2302 Great N Drive
Fargo, ND 58102

April 15, 2013

—Via Electronic Filing and U.S. Mail —

Darrell Nitschke
Executive Secretary
North Dakota Public Service Commission
State Capitol, 600 E. Boulevard
Bismarck, North Dakota 58505

RE: SHERBURNE COUNTY GENERATING STATION UNIT 3
RESTORATION UPDATE (CASE NO. PU-12-12)

Dear Mr. Nitschke:

Northern States Power Company, doing business as Xcel Energy, provides this update to the North Dakota Public Service Commission on restoration activities at the Sherburne County Generating Station Unit 3 after the event that occurred on November 19, 2011. In our December 6, 2011 update letter we committed to provide periodic updates to the Commission and this report will be followed by further updates in May and June.

In this letter we discuss our key findings from the preliminary root cause analysis of the initial failure and provide an update on the status of each of the major components affected by the event. We provided an estimate of replacement power costs through March in our last update, filed February 20, 2013 and we plan to include an update of replacement power costs in our June update.

A. Overview

In February we informed you that the return-to-service date would be delayed beyond first quarter 2013. Based on recent progress and current information, we forecast Sherco 3 to return to service by the end of the third quarter 2013. Since our last update we have made much progress, including:

- substantial completion of the onsite turbine machining and repairs;

- completion of all generator stator repairs, including delivery of the repaired rotor to the site; and
- delivery of all major turbine components, including the standards.

However, we note that while we are on track to meet our expected goal and many of the repaired components are now back at the plant, we still have considerable work ahead of us as we move into the final assembly portion of this project.

B. Failure Cause Analysis

Since November 19, 2011 we have made significant progress to disassemble, inspect, and evaluate the damaged turbine, generator, and associated components. We have retained specialists, including forensic engineers, metallurgists, water chemistry experts, and rotating machinery experts to investigate where the failure originated and the cause of the turbine failure. This work is not complete; however, the investigation has sufficiently progressed to enable sharing the following key findings:

- The failure event originated in the low pressure (LP) "B" turbine at the attachment location of the next to last row of turbine blades – known as the L-1 stage. The Sherco 3 steam turbine has four identical L-1 rows, one of which failed, resulting in the loss of significant mass from the rotor and subsequently creating a large imbalance. Image 1 shows one of the two LP turbine rotors and identifies the L-1 rows.

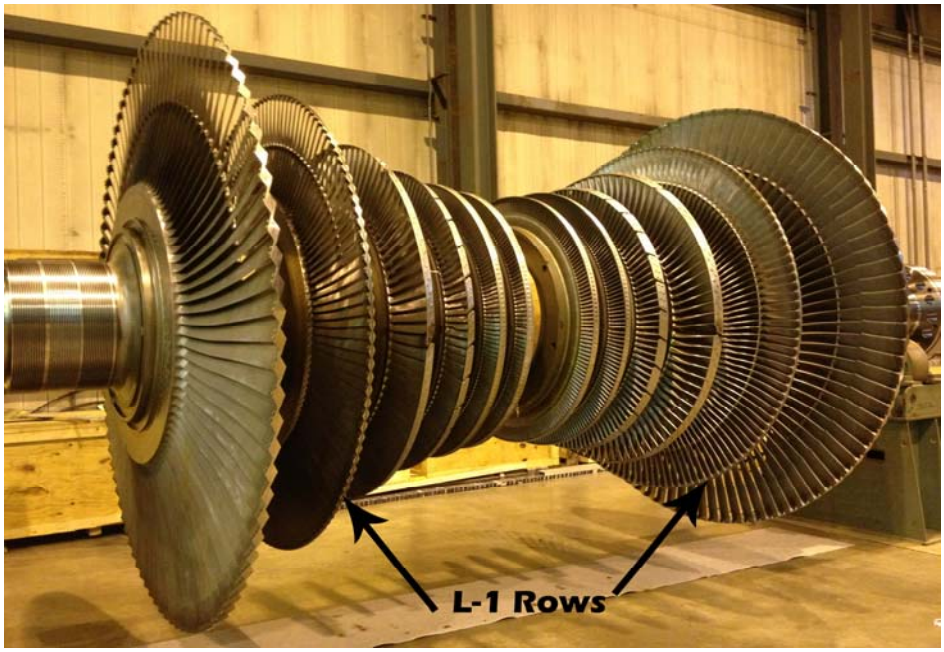


Image 1: One of the two LP turbine rotors.

