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March 4, 2022

Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Ms. Cheryl Blundon
Director of Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Holyrood Thermal Generating Station Unit 1 – Root Cause Investigation Report

In Newfoundland and Labrador Hydro's ("Hydro") correspondence of January 31, 2022,[1] Hydro committed to filing a root cause investigation report with respect to the Holyrood Thermal Generating Station Unit 1 – Cold Reheat Piping Support Failure that occurred in October 2021. Attached is Hydro's report in relation to this matter.

If you have any questions or comments, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Shirley A. Walsh
Senior Legal Counsel, Regulatory
SAW/kd

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[1] "Quarterly Report on Performance of Generating Units for the Twelve Months Ended December 31, 2021," Newfoundland and Labrador Hydro, January 31, 2022.

Holyrood Thermal Generating Station
Root Cause Investigation

Unit 1 – Cold Reheat Piping Support Failure

December 2021

newfoundland labrador hydro

Executive Summary

On Monday, October 25, 2021, Newfoundland and Labrador Hydro's ("Hydro") Holyrood Thermal Generating Station ("Holyrood TGS") Unit 1 experienced a forced outage during the initial start-up following the annual 2021 unit outage. The cold reheat ("CRH") piping system experienced considerable movement with damage to pipe supports, structural steel, and insulation in various sections of the CRH piping assembly.

Major capital work was completed on Unit 1 during the annual 2021 outage. This included an overhaul of the turbine, main valves, generator, and a level 2 condition assessment of the boiler. During the initial start-up, there were issues with the steam turbine overshooting speed setpoints and the CRH piping system had abnormal movement.

Immediately following the forced outage, an investigation team was assembled to determine the root cause(s) of the failure event. The team consisted of two mechanical engineers and a protection, controls and communications engineer. The investigation team lead was also onsite to coordinate the inspection and refurbishment work that was necessary to return Unit 1 to service.

The team used root cause analysis[1] to determine the causal factors[2] of the incident and then analysed each factor to determine the root cause(s).[3] It was determined that Unit 1 experienced a water hammer event on the CRH piping system during the October 25, 2021 start-up attempt. Unit 1 is equipped with a re-heat emergency spray attemperator line that is used to control the CRH steam temperature. The attemperator spray line is connected to the boiler feedwater piping system and the line has a temperature control valve that controls the CRH steam temperature by allowing water to enter the CRH line as required. This system has been isolated for a number of years because it was not required to maintain the CRH steam temperature setpoint during operation. A manual isolation valve (1-HFW-V183) had been closed to remove the attemperator spray line from service.

[1] Root cause analysis is a systematic process for identifying root causes of problems or events and an approach for responding to them.
[2] Causal Factor: A major unplanned, unintended contributor to an incident (a negative event or undesirable condition), that if eliminated would have either prevented the occurrence of the incident or reduced its severity or frequency.
[3] Root Cause: A fundamental reason for the occurrence of a problem or event. Analysts can look for the root cause of an event in order to prevent it from happening again in the future. The root cause is the primary driver of a process.

Manual valve 1-HFW-V183 was also included in the switching order on the worker protection permit as part of the lock out/tag out ("LOTO") for the unit outage work. Following completion of the Unit 1 annual outage work and removal of the worker protection permit, the valve was inadvertently opened and the emergency attemperator spray line discharged water into the CRH line. During the investigation, it was determined that the temperature control valve on the spray line was leaking water across the valve seat. This condition was verified during a leak test on the valve with the boiler feedwater system in service and the control valve in the closed position. Significant flow was observed through a drain valve located on the downstream side of the temperature control valve during the test. This condition caused water hammer[4] in the CRH line leading up to and during the October 25 start-up attempt after the boiler feedwater system was placed in service. The water leakage also caused the steam turbine speed control issues that were experienced during start-up. The CRH line is under a vacuum and the water would have partially flashed into steam and entered the turbine, causing turbine speed control issues. These issues were no longer present during the subsequent start-up and synchronization of Unit 1 following the investigation, inspection, and refurbishment activities after manual valve 1-HFW-V183 was closed.

The four causal factors identified during the investigation include:

- Item 93 on Isolation Permit: 1-HFW-V183 "Close and Lock - Closed";
- Item 7 on Restoration Permit 1-HFW-V183, "Unlocked with no operation - Closed";
- Manual valve 1-HFW-V183 opened during worker protection permit restoration even though the reverse switching order required it to remain closed; and
- Movement of the lines was reported to the control room and two operators investigated. However, there was no follow-up investigation prior to the start-up attempt.

The recommended actions that are based on the root causes include:

- Update the Holyrood TGS Unit 1 drawings to as-built standards and indicate where applicable any systems that are no longer required;
- Development of an audit program for Unit 1 to review the permitting sequence at a set interval. All points on the sequence should be for systems that are currently used for the production of

[4] Water hammer is a phenomenon that can occur in any piping system where valves are used to control the flow of liquids or steam. Water hammer is the result of a pressure surge, or high-pressure shockwave that propagates through a piping system when a fluid in motion is forced to change direction or stop abruptly.

electricity only. Any systems no longer required should be removed from the sequence and immediately locked and tagged "do not operate". In addition, preventative maintenance should be performed on items tagged "do not operate" until the equipment is removed from service. Arrangements should then be made to remove any systems that are no longer required;

- Consider the inclusion of a second checker on Unit 1 LOTO procedure to address complacency when performing repetitive work. There are hundreds of points on a worker protection permit that require isolation during a major unit outage and there is a chance that items can be missed during the permit removal. A second checker during permit removal could help mitigate this issue; and
- A procedure should be developed for operators or existing procedure validated when faced with abnormal conditions following a major unit overhaul. This procedure should include recommended follow up inspection(s), a signed hand off to the next shift, and contact information for the manager or supervisor in charge when faced with abnormal conditions. In addition, hold points should be in place when abnormal conditions are encountered to safeguard employees and the unit during start-up.

In addition, the following issues were not the direct root cause of the incident but should also be addressed:

- It is recommended to correct issues identified with the use of Unit 1 start-up procedures and documentation in Holyrood. Not having start-up check sheets completed can lead to errors.
- The Mark V turbine control system on Unit 1 does not have a historian. The system does not record any operational data, including speed setpoints, valve positions, and hydraulic pressure, etc. which compromises the ability to troubleshoot and assess events that may be related to turbine controls. It is recommended to add this functionality to the control system.
- Following any major overhaul, it is recommended to have the service contractor start-up engineer on site until the unit achieves full load.
- To apply all of the above recommendations to both Units 2 and 3 where applicable.

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List of Appendices

1.0 Introduction

Hydro's Holyrood TGS is located within the town of Holyrood and is an integral part of the Island Interconnected System. The Generating Station (Figure 1) consists of three oil fired units capable of producing a total capacity of 490 MW which is approximately 33 percent of the Island Interconnected System's installed capacity. Unit 1 was commissioned in 1969 and originally was designed to produce 150 MW, but upgrades in 1988 increased production to 175 MW. Following the annual 2021 Unit 1 outage and a major turbine and valve overhaul, an event occurred during start-up that caused excessive movement and vibration on the CRH piping system which caused pipe hanger damage, impacts to adjacent piping systems, structural steel, and the boiler reheater section. This report outlines the investigation to identify the root causes of the excessive movement on the CRH piping and associated damage and recommendations to correct these findings so that Unit 1 could be safely and reliably returned to service.

Figure 1: Holyrood TGS

1.1 Background

During the 2021 annual outage, Unit 1 was taken offline for scheduled major turbine and valve overhauls, an in-place generator overhaul and a boiler condition assessment. The scope of the overhauls included:

- Turbine Overhaul: The turbine overhaul scope included removal of the turbine casings, rotor, diaphragms and bearings for inspection and refurbishment as required. The turbine inner and outer casing studs were also replaced. Auxiliary equipment including the lube oil system was also overhauled.
- Turbine Valve Overhaul: The valve overhaul consisted of dismantling and refurbishment of all the control valves, main stop valve, combined reheat stop and intercept valves, extraction non-return valves, and the blowdown valve.
- Generator Electrical Testing: While on site performing the turbine and valve overhaul, the generator electrical testing of the rotor and stator windings was completed without dismantling the generator.
- Boiler Condition Assessment and Miscellaneous Upgrades: The boiler condition assessment and miscellaneous upgrades included a Level 2 condition assessment of the boiler internal components and associated external high-energy piping and miscellaneous upgrades such as welding repairs, replacement of boiler expansion joints, replacement of boiler refractory, etc. as required.

All work noted above was performed by General Electric (“GE”), the turbine-generator and boiler service provider. The failure event on the CRH piping system occurred after all outage work was completed and the unit was being returned to service following the annual outage.

1.1.1 Existing System

The three major components of the thermal generating units are the power boiler, turbine and generator. Through combustion of No. 6 fuel oil, the power boiler provides high energy steam to the turbine. The boilers and associated high energy piping (main steam piping, hot reheat piping, cold reheat piping and high pressure feedwater piping) are subjected to high temperatures, corrosion and erosion deterioration mechanisms. For these reasons, these components have been a focus of the Level 2 condition assessment projects since 2012.

The turbine is directly coupled to the generator and provides the rotating energy necessary for the generator to produce rated output power. The turbine is a GE Lynn Model D3 made up of three stages each designed to extract maximum energy from the high pressure steam and, in turn, to provide maximum rotational energy to the generator. The turbine is constructed of three sections**:** a single flow high pressure section; a single flow intermediate section (both in one high pressure-high temperature casing); and a separate double flow low pressure section. The high, intermediate and low pressure sections of the turbine rotor are built on a single shaft with solid couplings to form what is known as a tandem compound, double flow, reheat turbine. Each stage is designed such that it extracts energy from the supplied steam as efficiently as possible converting it into rotational energy.

The electrical generator is coupled to the steam turbine and converts the rotating energy into electrical power. It is pressurized and cooled by hydrogen gas to provide maximum efficiency both in heat transfer and windage losses. The generator has two basic components; a rotational excitation field and three stationary stator coils. The rotational field, through magnetic coupling, induces a high voltage into the stationary stator coils. The stator coils are connected via a step-up transformer to the main Holyrood Terminal Substation and then to the Island Interconnected System.

1.1.2 Operating and Maintenance

Unit 1 in Holyrood TGS supports the generation requirements on the Island Interconnected grid. Unit 1 is used for fall and winter operation, usually being ready for service before December 1 each year, which is the beginning of the winter availability season.

In line with original equipment manufacturer recommendation and industry standard practice, turbine valves are overhauled in three year cycles, major turbine overhauls are completed every nine years, and generator overhauls are completed every six years. The Unit 1 turbine valves were last overhauled in 2018 and the last major overhaul of the turbine was completed in 2012. In 2021, both overhauls were due. The generator was last overhauled in 2018 and is not due for another overhaul until 2024. However, because of the age of the windings and their criticality, it has been recent practice at Holyrood to perform electrical testing on the windings every three years, aligning with the turbine valve overhauls. This testing provides assurance that the windings are in acceptable condition for continued reliable operation.

The boiler has an inspection program called Boiler Condition Assessment and Miscellaneous Upgrades that started in 2012. Under the program, Level 2 condition assessments related to internal components

of the main steam generators (boilers) and associated external high-energy piping are completed to determine what, if any, refurbishment or replacements are required to ensure safe and reliable operation.

2.0 Investigation

2.1 Root Cause Analysis

Root cause analysis is a systematic process for identifying root causes of problems or events and an approach for responding to them.

The primary goal of using root cause analysis is to analyze problems or events to identify:

- What happened;
- How it happened;
- Why it happened…so that; and
- Actions for mitigating reoccurrence are developed.

2.1.1 Interviews

All Interviews were conducted with individuals that were present leading up to, during, and after the October 25, 2021 failure event. This included operations personnel, internal trade personnel, engineers, and contractor's employees. While conducting interviews, it was repeatedly mentioned that the turbine was overshooting the speed setpoint during the initial run-up. There was also mention that the CRH piping had abnormal movement prior the failure event.

2.1.2 Sequence of Events

The sequence of events preceding and following the event is captured in the chart from the TapRoot® Investigation in Appendix A.

Turbine Speed Control

The principle of steam turbine speed control relates to the flow of steam through the turbine. Turbine steam flow is controlled by adjusting a series of valves that admit super heated steam from the boiler to the turbine. Before steam enters the turbine, it has to pass through the main stop valve ("MSV") and the

main control valve ("MCV") (refer to Figure 2). During normal operation, the MSV is fully open and the MCV regulates the amount of steam entering the high-pressure ("HP") section of the turbine.

After passing through the HP section, steam leaves the turbine through the CRH line and flows through the re-heater section of the boiler. The re-heated steam exits the re-heater through the hot re-heat ("HRH") line and passes through another series of valves before flowing through the intermediate pressure ("IP") and low-pressure ("LP") sections of the turbine.

The left and right intercept valves ("LIV" and "RIV"), and the left and right re-heat stop valves ("LRSV" and "RRSV") provide additional protection to the turbine under unusual conditions. For example, if the turbine begins to speed up beyond the desired setpoint, the MCV will compensate by throttling the steam flow. However, a significant amount of steam remains in the re-heater lines. The re-heated steam will continue to flow through the turbine, further increasing its speed. In this case, the LIV and RIV will also throttle to prevent overspeeding. If for some reason, the speed continues to increase, the turbine trips and the MSV, MCV, LIV, RIV, LRSV, and RRSV close, cutting steam flow through the turbine.

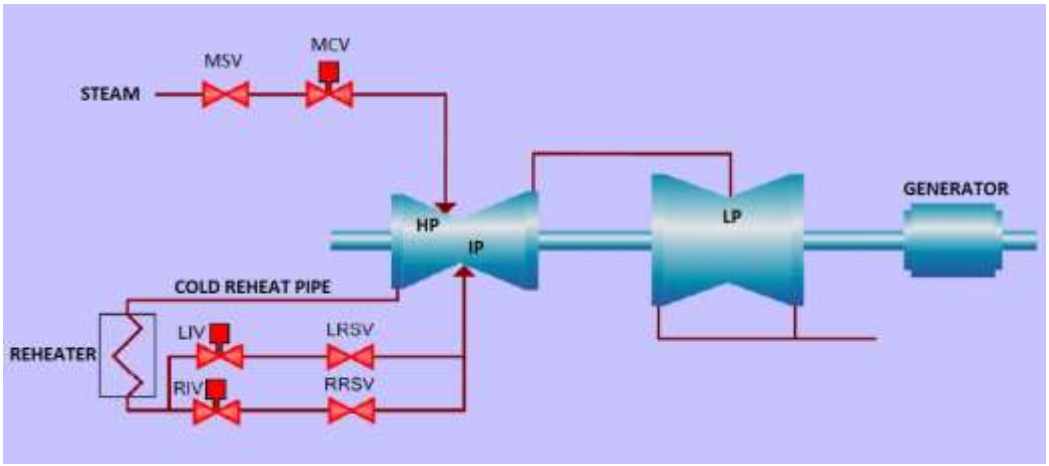


Figure 2: Simplified Steam Flow Diagram for Holyrood Unit 1 Steam Turbine

During start-up, the turbine operates in full-arc steam admission. In full-arc operation, the MCV is fully open and the MSV is closed. The MSV has a small pilot valve internally that regulates steam flow through the turbine during start-up. This internal pilot valve is sized to allow the turbine to reach full speed of 3600 rpm. When the generator is online and lightly loaded, operations switch from full-arc to partial arc operation. In partial arc, the MSV is fully open and the MCV modulates steam flow through the turbine.

Existing Turbine Control System

Unit 1 has a GE Speedtronic™ Mark V steam turbine control system, which monitors and controls the turbine speed and acceleration (among other functions) via operation of the steam valves, including the MSV, MCV, RIV, RRSV, LIV and LRSV.

The Holyrood Unit 1 Mark V turbine control system is currently obsolete (Appendix B). The historian option was never purchased, so the system does not record any operational data, including but not limited to speed setpoints, valve positions, and hydraulic pressure, which compromises the ability to assess events that may be related to turbine controls. Future upgrades of the turbine control system should include a historian. If there is no plan to upgrade the Mark V control system, it is recommended to purchase/integrate a historian for the existing system.

Speed Control Issue

During Dark NL in 2014, the standard operating procedure to accelerate Unit 1 from turning gear to 3600 rpm was modified to minimize vibration on Unit 1 turbine bearings and prevent unit trips during start-up. Operators manually ramp the unit through a series of speed setpoints and hold at each point for a determined amount of time (refer to Table 1) while monitoring bearing vibration, eccentricity, and other parameters.

Table 1: Holyrood Unit 1 Speed Setpoints for Start-up

Current Speed (rpm)	Next Speed Setpoint (rpm)	Ramp Rate (rpm/min)	Speed Hold Length (min)
2	250	150	30
250	500	150	30
500	750	150	30
750	1300	150	30
1300	3000	450	10/15
3000	3600	300	-

Following the 2021 overhaul, Holyrood operations and GE teams experienced speed control issues while attempting to accelerate the steam turbine incrementally from turning gear (roughly 2 rpm) to 3600 rpm. The steam turbine repeatedly overshot the setpoints entered by the operator and did not return to the desired speeds.

The information below summarizes the sequence of events extracted from interviews, operator logs, distributed control system and Asset Performance and Condition Monitoring Software (EtaPRO®) trends, and third party reports leading up to the failure event.

On Friday, October 22, 2021, shortly before 1340 hrs, Holyrood operations attempted to roll the turbine for the first time after completing the turbine and valve overhaul. GE's controls start-up engineer was not onsite at this time.

The initial setpoint of 250 rpm overshot above 500 rpm (refer to Figure 3 and Table 2) The operator modified the setpoints to try to achieve 250 rpm before continuing to the next speed setpoints, and continued to enter lower setpoints to achieve desired speeds. The setpoint vs. actual speed issue appeared to normalize at the 1300 rpm setpoint.

Table 2: Speed Setpoint vs. Actual Speed (October 22, 2021)

Setpoint Entered (% of Rated Speed)	Setpoint Equivalent (rpm)	Actual Speed (rpm)
6.9	250	530
2.2	79	254
9.2	331	500
16.4	590	751
36.1	1300	1300

The standard operating procedure does not require an operator to adjust the turbine speed setpoint to achieve a desired speed.

Shortly after 1700 hrs, the operator tripped the turbine and placed it on turning gear to investigate a significant steam leak under the turbine that was corrected. GE's controls engineer reported to site at 2100 hrs, but the start-up was delayed until the next morning.

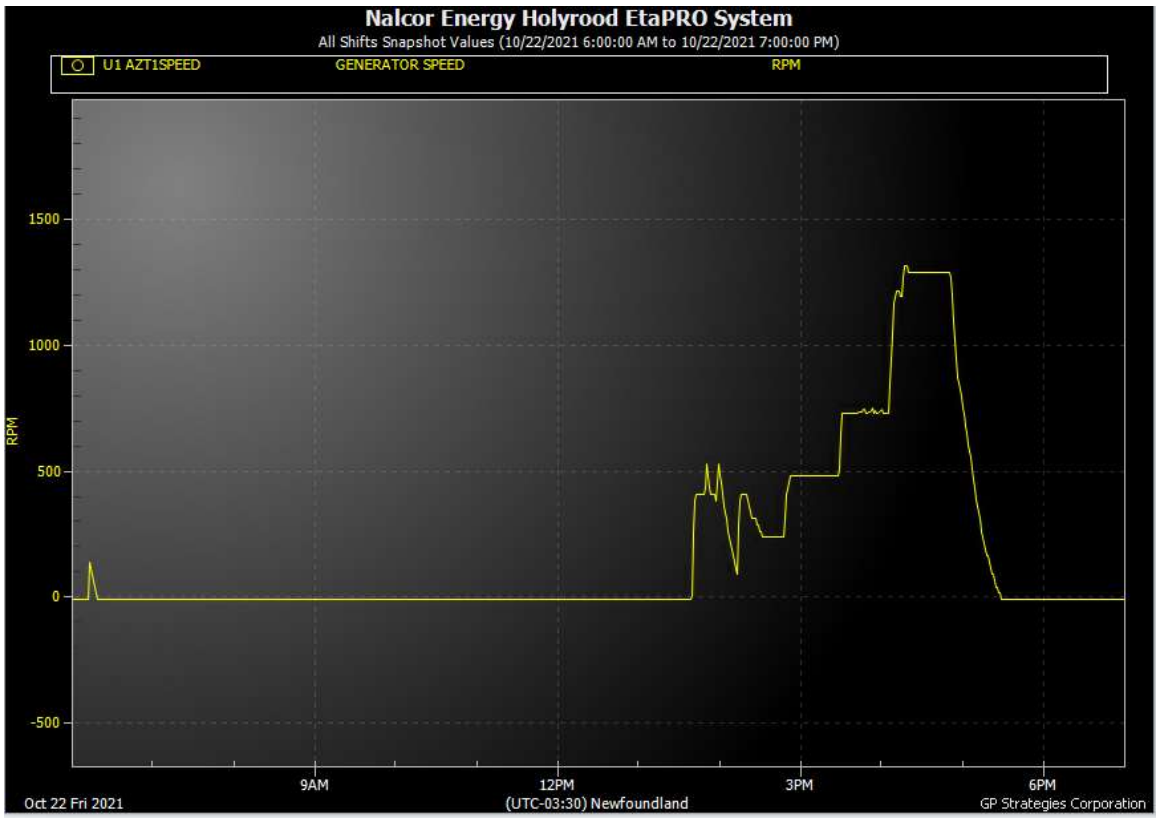


Figure 3: Holyrood Unit 1 Turbine Speed during Turbine Roll (October 22, 2021)

On Saturday, October 23, 2021, at 0935 hrs, Holyrood operations started rolling the turbine. GE's controls engineer was present. The operator logs do not have enough detail regarding the setpoints used, but it is visible in Figure 4 that turbine initially accelerated to nearly 400 rpm. GE's controls engineer report (Appendix C) states that the unit accelerated to a few hundred rpm on reset. While ramping the speed towards 3000 rpm, operations experienced a drop in hydraulic pressure (as low as 5872kPA) and decided to trip the turbine. Operations reset the turbine and reengaged it at 1300 rpm.

The GE controls engineer attempted to improve speed control by changing the control curve of the MSV pilot valve, but was unsuccessful, so he suggested that the MSV valve might be leaking too much steam across the seat. Upon investigation and review of the MSV overhaul work, GE mechanical team did not think the valve could be leaking a significant amount of steam, but GE suggested the installation of a shim in the MSV actuator to increase the spring tension and make sure the valve is closed.

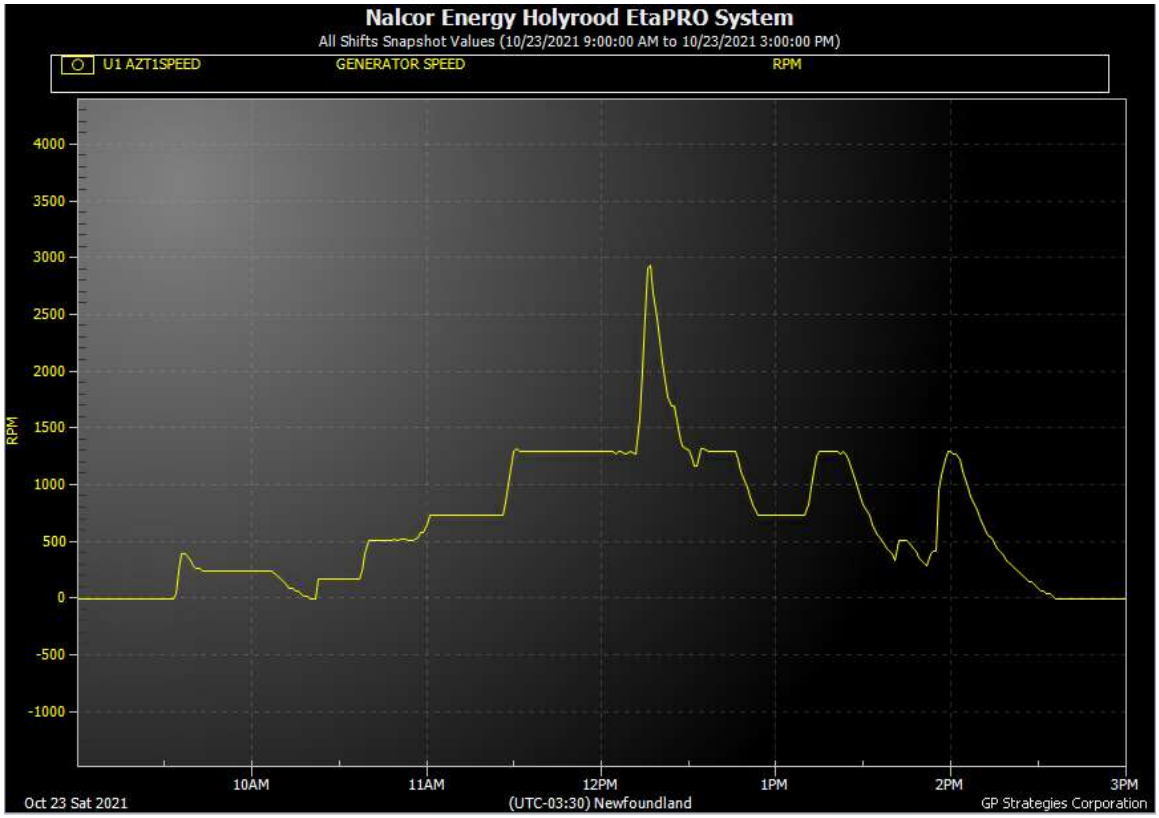


Figure 4: Holyrood Unit 1 Turbine Speed during Turbine Roll (October 23, 2021)

Holyrood maintenance personnel replaced the servo on MSV to address the hydraulic pressure issue and an 18 thou shim was procured for the MSV actuator.

On Sunday, October 24, 2021, while GE's mechanical team installed the shim on the MSV actuator, the GE controls engineer validated the calibration of all control and stop valves. During the calibration process, the hydraulic pressure was dropping while stroking the MCV, so the Holyrood maintenance team also replaced the MCV servo. However, it was later determined that the hydraulic pressure issue was caused by air in the hydraulic lines, so neither the MSV nor the MCV servos needed to be replaced. The replaced servos were bench tested and stored in the warehouse as spares.

On Monday, October 25, 2021 around 1030 hrs, the GE controls engineer performed a MSV leak test. According to GE specifications, the test is unsuccessful if the turbine accelerates above 300 rpm and maintains speed above 250 rpm. During the test, the unit accelerated to 170 rpm and started to coast down. As a result, the MSV leakage test was deemed to be acceptable.

Shortly after 1200 hrs, Holyrood operations team started to roll the turbine to 250 rpm. The turbine overshot the speed setpoint by less than 40 rpm but it returned to the desired value without any change in setpoint (refer to Appendix C) to see the data recorded by GE. Figure 5 shows the recorded speed in EtaPRO®). Similarly, the turbine overshot by even smaller margins at the 500, 1300, 3000, and 3600 rpm setpoints. There were no issues with the acceleration of the turbine or any other turbine parameters. Operations synchronized the generator to the power grid at approximately 1500 hrs.

