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BEFORE THE OFFICE OF ADMINISTRATIVE HEARINGS
FOR THE
MINNESOTA PUBLIC UTILITIES COMMISSION
STATE OF MINNESOTA

IN THE MATTER OF AN APPLICATION OF NORTHERN STATES POWER COMPANY FOR AUTHORITY TO INCREASE RATES FOR ELECTRIC SERVICE IN THE STATE OF MINNESOTA	MPUC Docket Nos. E002/GR-12-961 E002/GR-13-868
IN THE MATTER OF THE REVIEW OF THE ANNUAL AUTOMATIC ADJUSTMENT REPORTS FOR ALL ELECTRIC UTILITIES	E999/AA-13-599 E999/AA-14-579 E999/AA-16-523 E999/AA-17-492 E999/AA-18-373

OAH Docket No. 65-2500-38476

REBUTTAL TESTIMONY OF

TIMOTHY P. MURRAY

On Behalf of

NORTHERN STATES POWER COMPANY

September 22, 2023

Exhibit___(TPM-2)

Turbine Operations

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Schedules

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND EMPLOYER.

A. My name is Timothy Patrick Murray. I retired from Northern States Power Company – Minnesota, d/b/a Xcel Energy in 2021.

Q. HAVE YOU PREVIOUSLY PROVIDED TESTIMONY IN THIS PROCEEDING?

A. Yes. On June 16, 2023, I filed my Direct Testimony on behalf of Northern States Power Company (Xcel Energy or the Company) that provided the operation, maintenance, and relevant history of the low-pressure turbine that failed on November 19, 2011 (the Event). I further detailed how I, along with other Company engineers, took prudent action to gather and implement all relevant maintenance/inspection guidance for Unit 3 at the Sherburne County generating plant (Sherco 3 or Unit 3). As I discussed, the Company's maintenance and inspection decisions (and inspection history) for Sherco 3 were not only reasonable, but they were also consistent with industry practices and knowledge existing prior to the Event.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. My Rebuttal Testimony responds to testimony filed by Mr. Richard Polich of GDS Associates, Inc. on behalf of the Minnesota Department of Commerce (Department), and specifically addresses the Company's operations and maintenance practices at Sherco Unit 3 prior to the Event, as well as the state of industry knowledge and recommended practices during that time.

II. OVERALL RESPONSE TO WITNESS RICHARD POLICH

Q. WHAT OVERARCHING OBSERVATIONS DO YOU HAVE REGARDING MR. POLICH'S TESTIMONY?

A. From reading his testimony and his responses to Company Information Requests, it does not appear that Mr. Polich has any direct experience relating to planning and executing steam turbine generator overhaul[1] work.[2] Mr. Polich also does not seem to be familiar with prudent utility practice regarding steam turbine inspections. To the contrary, Mr. Polich's experience and focus has largely been with nuclear power plants and in providing testimony on rates, cost of service, and engineering problems to state and federal regulatory commissions. This lack of relevant steam turbine generator overhaul and inspection experience leads to a number of misunderstandings, misrepresentations and misstatements that culminate in a number of general and unfounded allegations regarding Xcel Energy's operation and maintenance practices at Sherco Unit 3. Mr. Polich even goes so far as to suggest in conclusory fashion that Xcel Energy's steam turbine operators, such as Company witness Mark Kolb and myself, were reckless and "knowingly and unreasonably risked delaying inspections of the Sherco 3 steam turbine…even though [we] knew that this delay increased the risk of failure."[3] I take serious issue with this unsubstantiated allegation as nothing could be farther from the truth.

[1] "Overhauls" are also referred to as planned outages—scheduled events in which we plan to take a unit offline to conduct normal maintenance and equipment improvements, perform inspections and testing, and investigate and resolve issues.
[2] *See* Sirois Rebuttal, Exhibit___(HJS-2), Schedule 2 (Department's responses to Xcel Energy Information Requests 2, 3, and 4).
[3] Polich Direct, p. 6.

Q. WHY DO YOU TAKE SUCH ISSUE WITH MR. POLICH'S ALLEGATIONS?

A. I do so for a number of reasons, as I will discuss in this Rebuttal Testimony, most of which center on his misstatements and misunderstandings of critical facts. However, as an initial matter, I would note that I had a vested interest in ensuring the safety of the Sherco personnel, including myself, who worked in close proximity to the low-pressure turbines. I personally officed on the turbine deck and, in preparation for the 2011 outage, I moved my office within 50 feet of Unit 3. I would never "knowingly and unreasonably" delay inspections that would "increase the risk of failure," as I know that any such failure could result in serious injuries (or worse) to my colleagues and/or myself—and extensive damage to the facilities. Our top priority was always the safety of plant personnel. I take offense at Mr. Polich's suggestion that I (along with the other steam turbine operators) would "knowingly and unreasonably" take certain actions (or not take certain actions) that would jeopardize the safety and livelihood of my colleagues.

I also had a vested interest in making sure that the Sherco units ran properly because, if there was a problem, I would be tasked with fixing it. My job, along with dozens of other very experienced plant personnel (including operations and maintenance engineers, turbine engineers, supervisors, and others) was to research, plan, and then execute the outages—*i.e.*, taking apart, inspecting, and repairing turbine components and then returning those components successfully back into service. I did this for more than 30 years and was involved in every Sherco 3 outage during my tenure in the Turbine Overhaul Services group. In fact, I was onsite every day of every outage if there was activity on the turbine (anywhere from 8-12 hours a day or, when critical steps were being completed, 24 hours a day) to ensure that everything ran smoothly.

Q. IN ADDITION TO YOUR PERSONAL INTEREST AND INVESTMENT IN UNIT 3, DID OTHERS HAVE A STRONG INTEREST IN MAINTAINING SAFE, RELIABLE OPERATION OF THE FACILITY?

A. Absolutely. Most notably, the Company, Unit 3 co-owner Southern Minnesota Municipal Power Agency (SMMPA), and the turbine manufacturer General Electric (GE) all had strong incentive to ensure safe and reliable operation of the facility. Sherco 3 is Xcel Energy's most substantial unit and is a critical part of the Company's fleet. And, while Xcel Energy was responsible for maintenance and operation of Unit 3, SMMPA representatives were on site and attended daily operations meetings and were fully apprised of maintenance schedules, planned scope of work, and budgets as SMMPA was responsible for 41 percent of those costs. Xcel Energy and SMMPA were in lock-step agreement about Unit 3's maintenance decisions and, frankly, beyond just the safety issues I discussed above, it is nonsensical that Xcel Energy (and SMMPA) would "knowingly and unreasonably" put this critical asset in jeopardy. To the contrary, the Company made careful, considered, and informed decisions—taking into account not only industry recommendations, but also our internal experiences at both the Sherco Plant and across our entire fleet in the Company's footprint. We also engaged with our designated GE representatives for the Sherco Plant, asking questions and staying apprised of industry developments. Simply put, overhaul/inspection decisions were not made in a vacuum. We had an entire team dedicated to Sherco Unit 3 that constantly monitored and evaluated numerous data points while operating and making maintenance decisions. And as will be discussed in more detail, we coordinated with our designated GE representatives by sharing overhaul/inspection plans while seeking input, guidance, and budgets from GE (who was retained to perform much of the steam turbine overhaul work). And we collaborated

closely with Unit 3's co-owner, SMMPA, to execute those overhaul/inspection plans.

Mr. Polich's conclusion that Xcel Energy knowingly and unreasonably delayed inspections of Sherco 3, based on sweeping statements about *general* knowledge of risks related to stress corrosion cracking—along with his erroneous and incomplete interpretation of manufacturer guidance—ignores how reasonable industry operators like Xcel Energy plan and execute steam turbine generator overhaul work. He relies on an incomplete review of the record of a previous proceeding and cherry-picks from industry guidance, without regard for whether the guidance actually applied to the Sherco 3. He also ignores what was actually known about stress corrosion cracking susceptibility in the *specific* components present in Unit 3 (as opposed to components present in other types of steam turbines). Simply put, Mr. Polich engages in nothing more than "Monday morning quarterbacking"—second guessing, without a thorough review of all of the relevant facts and without the requisite experience or knowledge to do so, all of the extensive experience and decision making that went into the overhaul planning process.

