2302 Great N. Drive
Fargo, North Dakota 58402

May 15, 2012

**VIA ELECTRONIC AND U.S. MAIL**

Darrell Nitschke, Executive Secretary
North Dakota Public Service Commission
Department 408
600 East Boulevard Avenue
Bismarck, ND 58505-0480

RE: SHERCO UNIT 3 RESTORATION UPDATE, CASE NO. PU-12-012

Dear Mr. Nitschke:

Northern States Power Company, doing business as Xcel Energy, provides this update to the North Dakota Public Service Commission ("Commission") on restoration activities at the Sherburne County Generating Station Unit 3 ("Sherco 3") after the event that occurred on November 19, 2011. In our December 6, 2011 letter to the Commission, we committed to provide periodic updates as they became available.

## DESCRIPTION OF EVENT

The event at Sherco 3 occurred at the end of the regularly scheduled Fall 2011 overhaul outage. In addition to the routine maintenance and repair activities scheduled for that outage, we were also completing the uprate project for Unit 3, designed to increase capacity by approximately 22 MW. The uprate required extensive work during the two-month construction period, including replacement of the high pressure and intermediate pressure turbines and upgrades to various generator components, the exciter, and the generator step-up transformer.

The scheduled outage began on September 15, 2011. On November 15, 2011, all projects were completed, and Sherco 3 was ready for final testing and coming back on

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line. The testing procedures to be conducted after the overhaul and uprate were developed by our employees and vendors. The written procedures documented the tests to be completed before the unit could be returned to full service. This set of tests was expected to take approximately two weeks to complete.

The first test was an "overspeed" test of the steam turbine to confirm automatic safety mechanisms would operate properly to shut off the steam to the turbine (allowing it to coast down) if operating events caused the steam turbine to exceed normal speed conditions. For this test, the turbine speed is increased to above 4,040 RPM (compared to a normal speed of 3,600 RPM), and the operations of the automatic steam shutoff mechanisms are functionally tested.

On November 18, 2011, Sherco 3 began ramping up as part of the post-overhaul testing procedure. The unit was synchronized to the grid by mid-afternoon, ramped up to 240 MW (just over 25% of full load), and held at that level overnight. All operating indicators registered normal. The next morning, Sherco 3 was brought offline for final balancing in preparation for the overspeed test. The overspeed test began, and at 3,600 RPM, the unit was running smoothly. The speed of the turbine was increased to 3,960 RPM, still below the overspeed trip set-point. At 12:39:10 PM, all operating indicators registered normal, but two seconds later (at 12:39:12), Sherco 3's turbine and generator instrumentation reported vibration levels significantly above normal, and the unit was shut down.

The vibration damaged many of the steam, oil, and hydrogen seals in the turbines and generator. A fire occurred as a result of oil, hydrogen, and other combustible materials being released during the event. The automatic fire protection systems performed as designed and mitigated the amount of damage from the fire. Our employees took the measures necessary to address the situation as safely as possible, immediately shutting down Unit 3, contacting the local fire departments to extinguish the fire, implementing the Company's safety procedures, and accounting for all on-site personnel. No physical injuries occurred as a result of the equipment failure, but one minor smoke inhalation injury did result from the fire.

## XCEL ENERGY'S RESPONSE TO THE EVENT

After the fire was extinguished, we secured the turbine area and created an exclusion zone with limited and monitored access. This was done both as a safety measure and to ensure that potential evidence would be preserved for future analysis. We conducted an initial damage assessment and interviewed employees and contractors who had been present during the event to preserve their recollections.

The day after the event, we developed a response action plan consistent with response plans for unplanned outages. Due to the magnitude of this event, we added additional resources to this effort. The response team consisted of Xcel Energy employees as well as contractors and representatives from various vendors and insurance companies. We also undertook a significant redeployment of Company personnel to ensure that we had experienced employees from a variety of disciplines dedicated to the effort.

Our response plan included three functional phases of work:

- Phase 1: Documentation and Evidence Collection
- Phase 2: Clean up, Disassembly, and Damage Assessment
- Phase 3: Repair and Restoration

From a project planning and organizational perspective, the three phases are generally sequential in nature. However, there is some overlap in the work actually done in each phase. For example, while the majority of the photographic documentation was completed in Phase 1 before any equipment was moved, documentation and evidence collection continued in Phase 2 as damaged components were disassembled.

*Phase 1: Documentation and Evidence Collection, November 20 – December 13*

The first task was to preserve and document all relevant information and gather forensic evidence. This was a vital step required by Xcel Energy and our insurers to process claims and to provide information about what components may have failed and why.

We actively solicited the participation of several of our major suppliers in this phase and worked with them on a daily basis. For example, we regularly had representatives from contractors, suppliers, and insurance companies on the scene. Thousands of photographs were taken and forensic evidence was gathered. To ensure a transparent review of all relevant considerations for all parties, nothing was moved until this phase was complete.