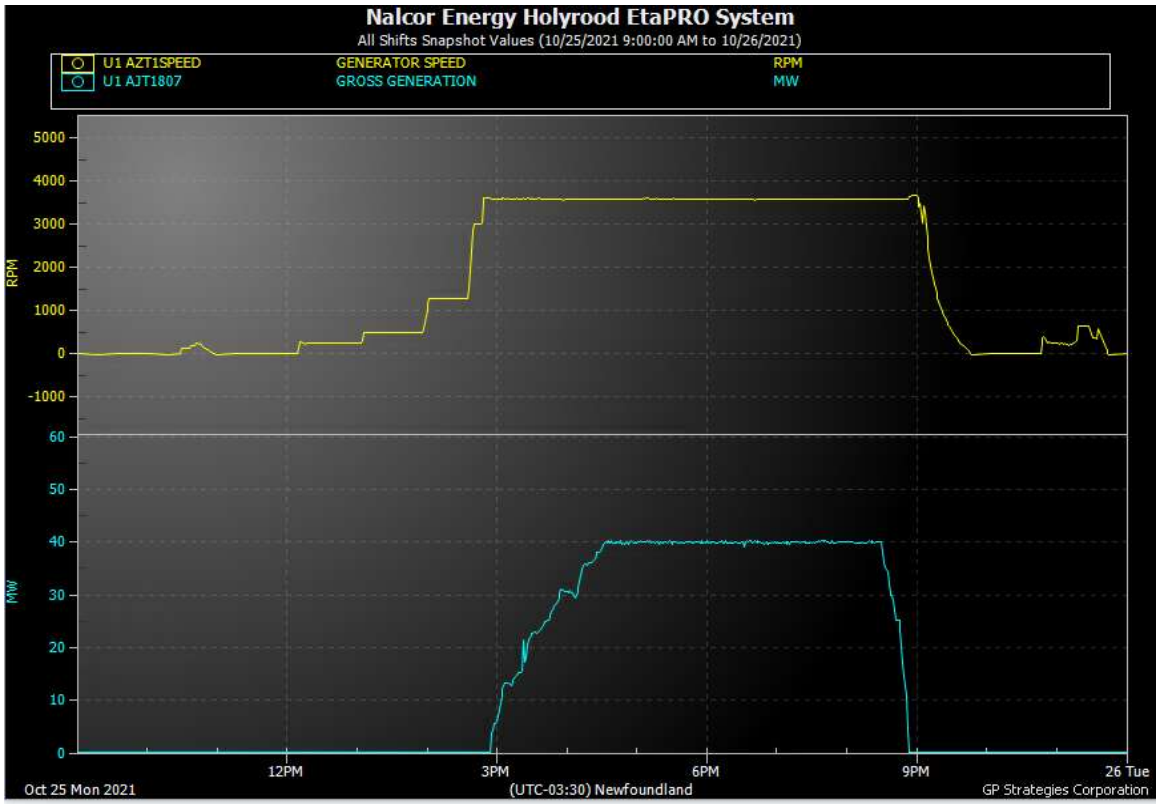


Figure 5: Holyrood Unit 1 Turbine Speed during Turbine Roll (October 25, 2021) and Gross Generation

At 1630 hrs, Holyrood Unit 1 was operating at 40 MW in preparation for overspeed tests. As per plant operating procedures, the unit is heat soaked at 40 MW for four hours before performing overspeed tests. According to GE, all turbine parameters were within recommendations and specifications. Hydro operations was comfortable with the speed control of the unit and GE's control engineer left site.

In light of the experienced speed issues following the major overhaul, both Hydro and GE should not have dismissed the start-up controls engineer before the completion of the overspeed tests. Holyrood

Unit 1 had only been loaded to 40 MW. It is recommended for future overhauls that both the mechanical and control start up engineers be onsite until the unit is loaded to at least 150 MW.

Near 2100 hrs, Holyrood operations removed Holyrood Unit 1 from the grid to test the overspeed trips. The primary overspeed trip occurred at 3738 rpm, lower than the expected 3960 rpm test setting. The emergency overspeed trip occurred at 3705 rpm, lower than the expected 3762 rpm test setting. Neither Hydro nor GE highlighted the results as a concern.

The boiler tripped on high water level during the overspeed test and the turbine coasted down to turning gear. At 2238 hrs, Operations attempted to accelerate the Unit 1 turbine, but was now having speed control issues again. With a setpoint of 250r pm, the turbine overshot above 400 rpm. The operator reduced the setpoint to try matching 250 rpm before going to 500 rpm.

Shortly after 2300 hrs, the Unit 1 turbine speed was overshooting to 650 rpm and, while trying to bring it down to 500 rpm, the operators heard a loud noise and felt vibration coming from the powerhouse. Further investigation revealed that a pipe hanger on the Holyrood Unit 1 CRH line had failed, causing damage to insulation, adjacent hangers and pipes, and steel structure. The turbine was shut down and placed on turning gear.

2.1.3 Cold Reheat Line

As described in Section 2.1.2, the CRH line carries steam from the HP section of the turbine to the re-heater section of the boiler (see Figure 2). This pipe extends from below the Holyrood Unit 1 turbine, second floor of the plant, to the boiler re-heater inlet located on the tenth floor of the plant (see drawings in Appendix D).

Cold Reheat Line Issue

After completion of a major overhaul of Holyrood Unit 1 turbine and MSV, the unit was being accelerated for operation when an event on the CRH line caused excessive movement of the piping and damaged several pipe hangers and adjacent structural steel. Appendix E presents a comprehensive visual inspection of CRH Line performed by GE and include several pictures of the damage. Early indications suggested that Holyrood Unit 1 experienced a water hammer event on the CRH line.

There are only two locations that water ingression can occur on the CRH line: the bled steam line connected to the No. 6 HP Heater, and the Re-heat Emergency Spray Attemperator (see drawings in Appendix D).

Bled Steam Line

HP heaters pre-heat boiler feedwater to improve plant efficiency. They consist of feedwater flowing through a tube bundle surrounded by steam, thus heating up the feedwater.

The Holyrood Unit 1 No. 6 HP heater uses extraction steam from the CRH line through the bled steam line BS-05-101 to pre-heat boiler feedwater (see drawings in Appendix D). If the heater overflows, either with condensate or with feedwater leaking from a failure in the feedwater tube bundle, water can flow into the bled steam line. However, the check valve BS-V101 should prevent water from reaching the CRH line.

From October 20, 2021 to October 27, 2021, the level of water in the No. 6 HP heater remained below 70% (see Figure 6). The check valve was inspected on November 24 and was functioning properly. Therefore, water ingression from the No. 6 HP heater was not possible.

Figure 6: Holyrood Unit 1 No. 6 HP Heater Level (October 20, 2021 to October 27, 2021)

Attemperators Spray

Attemperators are control elements responsible for regulating steam temperature. If steam is beyond design temperatures, an attemperator sprays water into a steam line to control steam temperature. The Holyrood Unit 1 emergency reheat attemperator spray consists of feedwater tapped after the boiler feed pump and sent through a set of control and isolation valves that lead to the CRH line (see Figure 7; 238-10-0210-003 in Appendix D). The control valve (1TV 623A) and pneumatic block valve (1TV 623B) operate to control reheat steam temperature.

The Holyrood Unit 1 reheat spray has not been required in the past decade or longer. As per design, the target temperature for reheat steam is 538°C, but temperatures have been consistently below 500°C. For this reason, the manual block valve HFW-V183 is set to remain closed after removing a work permit.

During the implementation of the work protection permit for the annual Unit 1 outage, valve HFW-V183 was locked on May 27, 2021 with no operation (remain closed, step 93). On October 16, 2021, following completion of the annual outage work, operations completed the reverse switching order of the work permit. Step 7 of the reverse switching order mandates that valve HFW-V183 be unlocked with no operation, (i.e. remain closed). However, on Tuesday, October 26, 2021, a Holyrood employee found the manual block valve HFW-V183 in the open position. An entry in the shift supervisor log on October 28, 2021, confirms that the valve was open.

In addition to the open manual valves, there is an outstanding work order (1446407) on the pneumatic block valve (TV-623B). An issue with the valve was identified in November 2019 and investigated in February 2020 (work order 1426742). Parts to complete the work were ordered in 2021, but they have not been received and, due to the historical use of the reheat spray and the fact that the manual block valve is supposed to be closed, the work is classified as low priority.

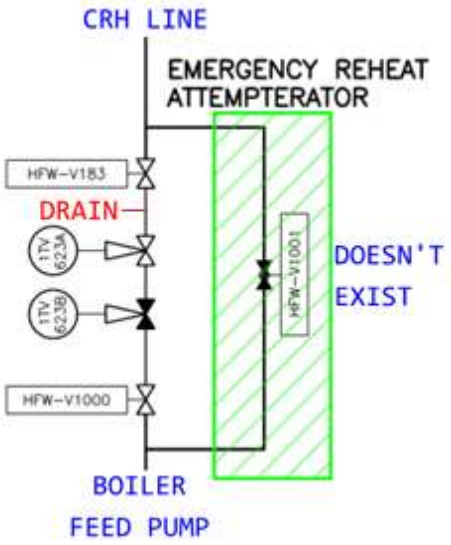


Figure 7: Holyrood Unit 1 Emergency Reheat Attemperator Spray Valves

Given the findings regarding the position of the manual block valve and the condition of the pneumatic block valve, the investigation team (see Section 5.0) requested a test to determine whether the control and pneumatic block valves were leaking while closed. On November 10, 2021 Holyrood operations executed a test based on the following steps:

1) Close HFW-V183 and HFW-V1000 manual valves.

2) Operate a boiler feed pump (roughly 20,000kPA of water pressure at the inlet of spray).

3) Verify that 1TV-623A and 1TV-623B valves are showing as closed in the control system screen.

4) Open the drain located between 1TV-623A and HFW-V183.

5) Slowly open HFW-V1000.

6) Check if water is coming out of the drain.

The test determined that valves 1TV-623A and 1TV-623B were leaking significantly and injecting water into the CRH line. All manual block valves were closed after the test.

Further analysis of temperature and pressure readings indicate that water was sprayed into the CRH line as early as October 20, 2021. Figure 8 shows that the temperature in the CRH line started to climb and roughly match the temperature of the boiler feedwater when the boiler feed pump was operating. On October 20, 2021, there was no steam being admitted to the turbine. The temperature change in the

CRH line should not have been this significant. This and several other similar occasions are observed throughout October 22, 2021 to October 25, 2021 (see Appendix F). This also confirms that saturated steam/water was being introduced to the CRH line via the attemperator spray.

As a result, the attemperator spray was deemed the source of water hammer issue in the CRH line.

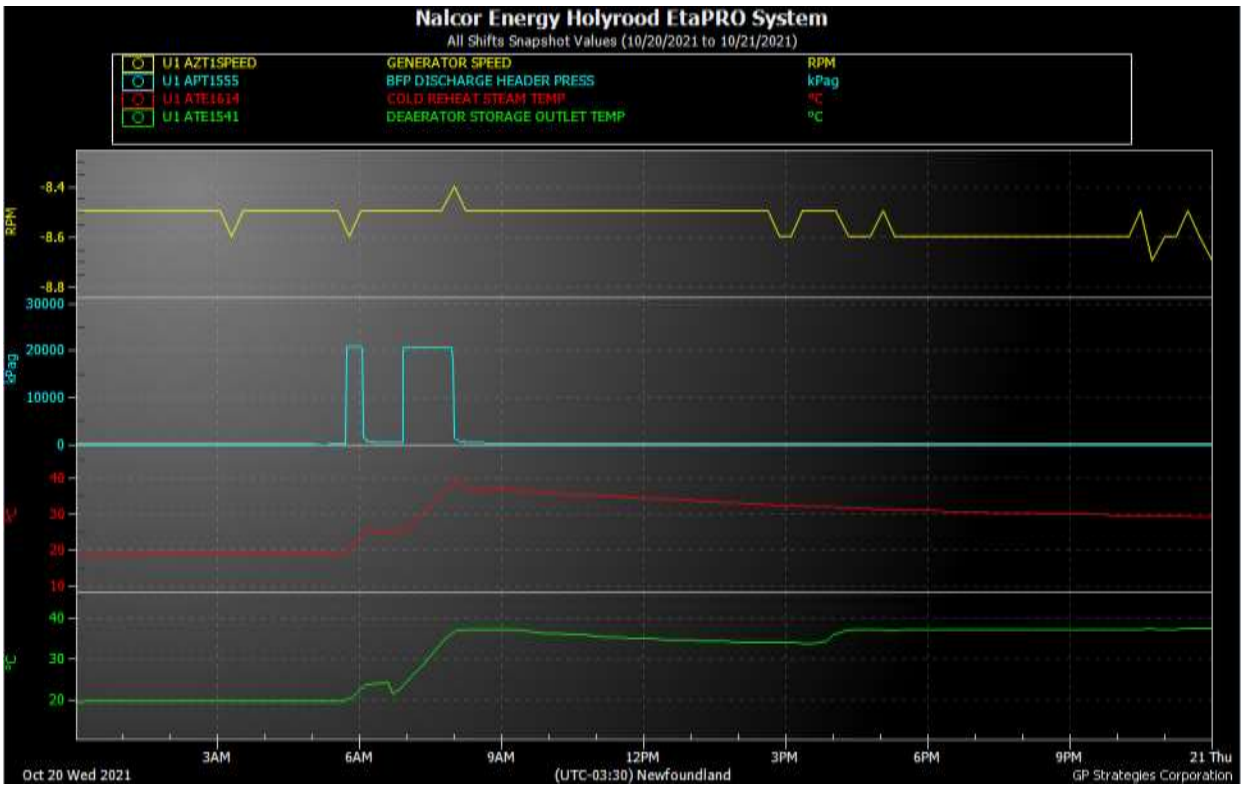


Figure 8: Temperature in CRH Line following Feedwater Temperature – No Steam in Turbine

2.1.4 Information Analysis

The speed and CRH line issues (described in Sections 2.1.2 and 2.1.3) appeared to be separate events. However, they were connected. After discovering that water entered the CRH line through the attemperator spray, Hydro, GE and Hatch agreed that water was flashing into steam in the reheat lines, causing the turbine to overshoot speed setpoints.

Further investigation determined that it was only possible to synchronize the generating unit without speed issues on October 25, 2021 because the GE controls engineer requested operations to open all line drains 100% for the MSV test. Normally, these drains are only open a fraction of that for start-up and are closed when the generating unit reach 15–20MW.

While the drains were 100% open, most of the water entering the CRH line drained, allowing operations to synchronize the unit without speed issues. Then, operations closed the drains at 15–20MW, loaded the unit to 40MW, and the system remained stable until the boiler tripped during the overspeed trip tests. Between the boiler trip and the following run-up, the unit was on turning gear for approximately two hours, while water continued to enter the CRH line. When attempting to synchronize after the trip, operations followed normal procedures and partially opened the drains. The water entering the CRH line caused speed issues again and a CRH pipe support failed after water hammer in the pipe.

Up until Monday, October 25, 2021, all tests suggested that the MSV was leaking too much steam, causing the speed issues. After installing the shim and recalibrating the valves, operations was able to synchronize Unit 1 and load it to 40MW without any speed issues, giving the impression that the problem was resolved.

The speed issue was unsettling among Holyrood staff. All Holyrood interviewees expressed concern regarding the installation of a shim in the MSV actuator and questioned the quality of the turbine and MSV overhaul work performed by GE. During the entire weekend, both parties focused on resolving the apparent speed control issues and dismissed the CRH line water hammer.

On Saturday, October 23, 2021, an experienced member of the Holyrood maintenance team reported the CRH pipe movement to the Holyrood Operations team, highlighting that it was not normal. Two operators assessed the movement, but start-up of the Holyrood Unit 1 continued, as GE and Holyrood Operations were troubleshooting the apparent speed control issues.

GE interviewees claim that they were either not aware of the pipe movement or not aware of the severity of the movement. Hydro interviewees confirmed that they observed movement of the CRH piping system on multiple occasions between Friday, October 22, 2021 and Monday, October 25, 2021. There was a lack of communication between Hydro and GE and a disagreement over ownership of the unit as it was the first start-up following a major overhaul. Although, Holyrood operations were controlling the unit at all times.

Water hammer in the CRH line caused the failure of the pipe hanger. The failure could have been avoided if start-up had been halted to investigate possible sources of water hammer in the CRH line, but the apparent speed issue clouded the pipe movement issue.

Although not determined to be a contributing factor to this forced outage, it is also worth mentioning that the CRH line drain pots were installed on Unit 1 in 2010 and have not been fully commissioned and placed in service. The project was partially commissioned in 2010 but was not placed in service due to deficiencies that have not been resolved. CRH drain pots are condensate collection systems installed on the low point of the CRH piping system that are equipped with level switches and an automatic valve. They function to prevent water induction into the turbine through the CRH line. Water in the drain pot will provide an alarm at the control room and will also open the automatic valve and allow the water to discharge to the condenser flash tank, thereby preventing water induction and damage to the turbine. It is recommended that these systems be fully commissioned and placed in service to prevent future turbine damage caused by water induction through the CRH lines. It should also be noted that it is unlikely that the CRH drain pots would have mitigated the damage to the CRH line caused by the water hammer event, had they been fully commissioned and placed in service. The system would have provided an alarm for an operator in the control room indicating that there was an issue during start-up but the leak test performed on the CRH emergency attemperator spray line verified that there was a considerable leakage flowrate across the temperature control valve while in the closed position that likely would not have been handled by the CRH drain pots.

2.2 Immediate Corrective Actions

Immediately following the Unit 1 forced outage that occurred on October 25, 2021, a team was assembled from Engineering and Technology to conduct a root cause analysis in order to determine the root cause(s) of the forced outage and to identify future mitigating actions. Early indications suggested that Unit 1 experienced a water hammer event on the CRH piping system during the October 25, 2021 start-up attempt that resulted in excessive movement of the piping and damage to pipe supports at high stressed locations. Damage was also sustained to structural steel at certain locations where pipe supports were mounted or where the piping contacted the steel.

GE, the boiler and turbine/generator service provider was immediately consulted as part of the analysis to review information related to the failure event and develop an inspection and testing plan for Unit 1 equipment that sustained damage. Photos of visual equipment damage on the CRH piping system were taken and sent to GE engineering for review. Drawings of the high energy piping systems (MS piping, HRH piping, and CRH piping) were provided. In addition, turbine vibration, eccentricity, and differential expansion data was also provided to GE engineering for analysis. Following a review of information

provided, GE recommended that Hydro complete non-destructive evaluations ("NDE") on the CRH piping system at high stressed locations using a magnetic particle inspection technique. A drawing was then provided to Hydro with the high stressed locations noted for inspection. Pipe supports that sustained visual damage were to be removed from service, inspected, and refurbished as required. Based on an evaluation of the turbine vibration, eccentricity, and differential expansion data, GE did not recommend disassembly of the turbine for an internal inspection.

Hydro then engaged Hatch to review the recommendations by GE and provide a third party opinion on the inspection and testing plan for Unit 1. Following a review of the recommendations by GE, Hatch also agreed with the inspection and testing plan and to focus on the CRH piping system only.

Local contractors were then engaged to erect scaffolding, remove pipe insulation, and complete NDE on the piping system. Plant forces were also engaged to temporarily support the CRH pipe and remove supports that were damaged for inspection. A local contractor was then engaged to develop an inspection and testing plan for the pipe supports and complete refurbishment as required.

Hatch was also retained by Hydro as the engineer of record to provide support for reviewing pipe inspection data and design engineering for mechanical and structural refurbishment work as required.

Hydro also decided to proceed with inspections on the boiler reheater section, given the apparent water hammer event that occurred on the CRH piping. The GE boiler service provider was retained to inspect the boiler reheater section. An acoustic test was completed on the boiler reheater using compressed air to check for leaks. Magnetic particle inspections were also completed on the boiler reheater inlet and outlet headers to check for cracks. No leaks were identified during the acoustic test on the reheater but a number of cracks were discovered on the inlet and outlet headers that required refurbishment.

2.3 Post Investigation Actions

After completion of all inspection and corrective actions, Hydro engaged GE to provide turbine vibration and controls specialists to support start-up of Unit 1 and verify that there were no concerns remaining from the October 25, 2021 incident.

The controls specialist guided operations to perform a series of tests during start-up in order verify that the MSV and speed control are operating as expected. The MSV was stable and operating smoothly

during the testing. The turbine experienced minimal speed overshooting and controlled quickly to the speed setpoints (see GE's Troubleshooting Report - HTGS in Appendix G).

A turbine vibration specialist was also onsite during start-up to monitor the turbine and generator bearing vibration levels. Using the start-up procedure, Unit 1 was accelerated from turning gear to 3600 rpm and was synchronized to the grid. Vibration levels were acceptable with alarms on turbine bearing No.'s 1 and 3. Bearing vibration levels will be monitored throughout the 2022 winter operating season and it is recommended that Hydro consider balancing the turbine rotor during an upcoming annual outage to reduce the vibration levels on bearing No.'s 1 and 3.

3.0 Root Causes Investigation Analysis

Analysis of the root causes begins with the identification of causal factors. Causal factors are defined as mistakes, errors, or failures that directly lead to an incident, or fail to mitigate the consequences of the original error. Root cause analysis is performed on each causal factor. A root cause is the absence of a best practice or the failure to apply knowledge that would have prevented the problem, or significantly reduced its likelihood or consequences. For this investigation, causal factors and the underlying root causes were identified based on the sequence of events and associated conditions leading up to and following the incident. The following sections document the identified causal factors and root causes of the incident, as well as recommended corrective actions to mitigate the occurrence of similar issues in the future.

The root cause analysis was performed using TapRoot® methodology and supporting software.

3.1 Causal Factor: Item 93 on Permit: 1-HFW-V183 "Close and Lock - Closed" Valve has not been used in a number of years but remains on the permit sequence.

To implement the work protection permit on Unit 1, the sequence of operation used is antiquated. The sequence identifies re-heat emergency spray attemperator line isolation valve V-183 to remain closed with no operation. The emergency spray attemperator line has not been used for a number of years on Unit 1 but the system and valves were never locked out or tagged out with a do not operate notice.

3.1.1 Root Cause: Drawing/Prints Need Improvement

The drawings used in the investigation still include the emergency spray attemperator system that is no longer in service with no indication this system is not used.

- ✓ ***Corrective Action:***
  Update the drawings to as built standards and indicate where applicable any items that are not used (locked and tagged out) or not there anymore.
  Group Responsible: Thermal Production Group.
  Recommended Timing: Within one year.

3.1.2 Root Cause: Infrequent Audits and Evaluations

The permit sequence used develop the LOTO includes systems such as the emergency spray attemperator that are no longer used.

- ✓ ***Corrective Action:***
  Development of an audit program to review the permitting sequence at a set interval. All points on the sequence should be for systems that are currently used for the production of electricity only. Any systems no longer required should be removed from the sequence and immediately locked and tagged “do not operate”. In addition, preventative maintenance should be performed on items tagged “do not operate” until the equipment is removed from service. Arrangements should then be made to remove any systems that are no longer required.
  Group Responsible: Thermal Production Operations Department.
  Recommended Timing: Within one year.

3.1.3 Root Cause: Work Package/Permit Needs Improvement

The permit sequence needs to be updated to include only equipment that will be used.

- ✓ ***Corrective Action:*** Same as 3.1.2

3.1.4 (Near) Root Cause: Wrong Permit Sequence

This near root cause indicates that the permit sequence used was factually wrong because it included systems not used.

- ✓ ***Corrective Action:*** Same as 3.1.2

3.2 Causal Factor: Item 7 1-HFW-V183, "unlocked with no operation -Closed"

This item on the permit was signed off to unlock the valve and perform no operation which was to keep valve closed. On October 26, 2021, 10 days after the work protection permit was removed from Unit 1, V183 was found open and was noted in the operators log to close the valve.

3.2.1 Root Cause: Second Checker Needed

There are currently no requirements in the worker protection code ("WPC") to have a second checker when removing a permit and restoring a unit.

- ✓ ***Corrective Action:*** Consider the inclusion of a second checker to address complacency when performing repetitive work. There can be hundreds of points on a permit that require various tasks such as opening or closing valves there is a chance that items can be missed and a second checker could help mitigate this issue.
  Group Responsible: Worker Protection Committee.
  Recommended Timing: Within one year.

3.2.2 (Near) Root Cause: Followed Incorrectly

This near root cause indicates that the person performing the task made a mistake when using the procedure but if followed correctly, the event would not have occurred. The procedure was followed incorrectly.

- ✓ ***Corrective Action:*** Same as 3.2.1

3.3 Causal Factor: Valve V183 mistakenly left open (Assumed to be at this date when WPC was removed on October 16, 2021)

When performing LOTO to isolate the unit from all energy sources, an operator will perform all the LOTO duties and a second checker will verifies each point. Prior to starting work, all trades people have the right and are encouraged to walk the permit to identify all isolations and tags to ensure the unit is safe to work on. Following completion of the work, the permit is removed and one operator will remove all isolations and sign the check sheet similar to the installation of the LOTO. However, there is no second checker required to verify if all isolations were correctly operated, and no trade's people are required to do any checks or verification that the permit was correctly removed.

3.3.1 Root Cause: Second Checker Needed

There are currently no requirements in the WPC to have a second checker when restoring a unit.

- ✓ ***Corrective Action:*** Same as 3.2.1

3.3.2 (Near) Root Cause: Followed Incorrectly

This near root cause indicates that the person performing the task made a mistake when using the procedure but if followed correctly, the event would not have occurred. The procedure was followed incorrectly.

- ✓ ***Corrective Action:*** Same as 3.2.1

3.4 Causal Factor: Movement of the lines was reported to the control room and 2 operators investigated. Operations did not give any recommendations to stop the run up of the unit. GE was not aware of the CRH piping movement.

During the interview process, it was confirmed by an experienced employee at the Holyrood TGS that the CRH line had abnormal movement on October 23, 2021 during the initial unit start-up. This condition was brought to the attention of Operations and two operators went to check the CRH line. However, there was no record of the movement in the CRH line in the operator logs and no other inspections were noted until the failure event occurred on October 25, 2021.

3.4.1 Root Cause: No Hold Point

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. However, there was no formal procedure to follow up on the abnormal condition or to hold the start-up of the unit to confirm this condition was corrected or it was not an issue.

- ✓ ***Corrective Action:***

  A procedure should be developed to have hold points on the startup of a unit when abnormal conditions are reported.

  Group Responsible: Thermal Production Group.

  Recommended Timing: Within one year.

3.4.2 Root Cause: Inspection Techniques Need Improvement

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. There was no indication that operations monitored the piping after the initial inspection.

- ✓ ***Corrective Action:***
  A procedure should be developed for operators when faced with abnormal conditions. This procedure should have a follow up inspection recommended, a signed hand off to the next shift, and contact information for the correct manager or supervisor when faced with abnormal conditions.
  Group Responsible: Thermal Production Group.
  Recommended Timing: Within one year.

3.4.3 Root Cause: No Standard Turnover Process

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. Upon a shift change, the current operators log is the turnover process.

- ✓ ***Corrective Action:*** Same as 3.4.2

3.4.4 Root Cause: Turnover Process Needs Improvement

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. Upon a shift change the current operators log is the turnover process.

- ✓ ***Corrective Action:*** Same as 3.4.2

3.4.5 Root Cause: Employee Feedback Needs Improvement

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. There is no process to contact management to receive proper feedback when faced with abnormal conditions.