III. GE'S INSPECTION RECOMMENDATIONS PRECEDING THE NOVEMBER 2011 EVENT

Q. MR. POLICH CLAIMS THE COMPANY DID NOT FOLLOW GE'S INSPECTION RECOMMENDATIONS PRIOR TO THE EVENT, PARTICULARLY CALLING OUT TECHNICAL INFORMATION LETTER (TIL) 1121-3AR1. HAS HE ACCURATELY SUMMARIZED THAT TIL?

A. No. Mr. Polich either misunderstands or misrepresents the instructions contained in TIL 1121-3AR1—the only TIL that GE issued to Sherco 3 prior to November 2011 related to the failure at issue here: latent stress corrosion cracking of the internal turbine finger dovetail attachments. In his Direct Testimony, Mr. Polich is asked "[w]hat instructions are contained in TIL 1121-3AR1 (Inspection of Steam Turbine Rotor Wheel Finger Dovetails) that pertain to the Sherco 3 LP turbine failure?"[4] Mr. Polich represents that this TIL "recommend[s] that *all* GE steam turbines that have been in service for more than ten years have the rotor wheel with finger dovetail joints inspected, with the buckets removed, using MPI."[5] Mr. Polich is wrong. This "within ten years of service" recommendation appears *nowhere* in TIL 1121-3AR1.[6] Underscoring his lack of relevant experience, Mr. Polich appears to have confused or conflated GE's various Technical Information Letters.

In Mr. Polich's description of TIL 1121-3AR1 he is referencing language that actually appears in a different document, ***TIL 1277-2***,[7] which was ***not*** issued to Sherco 3 and only applies to fossil steam turbines with once-through boilers (as opposed to the Sherco Units' drum boilers).[8] In other words, Mr. Polich both misstates the instructions contained in TIL 1121-3AR1 and, in his apparent confusion, opines that the Company should have applied instructions from GE that are explicitly not applicable to Sherco 3.

[4] Polich Direct, p. 40.
[5] Polich Direct, p. 41 (emphasis in original).
[6] Murray Direct, Exhibit___(TPM-1), Schedule 3 (TIL 1121-3AR1).
[7] Polich Direct, Schedule 20 (RAP-D-20) (TIL 1277-2).
[8] The difference between a once-through boiler and a drum boiler are described in detail in Mr. Mark Kolb's Direct Testimony (page 39).

Q. IS THERE ANYTHING ELSE FLAWED ABOUT MR. POLICH'S DESCRIPTION OF TIL 1121-3AR1?

A. Yes. In addition to incorrectly referencing language from the non-applicable TIL 1277-2 in his description of TIL 1121-3AR1, Mr. Polich then states that "[t]his inspection" (*i.e.*, the TIL 1121-3AR1 magnetic particle inspection of the turbine finger dovetails) "should be part of the major turbine inspection."[9] Mr. Polich further erroneously opines that "GE recommends three-to-five year service interval [sic] for major turbine inspections."[10] It is undisputed, however, that the TIL 1121-3AR1 magnetic particle inspection of the turbine finger dovetails necessarily requires that the blades be removed. Accordingly, Mr. Polich's interpretation of GE's guidance would require operators to remove the turbine blades every 3 to 5 years as part of *every* major inspection.

As explained previously by Company witness Mr. Herbert J. Sirois in his Direct Testimony, such an inspection requires an additional 2 to 4 week outage (beyond an ordinary 4-6 week "major" inspection outage) and involves an onerous disassembly (and reassembly) process with increased inspection costs of approximately $1,000,000 to $2,000,000 (plus any additional costs incurred to repair any damage to the dovetails caused by removal of the blade dovetail pins).[11] In addition, these inspections shorten the expected life of the asset as approximately 1,600 dovetail pins must be removed and it is not unusual to have to machine many of those pins, leaving an oversize hole in the blade attachment. There is a limit on how oversized a hole can become before excessive "ligament" stress occurs between adjacent pins. At a certain point, a

[9] Polich Direct, p. 41.
[10] Polich Direct, p. 39.
[11] Sirois Direct, pp. 20-21.

costly weld repair becomes necessary. The potentially destructive process of removing the pins reinforces why this inspection should be performed judiciously and only in conformance with the express recommendations set forth in TIL 1121-3AR1. Mr. Polich's inspection opinions to the contrary are neither prudent nor consistent with GE's own guidance and would only add costs to customers over the long-term.

Q. CAN YOU ELABORATE ON WHY REMOVING THE BLADES IS SUCH A LABOR INTENSIVE, TIME-CONSUMING, AND ONEROUS PROCESS THAT SIGNIFICANTLY EXPANDS THE SCOPE OF AN ORDINARY MAJOR INSPECTION?

A. As explained in more detail in my Direct Testimony (pages 10-11 and Figures 1 and 2), understanding the distinction between finger dovetail attachments and tangential entry attachments is critical to understanding why this process of blade removal should not be undertaken lightly. Tangential entry blade attachments can be more easily removed from the rotor wheel, as they slide in and out during removal and re-loading. In contrast, finger dovetail attachments are extremely difficult to remove as each finger dovetail blade is held in place using its own set of three pins. To remove the L-1 and L-0 finger-attached blades from the LP turbine rotor, the pins need to be driven out individually, one at a time with a pneumatic peening gun. As it relates to inspections, the tangential entry attachment design allows for a full examination of the rotor attachment area through a phased array ultrasonic inspection can be performed with the blades still attached to the rotor. The finger dovetail design, in contrast, is much more difficult to inspect as the internal fingers are hidden and not visible when the turbine is assembled. As such, the blades must be removed to expose the internal fingers for inspection. Finally, and relevant here, tangential

entry dovetails are more susceptible to stress corrosion cracking. The finger-style attachment did not present the same issues for cracking susceptibility.

The additional work involved with the finger dovetail design includes removal of all pins and blades from each of the four L-1 rows of the two low pressure turbines for Sherco Unit 3. Each L-1 finger-dovetail row for Unit 3 has 133 blades with integral tip seal, 399 precision ground and fitted dovetail pins, 133 side-entry blade covers, 266 tenons (2 per side cover), and 133 blade airfoil vibration dampening sleeves. The steps involved in this process include the following:

1. All 399 pins of each of the four L-1 rows must be driven out one by one with a peening gun. If we cannot remove the pins with the peening gun, our next step is to drive them out with an explosive charge in a Hilti gun. Any pins that cannot be removed through that process must then be machined out, which is an expensive and time-consuming process.
2. Next, we must cut in half every 4th or 5th side entry cover with a cut off wheel taking care not to damage the adjacent blade tips. This allows the blades to be removed in groups of 4 or 5 at a time, to make the process more efficient.
3. Once the covers are cut, the blades can be flexed just enough to allow every 4th or 5th airfoil dampening sleeve to be removed.
4. The blade groups are then lashed together with nylon binders to prevent them from moving as they are extracted one group at a time from the rotor wheel with an overhead crane.
5. The damaged side entry covers are then removed by carefully grinding the peened tenon material taking care not to damage the blade tips.
6. The blade finger dovetails are glass bead blast cleaned to allow for magnetic particle examination of the blade fingers.
7. With the blades now removed from the rotor wheels, the rotor wheel finger dovetails are also glass bead blast cleaned. Glass bead blasting is time consuming, but a necessary method for cleaning

the rotor wheels for magnetic particle examination. Cleaning alternatives, like the use of aluminum oxide, cannot be used on finger dovetails because it carries a risk of removing material and losing the precision fit between the rotor dovetails and the blade dovetails.

