
- 1) FAN B IS PRIMARY: Fan B is energized and fan A is de-energized

OPERATOR INTERFACE DEFINITIONS

Local Hardware/Manual Operator Controls

None

Software HMI/EPICS Digital Operator Controls

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

Software HMI/EPICS Digital Displays

- 1) Primary Fan Mode switch status
 - a. OFF
 - b. Fan A is primary
 - c. Fan B is primary
- 2) Exhaust fan on/off status (*F2701, F2702, F2703, F2704, F2705*)
- 3) Exhaust fan differential pressure status (*PDS2701A, PDS2701B, PDS2702A, PDS2702B, PDS2703A, PDS2703B, PDS2704A, PDS2704B, PDS2705A, PDS2705B*)
- 4) Exhaust fan damper position (*ZSH2701A, ZSL2701A, ZSH2701B, ZSL2701B, ZSH2702A, ZSL2702A, ZSH2702B, ZSL2702B, ZSH2703A, ZSL2703A, ZSH2703B, ZSL2703B, ZSH2704A, ZSL2704A, ZSH2704B, ZSL2704B, ZSH2705A, ZSL2705A, ZSH2705B, ZSL2705B*)
- 5) Central exhaust building power automatic transfer switch position (*ZS2701*)
- 6) Linac and RTBT tunnels exhaust damper position (*SOV2107, SOV2354*)

Software HMI/EPICS Analog Operator Controls

- 1) Exhaust Flow Setpoint
- 2) SCE and PCE Exhaust Fans Inlet Dampers Position Setpoint

Software HMI/EPICS Analog Displays

- 1) Exhaust pressure (*PT2701, PT2702, PT2703, PT2704, PT2705*)
- 2) Exhaust flow (*FT2701, FT2702, FT2703, FT2704, FT2705*)
- 3) Exhaust fan speed setpoint (*SC2701A, SC2701B, SC2702A, SC2702B, SC2703A, SC2703B, SC2704A, SC2704B, SC2705A, SC2705B*)
- 4) Exhaust fan actual speed (*ST2701A, ST2701B, ST2702A, ST2702B, ST2703A, ST2703B, ST2704A, ST2704B, ST2705A, ST2705B*)
- 5) Central exhaust stack gas monitor reading (*AT2701*)
- 6) Exhaust fan manual flow dampers position (*ZT2703C, ZT2703D, ZT2705C, ZT2705D*)
- 7) Central exhaust building temperature (*TT2701*)
- 8) Linac and RTBT tunnel exhaust flow (*FT2107, FT2354*)

Software HMI/EPICS Alarms (via EPICS Alarm Handler)

- 1) Exhaust flow high and low limits
- 2) Exhaust pressure high and low limits
- 3) Exhaust fan failure
- 4) Central exhaust building temperature high limit

Control Logic Description

In the OFF mode, the primary and backup fan will be de-energized, fan dampers closed, and the fan speed setpoint set to 0%.

In the FAN A IS PRIMARY mode, Fan A will be energized per tunnel operations commands describe in SNS 10805000-TD80001, Tunnel Operations FSD, Fan A damper will be opened, and Fan A speed setpoint will be modulated by a PID algorithm. Fan B will be de-energized,

Fan B damper will be closed, and Fan B speed setpoint set to 0%. After a delay period, Fan A will be periodically checked for low flow. If low flow is detected, Fan A will be de-energized, damper closed, and speed setpoint set to 0%; and Fan B will be energized, damper opened, and speed setpoint modulated by a PID algorithm. An alarm will be generated to the operator. After a delay period, Fan B will be periodically checked for low flow. If low flow is detected, Fan B will be de-energized, damper closed, speed setpoint set to 0%, and a “No Flow” alarm will be generated to the operator.

In the FAN B IS PRIMARY mode, Fan B will be energized per tunnel operations commands describe in SNS 10805000-TD80001, Tunnel Operations FSD, Fan B damper will be opened, and Fan B speed setpoint will be modulated by a PID algorithm. Fan A will be de-energized, Fan B damper will be closed, and Fan B speed setpoint set to 0%. After a delay period, Fan B will be periodically checked for low flow. If low flow is detected, Fan B will be de-energized, damper closed, and speed setpoint set to 0%; and Fan A will be energized, damper opened, and speed setpoint modulated by a PID algorithm. An alarm will be generated to the operator. After a delay period, the Fan A will be periodically checked for low flow. If low flow is detected, Fan A will be de-energized, damper closed, speed setpoint set to 0%, and a “No Flow” alarm will be generated to the operator.

For the Linac Tunnel / RTBT Tunnel exhaust fans (EF-PE-01 and EF-PE-02) both tunnel exhaust dampers (SOV2107 and SOV2354) will be opened when the exhaust fans are started and the tunnel operating mode is Ventilation.

If the Linac tunnel operating mode is Ventilation, open the Linac Tunnel damper. If the Ring tunnel operating mode is Ventilation, open the RTBT damper.

The SCE exhaust fans cannot be started unless the PCE exhaust fans are running. If the PCE exhaust fans fail, the SCE exhaust fans will be de-energized, dampers closed, and speed setpoint set to 0%. In addition, if the SCE exhaust fans are not running, the target make-up air system fans will be stopped.

SCE and PCE exhaust fan inlet dampers (IP2703C, IP2703D, IP2705C, IP2705D) shall be set to match the operator entered position setpoint. Only one damper in each subsystem will be open at a time. The other damper must be fully closed and will be forced by the software. Therefore, if IP2703C or IP2705C is greater than zero, IP2703D or IP2705D respectively will be set to zero.

The auto transfer switch current position will be displayed on the central exhaust EPICS screens. The field will indicate “Normal” for power supplied by the power line and “Backup” for power supplied by the generator.