- ✓ ***Corrective Action: :*** Same as 3.4.2

3.4.6 Root Cause: Work Package/Permit Needs Improvement

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. The inspection and the risk associated with their findings did not adequately assess the condition properly.

- ✓ ***Corrective Action:*** Same as 3.4.2

3.4.7 (Near) Root Cause: No Communication or Not Timely

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. There is no process to contact management to receive proper feedback when faced with abnormal conditions.

- ✓ ***Corrective Action:*** Same as 3.4.2

3.4.8 (Near) Root Cause: Corrective Action

An abnormal condition was reported to operations (movement of the CRH piping) and two operators did perform a visual inspection. There was no indication that operations monitored the piping after the initial inspection.

- ✓ ***Corrective Action:*** Same as 3.4.2

4.0 Observations and Lessons Learned

4.1 Procedures

During the investigation, the application of the WPC was reviewed by the investigation team. When the permit is applied, there are numerous checks and verifications of the isolation points by both operations and trades personnel to ensure worker protection is adequate. When the unit is restored and the permit is removed, the reverse switching order is performed by one person doing the task with a sign off and no verification is required to ensure equipment and personnel safety. There is no requirement under the WPC to have a second checker.

To mitigate any missed or improper isolations when removing a work protection permit, the consideration of a second checker is recommended.

4.2 Management Expectations

A common theme during the root cause analysis was the lack of standards, policies and administrative controls as they relate to the drawing database for Holyrood and the lack of an audit program of the permitting sequence. Without updated drawings and a review of procedures, employees need to have knowledge of redundant systems that are still represented on drawings and have to work with switching sequences that have been updated to state “no operation” of equipment not used. This poses increased risks and liabilities to the organization and individuals as there is a greater opportunity for errors, deficiencies and complacency.

While it is recognized that updating all drawings to as built status would be a massive undertaking, it is recommended to have set intervals to review and update drawings to as built status. In addition, an audit program is required for the permitting sequence so redundant and not used equipment can be removed from the switching order.

4.3 Work Direction/Quality Control/Communications

Another common theme observed during the root cause analysis was the absence of work direction, quality control, and communications when operations were faced with an abnormal condition. During the investigation, there were reports of abnormal movement on the CRH line two days before the failure event occurred. Operations did investigate this abnormal condition but a root cause was not identified. When abnormal conditions being reported to the control room, there needs to be a documented procedure in place to deal with such conditions. This procedure should have a recommended follow up inspection(s) section, a signed hand off to the next shift, contact information of the correct manager or supervisor while facing the abnormal condition, and a safeguard in place such as a hold point on the start-up to ensure the abnormal conditions are corrected before proceeding with the start-up of the unit.

4.4 Other Considerations

Initially during the investigation, the team focused on the procedures used for unit start-up due to the turbine overshooting speed setpoint issue and major capital work that was completed on Unit 1 during the 2021 outage season. The start-up procedure used was 1141 POI-106. This procedure is over seven pages in length and references seven other procedures to be followed at different times during start-up which adds eight more pages of activities to perform. Procedure POI-106 does reference two check

sheets that are to be filled during start-up. However, during the investigation, the team was informed these sheets were not filled out. The other seven procedures do not have check sheets to confirm the activities within the procedure were performed. The investigation team then had to rely on the Control Room and Shift Supervisor logs along with the procedures to determine when certain start-up activities were performed. This was not a root cause for the incident but it does identify gaps in the use of procedures and documentation for the start-up of a unit in Holyrood that should be addressed.

5.0 Recommendations

The investigation team followed TapRoot® methodology to systematically analyze the Unit 1 forced outage that occurred on October 25, 2021. The investigation identified four main causal factors that led to the forced outage as detailed in Section 3 along with three observations to be corrected as detailed in Section 4. A summary of recommendations are included below.

Recommendations:

- Update the HTGS Unit 1 drawings to as built standards and indicate where applicable any systems that are no longer required;
- Development of an audit program for Unit 1 to review the permitting sequence at a set interval. All points on the sequence should be for systems that are currently used for the production of electricity only. Any systems no longer required should be removed from the sequence and immediately locked and tagged “do not operate”. In addition, preventative maintenance should be performed on items tagged “do not operate” until the equipment is removed from service. Arrangements should then be made to remove any systems that are no longer required;
- Consider the inclusion of a second checker on Unit 1 LOTO procedure to address complacency when performing repetitive work. There are hundreds of points on a worker protection permit that require isolation during a major unit outage and there is a chance that items can be missed during the permit removal. A second checker during permit removal could help mitigate this issue; and
- A procedure should be developed for operators when faced with abnormal conditions. This procedure should include recommended follow up inspection(s), a signed hand off to the next shift, and contact information for the manager or supervisor in charge when faced with

abnormal conditions. In addition, hold points should be in place when abnormal conditions are encountered to safeguard employees and the unit during start-up.

In addition, the issues below were not the direct root cause of the incident but should also be addressed:

- Correct issues identified with the use of Unit 1 start-up procedures and documentation in Holyrood. Not having start-up check sheets completed can lead to errors.
- The Mark V turbine control system on Unit 1 does not have a historian. The system does not record any operational data, including speed setpoints, valve positions, and hydraulic pressure, etc. which compromises the ability to troubleshoot and assess events that may be related to turbine controls. It is recommended to add this functionality to the control system.
- Following any major overhaul, it is recommended to have the service contractor start-up engineer on site until the unit achieves full load.
- To apply all of the above recommendations to both Units 2 and 3 where applicable.

6.0 Investigator/Investigation Team

An investigation team was established on Thursday, October 28, 2021 to review the incident to determine the root causes and identify corrective actions to mitigate the event from occurring again in the future. The investigation was completed in November 30, 2021. The team members are:

Team Members

Todd Collins	Team Lead	Engineering Services
Dave Royle	Investigator	Engineering Services
Arthur Altoe	Investigator	Engineering Services
Howard Richards	Independent Review	Engineering Services

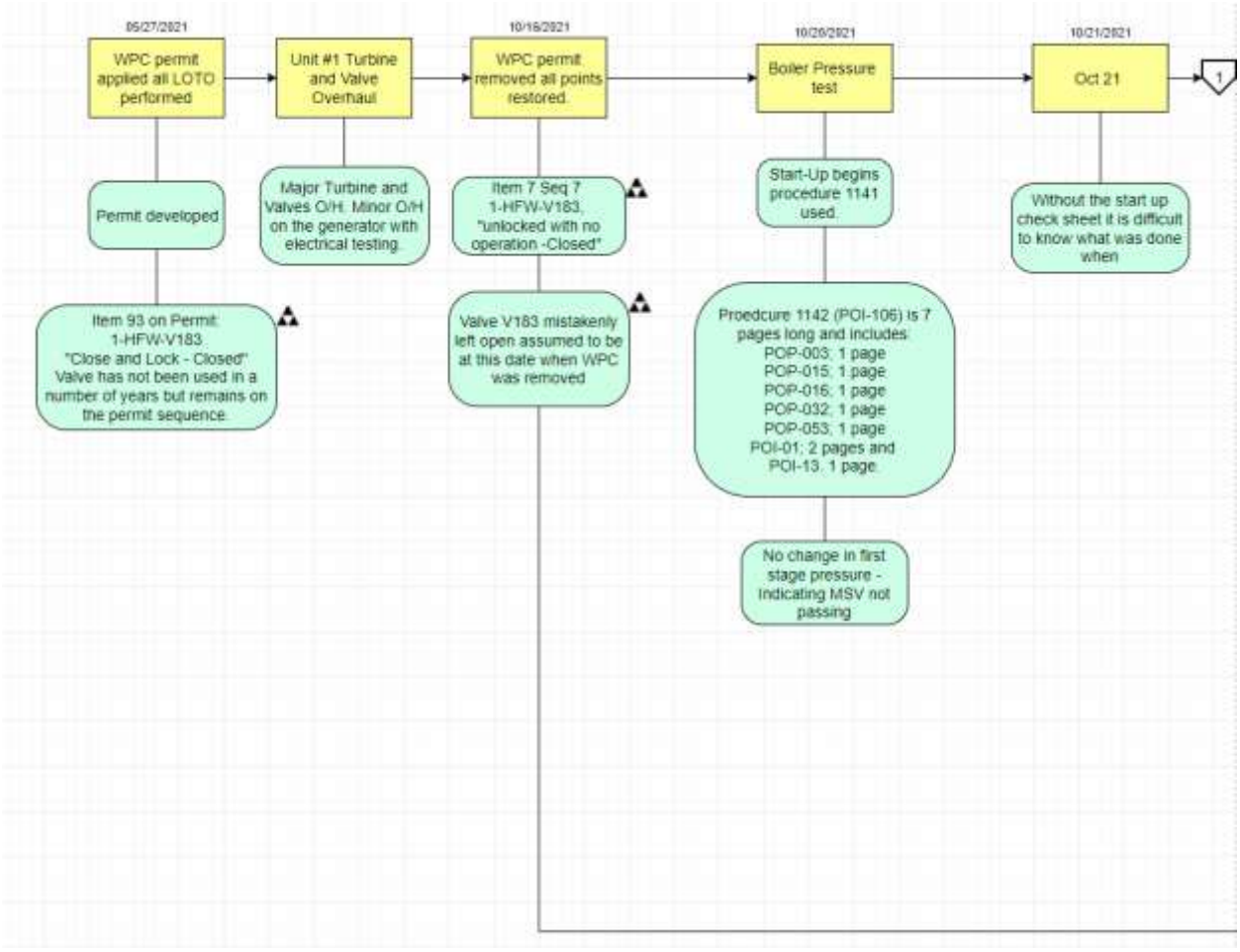
Team Governance

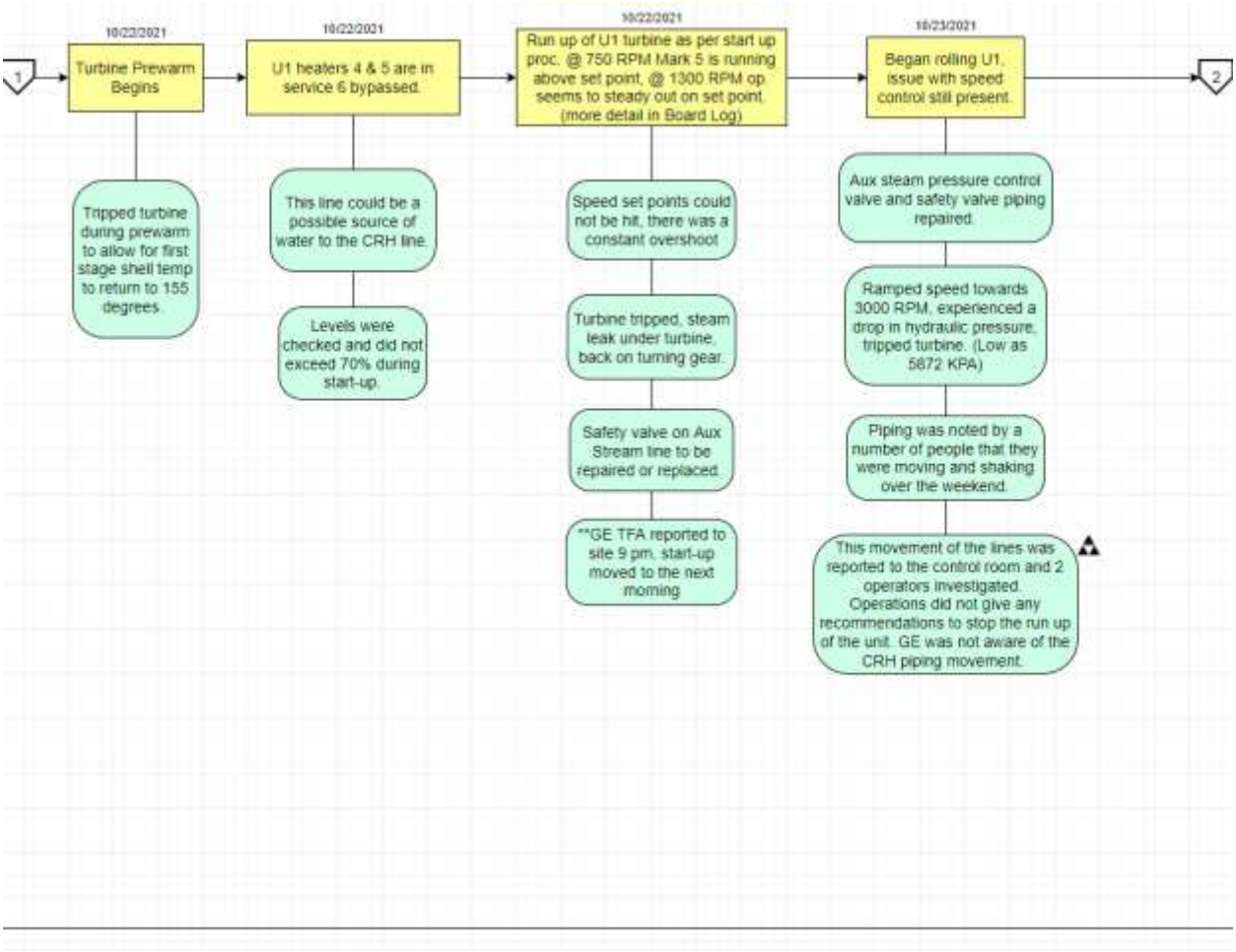
Jeff Vincent	Sponsor	Thermal Production Ops.

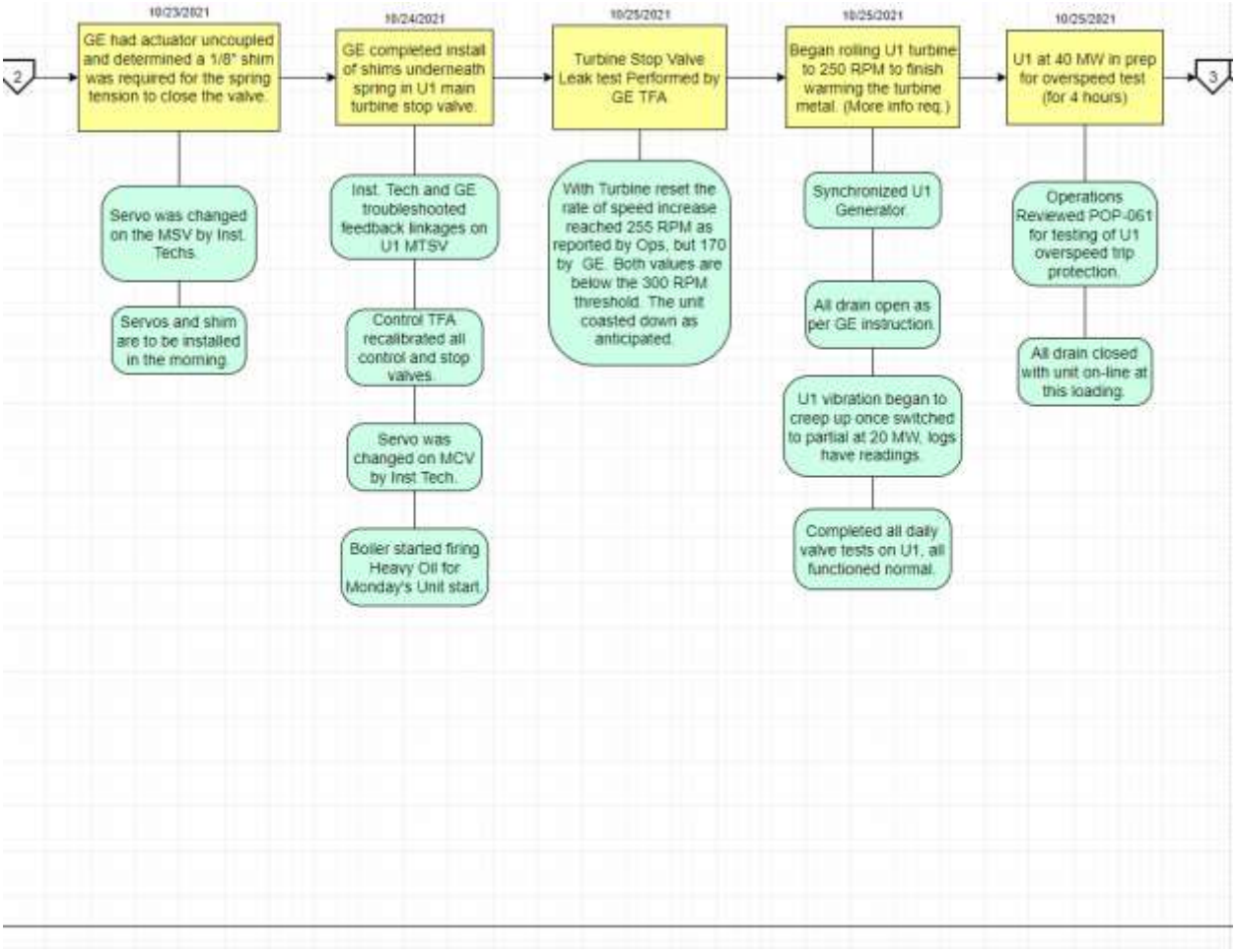
Appendix A

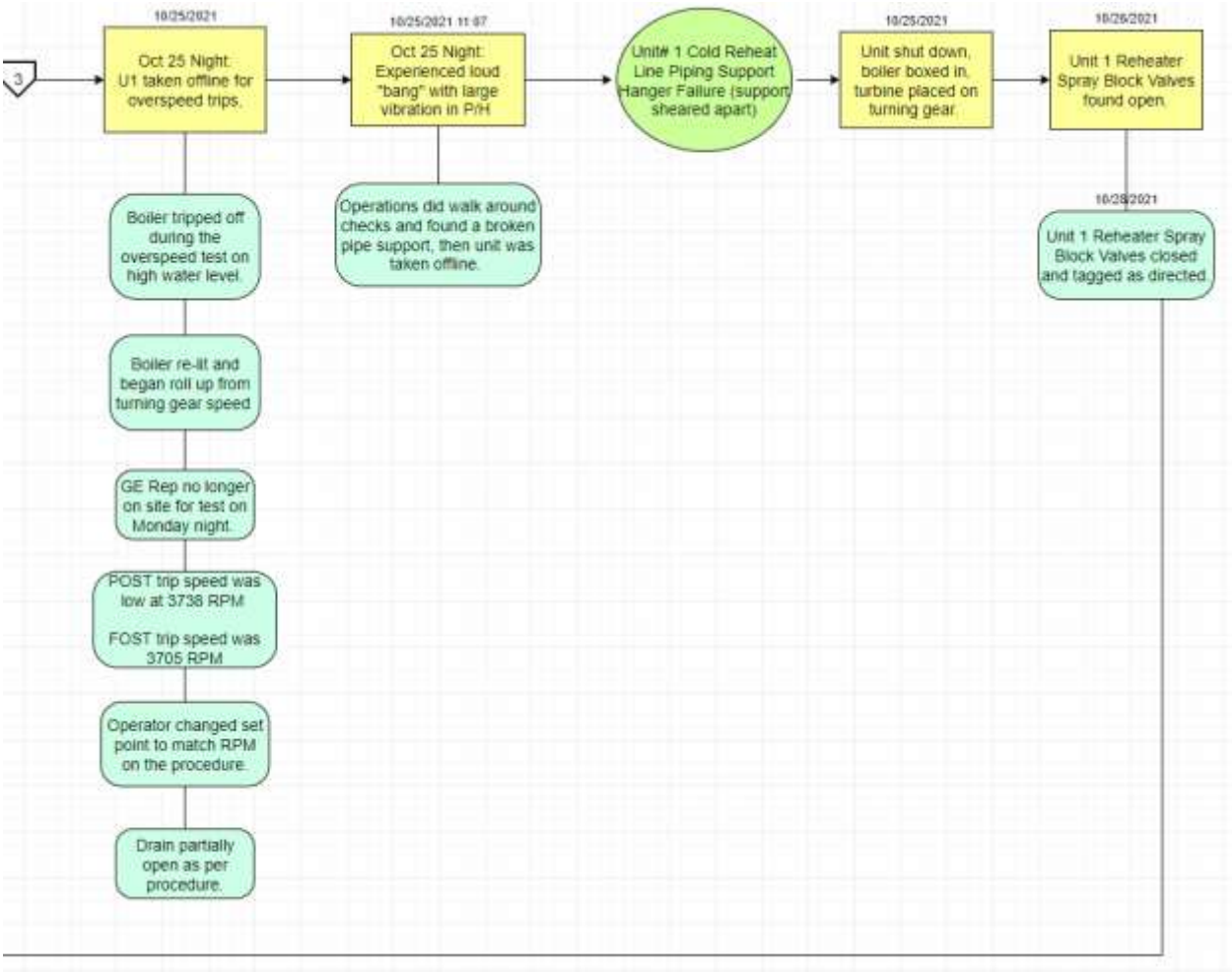
Sequence of Events: SnapChart (from TapRoot® software)

newfoundland labrador hydro


05/27/2021
WPC permit applied all LOTO performed
Unit #1 Turbine and Valve Overhaul
10/16/2021
WPC permit removed all points restored
10/20/2021
Boiler Pressure test
10/21/2021
Oct 21
1
Permit developed
Major Turbine and Valves O/H. Minor O/H on the generator with electrical testing
Item 7 Seq 7 1-HFW-V183, "unlocked with no operation -Closed"
Start-Up begins procedure 1141 used
Without the start up check sheet it is difficult to know what was done when
Item 93 on Permit: 1-HFW-V183 "Close and Lock - Closed" Valve has not been used in a number of years but remains on the permit sequence
Valve V183 mistakenly left open assumed to be at this date when WPC was removed
Proedcure 1142 (POI-106) is 7 pages long and includes: POP-003; 1 page POP-015; 1 page POP-016; 1 page POP-032; 1 page POP-053; 1 page POI-01; 2 pages and POI-13; 1 page
No change in first stage pressure - Indicating MSV not passing


1
10/22/2021
Turbine Prewarm Begins
Tripped turbine during prewarm to allow for first stage shell temp to return to 155 degrees.
10/22/2021
U1 heaters 4 & 5 are in service 6 bypassed.
This line could be a possible source of water to the CRH line.
Levels were checked and did not exceed 70% during start-up.
10/22/2021
Run up of U1 turbine as per start up proc. @ 750 RPM Mark 5 is running above set point, @ 1300 RPM op seems to steady out on set point. (more detail in Board Log)
Speed set points could not be hit, there was a constant overshoot
Turbine tripped, steam leak under turbine, back on turning gear.
Safety valve on Aux Stream line to be repaired or replaced.
**GE TFA reported to site 9 pm, start-up moved to the next morning
10/23/2021
Began rolling U1, issue with speed control still present.
Aux steam pressure control valve and safety valve piping repaired.
Ramped speed towards 3000 RPM, experienced a drop in hydraulic pressure, tripped turbine. (Low as 5872 KPA)
Piping was noted by a number of people that they were moving and shaking over the weekend.
This movement of the lines was reported to the control room and 2 operators investigated. Operations did not give any recommendations to stop the run up of the unit. GE was not aware of the CRH piping movement.
2


2
10/23/2021
GE had actuator uncoupled and determined a 1/8" shim was required for the spring tension to close the valve.
Servo was changed on the MSV by Inst. Techs.
Servos and shim are to be installed in the morning.
10/24/2021
GE completed install of shims underneath spring in U1 main turbine stop valve.
Inst. Tech and GE troubleshooted feedback linkages on U1 MTSV.
Control TFA recalibrated all control and stop valves.
Servo was changed on MCV by Inst Tech.
Boiler started firing Heavy Oil for Monday's Unit start.
10/25/2021
Turbine Stop Valve Leak test Performed by GE TFA.
With Turbine reset the rate of speed increase reached 255 RPM as reported by Ops, but 170 by GE. Both values are below the 300 RPM threshold. The unit coasted down as anticipated.
10/25/2021
Began rolling U1 turbine to 250 RPM to finish warming the turbine metal. (More info req.)
Synchronized U1 Generator.
All drain open as per GE instruction.
U1 vibration began to creep up once switched to partial at 20 MW, logs have readings.
Completed all daily valve tests on U1, all functioned normal.
10/25/2021
U1 at 40 MW in prep for overspeed test (for 4 hours)
Operations Reviewed POP-061 for testing of U1 overspeed trip protection.
All drain closed with unit on-line at this loading.
3


3
10/25/2021
Oct 25 Night: U1 taken offline for overspeed trips.
10/25/2021 11:07
Oct 25 Night: Experienced loud "bang" with large vibration in P/H
Unit# 1 Cold Reheat Line Piping Support Hanger Failure (support sheared apart)
10/25/2021
Unit shut down, boiler boxed in, turbine placed on turning gear
10/26/2021
Unit 1 Reheater Spray Block Valves found open
Boiler tripped off during the overspeed test on high water level.
Operations did walk around checks and found a broken pipe support, then unit was taken offline.
10/28/2021
Unit 1 Reheater Spray Block Valves closed and tagged as directed
Boiler re-lit and began roll up from turning gear speed
GE Rep no longer on site for test on Monday night.
POST trip speed was low at 3738 RPM
FOST trip speed was 3705 RPM
Operator changed set point to match RPM on the procedure.
Drain partially open as per procedure.

Appendix B

SPEEDTRONIC Mark V Turbine Control

End of Production

newfoundland labrador hydro

GE Energy

GEZ-S2002

Originally announced to GE employees and customers in September of 2003

SPEEDTRONIC* Mark* V Turbine Control
End of Production

September 2003

GE Drives and Controls, Inc. will cease normal production of the SPEEDTRONIC Mark V Turbine Control system on March 31, 2004. As with many products, and particularly with electronics, the Mark V control will eventually exceed its supportable life. Parts and components will become unavailable and technology resources will become scarce. This will make it increasingly difficult to guarantee timely availability and reparability of parts for an extended period.

In order to address this issue and support customer initiatives, GE has established the following guidelines. These guidelines are designed to help customers as they develop their plans to purchase and retire equipment and to minimize costs throughout the Mark V control end-of-life stages.

Product End of Life

Once production of Mark V control systems ceases, its end-of-life process will have begun. During this process, the Mark V control will be supported by renewal parts and technical support for 10 years, or as long as feasible. The length of time for continued support after obsolescence is dependent upon numerous items including: supplied parts and components, design automation tools, test equipment, technical expertise, and manufacturing facility. A product end-of-life team reviews each product annually to determine its status and future plans for continued support.