8. Once the rotor dovetails are clean and an adequate magnetic field strength has been established, the magnetic particle examination can begin. Each side of each dovetail pin hole and each ledge on each finger is inspected. The pin holes and ledges at the bottom of the dovetails can only be inspected using a mirror. This is a labor-intensive and time-consuming process.
9. If no defects are found on the blade or rotor finger dovetails, then reassembly begins. The blade groups are reloaded back onto the rotor wheels one group at a time in the exact location from which they were removed. They are held to the rotor with temporary undersized dovetail pins. New side entry covers and new airfoil vibration dampening sleeves are then installed. One at a time, the temporary dovetail pins are removed and the dovetail pin holes are reamed 0.005" oversize using a precision ground reamer. Each hole is visually inspected to verify 100% clean-up. This is necessary to ensure each rotor and blade finger is evenly loaded as per the original design of the turbine. If the dovetail pin hole does not clean-up at 0.005" oversize, the hole is reamed to 0.010" over original design. This process can continue to 0.015", but any reaming beyond that measurement would require involvement of GE product service engineering.
10. Once 100% of the holes are verified as cleaned-up, a new precision ground dovetail pin is installed. The pins are driven in with a one-half-of-one-thousandth of one-inch clearance, or 0.0005 +/- 0.0002".
11. The pins are each staked in position at each end so that it cannot back out during operation.
12. The cover tenons are then peened on one side to lock the covers to one blade airfoil and on the other side they are swelled to allow a small amount of relative movement between the cover and the adjacent blade airfoil tip. This accommodates the airfoil twist as the unit comes to speed and still provides adequate dampening during operation.
13. Next, a liquid penetrant examination is performed to ensure the cover tenons did not crack during the peening process.

14. Once reassembled and tested for cover tenon cracking, the rotors are placed in a lathe/balance machine to machine the new covers to design diameter.
15. Finally, a low-speed balance is performed to account for any weight changes associated with the blade removal and wheel inspection process.

Q. CAN YOU ELABORATE ON THE ADDITIONAL COSTS ASSOCIATED WITH REMOVING THE BLADES TO PERFORM A TIL 1121-3AR1 MAGNETIC PARTICLE INSPECTION OF THE FINGER DOVETAILS?

A. As previously stated by Mr. Sirois, the estimated additional inspection costs for performing a TIL 1121-3AR1 inspection are approximately $1,000,000 to $2,000,000. This estimate includes the labor costs associated with all the time-consuming and precise work detailed above in my last response. This estimate does *not*, however, include costs associated with labor, supplies, or other costs associated with further investigation and/or repair of the rotors in the event cracking is discovered or other damage occurs during the onerous disassembly and reassembly process. This estimate also only reflects the costs associated with performing the TIL 1121-3AR1 inspection on the four L-1 rows of the Sherco Unit 3 low pressure turbines; it does not, however reflect the additional costs associated with a similar inspection of the L-0 rows on the two low pressure turbines. If the L-0 rows were added to the process, I would estimate that there would be an additional cost of $750,000 and an additional 2 weeks of outage time—assuming that no dovetail pins would need to be machined for removal, no blades were damaged during removal and reinstallation, and that all reaming, machining operations, and balancing are performed properly.

In sum, the combined estimated cost of conducting a magnetic particle inspection under TIL 1121-3AR1 on all L-1 and L-0 rows for Sherco Unit 3,

above and beyond the work expected during a major overhaul, is $1.75 to $2.75 million, and the combined incremental increase to the major outage timeline would be an additional 4 to 6 weeks. This 4-6 week window would be extended, potentially significantly, if damage were caused and needed to be repaired.

Q. HAD XCEL ENERGY PERFORMED THE INSPECTION THAT MR. POLICH ERRONEOUSLY ARGUES WAS REQUIRED IN 2011 (*i.e.*, TIL 1121-3ARI MAGNETIC PARTICLE INSPECTION OF THE FINGER DOVETAILS), AND DISCOVERED THE STRESS CORROSION CRACKING THAT COULD NOT HAVE BEEN DETECTED WITHOUT THE BLADES REMOVED, CAN YOU ESTIMATE THE COSTS THAT WOULD HAVE BEEN INCURRED TO PERFORM THE INSPECTION AND MAKE THOSE REPAIRS?

A. Yes, the costs for this hypothetical-inspection scenario can be calculated. As an initial matter, the hypothetical-inspection would minimally require that the machine be opened, cleaned, inspected, and closed. To perform the TIL 1121-3AR1 magnetic particle inspection, the 4 rows of L-1 blades would first need to be removed and then we would glass bead blast the dovetails. If cracking was discovered following the TIL 1121-3AR1 magnetic particle inspection, the rotors would need to be removed and shipped off-site to repair all 4 of the L-1 rotor wheels. Once the repairs were performed, the blades would be re-installed and the rotors would be shipped back to the Sherco Plant. The total estimated costs for the 2011 hypothetical-inspection and repair are approximately $4.5 million to $5 million. This estimate includes the labor costs associated with the time-consuming and precise work involved and shipping costs (*e.g.*, shipping permits, shipping skids, etc.). This estimate does not, however, include costs associated with labor, supplies, or other costs associated with any additional damage incurred with the onerous blade disassembly and reassembly process.

Q. IS IT POSSIBLE TO ESTIMATE THE DURATION OF THE OUTAGE ASSOCIATED WITH THE HYPOTHETICAL-INSPECTION AND REPAIR SCENARIO THAT YOU JUST DESCRIBED?

A. Yes. The additional outage time associated with the work detailed in my previous answer would be 2-3 months—the estimated time needed to perform the hypothetical 2011 major inspection plus a blades-off, TIL 1121-3AR1 magnetic particle inspection and then, once cracking discovered, the estimated time needed to get the rotors out the door, repaired, and back to the plant. Importantly, this 2-3 month additional-outage-time estimate assumes that everything runs smoothly (*e.g.*, availability of products and parts, access to high-speed balancing equipment and facilities, and available permitting for safe transportation of the rotor) and, most importantly, that there is availability at a qualified repair shop to make the needed repairs.

By way of example, when we had to ship Sherco's Unit 1 rotors offsite to repair the tangential dovetail cracking discovered in 2007, the rotors sat on-site for 3-4 weeks while we selected a repair contractor and shop location (the Alstom shop in Richmond, Virginia), confirmed repair shop space availability, and obtained the necessary shipping permits. Once the rotors were shipped offsite to Alstom's facility, it then took 32 days to make the needed repairs and return the rotors to the Sherco Plant. Notably, fine-line welding repairs—the type of repair that would be required for cracking discovered on the L-1 finger dovetail row (*i.e.*, the hypothetical scenario at issue in this matter)—requires an additional 2 weeks beyond what was required to repair Unit 1's rotor wheels in 2007. Accordingly, I estimate that the additional outage time associated with the hypothetical 2011 inspection-and-repair scenario is, conservatively, 2-3 months.

Q. ARE THERE OTHER CONCERNS YOU HAVE REGARDING MR. POLICH'S DISCUSSION OF TIL 1121-3AR1?

A. Yes. Mr. Polich seems to be unaware that TIL 1121-3AR1 only applies: (1) whenever the blades are removed for a reason such as replacement (which typically only occurs about once every 20 to 40 years); ***or*** if "abnormal events" or "operational anomalies" occur during operation that cause concern for long-term reliability. Prior to the November 2011 event, there were no time-based inspection frequency instructions associated with the TIL 1121-3AR1 recommendations.

Q. IS IT YOUR UNDERSTANDING THAT, IN NOVEMBER 2011, GE DID ***NOT*** RECOMMEND THE REMOVAL OF THE BLADES FOR INSPECTION OF THE ROTOR WHEEL FINGER DOVETAILS ***UNLESS*** ABNORMAL EVENTS OR OPERATIONAL ANOMALIES WERE ENCOUNTERED?

