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C-A OPERATIONS PROCEDURES MANUAL

7.1.58 Regeneration of Warm Turbines "B" Train

Text Pages 2 through 10

Hand Processed Changes

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Approved: _____ ***Signature on File*** _____
Collider-Accelerator Department Chairman Date

D. Lederle

7.1.58 Regeneration of Warm Turbines “B” Train

1. Purpose

To provide instructions for regenerating the warm turbine “B” train on the RHIC 25 kW helium refrigerator. The procedure is used to warm the turbines and remove moisture. The procedure contains the following sections:

- 5.1 Regeneration of Turbines 1B/2B Only.
- 5.2 Regeneration of Turbines 3B/4B Only.
- 5.3 Regeneration of HX3B Only.
- 5.4 Regeneration of Turbines 1B/2B, 3B/4B and Heat Exchanger HX3B.

2. Responsibilities

- 2.1 The Shift Supervisor, or an Operator designated by the Shift Supervisor, is responsible for conducting the procedure and providing documentation in the Cryogenic Control Room Log.
- 2.2 Should a problem arise in the process of the procedure, the Shift Supervisor shall report to the Technical Supervisor for instructions before continuing.

3. Prerequisites

- 3.1 Operator shall be familiar with the refrigerator P&ID drawing 3A995009, the physical location of components on the refrigerator, and the refrigerator control pages found on the CRISP control system.
- 3.2 The regeneration skid must be available for use.

4. Precautions

- 4.1 If there is liquid helium in the refrigerator pots, all personnel entering the refrigeration wing of 1005R must be ODH Class 1 qualified, have a Personal Oxygen Monitor (POM) and carry an emergency escape pack, if the refrigerator is operating.

5.

Procedure

5.1 Turbines 1B/2B Only

_____ 5.1.1 Date_____.

_____ 5.1.2 Ensure mechanical brakes are installed per [C-A-OPM 7.1.26, “Expander Brake System Installation and Removal.”](#)

_____ 5.1.3 Ensure the following valves are closed:

Process:

H728A_____

H738M_____

Other:

H407M_____

H400M_____

H266M_____

H373M_____

H9168M_____

_____ 5.1.4 Start the regeneration (regen) skid per [C-A OPM 7.1.36, “Regeneration System Normal Operation.”](#)

_____ 5.1.5 Ensure that the regulator PR9166M has been replaced with the spool piece.

_____ 5.1.6 Open the following valves:

H405M_____

H243M_____

H703M_____

H730A_____ (Vanes)

H9166M_____

H739A_____ (Vanes)

H773M_____

_____ 5.1.7 Close regen manifold bypass valve H9100M.

_____ 5.1.8 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.1.9 Monitor temperature at TI734H.

_____ 5.1.10 When TI734H reaches 290°K, continue to regenerate for at least one hour. Hygrometer reading must be –30°C to –40°C and improving less than 0.5°C/hour.

_____ 5.1.11 Turn off regen skid pre-heater.

_____ 5.1.12 Open bypass valve H9100M.

_____ 5.1.13 Close the following valves:

H739A_____	H9166M_____
H730A_____	H703M_____
H243M_____	H405M_____
H773M_____	

_____ 5.1.14 Secure the regen skid per [C-A OPM 7.1.36](#).

_____ 5.1.15 Install regulator PR9166M.

_____ 5.1.16 Purge expander 1B/2B per [C-A OPM 7.1.27, "Warm Expander Purge Procedure."](#)

5.2 Turbines 3B/4B Only

_____ 5.2.1 Date_____.

_____ 5.2.2 Ensure mechanical brakes are installed on turbines 3B/4B per [C-A OPM 7.1.26, "Expander Brake System Installation and Removal."](#)

_____ 5.2.3 Ensure the following valves are closed:

Process:

H752A_____

H780A_____

H760M_____

Other:

H429M_____	H9174M_____
H377M_____	H427M_____
H6182M_____	H378M_____

_____ 5.2.4 Start the regeneration (regen) skid per [C-A OPM 7.1.36, "Regeneration System Normal Operation."](#)

_____ 5.2.5 Ensure that regulator PR9172M has been replaced with the spool piece.

_____ 5.2.6 Open the following valves:

H428M_____	H415M_____
H777M_____	H754A_____ (Vanes)
H9172M_____	H757A_____ (Vanes)
H778M_____	

_____ 5.2.7 Close regen skid bypass valve H9100M.

_____ 5.2.8 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.2.9 Monitor turbine 3B inlet temperature at TI751H.

_____ 5.2.10 When TI751H reaches 290°K, continue to regenerate for at least one hour. Hygrometer reading must be -30°C to -40°C and improving less than 0.5°C/hour.

_____ 5.2.11 Turn off regen skid pre-heater.

_____ 5.2.12 Open bypass valve H9100M.

_____ 5.2.13 Close the following valves:

H757A_____	H9172M_____
H754A_____	H777M_____
H415M_____	H428M_____
H778M_____	

_____ 5.2.14 Secure the regen skid per [C-A OPM 7.1.36, “Regeneration System Normal Operation.”](#)

_____ 5.2.15 Install regulator PR9172M.

_____ 5.2.16 Purge expanders 3B/4B per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

5.3 Heat Exchanger HX3B Only

_____ 5.3.1 Date_____.

_____ 5.3.2 Ensure mechanical brakes are installed on turbines 1B/2B and 3B/4B per [C-A OPM 7.1.26, “Expander Brake System Installation and Removal.”](#)

_____ 5.3.3 Ensure the following valves are closed:

Process:

H730A_____ (Vane)	H776M_____
H739A_____ (Vane)	H746M_____
H754A_____ (Vane)	H826M_____
H757A_____ (Vane)	H780A_____ (Physically Block)
H744A_____	H728A_____ (Physically Block)
H741M_____	

Other:

H429M_____	H9174M_____
H6182M_____	H400M_____
H377M_____	H373M_____

_____ 5.3.4 Start the regeneration (regen) skid per [C-A OPM 7.1.36, "Regeneration System Normal Operation."](#)

_____ 5.3.5 Ensure that regulator PR9172M has been replaced with the spool piece.

_____ 5.3.6 To avoid spinning turbines, ensure pressure in HX3B is approximately equal to pressure in expanders (with 0.5 atm).