Renewal Parts End of Life

A renewal parts end-of-life planning team will determine the support strategy for parts, which will be coded to identify their availability and stage of support as follows:

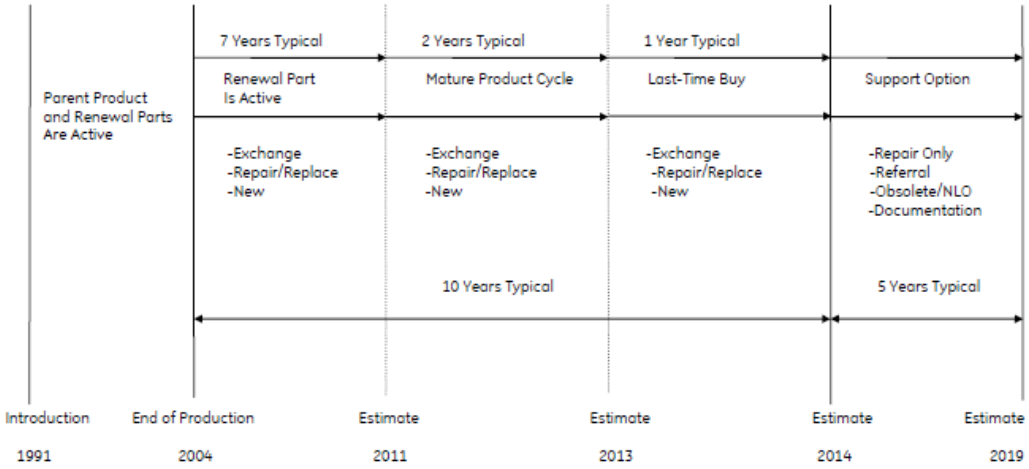
RTS&S Refer to Sales & Service (RTS&S) is temporarily assigned due to part problems including: cost, availability, quality, test equipment, technical expertise, EHS concerns, and low volume. The part will be reviewed for availability at the time of request.

OBS - No Replacement Obsolete (OBS) - No Replacement is assigned to designate parts that GE Industrial Systems can no longer manufacture or obtain from suppliers, and for which no replacement part is available.

OBS - USE _xxxx_ Obsolete (OBS) - Use _xxxx_ is assigned to designate parts that GE Industrial Systems can no longer manufacture or obtain from suppliers, but has assigned a replacement.

NLO No Longer Offered (NLO) is assigned to designate parts that GE Industrial Systems can no longer offer.

The life-cycle stage of parts will be identified on the current order/quote system, along with the date that they entered each life-cycle stage. The stages of the part's life cycle are shown in the following table.



Mark V Control Timeline Overlay

GE is committed to the life-cycle support of your controls and associated equipment. For more information, contact the nearest GE Sales or Service Office, or an authorized GE Sales Representative.

George Belanger
Senior Product Marketing Manager
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GEZ-S2002 090610

Appendix C

GE's Control Engineer's Report

newfoundland labrador hydro

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STEAM TURBINE - CONTROL

MARK V STARTUP SUPPORT

UNIT S1

for

HORYLOOD THERMAL GENERATING STATION
Conception Bay, Newfoundland
Equipment Serial #: 940310 SY0019256
Startup Date: OCT 23, 2021
Report Issued: NOV 08, 2021

FSR #: I01-070892
Report Printed: NOV 09, 2021

Prepared By:
Ngo, Thuan
Field TA

Approved By:
Patel, Ghanshyam
Service Manager

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TABLE OF CONTENTS

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SUMMARY & RECOMMENDATIONS

Holyrood Generating Station Planned to start unit S1 S/N 940310-YS0019256 after Major Outage. A control TFA was at site on October 23, 2021 to October 25,2021 to support.

Prior to the Control TFA arrival, the unit was started; the Holyrood operation steam indicated unit speed was always higher than speed reference.

The control TFA reported to site at 9:00PM on October 23, 2021 to support startup. However, the startup schedule was moved to the next morning.

On October 24th, Holyrood Operation Start the unit with the Control TFA support. The unit accelerated to a few hundred RPM on reset, this indicated MSV was passing. Several attempts to limit the MSV passing by adjusted the pilot flow control curve but unsuccess. The unit was shutdown and turn over to mechanical team for further investigation.

While the mechanical team working on the MSV, the Control TFA validated, re-calibrated all control valves, and stop valves. All valves were calibrated for positive seated on zero flow demand.

On October 25th morning, the Mark V Software was setup do MSV seal test. In this test, the MSV and MCV stayed close on reset; the MSV failed the leak test if turbine speed accelerates above 3000RPM and maintain above 250RPM. On the MSV seal test reset, the unit accelerated to 170RPM and then started to coast down. This indicated the MSV had acceptable leakage for unit startup.

Startup sequence was return to normal and the unit was released back to Holyrood Operation for a normal startup. The unit was reset and rolled to 250RPM for warmup, then 500, then 1300RPM, then 3000, and FSNL. All bearing temperatures, vibrations, axials, and expansions were well with recommendations and specifications.

The unit was synch and loaded to 40MW for heat soak prior to overspeed test. All bearing temperatures, vibrations, axials, and expansions were well with recommendations and specifications during the 40MW heat soak.

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DATA and WORK LOG

Reset and 6.9% Speed Hold – Speed (Blue) over shot reference about 20RPM.

940310 HORYLOOD THERMAL GENERATING STATION Page 4

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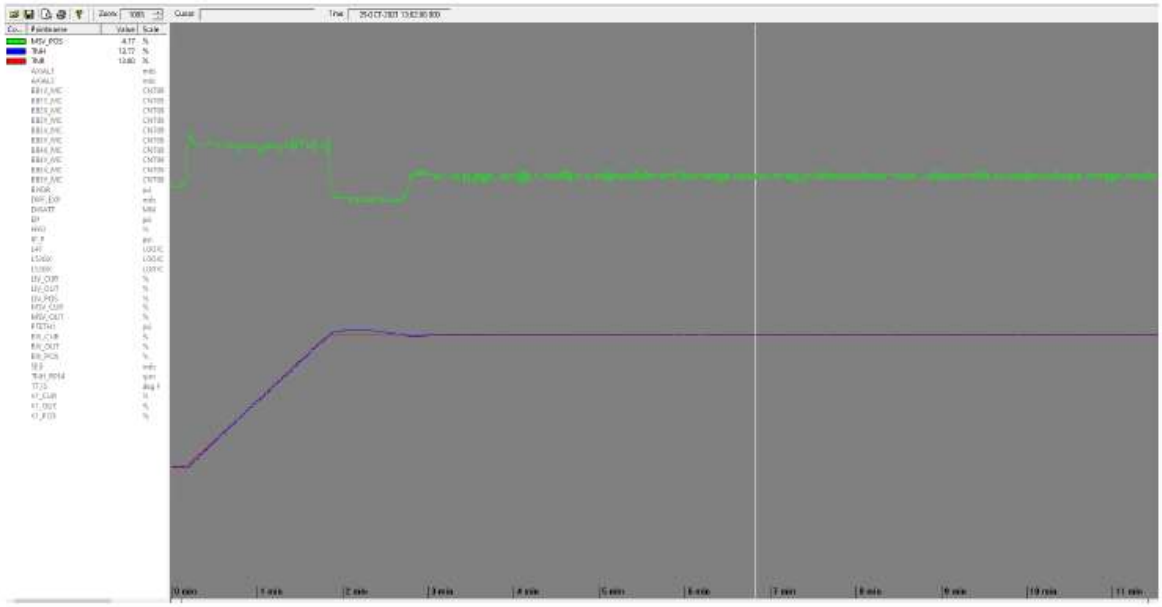
DATA and WORK LOG

Speed Hold at 13.80% - Speed (Blue) over shot reference less than 10RPM.



940310 HORYLOOD THERMAL GENERATING STATION Page 5

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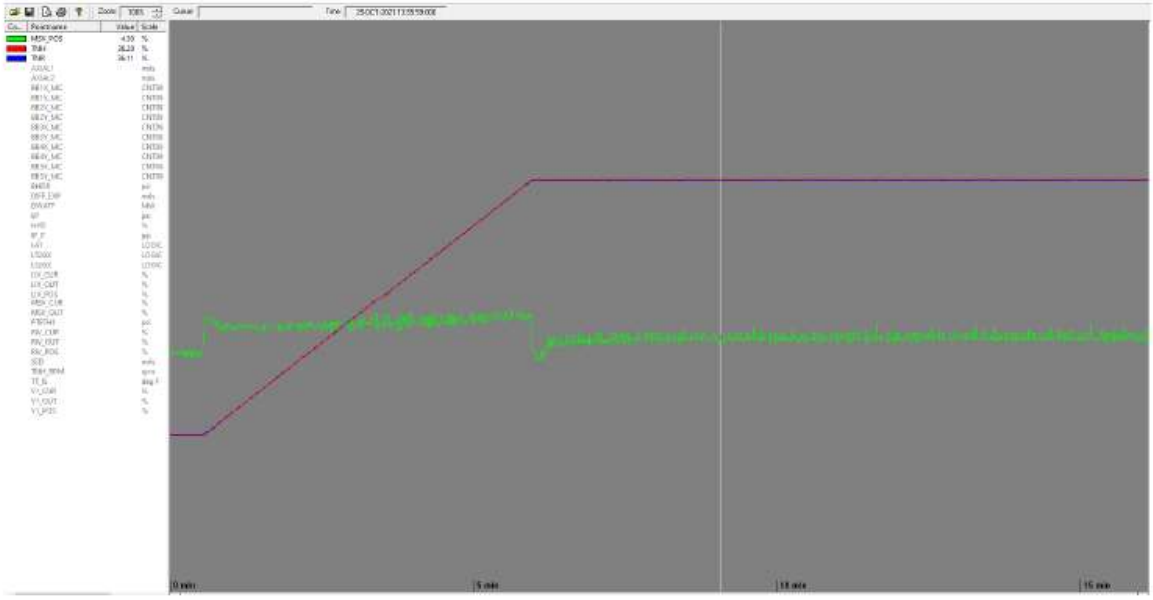
DATA and WORK LOG

Speed Hold at 36.11% - Speed (Blue) over shot reference less than 10RPM.



940310 HORYLOOD THERMAL GENERATING STATION Page 6

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DATA and WORK LOG

Speed Hold at 88.33.11%, FSNL, Synch and Load to 15MW.

940310 HORYLOOD THERMAL GENERATING STATION Page 7

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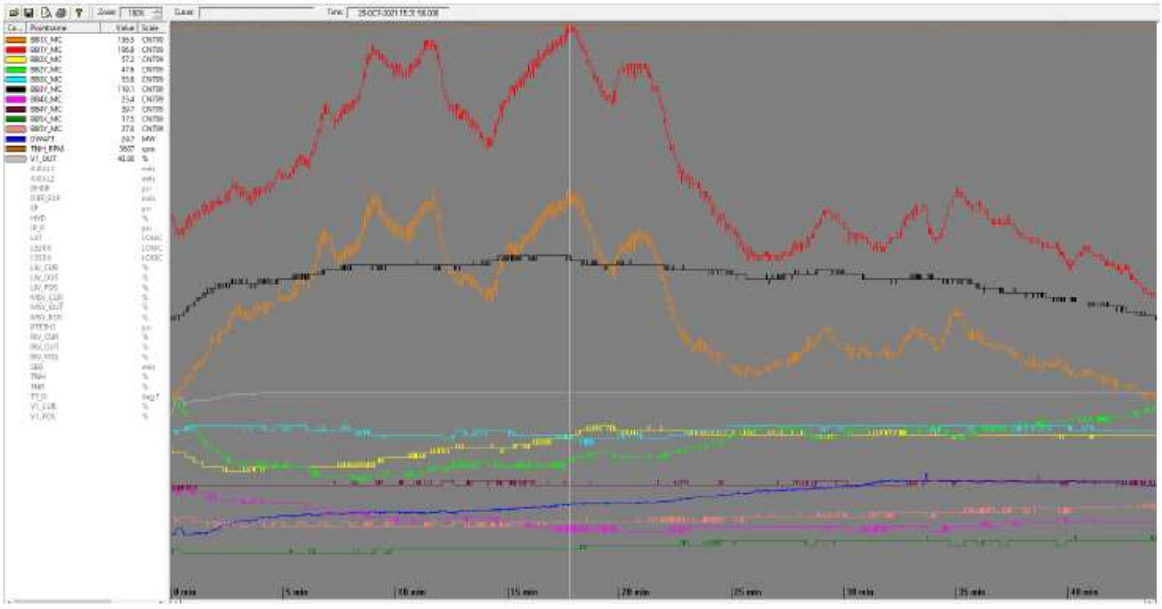
DATA and WORK LOG

Vibration During Loading and Load Hold at 30MW



940310 HORYLOOD THERMAL GENERATING STATION Page 8

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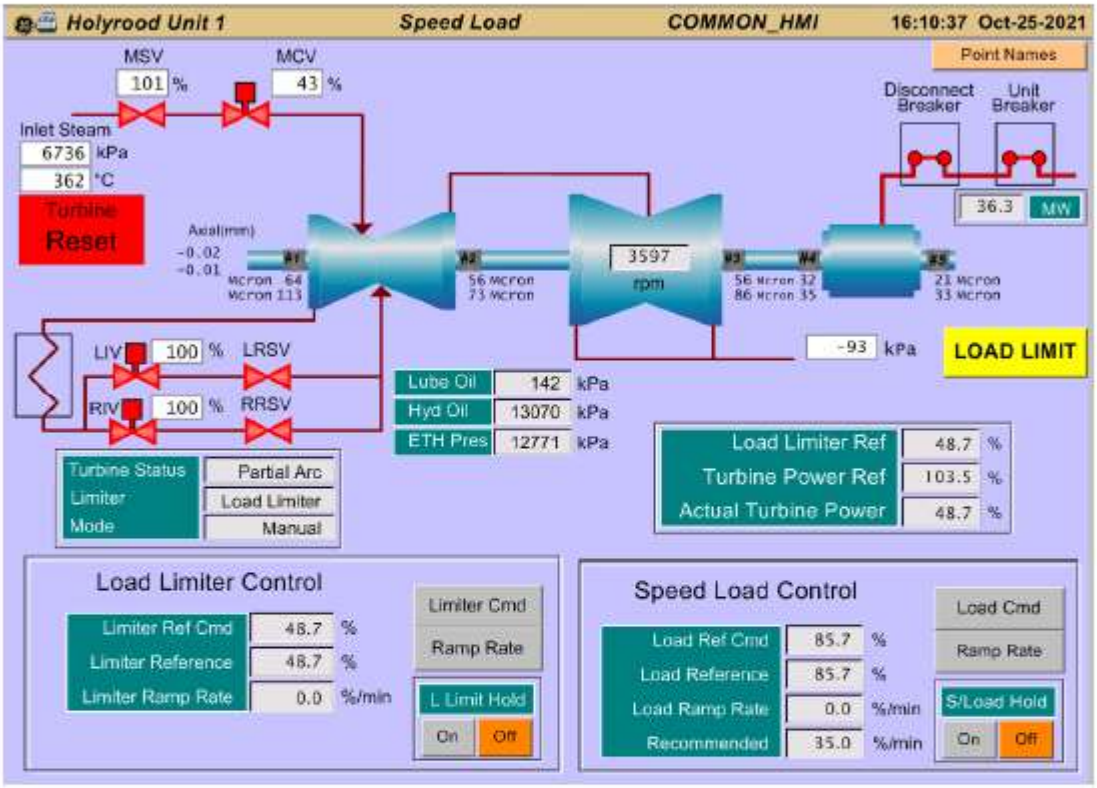
DATA and WORK LOG

35MW Heat Soak – Base Line Data

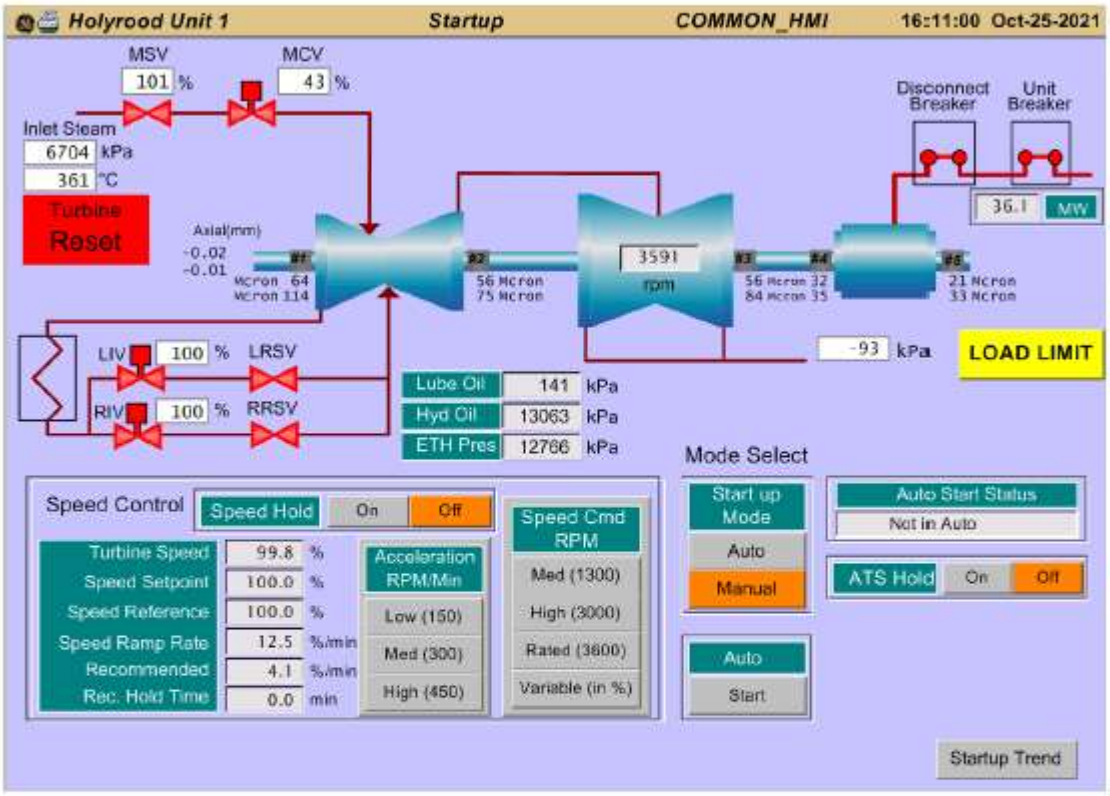


hydro

FieldCore

DATA and WORK LOG

35MW Heat Soak – Base Line Data

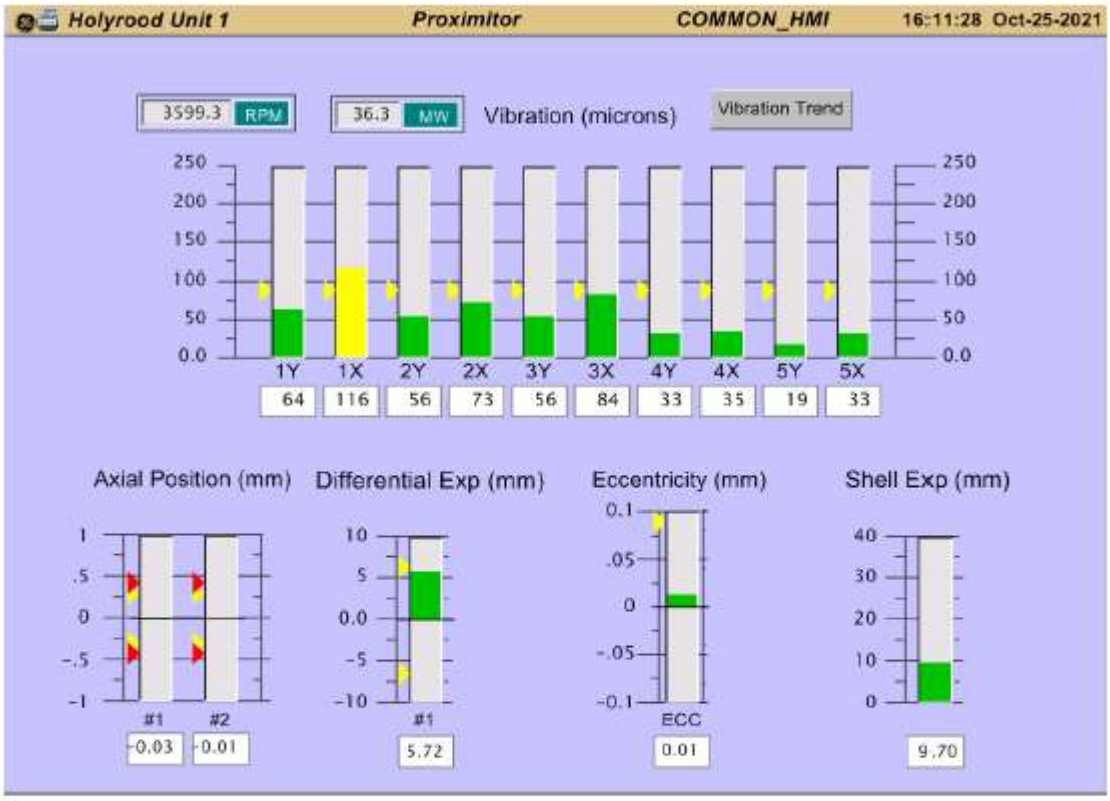


hydro

FieldCore

DATA and WORK LOG

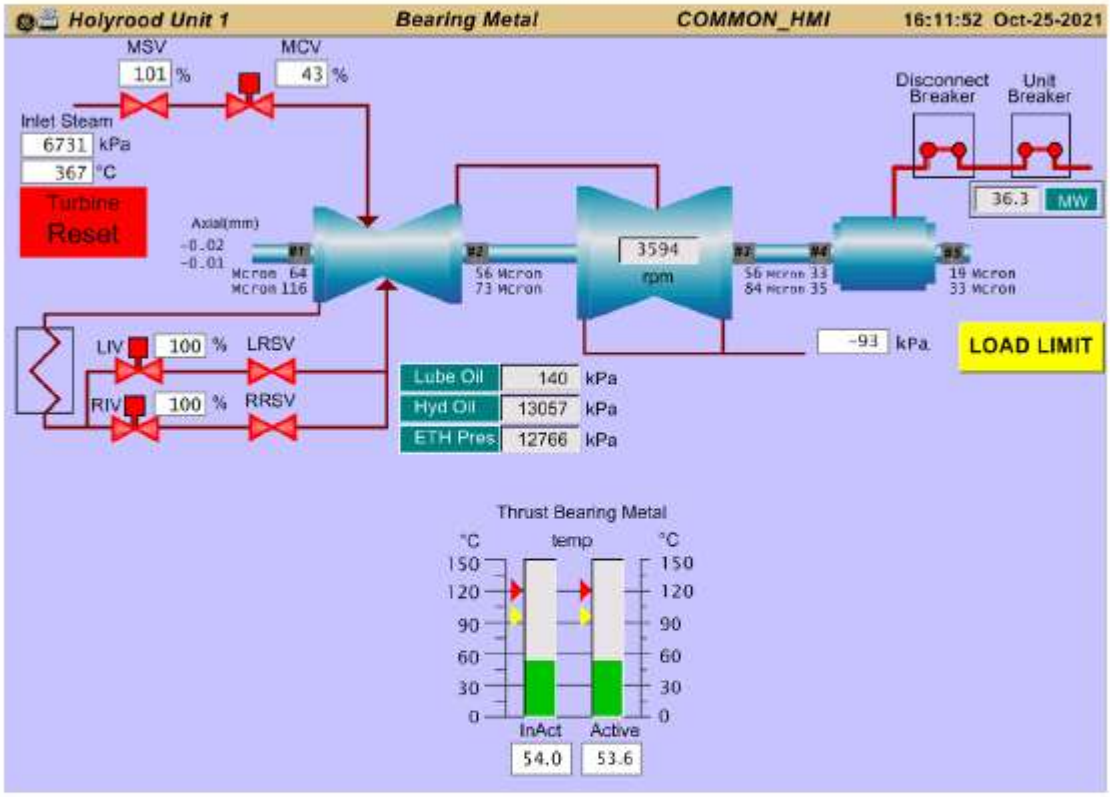
35MW Heat Soak – Base Line Data



FieldCore

DATA and WORK LOG

35MW Heat Soak – Base Line Data



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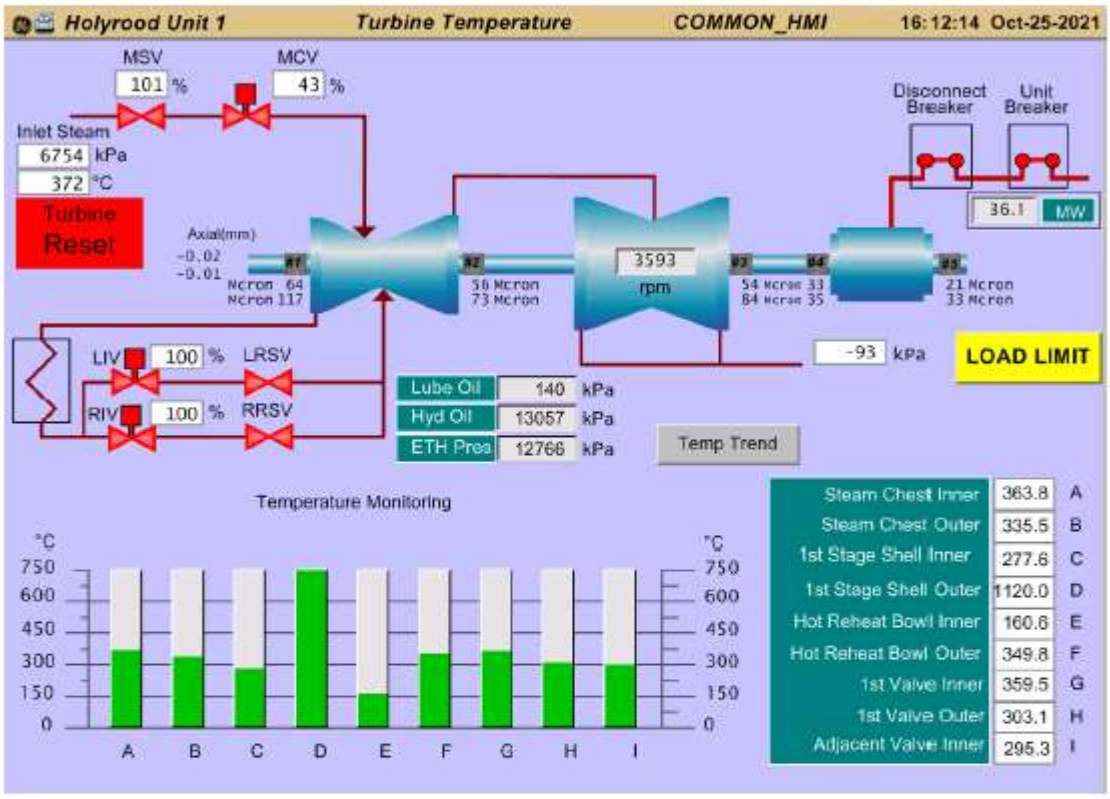
DATA and WORK LOG

35MW Heat Soak – Base Line Data



Appendix D

Drawings

238-10-6022-008;