A. Yes, and this was expressly confirmed in writing by GE. When GE shared TIL 1121-3AR1 (issued in 1993), GE indicated that the revision was issued to respond to questions received after the original issue of TIL 1121-3 (issued in 1992). GE's cover letter stated as follows:

> Attached you will find TIL-1121-3AR1, a revision of TIL 1121-3 issued in 1992. Revision 1 of this TIL was issued to respond to a number of questions received after the original issue, particularly to clarify what is meant by "abnormal operation or unusual operating events."
>
> As with the original TIL, this TIL DOES NOT recommend the removal of buckets for inspection of the rotor wheel finger dovetails, unless abnormal events or operational anomalies are encountered which may increase the risk of stress corrosion and/or fatigue.[12]

[12] Murray Direct, Exhibit___(TPM-1), Schedule 3 (emphasis in original).

In sum, prior to the November 2011 event, GE was very clear that a blades-off, magnetic particle inspection of the rotor wheel finger dovetails should only occur under very limited circumstances (*i.e.*, abnormal events or operational anomalies)—in contradiction to Mr. Polich's suggestion that the blades-off, magnetic particle inspection of the finger dovetails should routinely be part of every major inspection and occur every 3 to 5 years.

GE's constrained recommendation makes perfect sense when you factor in the onerous process (and additional outage times and costs) involved in removing the blades, as I described above. And as previously explained by Mr. Sirois, removing the blades potentially reduces the usable life of the low-pressure turbines since the finger dovetail blade removal process includes the risk of rotor damage when the dovetail pins are removed. The Company understood these risks. Accordingly, without a separate manufacturer's recommendation or an abnormal event or operational anomaly (consistent with TIL 1121-3AR1), it would not have been prudent for the Company to perform a costly blade removal and inspection that would add costs and could detrimentally affect the life of the rotor.

Q. DOES GE'S TIL 1277-2 FACTOR INTO THE PRUDENCY ANALYSIS AS IT RELATES TO SHERCO 3 MAINTENANCE DECISIONS RELATING TO THE L-0 AND L-1 ROTOR WHEEL FINGER DOVETAILS, AS STATED BY MR. POLICH (POLICH DIRECT, PP. 40-42)?

A. No. Mr. Polich is incorrect. TIL 1277-2 does not apply to Sherco 3 (or any of the Sherco units) because TIL 1277-2 only applies to steam turbines with once-through boilers (as opposed to the Sherco Units' drum boilers). But even if this TIL *had* been issued to Xcel Energy, which it wasn't, and even if it *did* apply to

any of the Sherco Units, which it didn't, a GE representative at a 2001 conference in Atlanta confirmed that TIL 1277-2 was issued because GE was starting to see *tangential entry dovetail* cracking in low-pressure turbines and therefore the manufacturer was recommending that utilities with both once-through and drum boilers conduct phased array ultrasonic inspections of all tangential entry dovetails to look for cracking. Nothing from that 2001 conference indicated a parallel industry issue for rotor wheels with *finger* dovetail attachments—the type of attachment on the L-1 stage of Sherco 3 that failed.

Nonetheless, based on the information learned at that conference, the Company implemented the recommendation for phased array ultrasonic testing on all tangential entry attachments at the next major outage. This occurred in 2005, and the inspection was performed by WesDyne. The WesDyne Report found no indications of cracking.[13] This is an example of how the Company constantly tried to stay apprised of industry standards and was prudent in its operations of Sherco 3. Even though TIL 1277-2 had not been issued to Xcel Energy, and even though GE had neither prepared nor issued any updated guidance that would apply to any of the Sherco Units (which had drum boilers),[14] Xcel Energy implemented the phased array ultrasonic inspection of tangential entry dovetails recommendations into its maintenance planning.

[13] Murray Direct, Exhibit___(TPM-1), Schedule 4.

[14] Notably, the Company sought updated guidance from GE, seeking unit-specific recommendations for the Sherco units. For example, in January 2018, I specifically sought feedback from GE's designated representative for the Sherco Plant (Joshua Bird) as to whether there were any updated TILs in the works and requested "[a]ny feedback [he] could provide regarding inspection recommendations for the rest of our drum boiler fleet." Mr. Bird's response indicated that GE was not planning on issuing an updated TIL regarding the dovetail cracking. That email is included as Exhibit___(TPM-2), Schedule 1.

Q. MR. POLICH SUGGESTS THAT "GE RECOMMENDS AN INSPECTION OF THE TURBINE ROTOR FOR PROBLEMS LIKE SCC SHOULD BE PERFORMED EVERY THREE TO FIVE YEARS." (POLICH DIRECT, P. 54.) IS THIS CORRECT?

A. No, this is not correct. The 3- to 5-year inspection interval is an old, outdated GE recommendation from the 1970s. In 2007, GE issued updated inspection recommendations in GEK 111680: Creating an Effective Steam Turbine Maintenance Program. This document identifies a 6-year major inspection maintenance interval, while expressly stating that such intervals could be extended beyond 6 years depending on "fleet experience, testing results, and operational assessment[.]" (*See* Sirois Rebuttal, Exhibit___(HJS-2), Schedule 4) As explained further in Mr. Sirois' Rebuttal Testimony, GE's guidance directly invalidates Mr. Polich's 3- to 5-year inspection-interval opinions.

Q. HOW DOES MR. POLICH RECONCILE GEK 111680'S INSPECTION-INTERVAL-FREQUENCY GUIDANCE WITH HIS 3- TO 5-YEAR INSPECTION-INTERVAL CONCLUSIONS?

A. Mr. Polich fails to even address GEK 111680, which was issued in 2007, in his Direct Testimony. The only GEKs referenced by Mr. Polich (GEK 63355 and GEK 46354) were issued in the 1970s. (Polich Direct, pp. 38-39.)

Q. DID GE OFFER ANY INFORMAL GUIDANCE THAT WOULD SUPPORT THE COMPANY'S CONTENTION THAT, IN NOVEMBER 2011, INDUSTRY TRENDS FOR MAJOR INSPECTION INTERVALS HAD INCREASED TO 10 TO 12 YEARS?

A. Yes. In 2006, GE representatives came to Xcel Energy and gave a PowerPoint presentation to Xcel Energy representatives (including myself) on the topic of maintenance. That PowerPoint presentation is attached as Exhibit___(TPM-2), Schedule 2. On page 34 of that presentation, GE *expressly recognized* that the

industry trend for the interval between major inspections was increasing to 10 to 12 years: "Was every 5 to 7 years…trend is to increase to 10 – 12."

Q. ARE YOU AWARE OF ANY OTHER OPERATORS DISASSEMBLING THEIR FINGER DOVETAIL ROTORS TO PERFORM MAGNETIC PARTICLE INSPECTIONS TO DETECT STRESS CORROSION CRACKING EVERY THREE TO FIVE YEARS, AS SUGGESTED BY MR. POLICH?

A. No, and if other utilities were removing the blades every 3 to 5 years to check for stress corrosion cracking in the finger dovetails, I certainly would have heard about it through our power generation industry contacts, which include steam turbine engineers at other utilities and industry groups such as EPRI. I am not familiar with any utilities routinely performing the TIL 1121-3AR1 inspections—either before *or after* the November 2011 Event. Notably, Mr. Polich does not point to any other utilities that are routinely performing the TIL 1121-3AR1 inspections.

Q. DID ANY OF THE VENDORS YOU RETAINED TO ASSIST WITH INSPECTIONS SUGGEST THAT A BLADES-OFF, MAGNETIC PARTICLE INSPECTION OF THE TURBINE FINGER DOVETAILS SHOULD BE PERFORMED EVERY THREE TO FIVE YEARS?

A. No. Prior to 2011, we worked with several reputable steam turbine generator overhaul contractors including Alstom Power, Siemens, Mechanical Dynamics & Analysis, Wood Group, and Turbine PROs, none of which ever recommended a blades-off, magnetic particle inspection of the turbine finger dovetails every 3 to 5 years. Further, GE—the Original Equipment Manufacturer—was retained to perform multiple major inspections of Sherco Unit 3 in the 1990s and 2000s. Yet, other than the 1999 major inspection, which

involved the removal and replacement of the turbine blades and therefore triggered the TIL 1121-3AR1 inspection since the blades were going to be removed, GE never performed or recommended a blades-off, magnetic particle inspection of the turbine finger dovetails as part of any of those major inspections. If GE truly intended for these types of inspections to be performed every 3 to 5 years, they certainly would have included such recommendations in their inspection proposals.