- Extensive cracking in the root area of the attachment location where the L-1 blades connect with the rotor disc caused the failure. Similar cracking was detected in the other L-1 stage attachments. Image 2 shows the L-1 turbine blade and pin ports where pins are inserted to "pin" the turbine blade to the turbine rotor disc. Extensive cracking was found in the inside "fingers" of the connector adjacent to the pin ports.

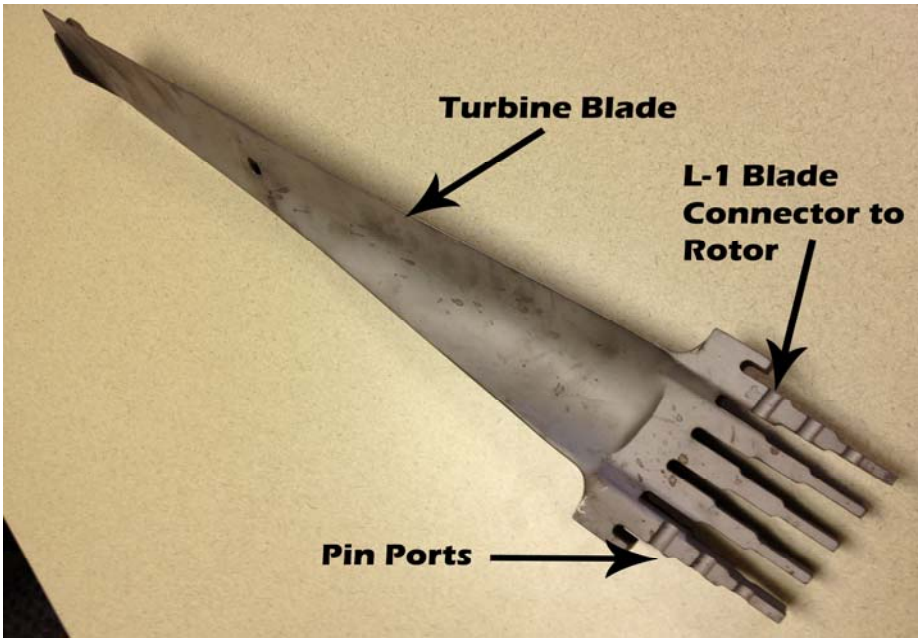


Image 2: L-1 turbine blade, disconnected from the turbine rotor disc.

- Metallurgical examination (including analysis of the fracture surface by a scanning electron microscope) determined the failure to be the result of what is commonly known as stress corrosion cracking. Image 3 shows the L-1 turbine blades that failed at the root connector to the turbine rotor disc. Image 1 and Image 3 are the same component- with Image 3 being before repairs.