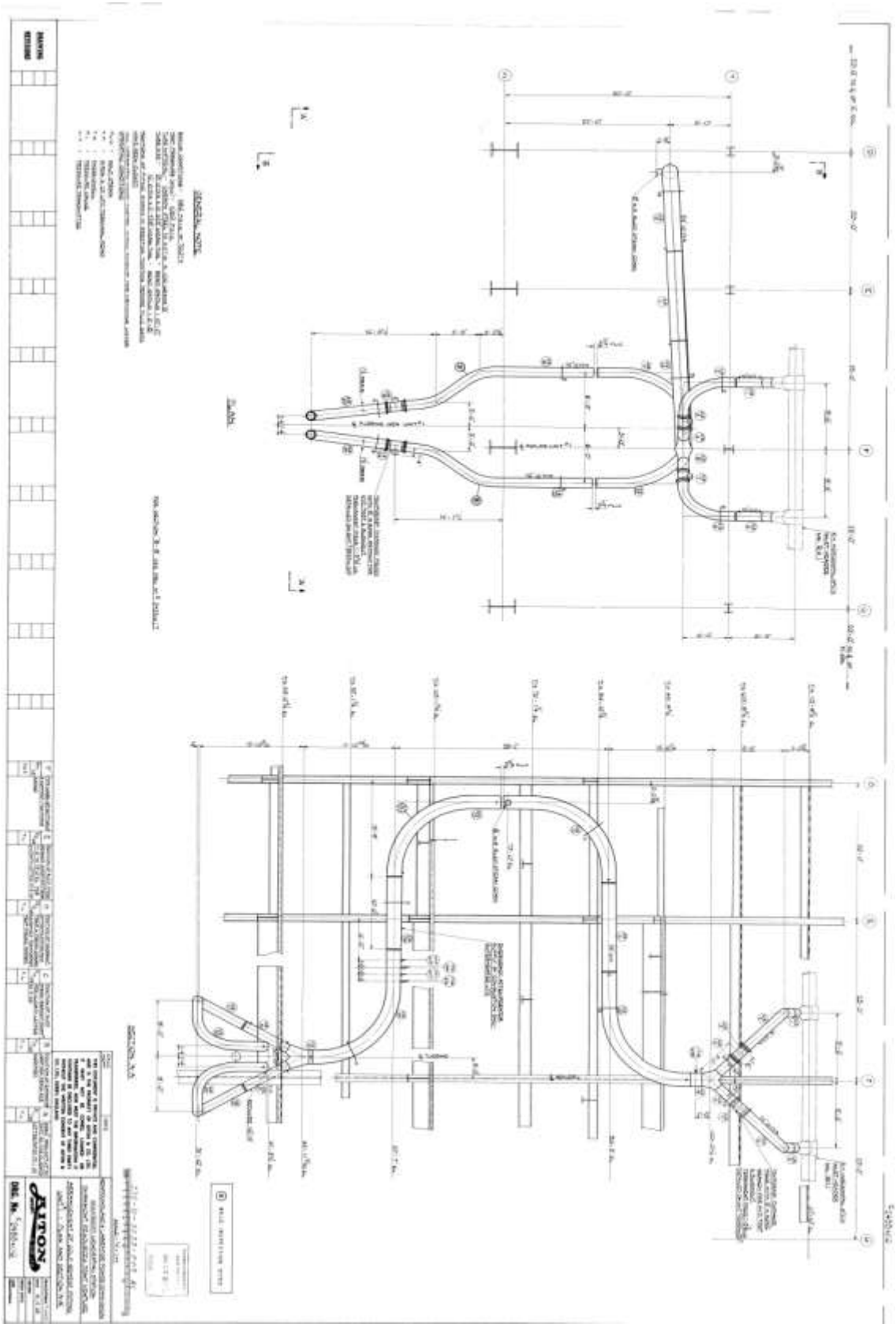
238-10-6022-009;

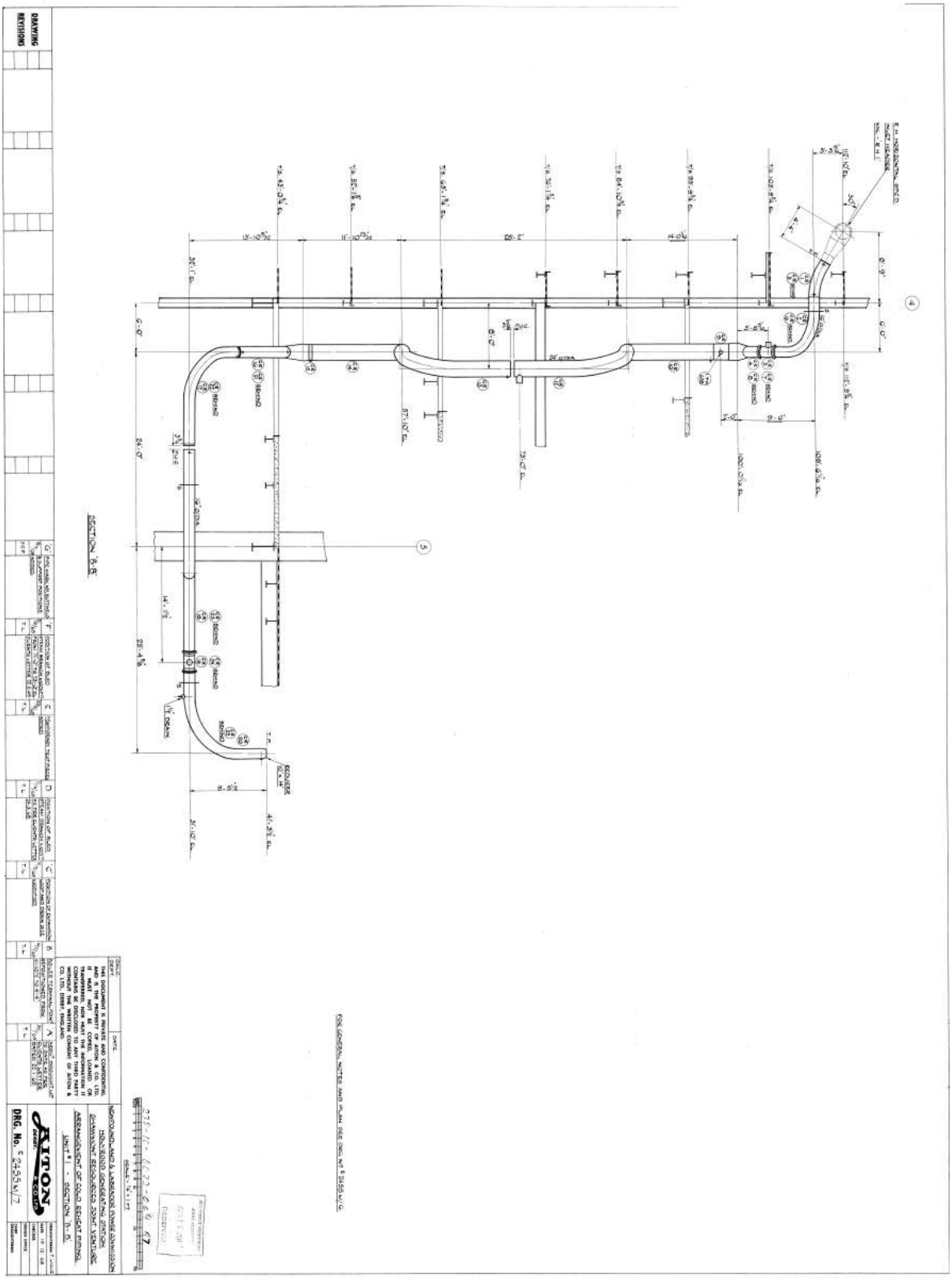
238-10-0210-002;

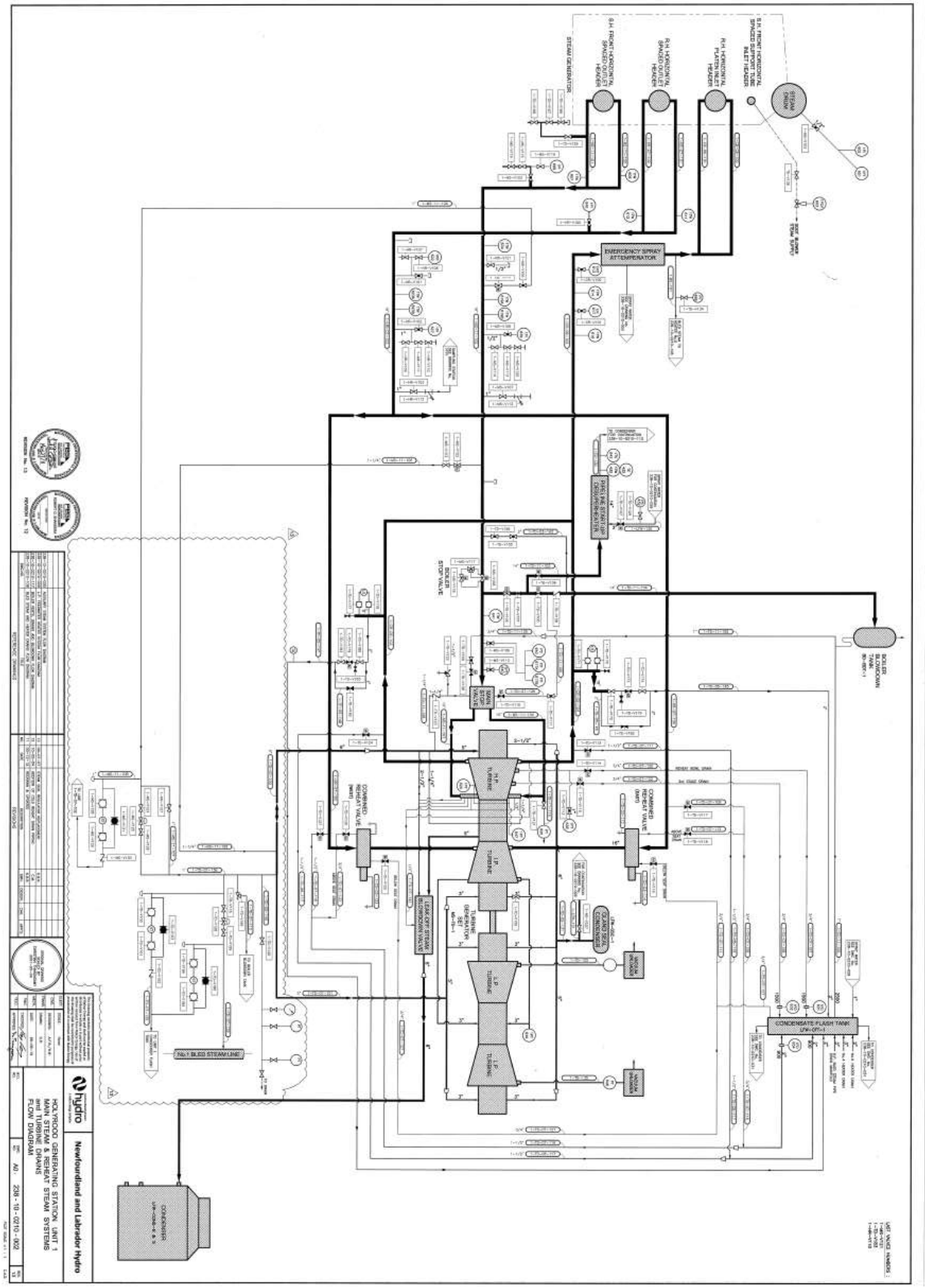
238-10-0210-003; and

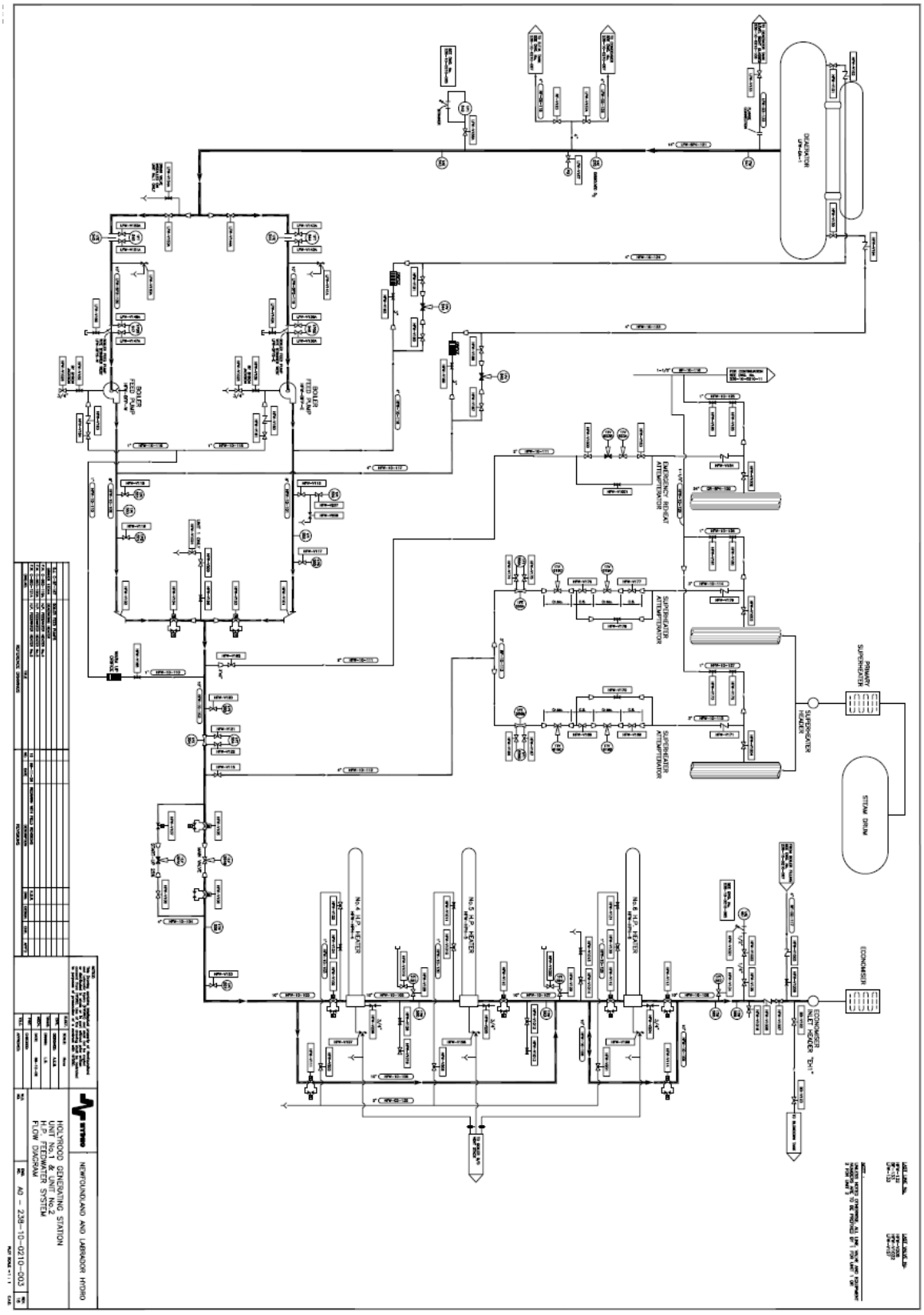
238-10-0210-106

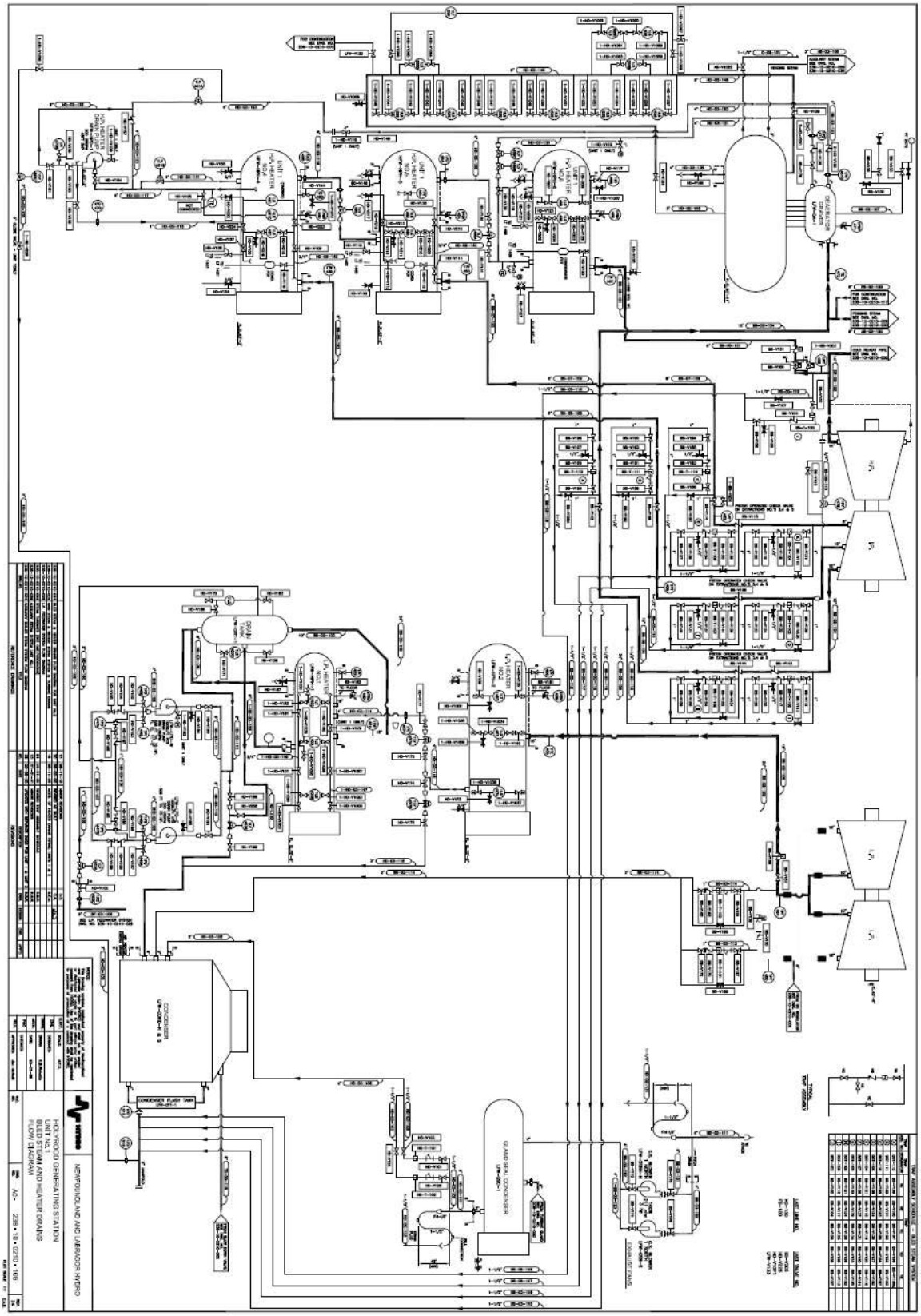
newfoundland labrador hydro




DRAWING REVISIONS
SECTION B-B
ARRANGEMENT OF SOLID SECRET PIPING
UNIT #1 - SECTION B-B
DRG. No. E-2455 M/7


EMERGENCY SPRAY ATTEMPERATOR
CONDENSATE FLASH TANK
No.1 BLDG STEAM LINE
CONDENSER
Newfoundland and Labrador Hydro
HOLYROOD GENERATING STATION UNIT 1
MAIN STEAM & REHEAT STEAM SYSTEMS
FLOW DIAGRAM


HOLYROOD GENERATING STATION
UNIT NO. 2
H.P. FEEDWATER SYSTEM
FLOW DIAGRAM
NEWFOUNDLAND AND LABRADOR HYDRO
DEAERATOR
BOILER FEED PUMP
BOILER FEED PUMP
ATTEMPERATOR
ATTEMPERATOR
ATTEMPERATOR
SUPERHEATER
REHEATER
STEAM DRUM
No.4 H.P. HEATER
No.5 H.P. HEATER
No.6 H.P. HEATER
ECONOMISER
ECONOMISER INLET HEADER


HOLYROOD GENERATING STATION
UNIT No. 1
BLEED STEAM AND HEATER DRAINS
FLOW DIAGRAM
NEWFOUNDLAND AND LABRADOR HYDRO

Appendix E

GE Inspection Report

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 1/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

SITE INSPECTION

REPORT

On the 25th of October at 23:07 an event occurred on Unit #1 that caused a shock wave to propagate through the cold reheat piping which caused hanger CR14 to fail and impacted adjacent piping systems and structural steel. See below pictures and brief description of findings.

PICTURES

Location 1

Hanger CR10(located below the 8th floor) appears to be out of plum, no signs of further damage from the point of access.

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor		Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒	
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒	

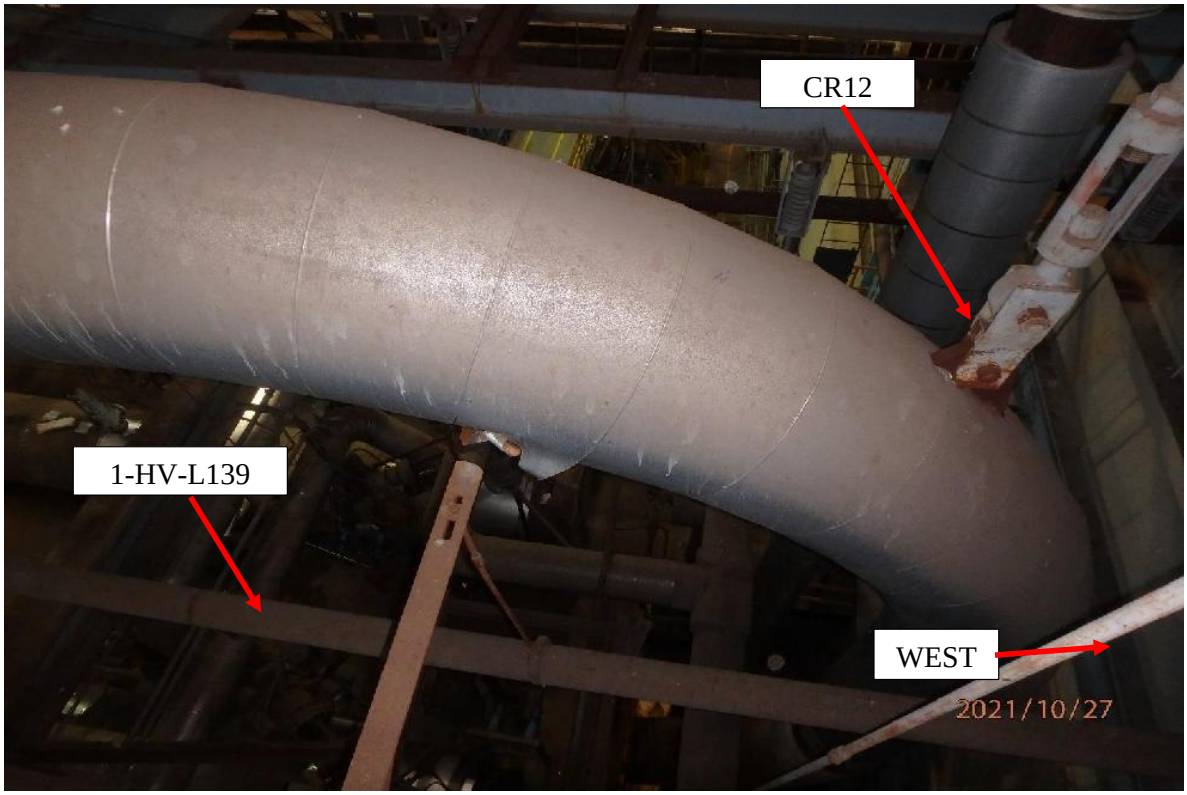
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 2/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 3/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

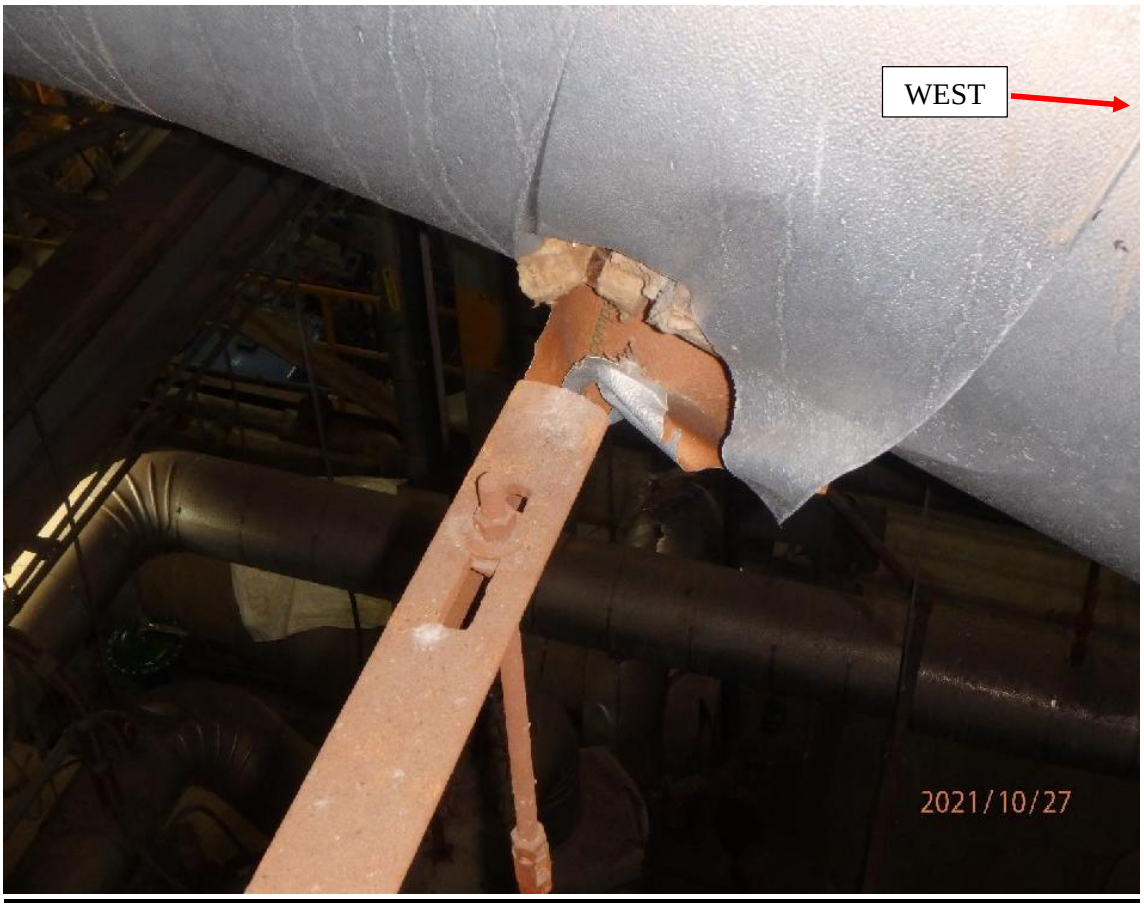
Location 2

CRH pipe contacted pipe hanger support for line # 1-HV-L139 causing damage to insulation. Also, hanger rod noted as being distorted (7th floor at grating level)



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 4/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

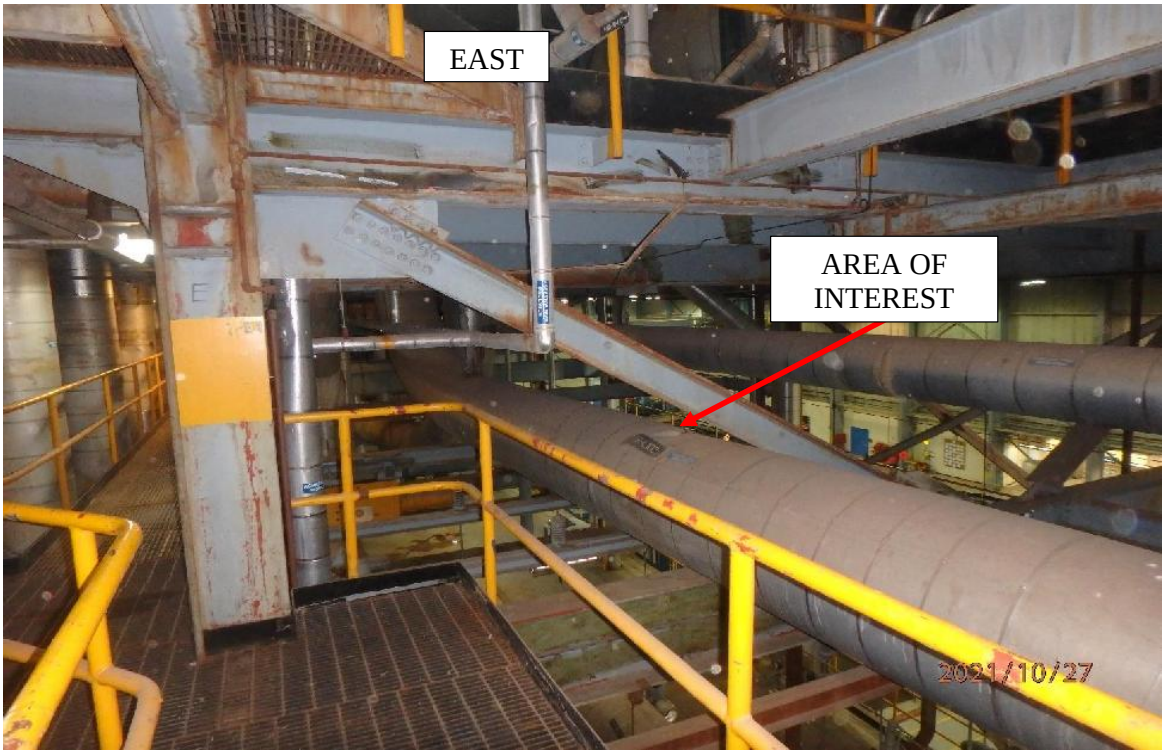


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 5/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Location 3

CRH pipe contacted cross member at column 7-E4 resulting in damage to insulation. No visible sign of damage to cross member from current access.



