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C-A OPERATIONS PROCEDURES MANUAL

7.1.57 Regeneration of Warm Turbines "A" Train

Text Pages 2 through 10

Hand Processed Changes

| <u>HPC No.</u> | <u>Date</u> | <u>Page Nos.</u> | <u>Initials</u> |
|----------------|-------------|------------------|-----------------|
| _____          | _____       | _____            | _____           |
| _____          | _____       | _____            | _____           |
| _____          | _____       | _____            | _____           |
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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 computer control system.
- 3.2 The regeneration skid must be available for use.
- 3.3 While work is underway and an abnormal condition arises, re-review the job against criteria in applicable SBMS Subject Areas, and/or work planning requirements. If unsure of further actions, discuss situation with supervisor.

### 4. Precautions

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

#### 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 Disable H328A in the closed position by closing the air supply valve and disconnecting the air line.

\_\_\_\_\_ 5.1.5 Apply LOTO to H338M.

\_\_\_\_\_ 5.1.6 Start the regeneration (regen) skid per [C-A OPM 7.1.36, “Regeneration System Normal Operation.”](#)

\_\_\_\_\_ 5.1.7 Ensure that the regulator PR9169M has been replaced with the spool piece.

\_\_\_\_\_ 5.1.8 Open the following valves:

H405M\_\_\_\_\_

H243M\_\_\_\_\_

H266M\_\_\_\_\_

H330A\_\_\_\_\_ (Vanes)

H9169M\_\_\_\_\_

H339A\_\_\_\_\_ (Vanes)

H373M\_\_\_\_\_

\_\_\_\_\_ 5.1.9 Close regen manifold bypass valve H9100M.

\_\_\_\_\_ 5.1.10 If turbine train is cold, turn on regen skid pre-heater.

\_\_\_\_\_ 5.1.11 Monitor temperature at TI334H.

\_\_\_\_\_ 5.1.12 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.

\_\_\_\_\_ 5.1.13 Turn off regen skid pre-heater.

\_\_\_\_\_ 5.1.14 Open bypass valve H9100M.

\_\_\_\_\_ 5.1.15 Close the following valves:

|            |             |
|------------|-------------|
| H330A_____ | H9169M_____ |
| H339A_____ | H266M_____  |
| H243M_____ | H405M_____  |
| H373M_____ |             |

\_\_\_\_\_ 5.1.16 Secure the regen skid per [C-A OPM 7.1.36](#).

\_\_\_\_\_ 5.1.17 Install regulator PR9169M.

\_\_\_\_\_ 5.1.18 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 Disable valves H352A and H380A in the closed position by closing the air supply valves and disconnecting the air lines.

\_\_\_\_\_ 5.2.5 Apply LOTO to H360M.

\_\_\_\_\_ 5.2.6 Start the regeneration (regen) skid per [C-A OPM 7.1.36, "Regeneration System Normal Operation."](#)

\_\_\_\_\_ 5.2.7 Ensure that regulator PR9175M has been replaced with the spool piece.

\_\_\_\_\_ 5.2.8 Open the following valves:

|             |                    |
|-------------|--------------------|
| H428M_____  | H415M_____         |
| H377M_____  | H354A_____ (Vanes) |
| H9175M_____ | H357A_____ (Vanes) |
| H378M_____  |                    |

\_\_\_\_\_ 5.2.9 Close regen skid bypass valve H9100M.

\_\_\_\_\_ 5.2.10 If turbine train is cold, turn on regen skid pre-heater.

\_\_\_\_\_ 5.2.11 Monitor turbine 3A inlet temperature at TI351H.

\_\_\_\_\_ 5.2.12 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.

\_\_\_\_\_ 5.2.13 Turn off regen skid pre-heater.

\_\_\_\_\_ 5.2.14 Open bypass valve H9100M.

\_\_\_\_\_ 5.2.15 Close the following valves:

|            |             |
|------------|-------------|
| H354A_____ | H9175M_____ |
| H357A_____ | H377M_____  |
| H415M_____ | H428M_____  |
| H378M_____ |             |

\_\_\_\_\_ 5.2.16 Secure the regen skid per [C-A OPM 7.1.36, “Regeneration System Normal Operation.”](#)

\_\_\_\_\_ 5.2.17 Install regulator PR9175M.

\_\_\_\_\_ 5.2.18 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_____ |
| H344A_____        | H328A_____ |
| H341M_____        |            |

Other:

|             |             |
|-------------|-------------|
| H429M_____  | H9177M_____ |
| H6182M_____ | H400M_____  |
| H777M_____  | H773M_____  |

\_\_\_\_\_ 5.3.4 Disable valves H328A and H380A in the closed position by closing the air supply valves and disconnecting the air lines.

\_\_\_\_\_ 5.2.5 Apply LOTO to H346M, H360M, H376M.

\_\_\_\_\_ 5.3.6 Start the regeneration (regen) skid per [C-A OPM 7.1.36, "Regeneration System Normal Operation."](#)

\_\_\_\_\_ 5.3.7 Ensure that regulator PR9175M has been replaced with the spool piece.

\_\_\_\_\_ 5.3.8 To avoid spinning turbines, ensure pressure in HX3A is approximately equal to pressure in expanders (within 0.5 atm).

\_\_\_\_\_ 5.3.9 Open process valves H338M\_\_\_\_\_ and H352A\_\_\_\_\_ (air line must be jumpered at valve).

\_\_\_\_\_ 5.3.10 Open the following valves:

|             |            |
|-------------|------------|
| H428M_____  | H373M_____ |
| H377M_____  | H243M_____ |
| H9175M_____ |            |

\_\_\_\_\_ 5.3.11 Close regen skid bypass valve H9100M.

\_\_\_\_\_ 5.3.12 If heat exchanger is cold, turn on regen skid pre-heater.

\_\_\_\_\_ 5.3.13 Monitor regen return line at valve H377M.

\_\_\_\_\_ 5.3.14 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.

\_\_\_\_\_ 5.3.15 Turn off regen skid pre-heater.

\_\_\_\_\_ 5.3.16 Open bypass valve H9100M.

\_\_\_\_\_ 5.3.17 Close the following valves:

|             |            |
|-------------|------------|
| H243M_____  | H377M_____ |
| H373M_____  | H428M_____ |
| H9175M_____ |            |

\_\_\_\_\_ 5.3.18 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.**

\_\_\_\_\_ 5.3.19 Purge heat exchanger HX3A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

\_\_\_\_\_ 5.3.20 Purge expanders 1A/2A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

\_\_\_\_\_ 5.3.21 Purge expanders 3A/4A per [C-A OPM 7.1.27, “Warm Expander Purge Procedure.”](#)

\_\_\_\_\_ 5.3.22 Ensure the following process valves are closed:

H352A\_\_\_\_\_ (Return air line to normal)  
H338M\_\_\_\_\_

\_\_\_\_\_ 5.3.23 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 Disable valves H328A and H380A in the closed position by closing the air supply valves and disconnecting the air lines.

\_\_\_\_\_ 5.4.5 Apply LOTO to H346M, H360M, H376M.

\_\_\_\_\_ 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