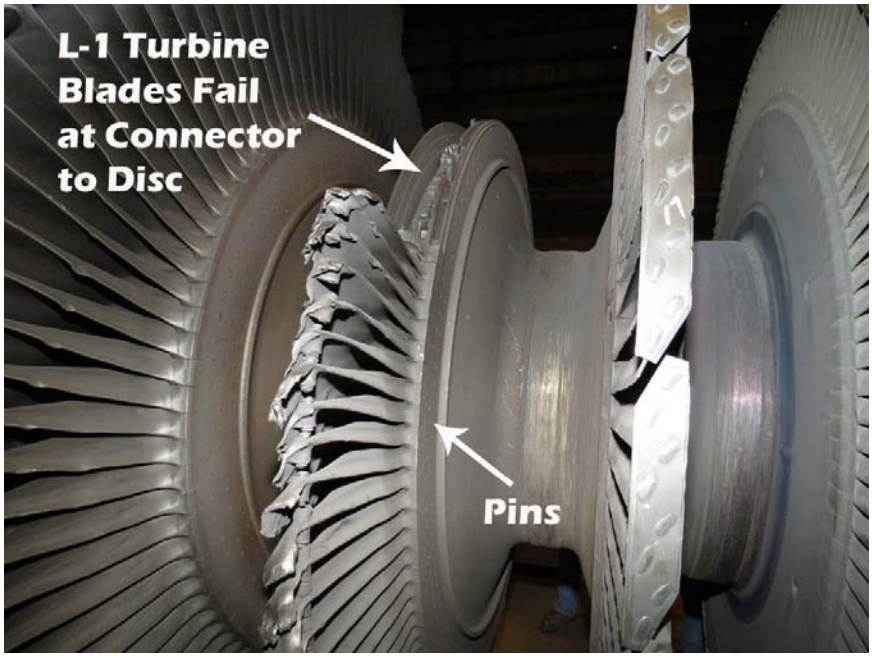


Image 3: L-1 turbine blades that failed, connected to turbine disc.

In addition to the findings regarding specific equipment, we note the following results from our investigation to date:

- The unit was operated normally and no anomalies (indications/warnings/alarms) were noted before the failure event.
- A review of the water chemistry operating history confirms that Sherco 3 has been operated in accordance with industry norms since the unit was commissioned in 1987.
- A review of the operations and maintenance procedures and history confirms that the unit has been operated and maintained in accordance with industry norms since the unit was commissioned in 1987.
- The primary causal factor responsible for the stress corrosion cracking of the low pressure turbine L-1 disks was the high static stresses generated during normal operation at the pin holes, ledges and at the base of the fingers of the finger pinned blade attachments in the low pressure turbine L-1 stage disks. The high stresses in the finger pinned blade attachments are a function of the original design.

C. Progress Update

While we currently expect the unit to return to service on or about September 30, 2013, potential delays may occur. In addition to general issues associated with any large complex project, there are some unique issues that could impact the schedule for this project, including:

- *Fit.* The damaged components were repaired by multiple vendors around the world. Once these parts are assembled together they will require an overall fit with a tolerance in the thousandths of an inch on a machine that is over 170 feet long. While we have taken steps to mitigate the chance that the parts will not fit with the exact precision necessary, we expect there may be modifications necessary when we put the pieces together. To help maintain our schedule, we have machine shops and tooling on standby to be able to make repairs on short notice. Fit and alignment will be monitored all the way through assembly and into startup as some fit issues may only apparent after the turbine is heated up to full temperature and operated at full speed.

- *Condition.* We have examined each component with the industry- available (and in some cases specialized) non-destructive examination techniques. In addition, we have performed comprehensive evaluations both before and after repairs. However, given the extensive nature of the damage, it is possible that some components may require further repair. While we have built some time into the schedule to address minor condition issues, a major issue could impact our return-to-service date.

- *Startup.* The overall unit has been in standby for over 16 months. We have made extensive efforts to properly "lay-up" the unit, including draining, cleaning, and protecting the unit. We also perform periodic checks and start-ups of many components to ensure they are in working condition. However, there are certain start-up steps that cannot be checked until actual start-up of the unit, and unforeseen issues could arise. We will take steps to minimize the chance of additional delay, including starting plant systems as early as practical. However, the level of operation limit is low without the steam turbine fully assembled and ready to operate.

We have built some time into the overall schedule to allow time to address minor issues and will include any schedule updates in our monthly reporting.

Attachment A is a visual summary of our progress to date by component. Below we provide a summary of the status of each major component.

- *Generator Rotor and Stator (74% complete)*

The stator rewinding, including testing, was completed in March. The stator has been turned over from the repairs contractor to the assembly contractor.

The generator rotor was repaired offsite and returned to the plant site on March 1, as forecasted in our previous filing.

Assembly of the rotor into the stator and other generator work will ramp up after the generator end shields (end bells) are returned to site next month. Mechanical completion of the generator assembly is forecasted to be completed by the end of July.

- *High Pressure and Reheat Turbines (77% complete)*

All major onsite repair work for both high pressure and reheat turbine outer shells was completed at the end of February as forecasted in our February 19, 2013 filing. These components have been turned over to the assembly contractor. After grouting is completed, the assembly contractors will perform welding of the high-energy pipe lines to each turbine outer shell followed by final fit up, alignment, and installation of internal components. We currently forecast the high pressure and reheat turbines to be substantially assembled by the end of August.