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

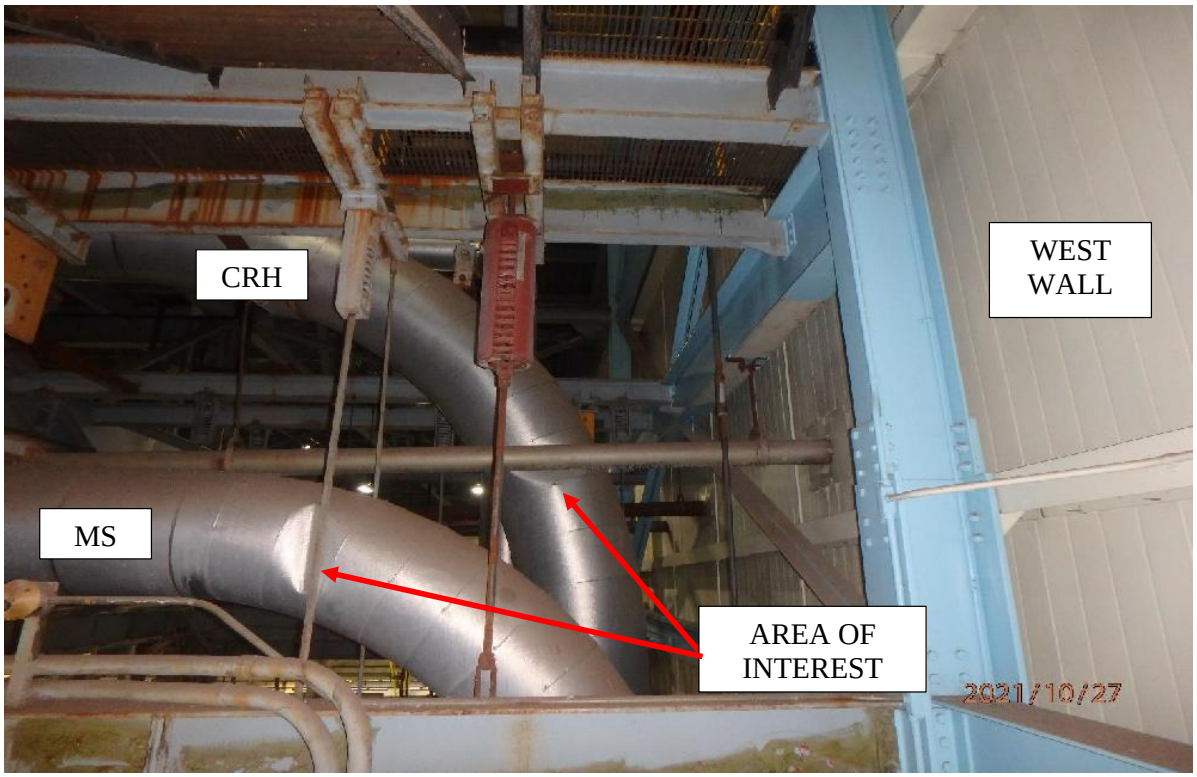
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 6/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 7/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

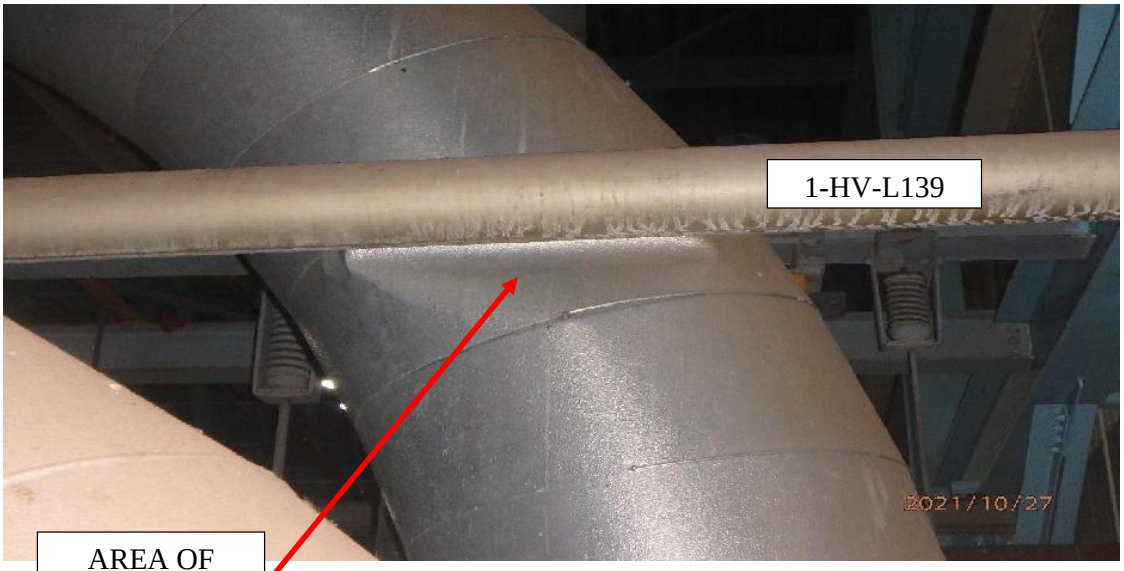
Location 4

CRH Pipe contacted line # 1-HV-L139 between the 6th & 7th floor next to West wall causing damage to insulation. Also, hanger rod for #6 HP Heater Bypass piping contacted main steam line, perhaps as a result of cold reheat pipe making contact with #6 HP Heater inlet valve gear box.



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor		Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒	
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒	

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 8/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



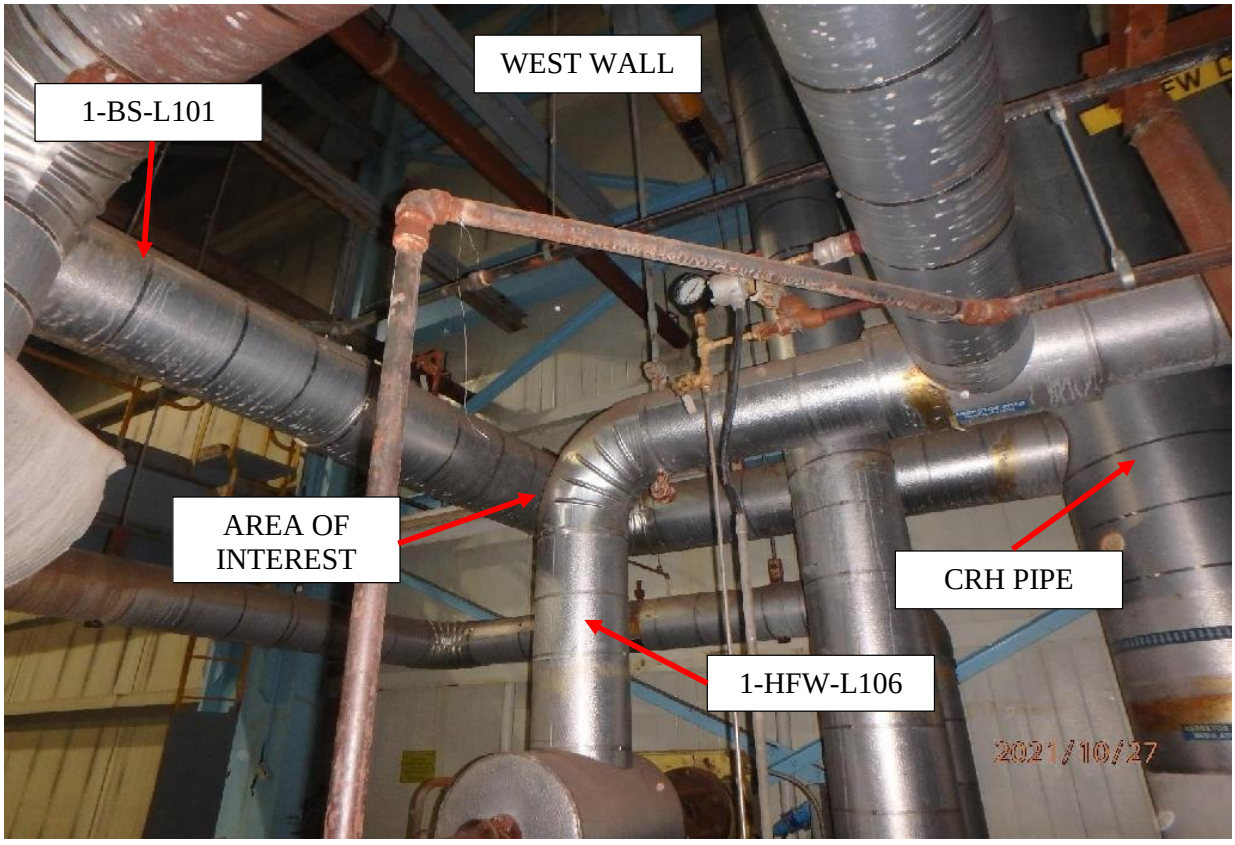
AREA OF INTEREST

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 9/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

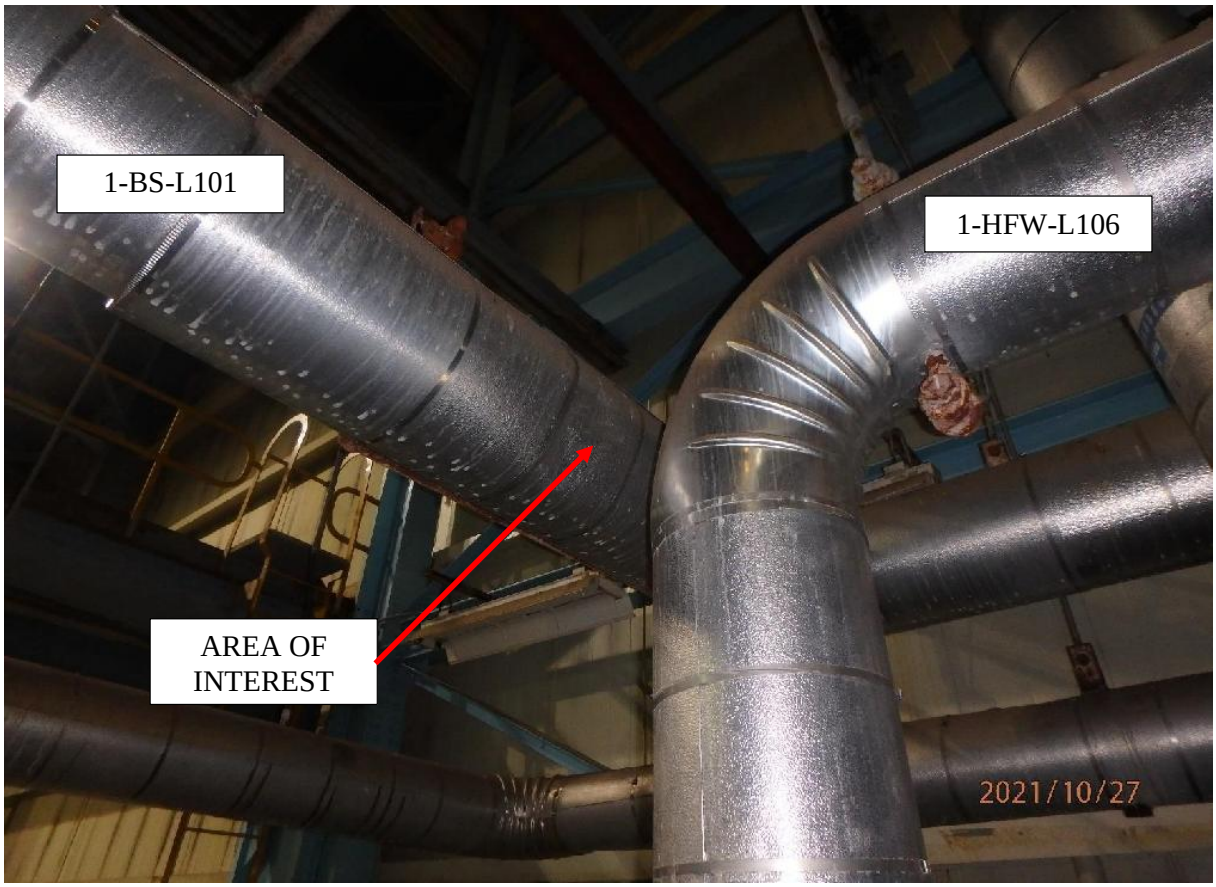
Location 5

Line # 1-BS-L101 contacted line # 1-HFW-L106 resulting in damage to insulation on BS line (5th floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 10/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

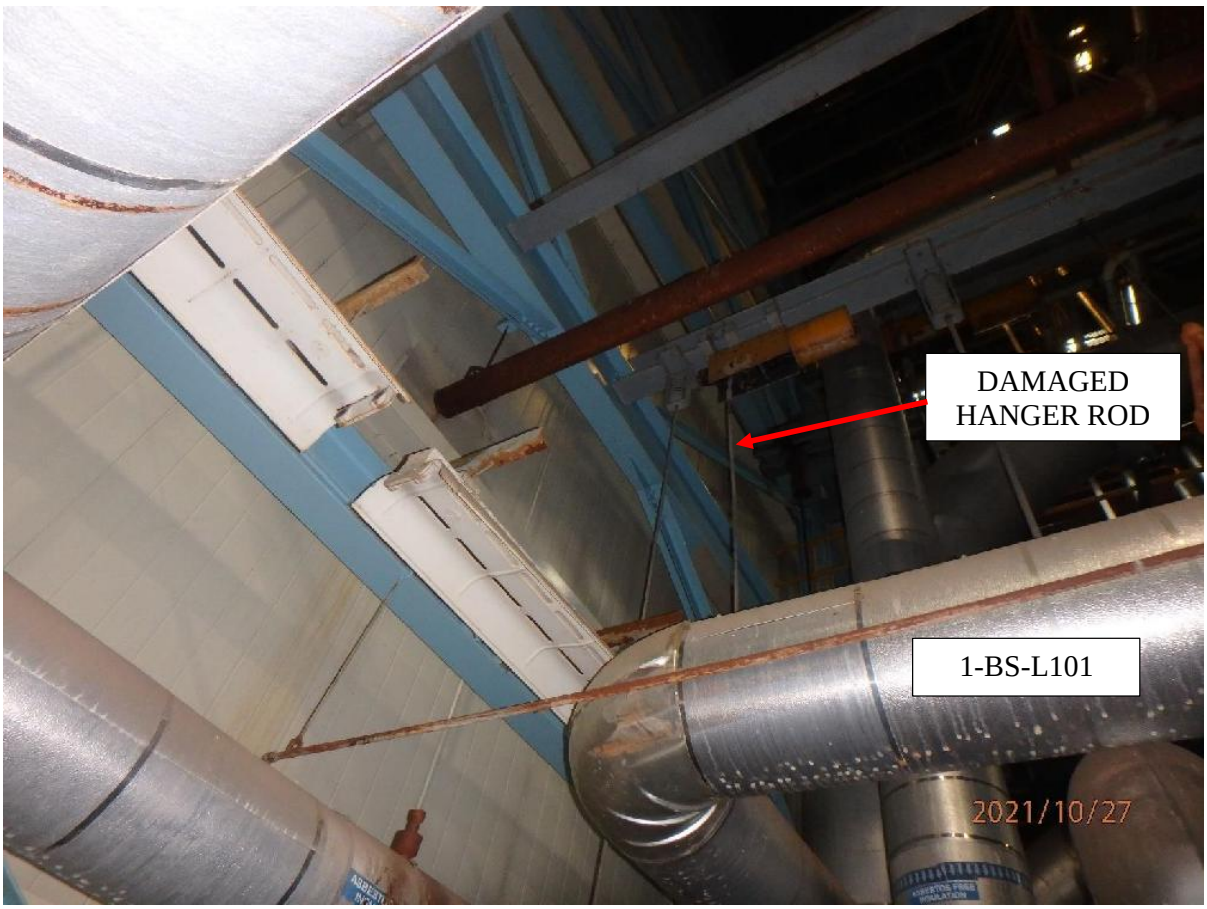


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 11/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

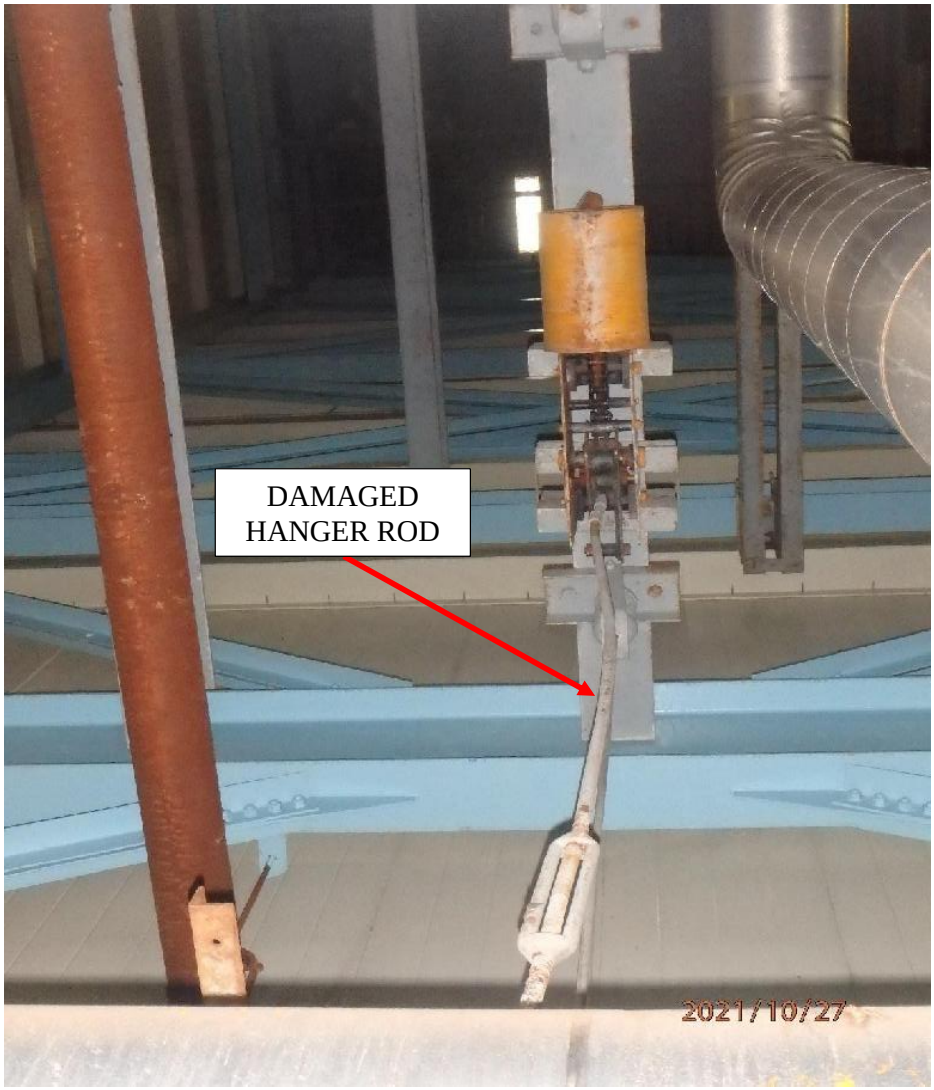
Location 6

Line # 1-BS-101 hanger rod at West wall distorted (5th floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 12/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

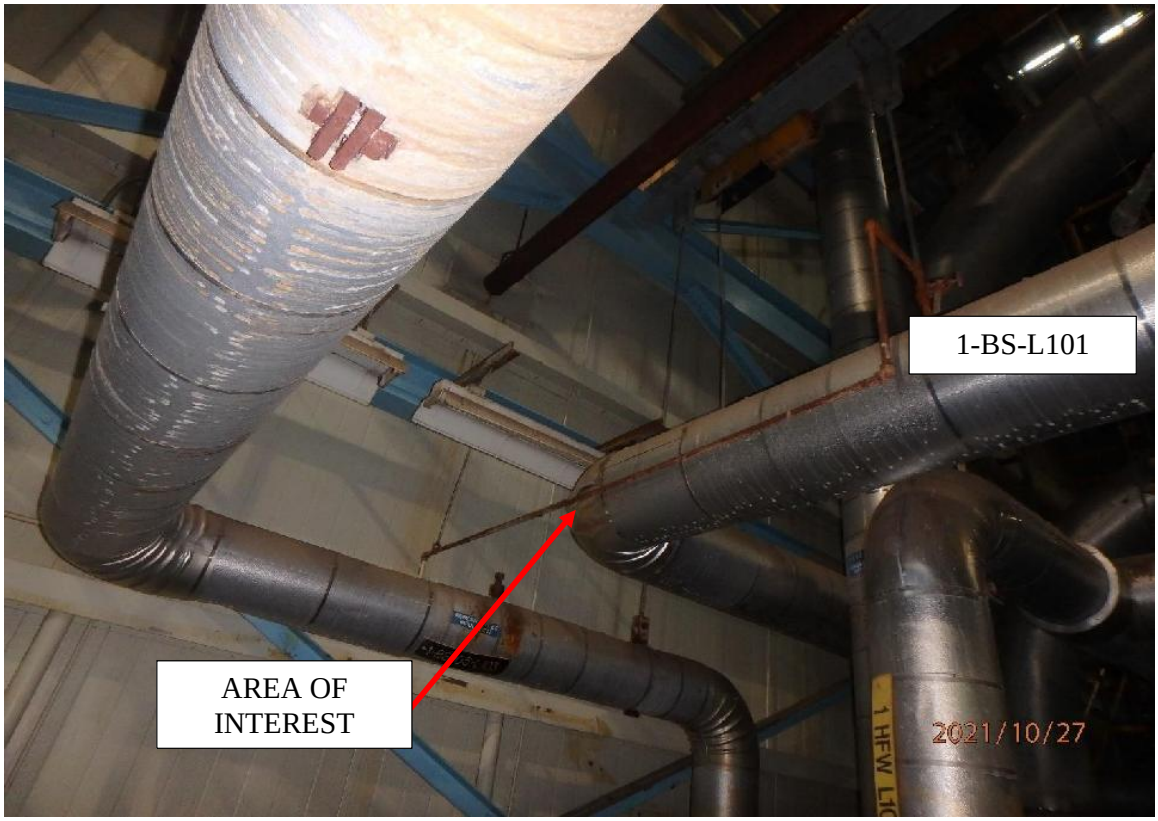
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 13/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 14/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

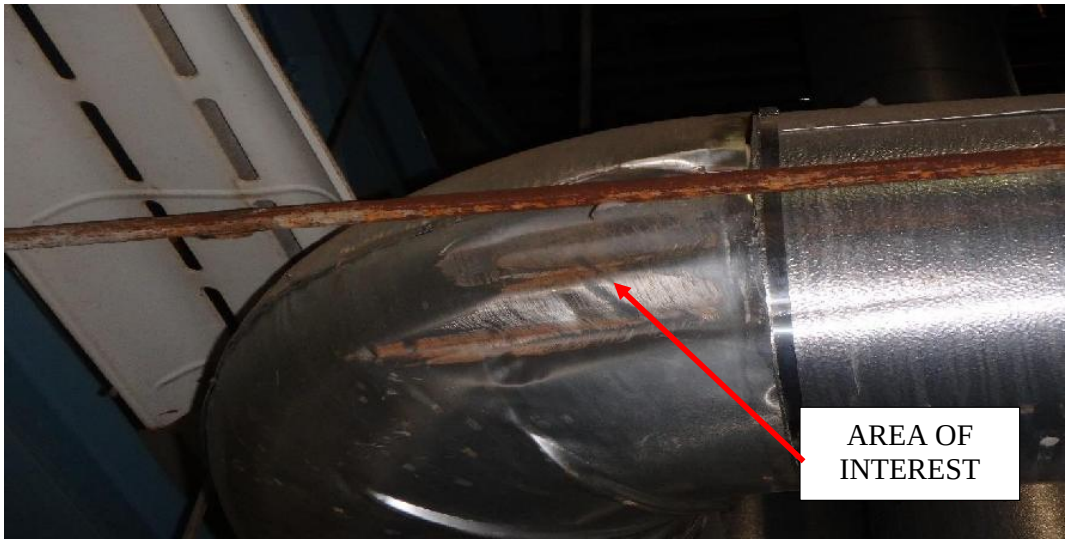
Location 7

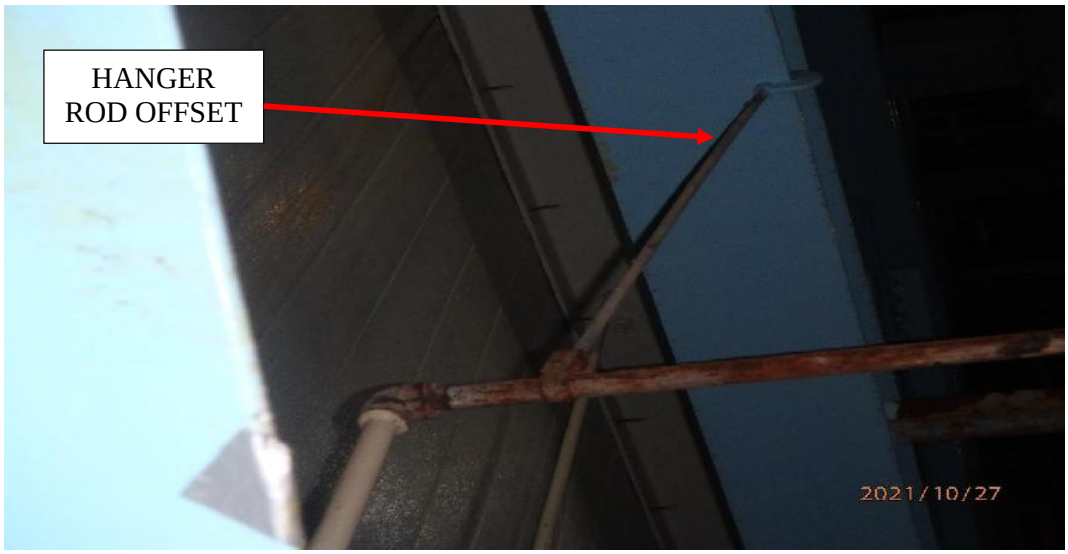
½" line exiting line # 1-BS-L101 and going to transmitter PT 1466 appears to have contacted insulation and shifted the hanger (5th floor)