Q. DID XCEL ENERGY CONSULT WITH GE REGARDING THE SCOPE OF PLANNED INSPECTIONS?

A. Yes, and this is something that Mr. Polich ignores. As set forth on pages 4-7 of my Direct Testimony, I utilized numerous resources to determine how we operated and maintained Sherco Unit 3. In addition to reviewing Original Equipment Manufacturer (OEM) guidance (including, but not limited to the applicable GEKs and TILs), attending industry conferences, and conferring with vendors to make the best decisions for the operation, maintenance, and long-term reliability of our units, I would also reach out to GE's field services representatives for specific questions and advice relating to the scope of planned inspections. For example, in advance of the Fall 2005 major inspection of the Sherco 3 Unit, I shared our maintenance plans and requested input and pricing. (*See* my Direct Testimony, Exhibit___(TPM-1), Schedule 5 (p. 1)).

Q. DID GE RECOMMEND A BLADES-OFF, MAGNETIC PARTICLE INSPECTION OF THE ROTOR WHEEL FINGER DOVETAILS FOR THE FALL 2005 MAJOR INSPECTION?

A. No, GE made no such recommendation. In my summary of the planned work for the Fall 2005 major inspection, which was provided to GE in April of 2004,

I addressed 6 specific items—including the planned inspection of the rotor wheel dovetails:

> 4. Perform a phased array ultrasonic inspection of the LP rotor wheel dovetails. I believe this would include rows L-2, L-3, and L-4 on both LP rotors, 12 rows total unless GE recommends differently. The L-0 and L-1 rows are finger dovetails so they probably wouldn't be included. Additionally, all 4 rows of the L-1 blading was replaced by GE in 1999 and wheel dovetails were mag tested at that time with no indications present. This inspection should include engineering evaluation of the test results. This would be onsite work as well.[15]

GE's representative (Joshua Bird) responded to me, and there were additional communications regarding the fifth item in my April 13, 2004 email (regarding an engineering study of the reheat section).[16] There was, however, no further comment or discussion about item four—the planned inspection of the rotor wheel dovetails. Further, GE's pricing quote associated with item four was for ultrasonic inspection of the rotor blade attachment areas using linear phased array testing.[17] Had GE actually believed that a TIL 1121-3AR1 blades-off, magnetic particle inspection of the rotor wheel finger dovetails was required as part of a major inspection—either on an inspection-interval-frequency basis or through an (improper) extension of the TIL 1277-2 instructions to the Sherco 3 L-0 and L-1 rows—why did they fail to make that recommendation for the Fall 2005 major inspection? Notably, the last such TIL 1121-3AR1 inspection had been performed in 1999—more than five years prior. The communications between GE and myself regarding the planned inspection, along with GE's

[15] Murray Direct, Exhibit___(TPM-1), Schedule 5, p. 1.
[16] Murray Direct, Exhibit___(TPM-1), Schedule 5, pp. 10-12.
[17] Murray Direct, Exhibit___(TPM-1), Schedule 6.

technical proposal, confirm that GE did not—as suggested by Mr. Polich—recommend that major inspections, including a TIL 1121-3AR1 blades-off, magnetic particle inspection of the rotor wheel finger dovetails, be performed every 3 to 5 years.

IV. XCEL ENERGY'S KNOWLEDGE ABOUT STRESS CORROSION CRACKING IN NOVEMBER 2011

Q. HOW DO YOU RESPOND TO MR. POLICH'S ASSERTION THAT "XCEL HAD SIGNIFICANT INFORMATION" AVAILABLE FROM SOURCES OUTSIDE OF GE THAT PROVIDED EVIDENCE THAT THE SHERCO 3 TURBINE WAS HIGHLY SUSCEPTIBLE TO STRESS CORROSION CRACKING" (POLICH DIRECT, P. 29)?

A. This is incorrect. As a general matter, *all* steam turbines are susceptible to stress corrosion cracking to some degree depending on a number of different factors, including: age of the unit; rotor material; boiler type (*i.e.*, once-through boiler or drum boiler) as that will factor into steam purity (*i.e.*, once-through boilers have more difficulty controlling steam purity because of the lack of a steam drum); blade-to-rotor-wheel-attachment configuration (*i.e.*, finger dovetail or tangential dovetail); rotor manufacturing techniques; operating stress levels; operating hours; and operating events. But none of these factors suggested that the Sherco 3 LP (which has a drum boiler) rotor wheel finger dovetail attachments were highly susceptible to stress corrosion cracking. Additionally, there was no information either from other Original Equipment Manufacturers, turbine maintenance companies, or industry organizations that the Sherco 3 turbine rotor wheel finger dovetails were highly susceptible to stress corrosion cracking. In sum, *general* knowledge about risks associated with stress corrosion cracking is not the same as having *specific* knowledge that the Sherco 3 turbine rotor wheel

finger dovetails were highly susceptible to stress corrosion cracking—especially in the absence of any such guidance from GE.

Q. MR. POLICH INCLUDED A 2008 INTERNAL EMAIL THAT PURPORTEDLY DEMONSTRATES THAT XCEL ENERGY EMPLOYEES INVOLVED IN THE OPERATION OF SHERCO 3 WERE AWARE OF THE RISKS ASSOCIATED WITH SCC (SCHEDULE RAP-D 31, P. 2, POLICH DIRECT, P. 31.) HOW DO YOU RESPOND?

A. Again, there is no dispute that both I and the other Xcel Energy employees involved in the operation of Sherco 3 were aware of the risks associated with stress corrosion cracking *generally*. But, as previously stated, the details about the scope of that knowledge matter. The email and draft recommendation document that Mr. Polich relies upon do not support his opinion that Xcel Energy employees had knowledge that the Sherco 3 turbine ***rotor wheel finger dovetails*** (in the L-0 and L-1 rows of the low-pressure turbine) were particularly susceptible to stress corrosion cracking. Instead, the draft recommendation's background summary reflects the Company's awareness that ***tangential-entry dovetails*** in GE low pressure turbines were particularly susceptible to stress corrosion cracking. (Schedule RAP-D-31, p. 1). As noted in the draft recommendations, this is probably due to the tangential entry dovetail design commonly used by GE. The draft recommendations then proceed to summarize GE's informal inspection recommendations for this specific emerging issue and details the inspections that Xcel Energy had performed across its entire fleet consistent with those recommendations. Therefore—and contrary to Mr. Polich's intimations—a close review of this document demonstrates that the Company was prudently monitoring ongoing developments and utility guidance with regard to stress corrosion cracking and making reasonable and appropriate inspection decisions across its entire fleet

based on such information. This document does not, as suggested by Mr. Polich, demonstrate that the Company was "well aware" that the Sherco 3 turbine rotor wheel *finger dovetails* were highly susceptible to stress corrosion cracking, which is the critical question for this event.

V. XCEL ENERGY'S INSPECTIONS UP TO 2011 WERE REASONABLE AND CONSISTENT WITH INDUSTRY PRACTICES AND KNOWLEDGE

Q. DID MR. POLICH ACCURATELY DESCRIBE THE SHERCO LP TURBINE INSPECTION AND MAINTENANCE HISTORY (POLICH DIRECT, PP. 32-38)?

A. No. The Sherco 3 LP turbine rotors were thoroughly and comprehensively inspected during major overhauls in 1993, 1999, and 2005—with minor inspections of the LP turbines performed in 1996, 2002, 2008, and 2011. A summary of the maintenance history for Sherco 3 was provided in my Direct Testimony (pp. 11-20) and the maintenance summary detailed in the Thielsch Engineering Report (*See* Tipton Direct, Exhibit___(AAT-1), Schedule 2, pp. 67-78 (or pp. 65-76 of the Report)). Importantly, there are specific details that are important to this analysis that Mr. Polich did not include in his maintenance summary that render his discussion incomplete and his conclusions unreliable.