As this first phase progressed, we determined it was necessary to add extra crews and extra shifts to speed completion of this work. At the height of this phase, we had employees and contractors working multiple shifts each day to ensure the action plan moved forward safely and as promptly as possible.

*Phase 2: Clean-up, Disassembly, and Damage Assessment, December 6 – Summer 2012*

Once the majority of the forensic evidence was gathered, our work shifted to cleaning up the debris field, disassembling equipment, assessing damage, and shipping components offsite for further investigation and assessment.

Before we could disassemble some of the large components affected, we had to repair the overhead crane at Sherco 3. While the crane structure itself was not damaged by the fire, the heat from the fire damaged the crane's wiring system. Once the crane was repaired, it was tested to ensure safe operation.

As disassembly progressed, we began sending certain components offsite for further testing, which is necessary as we do not have the technical capability or equipment on site to perform these investigations. Much of the analytical work must be conducted by component manufacturers and other vendors who have the necessary equipment. The type of examination and testing being done by our vendors includes sophisticated x-ray and metallurgical examination to determine extent of damage, whether repair or replacement of particular components is necessary, and potentially the root cause of the event. Thus far, we have shipped over 30 truckloads of components offsite for inspection and repairs.

We started Phase 2 with crews working 10-hour shifts, six days a week. We then doubled our efforts to include two shifts for approximately three weeks. This schedule was necessary as it was critical to get components separated and shipped to suppliers or repair facilities for further study. Currently we are back to a single disassembly team working 10-hour shifts.

To support this work, we prepared project schedules, including identification of critical-path items, and created cost management processes to ensure that all costs are adequately recorded and tracked to the various activities. We have also deployed a team of contract specialists to work with suppliers and vendors to ensure all contracts are properly implemented.

A description of the disassembly process for the high pressure turbine illustrates the nature and complexity of the work involved in completing this phase. We first removed the appearance enclosures, lagging, and insulation, then disconnected the piping and instrumentation and electrical cables so we could remove the upper outer shell of the turbine. Once the outer shell was removed, we attempted to remove the upper inner shell and learned that the two halves of the inner shell had become "welded" to each other. Thus, we could not access the turbine rotor and other internal components.  As a result, we decided to ship the entire inner shell together with the rotor as an assembly to an offsite vendor to complete the separation.

After we removed the upper outer shells from the four sections of the turbine, we determined the lower shells would also need to be removed.  We have now completed the removal of all the lower shells, which exposed the baseplates.  The baseplates were all damaged during the event and will require removal and repairs.  The grouting system under the baseplates will be replaced, and potential repairs to the concrete foundation are being considered.

Removal of the lower outer shells from the turbines was a major task for our team, as these components are anchored to the building foundation and are connected to numerous mechanical and electrical plant systems.  In particular, the lower shells are welded to large pipes that were stretched when put in place and are consequently under tension.  We engineered specialty restraints to attach to the pipes to ensure worker safety when the tension is released and to facilitate assembly once repairs are completed.

The damage from the event is not confined to surface areas only but extends to the internal parts of equipment, structures, and systems, including piping and wiring that is connected to or in close proximity to the steam turbine generator.  Thus, all equipment, piping, and cabling in the vicinity of the steam turbine generator must be cleaned and inspected to determine if it can be repaired or must be replaced.

In addition to disassembling damaged components and inspecting all nearby equipment, Phase 2 involved extensive work to protect the boiler and auxiliary systems that were not damaged by the event while they are idle during the restoration process.  This work, referred to as a "lay-up," is necessary to ensure these systems will be preserved for a more effective return to service once the other components are repaired or replaced.  This process took approximately three months to complete, and lay-up maintenance activities will be ongoing for the duration of the outage.

To date we have completed a substantial amount of the disassembly work and shipping of components.  However, there is still significant work remaining to complete the damage assessment portion of Phase 2.

*Phase 3:  Repair and Restoration, Beginning Summer 2012*

Phase 3 will encompass all repair and restoration efforts.  Once all damage assessments are complete, we will better understand the extent of the damage and know whether each component can be repaired or will need to be replaced.  Based on that information, we will develop cost estimates and schedules for fabrication, delivery, and installation of components as well as the eventual start-up and commissioning of Unit 3.

## PRELIMINARY DAMAGE ASSESSMENT

While our damage assessment and root cause investigation are ongoing, we can provide preliminary damage information. First, it appears the following components of Sherco 3 were directly impacted:

- the front standard (housing the turbine controls for Unit 3);
- the high pressure turbine;
- the intermediate pressure turbine;
- two sections of low pressure turbine;
- the rotor/blading within all turbines;
- the generator/rotor and stator;
- the exciter; the condenser;
- various electric cables in and around the generator; and
- the associated piping systems.

