

Lower Churchill Project

CH0030 Preservation and Storage

January 2017

Boundless Energy



Take a
MOMENT
for Safety

CH0030 Storage and Preservation

This presentation provides details of the CH0030 preservation, packaging and storage plans, a review of storage Audits completed to date, the issues found and future actions

Preservation of rotating equipment typically deals with fully assembled machines such as motors and pumps. This is the case with some of the auxiliary equipment for Package 30 such as the HPU.



The main machines (the turbines and generators) have been shipped completely disassembled. The large size means that they are broken down to their most basic parts. In fact the larger components are designed to be assembled from multiple parts.



Timeline

- 2013
 - Recognized there would be a storage requirement. CH0030 and CH007 milestone schedules did not align. Andritz was advised there would be a delay but the length was unknown.
 - Started development of packaging and preservation system
- 2014
 - Anchors and liners delivered to temporary location in 1st quarter of year.
 - Storage proposal requested from Andritz . Received in 4th quarter.
 - First delivery of draft tube liners and stay ring components arrived (November)
- 2015
 - Change Order put in place for hangar in Goose Bay (January 2015)
 - LCP Inspection of Site laydown and hangar (April)
 - 2nd and 3rd China shipments arrive. (August and November)
- 2016
 - Change order put in place for heated storage in Montreal (January 2016)
 - LCP audit of storage locations (March and April). Question raised about protective coating
 - Selective inspection conducted of parts in site laydown to check performance of preservation.
 - Final China shipment delivered to Marshalling yard (August)
 - Full inspection arranged for outdoor parts plus tarp replacement (September – December)

Andritz's Storage Proposal (Submitted in 2014)

Andritz was asked to investigate all possibilities. LCP's preference was to have storage in Goose Bay Area.

Three types of storage were proposed

- Indoor climate controlled for critical parts (electrical equipment, instruments, bearings, etc.)
- Indoor storage for less critical parts (nuts and bolts, smaller crated items)
- Outdoor storage for large parts (large mechanical structural components)

These were proposed as follows:

- Construction of inflatable building at Site
- Rental of Hangar in Goose Bay (1940's vintage with repairs required)
- Outdoor storage at Site (Company Laydown plus second location to be determined)

Change Order was issued for initially for the Goose Bay Hangar.

The inflatable building at Site was declined and Andritz was asked to look for storage in Montreal area. A change order was issued for storage at GTI Industries warehouse in Lachine.

Arrangements were made for the use of Company Laydown. Eventually space was made available at the Marshalling Yard for the 2016 delivery.

40,000 sq ft in Goose Bay Hangar, 20,000 sq ft in GTI Montreal, 150,000 sq ft at Site

Preservation and Packaging System Development

The selection of the preservation system was based on laboratory testing .

- Lab test #1 – Salt Spray Test - Small test plaques
- Lab test #2 – Salt Spray Test - Apply to small machined parts w/ threaded holes, grooves
- Lab test #3 – Deep freeze test - Validate resistance to cold (-40°C)

Field test panels were attached to first shipment from China

A layered protection system was selected which included coatings, film wrap and mechanical protection

Test Panels - Salt Spray Test #1



Lab Test #2 – Salt Spray Test



**VpCI 372
(2 coats)**



**Cosmoline 1102
(3 coats)**

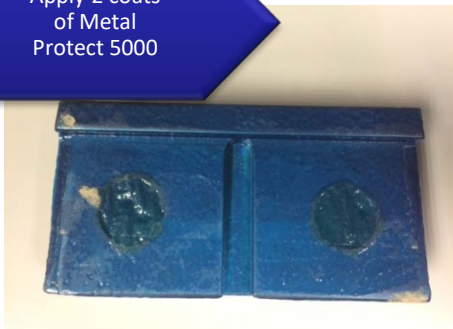


**Metal Protect
(2 coats)**

Test Panels attached to First Shipment



Apply 2 coats
of Metal
Protect 5000



Wrap with
Intercept Shrink
Film



Tarp & Wooden
covers



Layered Protection

- **Metal Protect 5000**
 - Peelable coating
 - Easy to remove
 - Non hazardous application and removal
 - Environmentally friendly
 - Provides some mechanical protection

- **Intercept Film**
 - Provides additional corrosion protection
 - 2 phase corrosion protection – no need for oils
 - Creates barrier to protect MP5000 coating until removal
 - 100% Recyclable

- **Maintain mechanical protection**
 - Solid wooden protective layer
 - Tarps to keep moisture out
 - Protects the rust protection system

Typical Outdoor Storage Packaging



Stainless Body
Carbon Steel Flanges and stiffeners

Stainless is left bare
Carbon steel coated with epoxy coating

Machined flanged surfaces coated with metal protect 5000.
The flanges are then wrapped in intercept film and wood protection strapped on.