Regarding the 1993 major inspection, a complete inspection of the LP rotor external surfaces was completed using visual, magnetic particle, and liquid penetrant exams in full accordance with GE inspection recommendations. This is a very thorough inspection of the rotor external surfaces and is fully compliant with the GE recommendations for rotor inspections. Because there were no abnormal events or operational anomalies (and no reason to remove the L-1 or L-0 blading), a TIL 1121-3AR1 magnetic particle inspection of the rotor wheel

finger dovetails was not completed as part of this inspection. The L-1 and L-0 blading dovetail pins were, however, inspected using ultrasonic inspection. The dovetail pins hold the blades to the rotor wheel. The design of the pins in the turbine had a tendency to crack in service, and GE recommended that they be tested at each major inspection, which we did. Any pins that were determined to be cracked were replaced. Notably, we never found a L-1 cracked pin.

As it relates to the 1999 major inspection, GE recommended that the blades be replaced; accordingly, a TIL 1121-3AR1 magnetic particle inspection of the rotor wheel finger dovetails was performed with no issues found. In addition to the TIL 1121-3AR1 inspection, GE also performed a rotor bore inspection, which is a very complete and thorough inspection of the rotor bore surfaces (and near surface material) for any evidence of defects. After the rotors were removed from the machine, the rotor bore plugs were machined out. After the rotor bore plugs were removed, the entire length of the bore was honed to remove any oxide scale that may have formed during operation. After honing, the bore was then visually inspected with a borescope for surface defects. A magnetic particle exam of the rotor bore was then performed for surface defects not visible to the naked eye. This involves the use of a black light and a borescope. The bore was then examined with ultrasonic transducers for sub-surface defects. The boresonic exam is arguably the most important part of this inspection as rotor forgings of the Sherco 3 vintage often contained many inclusions near the centerline. Over time, these inclusions can link together and become cracks that propagate through the rotor body. The ultrasonic inspection of the rotor bore is the only way to detect these subsurface indications. Again, nothing in the 1999 inspection indicated any issues.

Regarding the 2005 major inspection, a complete inspection of the low-pressure rotor external surfaces was performed using visual, magnetic particle, and liquid penetrant exams in accordance with GE inspection recommendations. As previously stated, this is a very thorough inspection of the rotor external surfaces and is fully compliant with the GE recommendations for rotor inspections. Similar to the 1993 inspection, there was no reason to remove the L-1 or L-0 blading (and there were no abnormal events or operational anomalies); accordingly, a TIL 1121-3AR1 magnetic particle inspection of the rotor wheel finger dovetails was not completed. A phased array ultrasonic inspection of the L-2 and L-3 rotor wheel dovetails was, however, completed by Wesdyne, with no actionable defects noted.

This additional detail demonstrates that the Sherco 3 turbine rotors were thoroughly inspected in full compliance with GE recommendations in 1993, 1999, and 2005. These are thorough and complex inspections that are carried out by highly skilled, competent, and certified personnel, and the nuances of all these various inspections are hard to capture in a general summary. But Xcel Energy was routinely using a combination of visual, magnetic particle, liquid penetrant, and phased array ultrasonic inspections depending on the specific part of component of the rotor to be inspected. At minimum, Xcel Energy was inspecting in accordance with GE's recommendations. But it is important to note that we did not limit our inspection decisions to only those expressly prescribed by GE. To the contrary, Xcel Energy utilized all available information—including GE guidance, fleet experience, and industry trends--to make informed and prudent inspection decisions. Our objective was to perform the appropriate and necessary maintenance at the right time for personnel and equipment safety, and to optimize value for the Company and our customers.

Q. DO YOU HAVE ANY OTHER CONCERNS WITH MR. POLICH'S SUMMARY OF SHERCO 3'S MAINTENANCE HISTORY?

A. Yes. Mr. Polich reports that the last magnetic particle inspection on the rotors was performed in 1999. (Polich Direct, p. 32: "It appears the last inspection of the Sherco 3 LP turbine rotor disks L-0, L-1, and L-2 dovetails that involved MPI or UT inspection was 1999, 12 years prior to the 2011 accident.") As set forth above, this is incorrect. A magnetic particle inspection of the rotors was performed in 2005. Further, Mr. Polich fails to accurately describe the maintenance work performed on the Sherco 3 steam turbine during the September 2011 inspection. (Polich Direct, p. 38: "Xcel installed new HP and IP turbine rotors and diaphragms. The LP turbine was originally scheduled for a major inspection, but Xcel deferred the work until a future outage that was planned for 2014.") Xcel Energy engaged Alstom to perform the 2011 inspection, and the inspection report is attached as Exhibit___(TPM-2), Schedule 3. Alstom completed a visual inspection of the low-pressure turbine rotor last-stage blades. Notably, "[n]o corrosion, pitting, cracks, or indications were noted during [sic] in the inspection." The report confirms that "The customer carried out a full NDE inspection of turbine last stage blading." Mr. Polich's summary fails to include these specific actions.

VI. XCEL ENERGY'S 2011 MAINTENANCE DECISIONS WERE REASONABLE AND CONSISTENT WITH INDUSTRY PRACTICES AND KNOWLEDGE

Q. DO YOU AGREE WITH MR. POLICH'S SUGGESTION THAT THE COMPANY "DELAYED" OR "DEFERRED" A 2011 INSPECTION THAT WOULD HAVE EXAMINED THE TURBINE ROTOR DISK DOVETAIL ATTACHMENTS THAT LATER FAILED?

A. No. The decision to move the Sherco Unit 3 low pressure turbine to a 9-year inspection interval was consistent with the 9-year inspection interval the Company had already implemented for the Unit 1 and Unit 2 low pressure turbines and industry trends of longer inspection intervals. For example, the Unit 1 low pressure turbines had a major inspection in 1998 and the next low pressure turbine major inspection was performed in 2007. The Unit 2 low pressure turbines had a major inspection in 2000 and the next major inspection was performed in 2010. The decision to move Sherco Unit 3 to a 9-year inspection interval was based on our unit operating data, inspection history, and prevailing industry trends at that time. Notably, GE's 2006 PowerPoint presentation to Xcel Energy employees (at our Maple Grove facility) confirmed our understanding that the industry "trend" was moving from 5 to 7 year inspection intervals to 10 to 12 year inspection intervals. The PowerPoint presentation is included as Exhibit___(TPM-2), Schedule 2.

Q. EVEN IF XCEL ENERGY HAD PERFORMED A "MAJOR" INSPECTION IN 2011, WOULD THAT HAVE DETECTED THE LATENT STRESS CORROSION CRACKING IN THE FINGER DOVETAIL ATTACHMENTS?

A. No. Because the Unit 3 LP turbine had not experienced any abnormal events or operational anomalies that would have caused concern for long-term reliability, the L-1 turbine blades would not have been removed for a TIL 1121-3AR1 blades-off, magnetic particle inspection of the finger dovetails. Only a peripheral magnetic particle exam on all the rotor external surfaces would have been performed. This exam would not have detected the cracking that led to the failure as *all* of the cracking was on the internal fingers. After the event, the external surfaces of the outer L-1 rotor wheel fingers showed no evidence of cracking.

Q. HOW DO YOU RESPOND TO MR. POLICH'S STATEMENT THAT "XCEL KNEW OF THE POTENTIAL FOR SCC IN THE LP TURBINE ROTORS, CHOSE TO TAKE THE RISK OF DELAYING INSPECTION AND PROPER TESTING OF THE TURBINE ROTOR DISK FINGER DOVETAIL JOINTS, AND IGNORED PREVIOUS OUTAGE EVIDENCE OF CHEMICAL DEPOSITS ON THE LP TURBINE ROTOR COMPONENTS AND WATER CHEMISTRY HISTORY AT SHERCO 3."

A. Stress corrosion cracking was not a major problem on the drum boiler machines like Unit 3, and, on the units that *had* experienced stress corrosion cracking, it was limited to *only the tangential entry dovetails*. For Sherco 3, that consisted of the L-2 and L-3 rows, which were inspected for stress corrosion cracking by phased array ultrasonic examination in 2005 with no actionable defects noted. The deposits in the steam path on this unit have always been relatively light and were not any different than any other unit in our fleet. Notably, the 2005 phased array ultrasonic inspection was completed by Wesdyne. Wesdyne recommended that the next phased array ultrasonic examination take place in 10 years. This would have been completed in the Company's next planned major inspection in 2014.