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 15/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		





Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

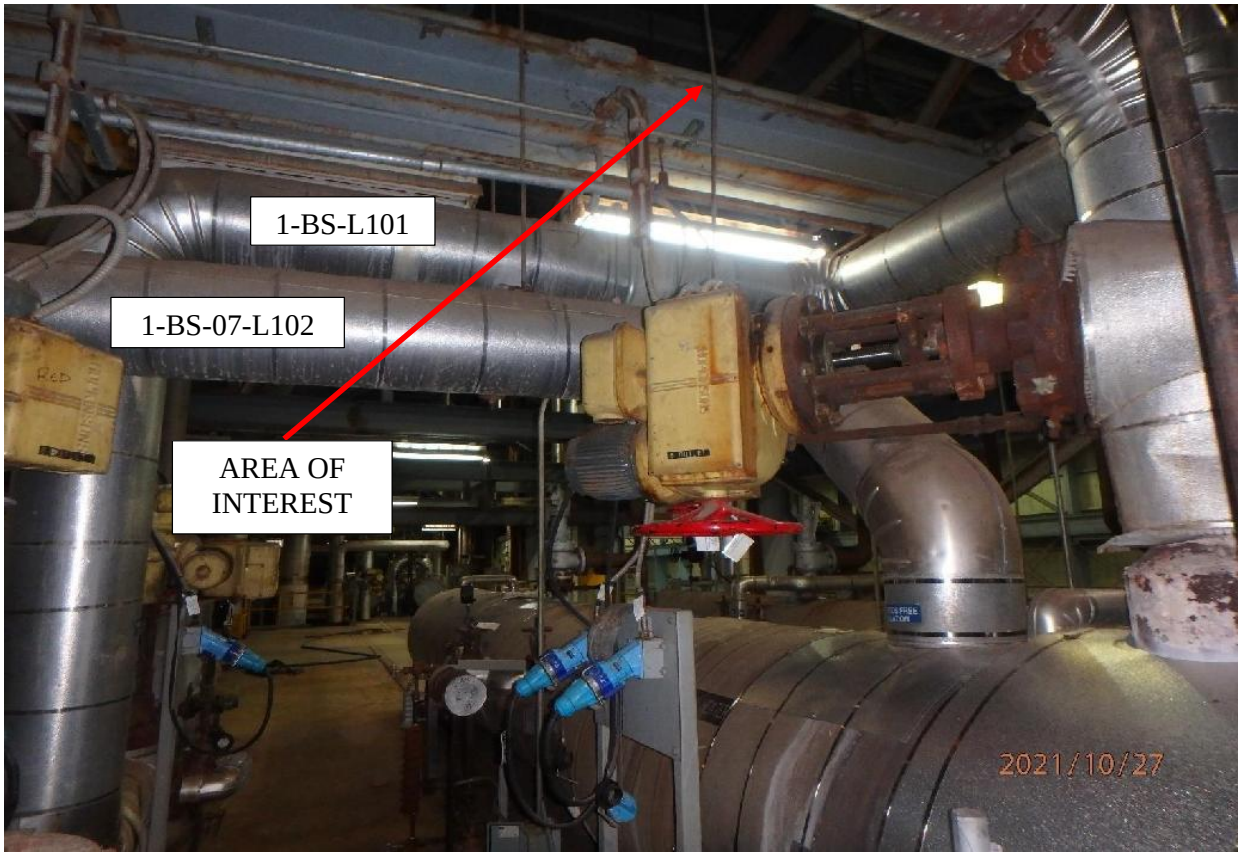
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 16/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 17/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Location 8

Pipe hanger rod for line # 1-BS-07-L102 appears to be distorted above #5 HP Heater (5th floor)



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor		Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒	
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒	

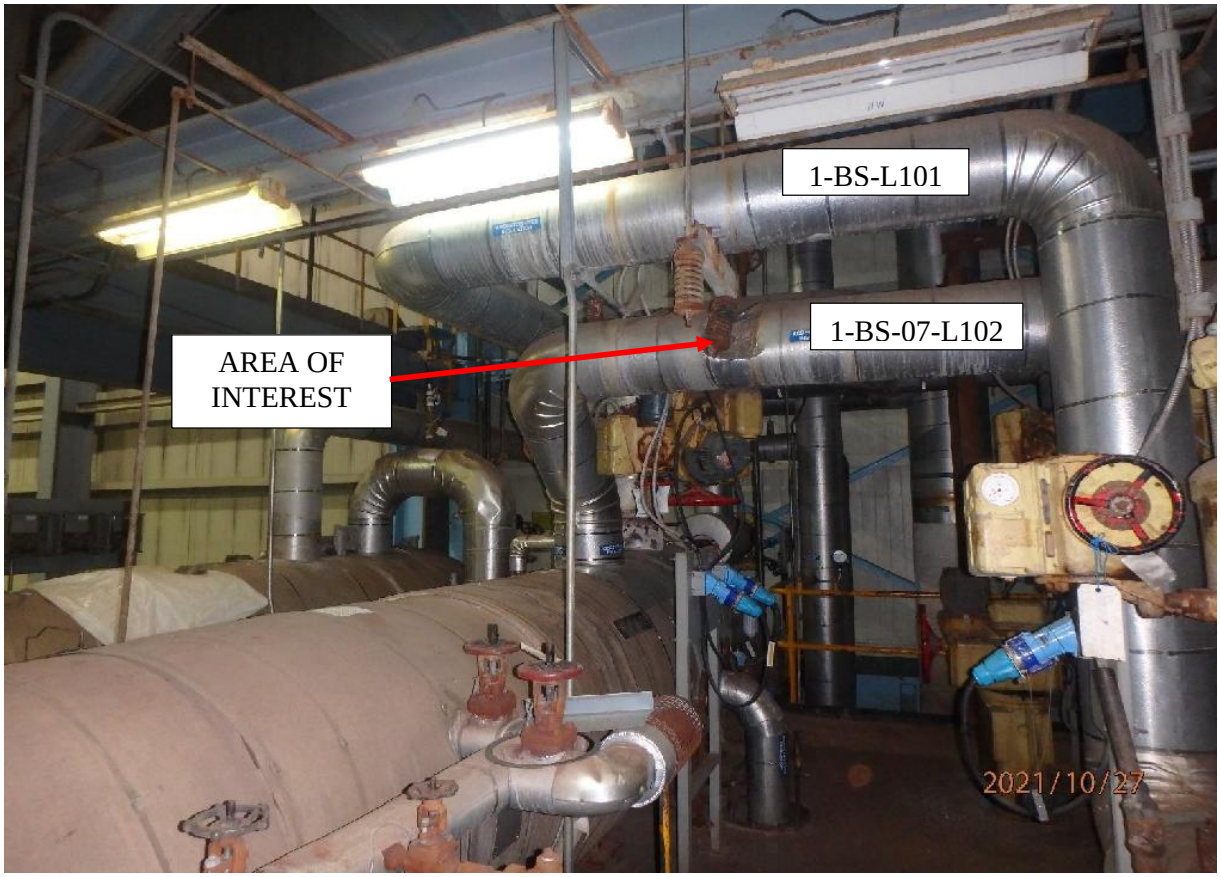
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 18/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 19/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

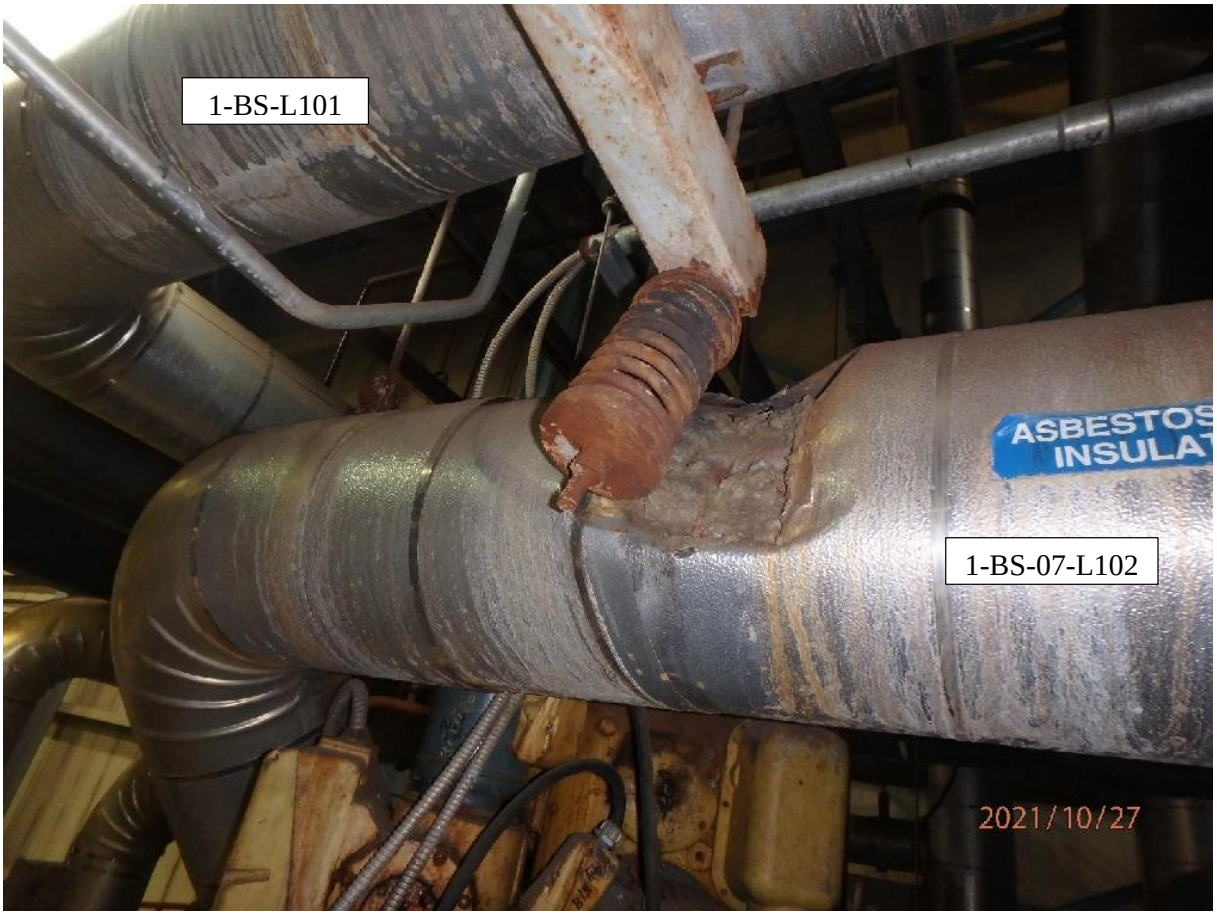
Location 9

Line # 1-BS-07-L102 insulation damaged from being struck by Line # 1-BS-L101 hanger above #5 HP Heater (5th floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 20/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

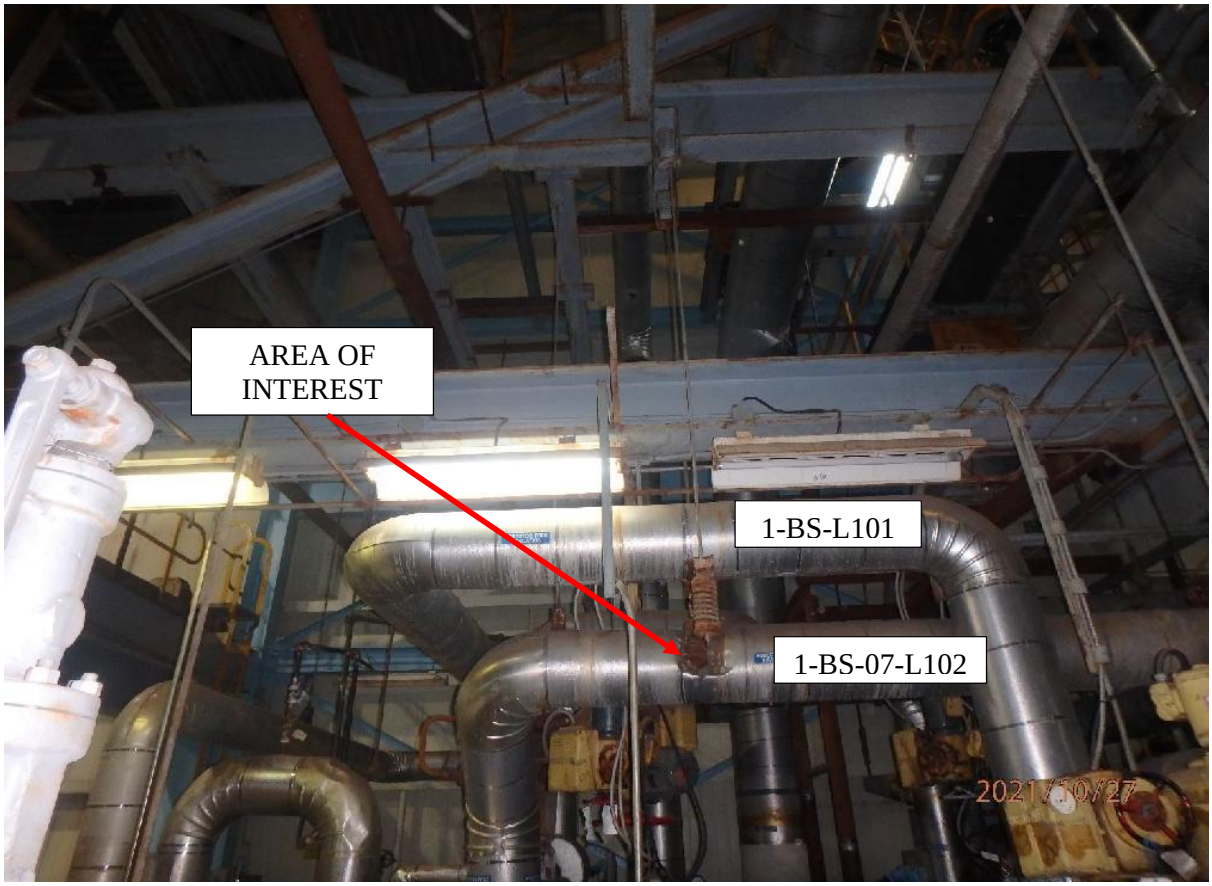


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 21/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

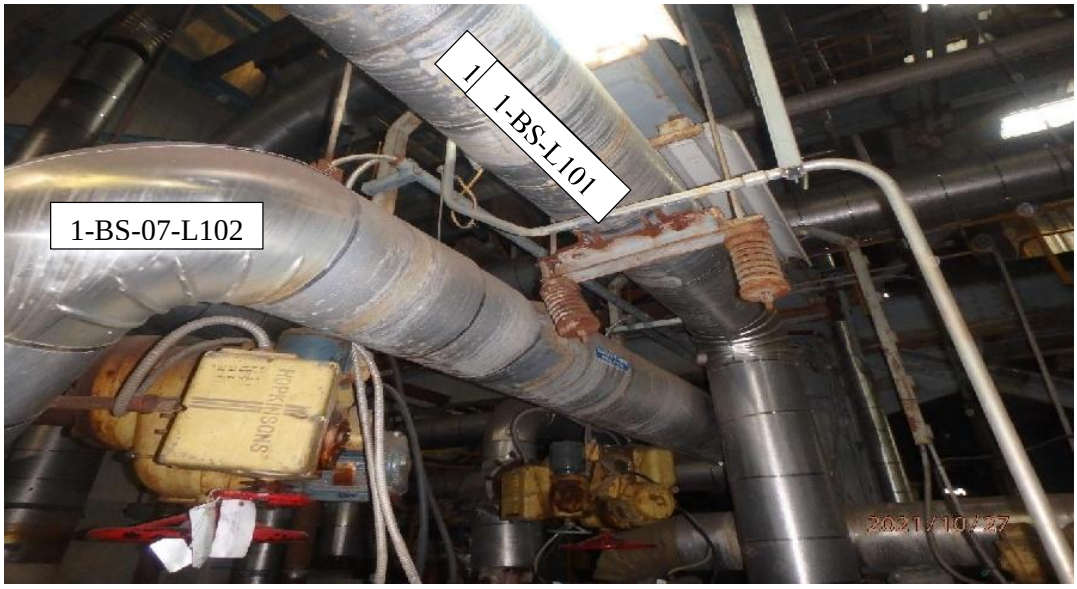
Location 10

Line # 1-BS-L101 hanger damaged from contacting line #1-BS-07-L102 above #5 HP Heater (5th floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 22/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

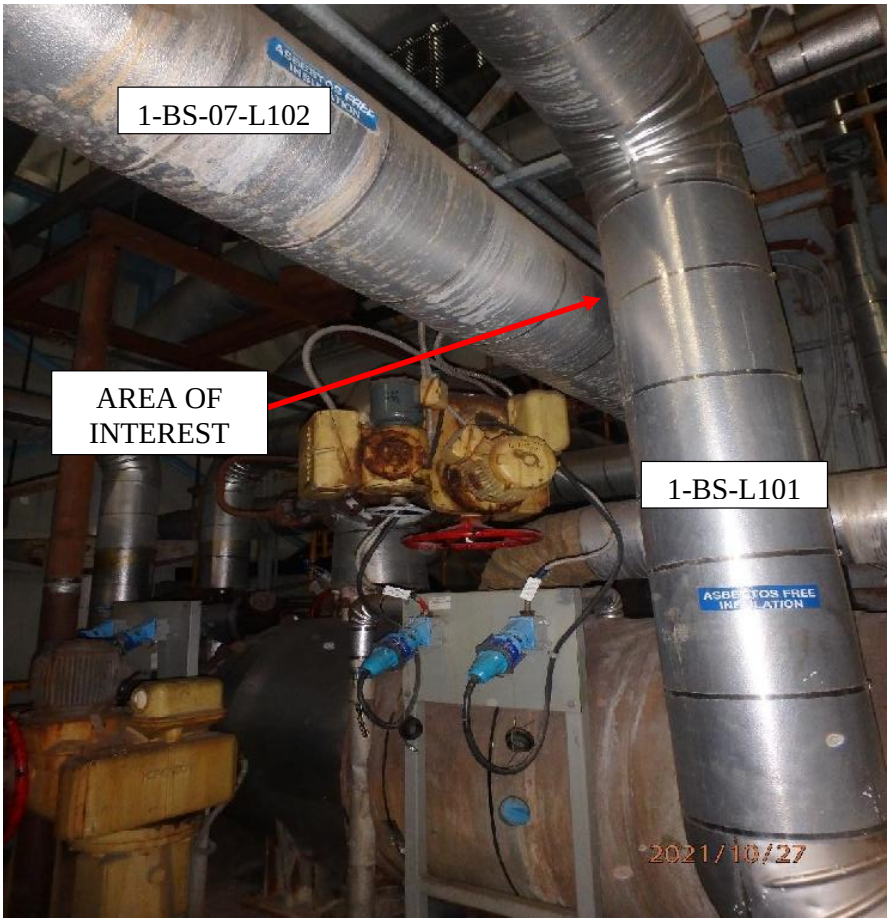
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 23/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 24/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

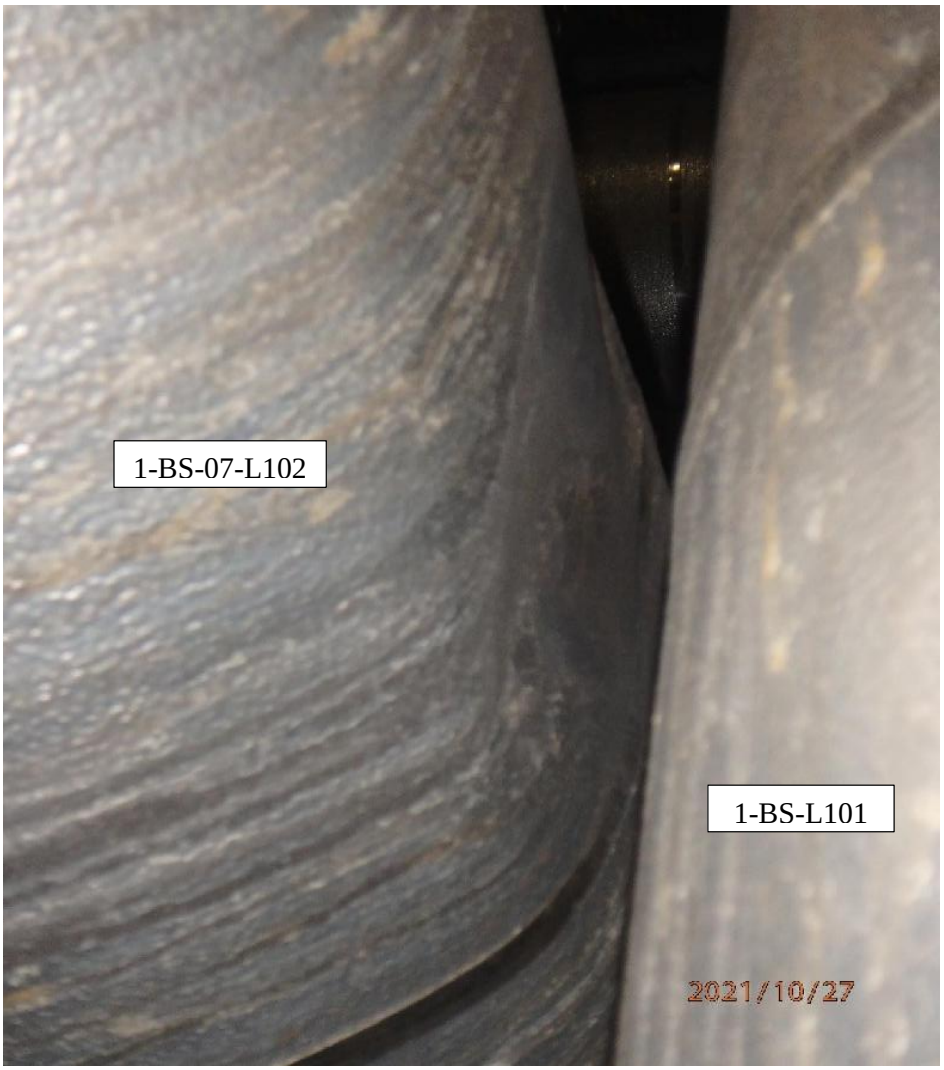
Location 11

Line # 1-BS-L101 contacted line # 1-BS-07-L102 above #6 HP Heater (5th floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 25/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

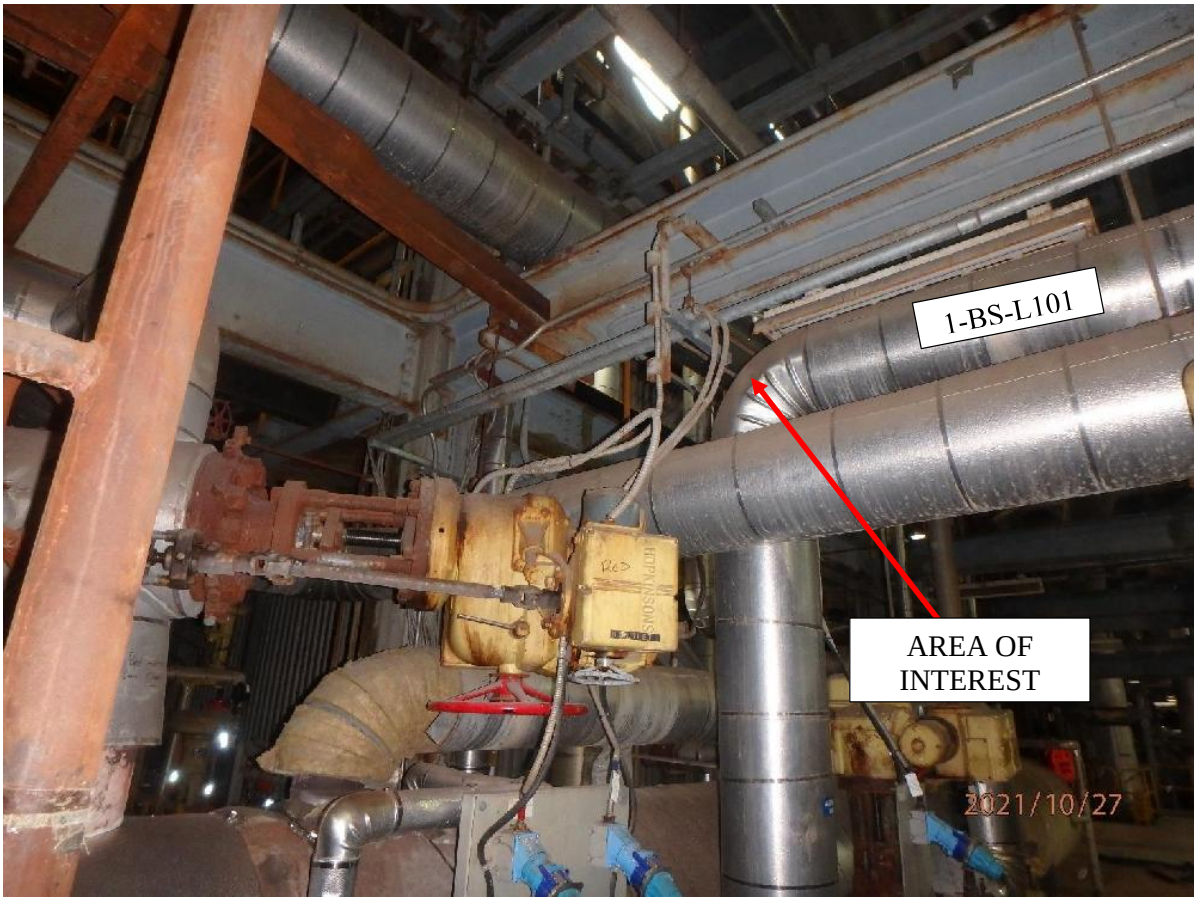


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 26/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

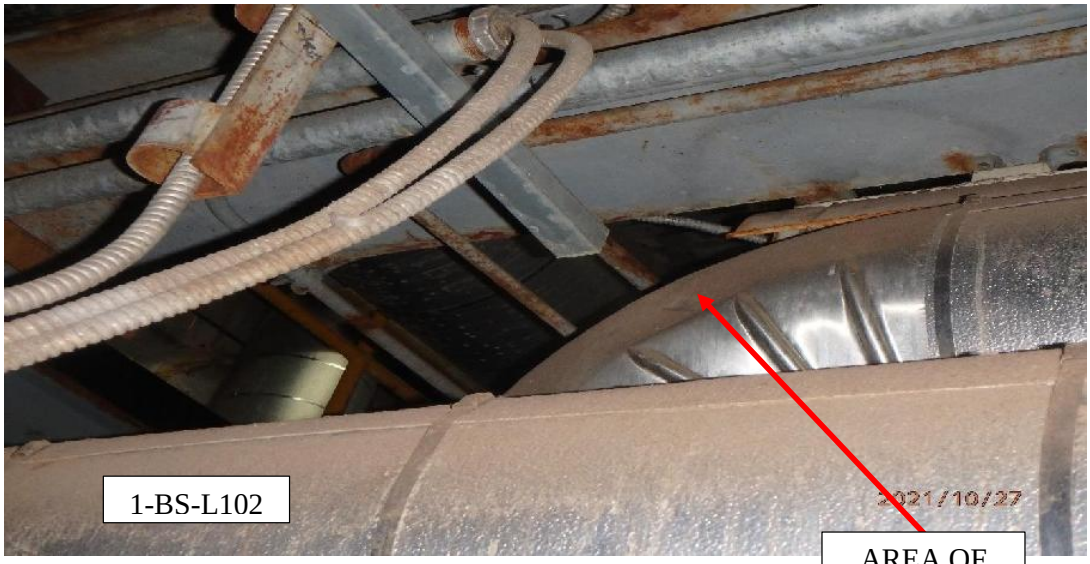
Location 12

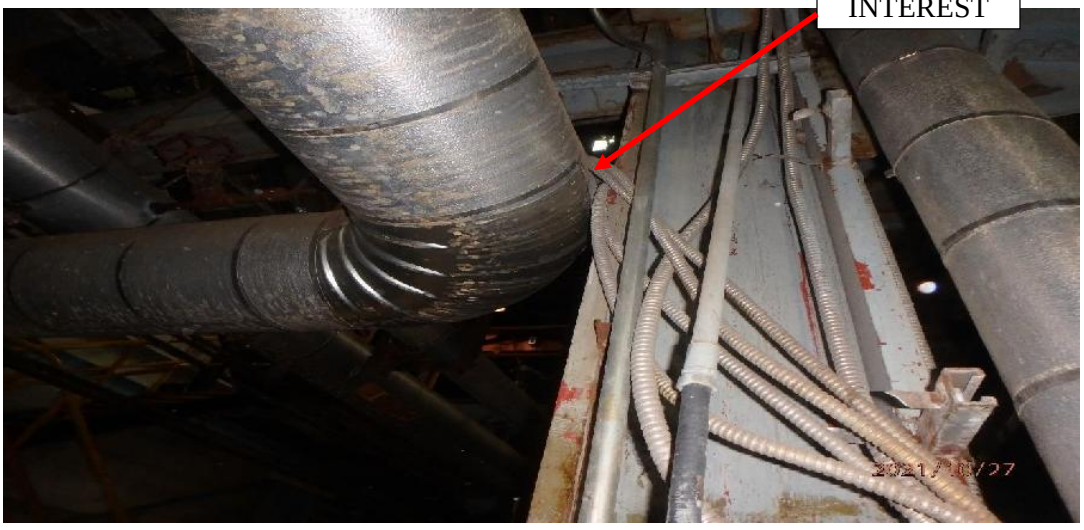
Line # 1-BS-L101 contacted conduit support bracket above #6 HP Heater and electrical cables being pinned between piping and column (5th floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 27/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		





Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 28/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Location 13

Line # 1-BS-L101 valve insulation damaged along side of #6 HP Heater (5th floor).