Component wrapped in tarp



Typical Indoor Storage Packaging



Metal Protect 5000 applied to machined surfaces.

Pack in crate with intercept lining

Top of crate is covered with a tarp

Critical components are vacuum packaged



2015 Inspection



Main finding was tarps were becoming damaged

2016 Storage Audit



Audit conducted of GTI, Goose Bay and Site (April 2016)



2016 Audit



Crate damaged during shipment was in hangar waiting for repairs to be made.

Inspector noted crack in coating that was covering machined surface

- Results of Audit were presented to Andritz.
- Andritz restated that they felt the system used was the optimal for the situation
- It was agreed that a targeted inspection would be performed where a number of components would be partially unpacked and the preservation performance checked.
- Three components located in the Company Laydown were selected
- The inspection occurred during August 2016.

Intermediate Head Cover



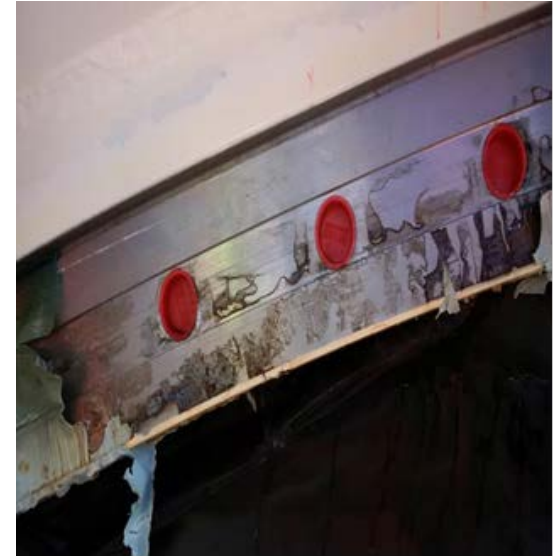
- Plywood is soaked in water
- Coating has deteriorated
- Light rust on surface. Could be easily cleaned.

Draft Tube Liner



- No water damaged noted
- Protective coating in good shape
- No damage to surface.

Stay Ring



- Some water damage
- Light staining/rust

Follow-on Inspection (September – December)



Repackaging (November – December)



Conclusions

- The inspections and audits performed by the project identified the issue at an early stage. The corrosion mechanism is that the machined carbon steel surfaces are being exposed to moisture.
- The corrosion seen to date is easily removed and has not effect the function of the components.
- The coating applied to the machined surfaces (MP 5000) is not performing as well as expected.
- With the extended storage requirement it is apparent that the parts stored outside will need periodic inspection and repair of packaging and preservation.
- Due to the variable weather conditions and the size of the parts it is difficult to execute the inspections and repairs.

Actions

- A large number of the components in the Company Laydown have been inspected. The machined surfaces have been coated with grease and the packaging restored. This work will continue as weather permits.

- Andritz is in the process of reviewing the inspection results. This includes;
 - A review of the preservation system used for the outdoor storage
 - A review of which components have been designated for outdoor storage to determine if some should be moved inside
 - A search for additional indoor storage facilities as well as investigating temporary facilities that could be erected at site
 - A plan for execution of inspections, cleaning and repackaging of the components
 - Andritz will reply with their recommendations within the next two weeks

- A search has been initiated for a 3rd party resource to review the preservation system, procedures, inspection and audit results, and Andritz's future plans.
- Spoke with Malcolm about using the PCS system to track the inspection and preservation activities. This will be investigated to see how it can be effectively used.
- Audits and inspections have been scheduled for this year. The past inspections have been general in nature. With a larger variety of equipment now in storage the inspections should be more focused. The audit scope includes:
 - 3rd party review of preservation procedures
 - Inspection of facilities in Montreal, Goose Bay and Site
 - Review of preservation records
 - A focus will be placed on the equipment such as the HPU's and Exciters plus any others recommended by 3rd party consultant
 - The unpacking, cleaning and preservation of the components stored outside will continue. These activities and records will be reviewed.

- An action plan for the outdoor storage will be put in place in the coming months for implementation this spring.
- Operational spares have been delivered into the Montreal and Goose Bay storage facilities. The storage of these items is included in the change orders already issued. A review of the spares delivered to date versus the contract requirements is being conducted. The preservation of these components will be part of the 3rd party review.

Sharing our ideas in an open and supportive manner to achieve excellence.

Teamwork

Open Communication

Fostering an environment where information moves freely in a timely manner.

Honesty and Trust

Being sincere in everything we say and do.

Relentless commitment to protecting ourselves, our colleagues, and our community.

Safety

Respect and Dignity

Appreciating the individuality of others by our words and actions.

Leadership

Empowering individuals to help, guide and inspire others.

Holding ourselves responsible for our actions and performance.

Accountability