_____ 5.3.7 Open process valves H738M_____ and H752A_____ (air line must be jumpered at valve).

_____ 5.3.8 Open the following valves:

H428M_____	H773M_____
H777M_____	H243M_____
H9172M_____	

_____ 5.3.9 Close regen skid bypass valve H9100M.

_____ 5.3.10 If heat exchanger is cold, turn on regen skid pre-heater.

_____ 5.3.11 Monitor regen return line at valve H777M.

_____ 5.3.12 When frost has cleared from the regen return line, continue to regen for at least one hour. Hygrometer reading must be -30°C to -40°C and improving less than $0.5^{\circ}\text{C}/\text{hour}$.

_____ 5.3.13 Turn off regen skid pre-heater.

_____ 5.3.14 Open bypass valve H9100M.

_____ 5.3.15 Close the following valves:

H243M_____	H777M_____
H773M_____	H428M_____
H9172M_____	

_____ 5.3.16 Install regulator PR9172M.

Note:

If the refrigerator is operating, heat exchanger and turbines are normally purged separately due to heat transfer between HX3 heat exchangers.

_____ 5.3.17 Purge heat exchanger HX3B per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

_____ 5.3.18 Purge expanders 1B/2B per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

_____ 5.3.19 Purge expanders 3B/4B per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

_____ 5.3.20 Ensure the following process valves are closed:

H752A_____ (Return air line to normal)
H738M_____

_____ 5.3.21 Secure regen skid per [C-A OPM 7.1.36, “Regeneration System Normal Operation.”](#)

5.4 Turbines 1B/2B, 3B/4B and Heat Exchanger HX3B

Note:
This section is normally completed only when the refrigerator is shut down due to heat transfer between HX3 heat exchangers.

_____ 5.4.1 Date_____.

_____ 5.4.2 Ensure that mechanical brakes are installed on turbines per [C-A OPM 7.1.26, "Expander Brake System Installation and Removal."](#)

_____ 5.4.3 Ensure the following valves are closed:

Process:

H728A_____	H826M_____
H746M_____	H760M_____
H776M_____	H780A_____

Other:

H407M_____	H740M_____
H266M_____	H9172M_____
H9168M_____	H427M_____
H773M_____	H378M_____
H745M_____	

_____ 5.4.4 Start the regeneration (regen) skid per [C-A OPM 7.1.36, "Regeneration System Normal Operation."](#)

_____ 5.4.5 Ensure that the regulator PR9166M has been replaced with the spool piece.

_____ 5.4.6 To avoid spinning turbines, ensure pressure in HX3B is approximately equal to expander pressure (within 0.5 atm).

_____ 5.4.7 Open process valves H738M_____ and H752A_____ (Air line must be jumpered at valve).

_____ 5.4.8 Open the following valves:

H405M_____	H730A_____ (Vanes)
H703M_____	H739A_____ (Vanes)
H9166M_____	H754A_____ (Vanes)
H778M_____	H757A_____ (Vanes)
H415M_____	

_____ 5.4.9 Close regen manifold bypass valve H9100M.

_____ 5.4.10 If turbine train is cold, turn on regen skid pre-heater.

_____ 5.4.11 Monitor turbine 1B inlet temperature at TI734H.

_____ 5.4.12 When TI734H reaches 290°K, continue to regenerate for at least one hour. Hygrometer reading must be -30°C to -40°C and improving less than 0.5°C/hour.

_____ 5.4.13 Turn off regen skid pre-heater.

_____ 5.4.14 Open bypass valve H9100M.

_____ 5.4.15 Close the following valves:

H757A_____ (Vane)	H778M_____
H754A_____ (Vane)	H9166M_____
H739A_____ (Vane)	H703M_____
H730A_____ (Vane)	H405M_____
H415M_____	

_____ 5.4.16 Install regulator PR9166M.

_____ 5.4.17 Purge expanders 1B/2B, 3B/4B and heat exchanger HX3B per [C-A OPM 7.1.27, "Expander Purge Procedure."](#)

_____ 5.4.18 Close the following process valves:

H752A_____ (Return air lines to normal)
H738M_____

_____ 5.4.19 Secure regen skid per [C-A OPM 7.1.36, "Regeneration System Normal Operation."](#)

6.

Documentation

- 6.1 The check-off lines are for place keeping only. The procedure is not to be initialed or signed, it is not a record.
- 6.2 The Shift Supervisor, or designee, shall document the completion of the procedure in the Cryogenics Control Room Log.

7. References

- 7.1 [C-A OPM 7.1.26, "Expander Brake System Installation and Removal"](#)
- 7.2 [C-A OPM 7.1.36, "Regeneration System Normal Operation"](#)
- 7.3 [C-A OPM 7.1.27, "Expander Purge Procedure"](#)

8. Attachments

None