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C-A OPERATIONS PROCEDURES MANUAL

7.1.57 Regeneration of Warm Turbines "A" Train

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Hand Processed Changes

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

D. Lederle

7.1.57 Regeneration of Warm Turbines “A” Train

1. Purpose

To provide instructions for regenerating the warm turbine “A” 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 1A/2A Only.
- 5.2 Regeneration of Turbines 3A/4A Only.
- 5.3 Regeneration of HX3A Only.
- 5.4 Regeneration of Turbines 1A/2A, 3A/4A and Heat Exchanger HX3A.

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 1A/2A 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:

H328A_____

H338M_____

Other:

H407M_____

H400M_____

H703M_____

H773M_____

H9171M_____

_____ 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 PR9169M has been replaced with the spool piece.

_____ 5.1.6 Open the following valves:

H405M_____

H243M_____

H266M_____

H330A_____ (Vanes)

H9169M_____

H339A_____ (Vanes)

H373M_____

_____ 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 TI334H.

_____ 5.1.10 When TI334H 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:

H330A_____

H9169M_____

H339A_____

H266M_____

H243M_____

H405M_____

H373M_____

- _____ 5.1.14 Secure the regen skid per [C-A OPM 7.1.36](#).
- _____ 5.1.15 Install regulator PR9169M.
- _____ 5.1.16 Purge expander 1A/2A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

5.2 Turbines 3A/4A Only

- _____ 5.2.1 Date_____.
- _____ 5.2.2 Ensure mechanical brakes are installed on turbines 3A/4A per [C-A OPM 7.1.26, “Expander Brake System Installation and Removal.”](#)
- _____ 5.2.3 Ensure the following valves are closed:

Process:

- H352A_____
- H380A_____
- H360M_____

Other:

- | | |
|-------------|-------------|
| H429M_____ | H9177M_____ |
| H777M_____ | H427M_____ |
| H6182M_____ | H778M_____ |

- _____ 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 PR9175M has been replaced with the spool piece.
- _____ 5.2.6 Open the following valves:

H428M_____	H415M_____
H377M_____	H354A_____ (Vanes)
H9175M_____	H357A_____ (Vanes)
H378M_____	
- _____ 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 3A inlet temperature at TI351H.

_____ 5.2.10 When TI351H 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:

H354A_____	H9175M_____
H357A_____	H377M_____
H415M_____	H428M_____
H378M_____	

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

_____ 5.2.15 Install regulator PR9175M.

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

5.3 Heat Exchanger HX3A Only

_____ 5.3.1 Date_____.

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

_____ 5.3.3 Ensure the following valves are closed:

Process:

H330A_____ (Vane)	H376M_____
H339A_____ (Vane)	H346M_____
H354A_____ (Vane)	H426M_____
H357A_____ (Vane)	H380A_____ (Physically Block)
H344A_____	H328A_____ (Physically Block)
H341M_____	

Other:

H429M_____	H9177M_____
H6182M_____	H400M_____
H777M_____	H773M_____

- _____ 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 PR9175M has been replaced with the spool piece.
- _____ 5.3.6 To avoid spinning turbines, ensure pressure in HX3A is approximately equal to pressure in expanders (with 0.5 atm).
- _____ 5.3.7 Open process valves H338M_____ and H352A_____ (air line must be jumpered at valve).
- _____ 5.3.8 Open the following valves:

H428M_____	H373M_____
H377M_____	H243M_____
H9175M_____	
- _____ 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 H377M.
- _____ 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°C/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_____	H377M_____
H373M_____	H428M_____
H9175M_____	
- _____ 5.3.16 Install regulator PR9175M.

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 HX3A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)
- _____ 5.3.18 Purge expanders 1A/2A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)
- _____ 5.3.19 Purge expanders 3A/4A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)
- _____ 5.3.20 Ensure the following process valves are closed:
 - H352A_____ (Return air line to normal)
 - H338M_____
- _____ 5.3.21 Secure regen skid per [C-A OPM 7.1.36, “Regeneration System Normal Operation.”](#)

5.4 Turbines 1A/2A, 3A/4A and Heat Exchanger HX3A

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:

H328A_____	H426M_____
H346M_____	H360M_____
H376M_____	H380A_____

Others:

H407M_____	H6180M_____
H703M_____	H9175M_____
H9171M_____	H427M_____
H373M_____	H778M_____
H6179M_____	

- _____ 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 PR9169M has been replaced with the spool piece.
- _____ 5.4.6 To avoid spinning turbines, ensure pressure in HX3A is approximately equal to pressure in expanders (within 0.5 atm).
- _____ 5.4.7 Open process valves H338M_____ and H352A_____ (air line must be jumpered at valve).
- _____ 5.4.8 Open the following valves:

H405M_____	H330A_____ (Vanes)
H266M_____	H339A_____ (Vanes)
H6169M_____	H354A_____ (Vanes)
H378M_____	H357A_____ (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 1A inlet temperature at TI334H.
- _____ 5.4.12 When TI334H 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:

H357A_____ (Vane)	H378M_____
H354A_____ (Vane)	H6169M_____
H339A_____ (Vane)	H266M_____
H330A_____ (Vane)	H405M_____
H415M_____	
- _____ 5.4.16 Install regulator PR9169M.
- _____ 5.4.17 Purge expanders 1A/2A, 3A/4A and heat exchanger HX3A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

_____ 5.4.18 Close the following process valves:

H352A_____ (Return air line to normal)

H338M_____

_____ 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, "Warm Expander Purge Procedure"](#)

8. **Attachments**

None