Q. PLEASE ADDRESS MR. POLICH'S CLAIM THAT "THE PLANNED INSPECTION OF THE LP TURBINE DISK DOVETAILS IN 2011 WOULD HAVE DISCOVERED THE EXTENT OF THE SCC IN THE LP TURBINE L-1 ROTOR DISK AND XCEL'S DECISION TO DELAY THAT INSPECTION TO 2014 WAS DIRECTLY RESPONSIBLE FOR THE ACCIDENT." (POLICH DIRECT, P. 58.)

A. This is not correct. Since the unit had not experienced any abnormal events or operational anomalies that would have caused concern for long-term reliability, the L-1 turbine blades would not have been removed for a rotor wheel finger dovetail inspection. Only a peripheral magnetic particle exam on all the rotor external surfaces would have been performed. This exam would not have

detected the cracking that led to the failure as ***all*** of the cracking was on the internal fingers. Again, after the event, the magnetic particle exam of the LP turbines showed no evidence of cracking on the external surfaces of the L-1 rotor wheels.

Q. EXPLAIN WHY THE MAINTENANCE DECISIONS YOU MADE IN 2011 WERE REASONABLE AND IN CONFORMANCE WITH GENERAL INDUSTRY PRACTICES EXISTING AT THAT TIME.

A. "General industry practice" with respect to turbine inspections encompasses a relatively wide array of prudent activities. For example, while a few utilities complete steam turbine overhauls, inspections, and repairs with their own, internal resources, most utilities contract out this work. Some of those utilities have fleet maintenance agreements with one contractor and others will have fleet agreements with several contractors and competitively bid each overhaul. Xcel Energy determined that the best means of ensuring that a contractor thoroughly inspected and evaluated the condition of the turbine generator components as part of the overhaul process was to establish multiple fleet maintenance agreements with several competent and qualified contractors (including GE) who would bid on the overhaul work. Xcel Energy's Turbine Overhaul Services group, which I was part of, wrote detailed work scopes for each overhaul that called for all work to be completed in accordance with the OEM recommendations.

In sum, our main concern was knowing and understanding the OEM's (*i.e.*, GE's) *then-current* maintenance and inspection recommendations for the specific unit and components and making sure our contractors both knew and implemented those recommendations during the overhaul. In other words, it

was not just Xcel Energy personnel making determinations about what maintenance was appropriate for the Sherco steam turbine units; rather, our third-party contractors were also involved in this process. Our maintenance planning practice for all of our units involved the following in coordination with our third-party contractor:

1. Review of the unit specific instruction books (steam turbine generator technical manuals) for the OEM maintenance and inspection recommendations.
2. Review of all unit specific service bulletins (GE technical information letters) issued by the OEM.
3. Review of updated operating and maintenance instructions. (GE GEKs)
4. Review of all previous overhaul reports, repair reports, and Non-Destructive Examination (NDE) inspection reports for all findings and recommendations for future inspections.
5. Review and discuss with plant staff any operating issues or events that may warrant advanced planning for additional inspections or repairs.

And as described above, our maintenance and planning practice also included conferring with our GE representatives and seeking input regarding planned maintenance. Consistent with GE's own guidance, as set forth in GEK 111680, Xcel Energy was in the best position to evaluate all of the available information and determine the appropriate inspection interval for Sherco 3.

Q. FOLLOWING THE SHERCO 3 NOVEMBER 2011 EVENT, DID GE ISSUE ANY ADDITIONAL GUIDANCE ON LP TURBINE INSPECTION AND TESTING THAT WOULD BE APPLICABLE TO UNIT 3?

A. Yes. General Electric issued TIL 1886, Inspection of Low Pressure Rotor Wheel Dovetails on Steam Turbines with Fossil Fueled Drum Boilers, dated October 2, 2013. (*See* Sirois Direct, Exhibit___(HJS-1), Schedule 16.) This TIL applies to the Sherco 3 Unit (*i.e.*, a LP turbine with a fossil-fueled drum boiler that incorporates a finger dovetail design in the L-1 stage) and was issued by GE to Xcel Energy.

Q. WHAT IS THE SIGNIFICANCE OF TIL 1886?

A. This Technical Information Letter notified GE customers that LP steam turbines on drum boilers that incorporate a finger dovetail design in the L-1 stage need rotor wheel inspections for stress corrosion cracking if the unit has been in service for more than 22 years. This TIL further confirmed that L-1 wheel finger dovetail cracking was confined to the *internal* fingers with no external evidence of cracking; hence, an inspection for evidence of stress corrosion cracking in the wheel finger dovetails necessarily required that the blades be removed: "Inspection of wheel finger dovetails for SCC indications is not possible without removal of the buckets. SCC of finger dovetail stages has involved the internal fingers with no external indication of cracking."

Q. DOES TIL 1886 PRESCRIBE A 3- TO 5-YEAR INSPECTION INTERVAL THAT WOULD INCLUDE A BLADES-OFF, MAGNETIC PARTICLE INSPECTION OF THE ROTOR WHEEL FINGER DOVETAILS?

A. No. Even with the benefit of hindsight and knowledge of the Sherco 3 event, GE did not change course and recommend time-based inspection frequency intervals. Rather, based on the Sherco 3 failure, TIL 1886 indicated that a 1121-3AR1 blades-off, magnetic particle inspection of the finger wheel dovetails was needed if the unit had been in service for more than 22 years. For units with

less than 22 years of service on their L-1 rotor wheel finger dovetails, GE recommended that such an inspection should occur at the "closest major inspection to the time in which the L-1 wheel dovetail is expected to exceed 22 years of service." Aside from this change, TIL 1886 confirms that the TIL 1121-3AR1 recommendations still apply: "Note that TIL 1121 recommends magnetic particle inspection of all wheel finger dovetails *whenever buckets* are removed." In sum, GE's post-event guidance did not materially change the maintenance guidance for inspecting rotor wheel finger dovetails for latent stress corrosion cracking that existed prior to the November 2011 event.

VII. CONCLUSION

Q. DID THE COMPANY OPERATE AND MAINTAIN UNIT 3 IN A REASONABLE MANNER CONSISTENT WITH INDUSTRY PRACTICES AND KNOWLEDGE?

A. Yes. The Company placed a high importance on sound operation and maintenance of Unit 3 for a number of reasons, including: (1) it is the Company's largest fossil unit, so it is critical to the overall reliability of energy supply; (2) because of the larger size, Unit 3 had its own control room and operating crews (by comparison Units 1 and 2, smaller units, share a control room and operators); and (3) it is co-owned with SMMPA and both entities had a vested interest in ensuring that Sherco 3 operated without issue.

Q. WAS IT COMMON INDUSTRY PRACTICE IN 2011 TO DO A BLADES-OFF, MAGNETIC PARTICLE INSPECTION TO DETECT LATENT STRESS CORROSION CRACKING IN THE ABSENCE OF ABNORMAL EVENTS/OPERATIONAL ANOMALIES?

A. No. This is an expensive and time-consuming process and cannot be justified unless there were abnormal events or operational anomalies that caused concern

for long-term reliability. Mr. Polich's recommendations to the contrary are well outside the range of reasonable utility practices and industry trends as they existed at the time of the November 2011 Event.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes, it does.

From: Bird, Joshua (GE Infra, Energy)
To: Murray, Timothy P
Sent: 2/26/2008 4:02:54 PM
Subject: RE: LP Turbine Rotor Wheel Dovetail Cracking
Attachments: GEK72281c.pdf

Hi Tim,

I am having a tough time finding you some of these other documents as well. I've attached GEK 72281, but none of the GER's you referenced show up in the system. Since they are not in the database, I'm not really sure where to go to get these three GER's.

As for TIL 770, I'll check with engineering to see what I can find out about this one.