The offsite reheat steam turbine repairs were completed and all reheat turbine components have been returned to the site.

- *Low Pressure Turbines (LP-A and LP-B) (77% complete)*

The onsite repairs achieved substantial completion on March 15, 2013, a few weeks earlier than forecasted in our previous filing. Minor onsite repairs will continue through unit assembly (for all parts of the turbine) as additional necessary work is identified when the parts are fully assembled with each other. The LP turbines have been turned over from the repairs contractor to the assembly contractor. After grouting is completed, the assembly contractors will perform final fit up, alignment, and installation of internal components. Assembly of the two low pressure turbines is forecasted to be substantially complete by the end of August.

The offsite repairs are also substantially complete and critical turbine parts have been returned to the site. The last low pressure rotor was returned to the plant on April 2.

- *Generator Exciter (63% complete)*

The exciter components were returned to the plant for assembly on February 20, as forecasted in our previous filing. Assembly has started.

- *Balance of Plant Systems and Components*

The balance of plant systems and components continue to be repaired and installed. The majority of miscellaneous parts have been delivered to site and are being installed as other work permits.

We will continue to include progress and component updates in future reports.

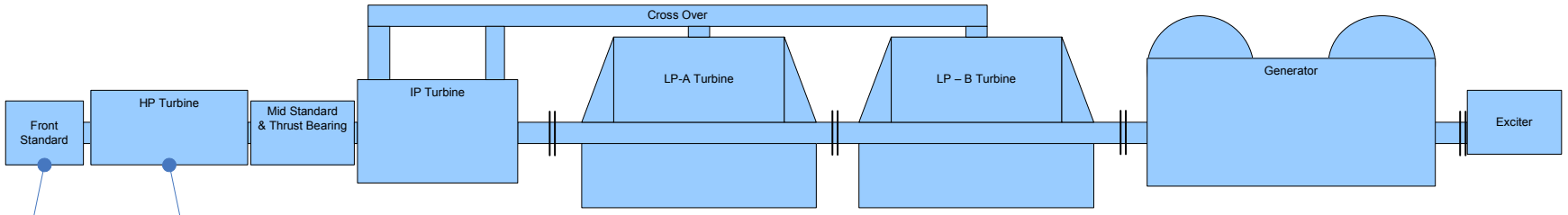
CONCLUSION

We appreciate the opportunity to update the Commission on our work to restore Sherco 3 to service. We will continue to provide periodic updates with our next update expected to be filed in May 2013. Please contact me at dave.sederquist@xcelenergy.com or 701-371-5256 if there are any questions regarding this update.

Sincerely,

DAVID H SEDERQUIST
SR. REGULATORY CONSULTANT
NORTH DAKOTA REGULATORY AFFAIRS

Xcel Energy SHERCO 3 Restoration Project Update: Apr. 10, 2013



	Standards	***HP Turbine***	***IP Turbine***	***LP Turbine - A***	***LP Turbine - B***	***Generator***	***Exciter***
SHOP REPAIR WORK	100% Complete	100% Complete	100% Complete	100% Complete	100% Complete	85% Generator End Shields 100% Generator Rotor	100% Stator/Frame 100% Rectifiers
SITE REPAIR WORK	N/A	100% Complete	100% Complete	100% Complete	100% Complete	100% Restack Complete 100% Rewind	100% – Doghouse Body 100% – Doghouse Electrical 25% - Alterrex Assembly
ASSEMBLY	30% - Standards Installed and Ready to Grout	10% - Casings on standards and ready to grout	10% - Casings on standards and ready to grout	10% - Ready to Grout	10% - Ready to Grout	2% - baseplate set	2% - baseplate set
STARTUP	Not Started	Not Started	Not Started	Not Started	Not Started	Not Started	Not Started
Percent Complete	***81%***	***77%***	***77%***	***77%***	***77%***	***74%***	***63%***

Notes:
1. BOP Mech/Electrical/Controls/Instrumentation/New Parts orders work not represented here, however, all is on track to support the re-assembly and startup of unit.