Second, we have determined that the boiler was not damaged and will be available for continued use. Other ancillary equipment is available for continued use once the turbine components have been repaired or replaced.[1]

At the time we submitted our last update to the Commission, we did not yet know the low pressure turbine had lost a major section of blades. The turbine rotors, including all blades and stationary diaphragms have been sent to repair facilities for cleaning, blade removal, and comprehensive inspections and examinations. The repair facilities will also perform a specialized cutting process to safely remove the fracture surfaces from the rotor for further metallurgical evaluation in a laboratory. We do not know yet if these components can be repaired or must be replaced. Two of the turbine shafts were slightly bent during the event.

The steam turbine generator rotor, weighing more than 80 tons, was shipped to the original equipment manufacturer for inspection and possible repair. Upon arrival at the vendor's facility, the fracture surface on the end of the rotor was cut off with a "clean" break technique and sent to a metallurgy firm for examination to gather facts for possible determination of the root cause of the failure. The generator rotor was

[1] Sherco Units 1 and 2, with a combined capacity of 1500 MW, were unaffected by the outage and are operating normally.

also bent in the incident. The vendor will disassemble the rest of the rotor to determine if it can be repaired or must be replaced.

Once we removed the rotor, we examined the generator stator and core. Examinations and testing confirmed that we would need to completely restack the core. We expect that both the core and stator can be repaired on site but this will be a major undertaking. To complete this repair, the existing stator winding and core have been removed and the remaining parts of the generator frame and casing will need to be moved from a horizontal to a vertical position to allow for restacking of the core. The core consists of approximately 400,000 laminated thin plates, which must be handled individually by the work crews.

We have determined that we will need to replace the exciter and have located a potential used replacement exciter. We are currently disassembling and inspecting that exciter to determine if it will be useable. We have also determined that the condensers will need to be repaired and completely re-tubed.

Insurance is expected to cover the majority of the repair and equipment replacement costs, and we will ensure expenditures are prudent and necessary.

## NEXT STEPS

To date, we have made significant progress in assessing the extent of the damage and the potential range of options going forward. We do not know yet how long it will take to complete the Phase 2 damage assessment and receive all necessary results from vendors. Some of the components have yet to be analyzed to confirm whether they can be safely repaired or must be replaced.

We are now developing preliminary plans and schedules for completing repair and restoration work. We note that we may experience some delay in receiving replacement or repaired components and long lead-times on some items as vendors and manufacturers involved in this process are also working on turbine repairs for other utilities and the normal scheduled outage work.

Based on our current assessment of conditions, our restoration plan targets Sherco 3 coming back online in the first quarter of 2013. However, the restoration is complex and given the remaining work to be done, some degree of uncertainty remains. We have taken the methodical approach described in this report to ensure that we fully learn the nature and root cause of the event and are able to return Sherco 3 safely to reliable service as soon as possible.

## REPLACEMENT POWER

While we cannot project an exact restoration date at this time, we provide below a replacement power cost estimate if we were to assume Sherco 3 would be offline through 2012.

Portions of the information provided below are considered trade secret pursuant to Minn. Stat. § 13.37 and have been marked accordingly. We maintain the confidentiality of this data, which has independent economic value from not being generally known or accessibly by proper means by others who could obtain economic value from its disclosure.

Currently we estimate replacement power costs related to the outage to be approximately **[TRADE SECRET BEGINS TRADE SECRET ENDS]** for 2012. While Sherco 3 provides a significant amount of energy throughout a typical year (approximately 3,500 GWh annually), low forecasted natural gas prices, as well as low forecasted MISO loads, have mitigated potential impacts. Natural gas prices are predicted to be in the range of $2.00 to $3.00/MMBtu for 2012, with prices dipping as low as $2.10/MMbtu for the critical summer period. This will cause MISO market clearing prices to be relatively low, since natural gas units have historically set the market clearing price throughout the MISO footprint.

Further, the Company has significant gas resources at High Bridge and Riverside that can take advantage of low gas prices to the benefit of our customers. Assuming current natural gas prices of $2.50/MMbtu, High Bridge and Riverside can generate energy at costs **of [TRADE SECRET BEGINS TRADE SECRET ENDS]** respectively. **[TRADE SECRET BEGINS TRADE SECRET ENDS]** This highlights the value of the Company's efforts to maintain a diverse resource portfolio, providing us with the flexibility to meet contingencies and take advantage of changing market conditions.

We note that the current replacement power cost estimate is subject to change, based upon natural gas and electricity market conditions.

## CONCLUSION

We appreciate the opportunity to update the Commission on our work to restore Sherco 3 to service. We have made substantial progress but also have significant work ahead of us. We will continue to provide periodic updates to the Commission as our work continues.

Please contact me at dave.sederquist@xcelenergy.com or (701) 241-8632 if there are any questions regarding this update.

Sincerely,

DAVID H SEDERQUIST
SR. REGULATORY CONSULTANT
ND REGULATORY AFFAIRS