Thanks,

Josh

-----Original Message-----
From: Murray, Timothy P [mailto:timothy.p.murray@xcelenergy.com]
Sent: Tuesday, February 26, 2008 1:43 PM
To: Bird, Joshua (GE Infra, Energy)
Subject: RE: LP Turbine Rotor Wheel Dovetail Cracking

Josh,
Another follow-up. Still no response to my request to fix the link within optimizer. Also, I found another reference to TIL 770, this time in a GE Stress Corrosion Cracking presentation made at the 2003 LSTG conference in Atlanta. Apparently it does in fact exist. In this same presentation there were references to the following GE documents also related to turbine rotor stress corrosion cracking;
GEK 72281
GER 2883
GER 3086
GER 3253
I tried locating these within optimizer as well. No luck. Could you provide copies of each? I'm working on Xcel fleet wide inspection recommendations. These documents should provice some valuable background info. I would really appreciate some help on this.
Thanks
Tim

-----Original Message-----
From: Murray, Timothy P
Sent: Thursday, February 21, 2008 9:26 AM
To: 'Bird, Joshua (GE Infra, Energy)'
Subject: RE: LP Turbine Rotor Wheel Dovetail Cracking

Josh,
As a follow-up to this. I did locate TIL 0770-3 on outage optimizer. It was issued against our Arapahoe Unit#4, turbine S/N 101604. The only problem is the link within optimizer is bad, it links up with the wrong TIL, TIL 550, something totally different. I did submit a TIL dispute through the optimizer web page asking to correct the link problem so I can view TIL 770. Maybe something will happen.
Tim

-----Original Message-----
From: Murray, Timothy P
Sent: Monday, February 11, 2008 3:28 PM
To: 'Bird, Joshua (GE Infra, Energy)'
Subject: RE: LP Turbine Rotor Wheel Dovetail Cracking

NSP, et al v GE
PLF EX 130
Date: 6-26-15
Richard G. Stirewalt
Stirewalt & Associates

Josh,
Thanks for checking on this. It is a mystery to me as to why this TIL shows up in our database. It is listed as TIL 770-3. Also when I was searching in outage optimizer I noticed that the older TILs show up as "0772", etc. I also have a reference to it from a 3rd party, they list it as TIL 770-2 issued in March 1975. If there are any special inspection recommendations for stress corrosion cracking on our non-reheat machines we would certainly be interested in finding out. Our Bayfront 5 outage starts next month. So if you could do some more checking we would certainly appreciate it.
Thanks again.
Tim

-----Original Message-----
From: Bird, Joshua (GE Infra, Energy) [mailto:joshua.bird@ge.com]
Sent: Monday, February 11, 2008 3:17 PM
To: Murray, Timothy P
Subject: RE: LP Turbine Rotor Wheel Dovetail Cracking

Hi Tim,

I could not find TIL 770 in the records... there was a TIL 769 and 771, but 770 was not in there. I also did a search by title using various keywords ("stress", "dovetails", etc.), and could not find a TIL specifically for SCC on non-reheat machines. The best I could find was TIL 1277 for SCC on once-through boiler machines, which you are familiar with.

Typically, the TIL's are removed from the database when they are either supreceded or obsolete. Unfortunately there is not a placeholder or ID that says why a TIL is unavailable... even if the TIL is superceded, only sometimes does the new TIL note that it superceded an old TIL. Either way, I don't know what happened to TIL 770, but I could try to chase down an answer if you wish.

As for the SCC at Sherco, I still haven't heard an official word one way or the other on the issuance of a TIL for SCC on drum-boiler units. Its been a few weeks since I last bugged engineering on this, so I figure its time for me to ask again. We'll see what they say.

Thanks,

Josh

-----Original Message-----
From: Murray, Timothy P [mailto:timothy.p.murray@xcelenergy.com]
Sent: Monday, February 11, 2008 2:29 PM
To: Bird, Joshua (GE Infra, Energy)
Subject: RE: LP Turbine Rotor Wheel Dovetail Cracking

Hi Josh,
I understand from Mark Kolb that GE is not planning on issuing a TIL on this. Be that as it may I'm wondering if you could help me out on a related issue? I'm looking for a copy of GE TIL 770, Stress Corrosion Cracking of Wheel Dovetails on 3600 Non-reheat Machines. I'm thinking that this would apply to a number of our machines such as Bayfront 4&5, Red Wing 1&2, and a some of our Colorado and Texas units. I can not locate a copy within outage optimizer for any of our units. If you could forward a PDF version I would appreciate it.
Thanks Josh.
Tim

-----Original Message-----
From: Bird, Joshua (GE Infra, Energy) [mailto:joshua.bird@ge.com]
Sent: Tuesday, January 15, 2008 2:56 PM
To: Murray, Timothy P
Subject: RE: LP Turbine Rotor Wheel Dovetail Cracking

Hi Tim,

I have not received any feedback yet from engineering regarding the dovetail cracking. Let me circle back with them, and see what they have. I'll also pass on the confirmation that the Sherco 1's cracking was stress corrosion.

Thanks,
Josh

-----Original Message-----
From: Murray, Timothy P [mailto:timothy.p.murray@xcelenergy.com]
Sent: Tuesday, January 15, 2008 2:52 PM
To: Bird, Joshua (GE Infra, Energy)
Subject: LP Turbine Rotor Wheel Dovetail Cracking

Josh,
Any feedback from engineering on the drum boiler LP turbine wheel dovetail cracking issue? Any TILs in the works? We just heard about several more drum boiler LPs that have been found with serious cracking in the wheel dovetails. By the way, we did get 2 independent failure analysis that indicate the root cause of the Sherco 1 wheel cracks is stress corrosion. Any feedback you can provide regarding inspection recommendations for the rest of our drum boiler fleet would be appreciated.
Thanks
Tim
763-261-3204

PUBLIC DOCUMENT
NOT-PUBLIC DATA HAS BEEN EXCISED

Northern States Power Company

MPUC Docket No. E999/AA-18-373, et al.
OAH Docket No. 65-2500-38476
Exhibit___(TPM-2), Schedule 2

Schedule 2

Exhibit___(TPM-2), Schedule 2 has been marked Not-Public in its entirety. This Schedule was provided by General Electric (GE) subject to a confidentiality agreement and GE considers it to include confidential and proprietary information to GE. Therefore, the Company considers this Schedule to be trade secret data as defined by Minn. Stat. § 13.37(1)(b) and Xcel Energy maintains this information as a trade secret pursuant to Minn. Rule 7829.0500, subp 3.

Pursuant to Minn. R. 7829.0500, subp. 3, the Company provides the following description of the excised material:

1. **Nature of the Material:** GE Maintenance/Reliability PowerPoint
2. **Authors:** General Electric Company
3. **Importance:** Confidential and proprietary information of GE and subject to a confidentiality agreement between the Company and GE.
4. **Date the Information was Prepared:** 2006

PUBLIC DOCUMENT
NOT-PUBLIC DATA HAS BEEN EXCISED

Northern States Power Company

MPUC Docket No. E999/AA-18-373, et al.
OAH Docket No. 65-2500-38476
Exhibit___(TPM-2), Schedule 3

Schedule 3

Exhibit___(TPM-2), Schedule 3 has been marked Not-Public in its entirety. This Schedule was provided by Alstom to Xcel Energy and includes confidential and proprietary information to Alstom. Therefore, the Company considers this Schedule to be trade secret data as defined by Minn. Stat. § 13.37(1)(b) and Xcel Energy has maintained this information as a trade secret pursuant to Minn. Rule 7829.0500, subp 3.

Pursuant to Minn. R. 7829.0500, subp. 3, the Company provides the following description of the excised material:

1. **Nature of the Material:** Customer Field Service Report-Sherco 3 – Steam Turbine and Generator Maintenance Work during Retrofit Outage
2. **Authors:** Christopher M. Kenyon, Alstom
3. **Importance:** Confidential and proprietary information of Alstom.
4. **Date the Information was Prepared:** November 21, 2011