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

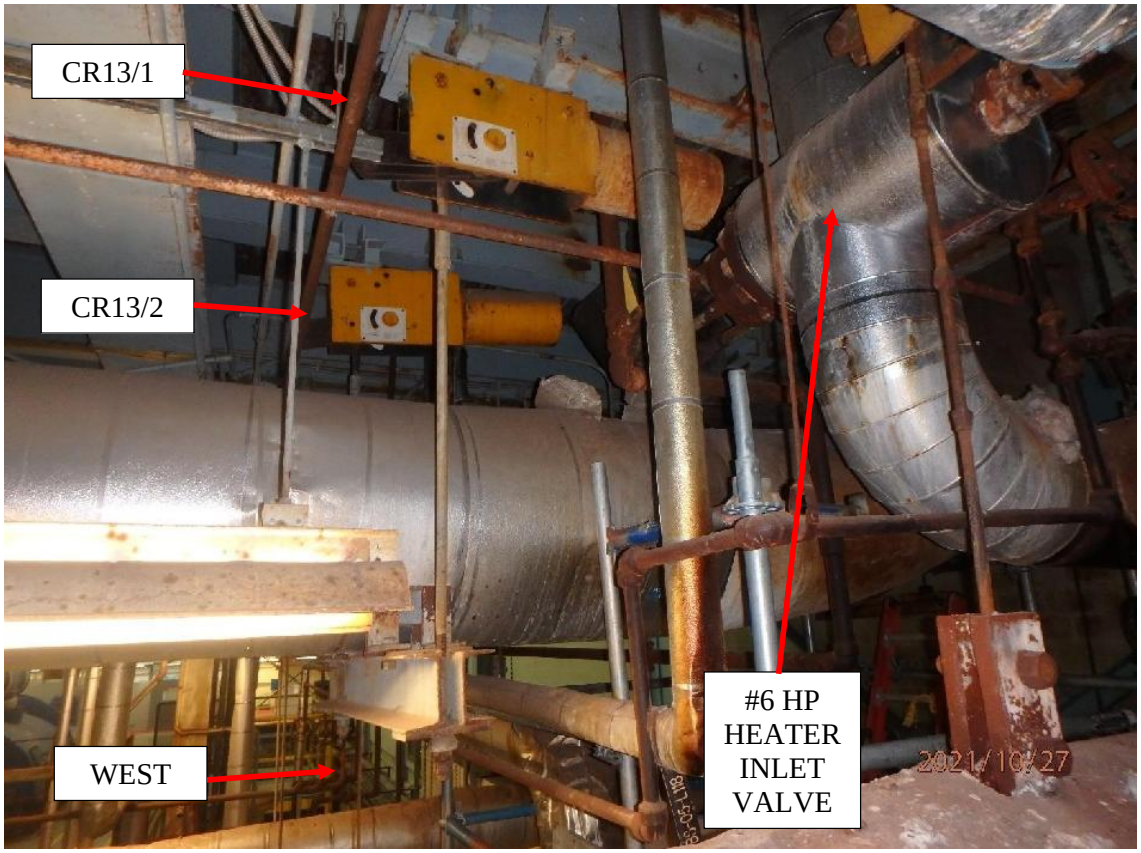
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 29/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 30/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Location 14

CRH Hangers CR13/1 & CR13/2 appear to be distorted, as well I-Beam flange distorted at CR13/2 (4th floor).

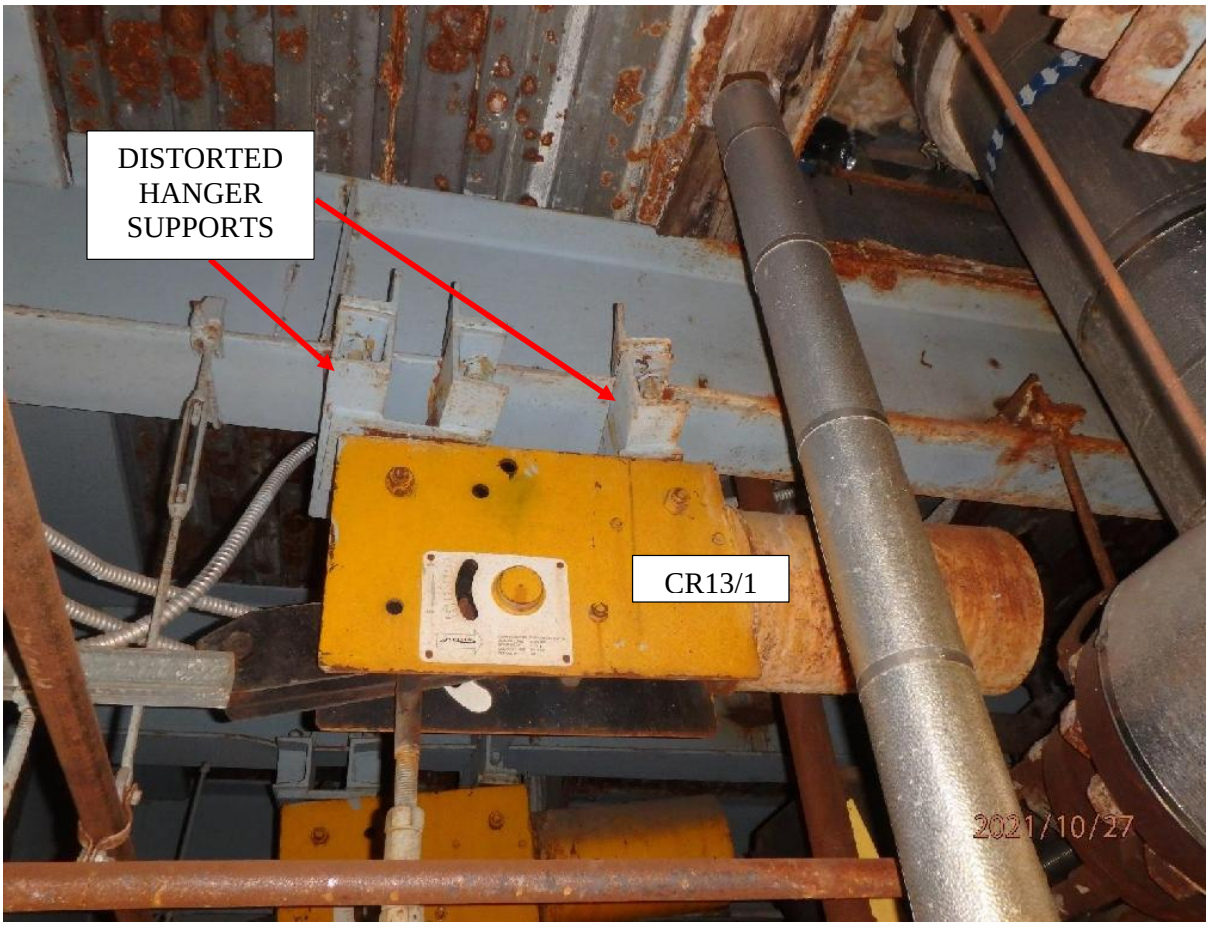


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 31/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

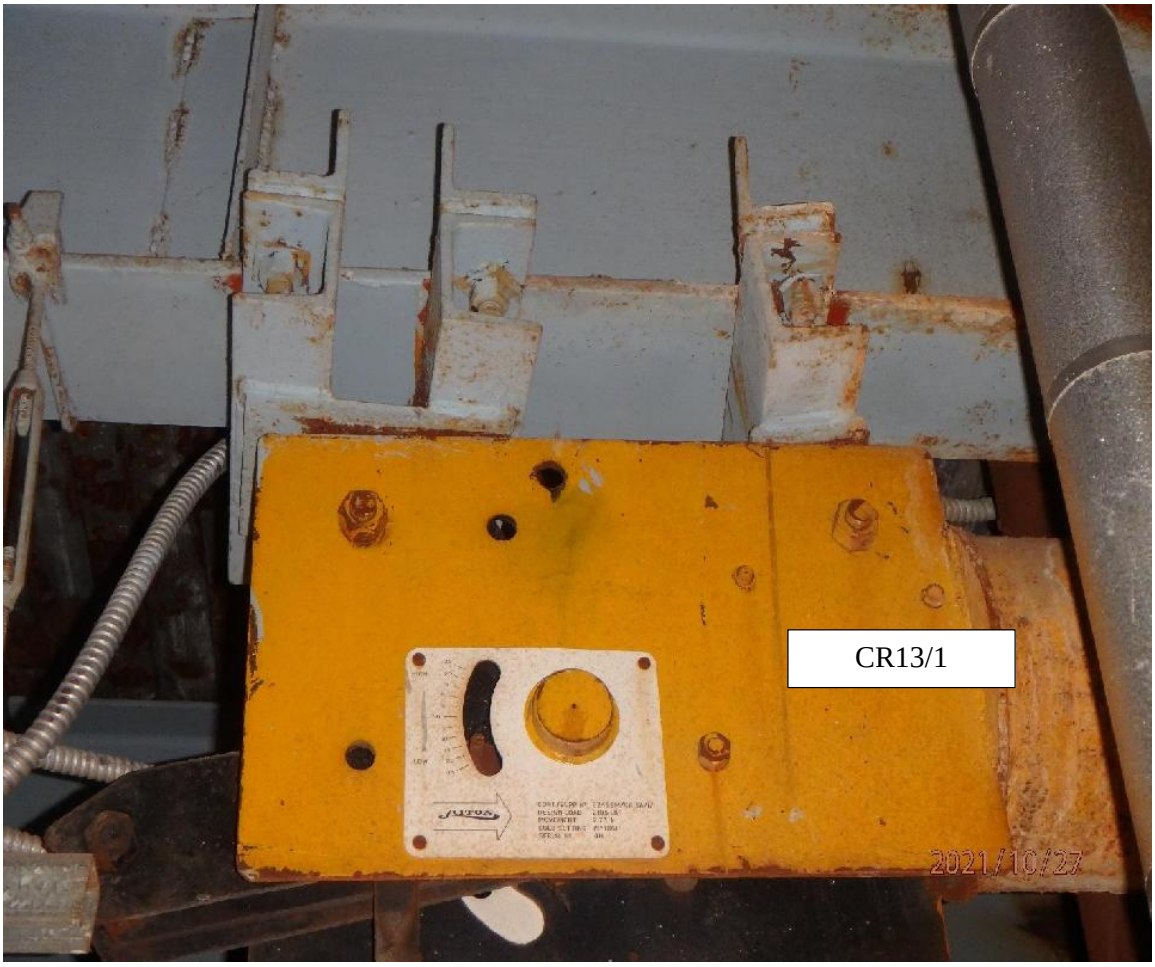
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 32/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 33/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

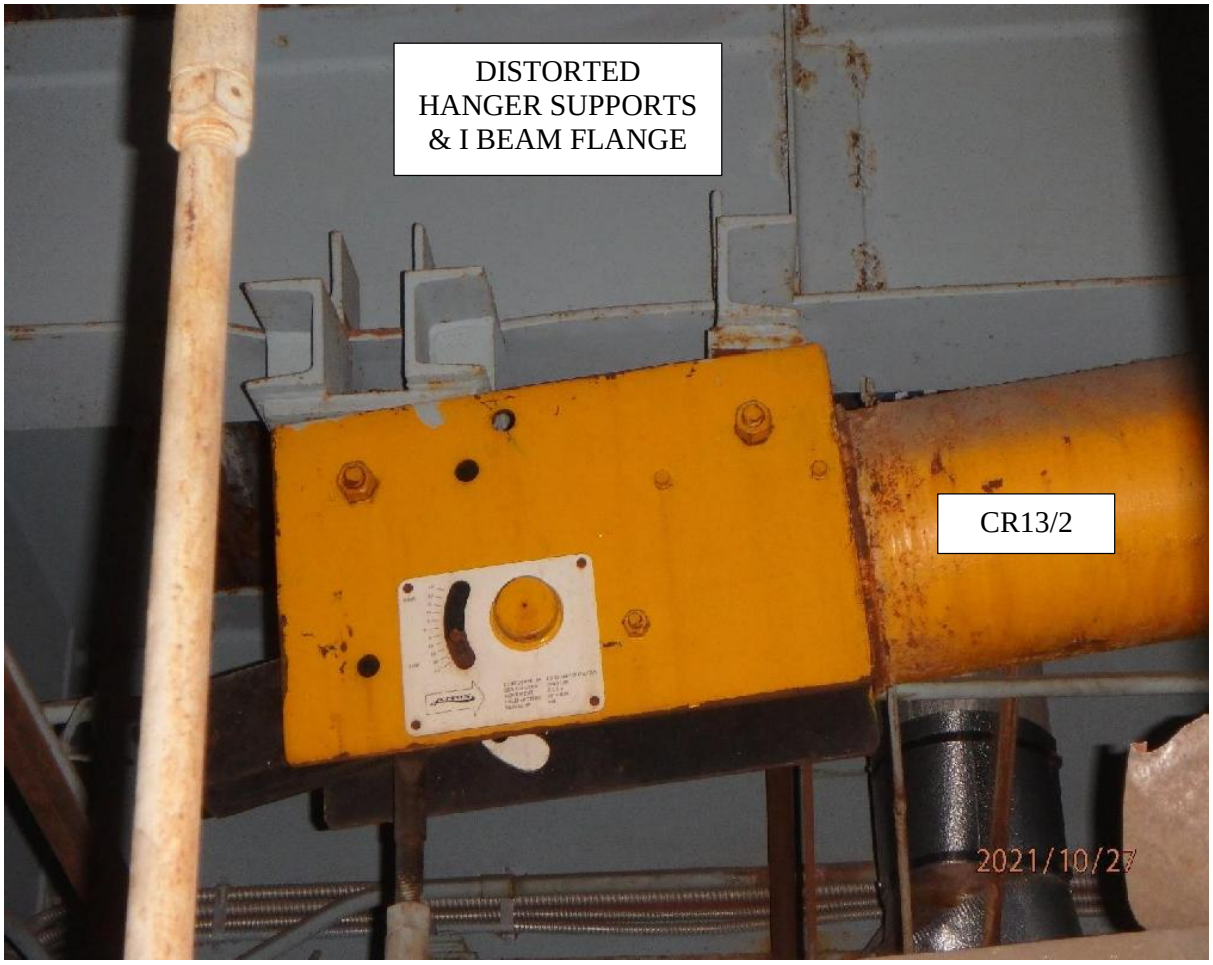


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 34/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

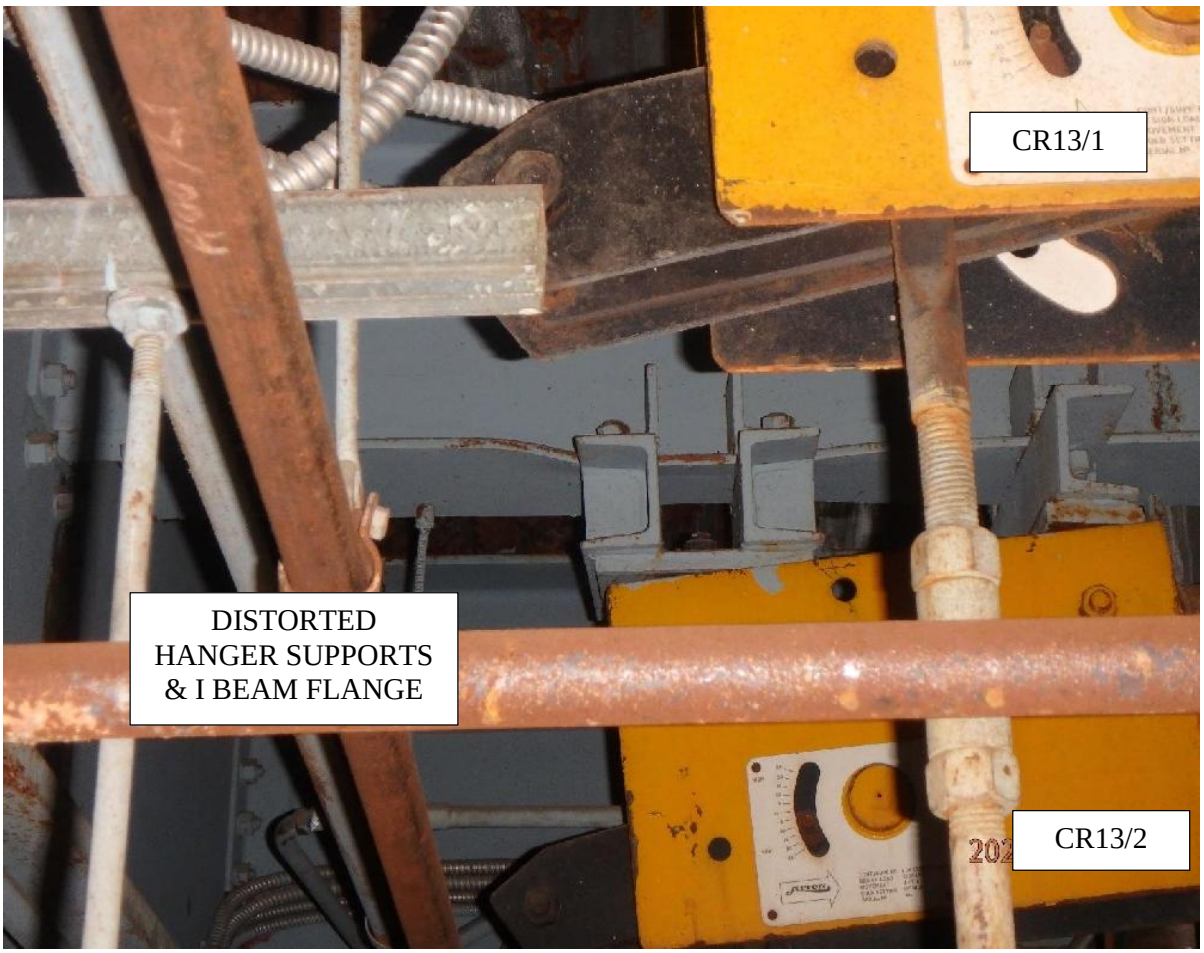
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 35/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 36/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

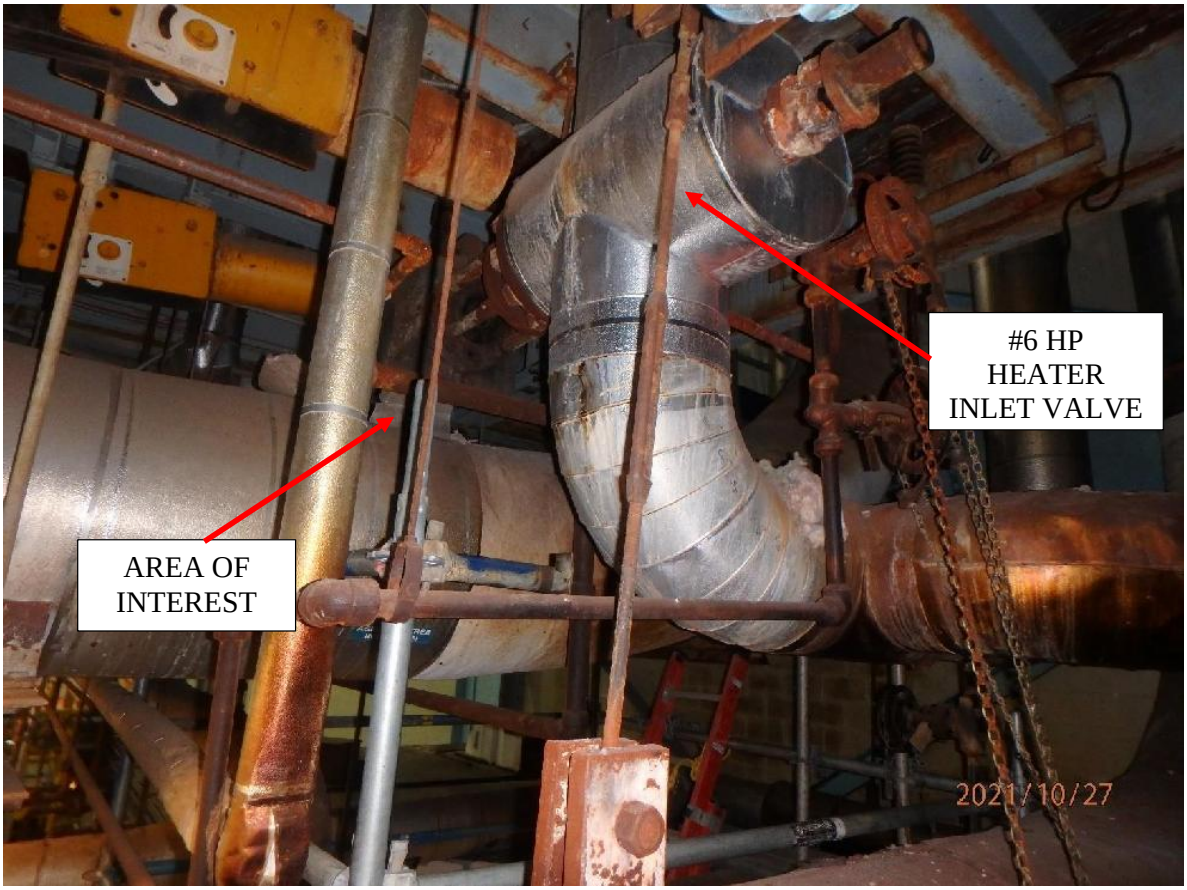


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 37/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Location 15

CRH pipe contacted #6 HP Heater bypass valve gear box resulting in damaged insulation (4th floor).

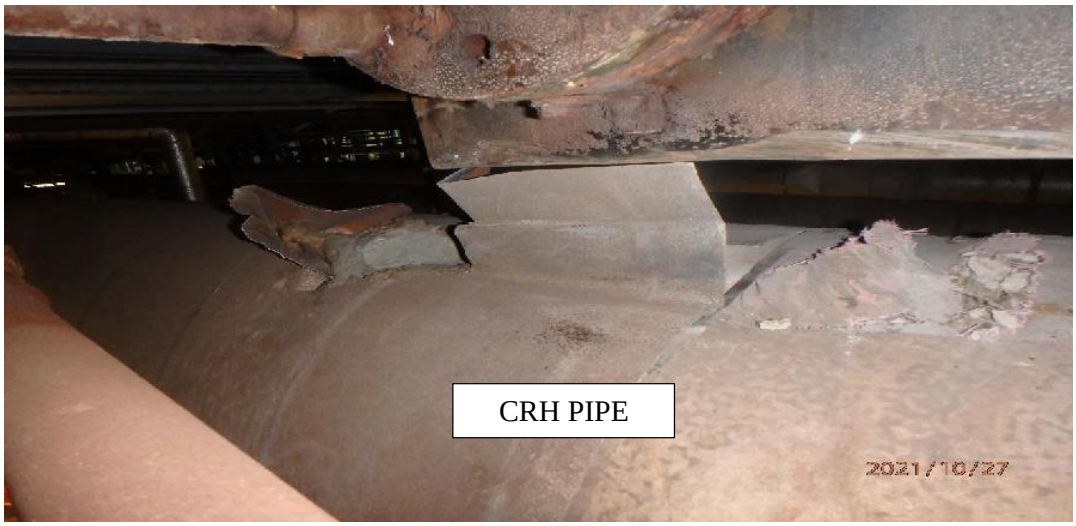


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 38/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 39/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 40/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Location 16

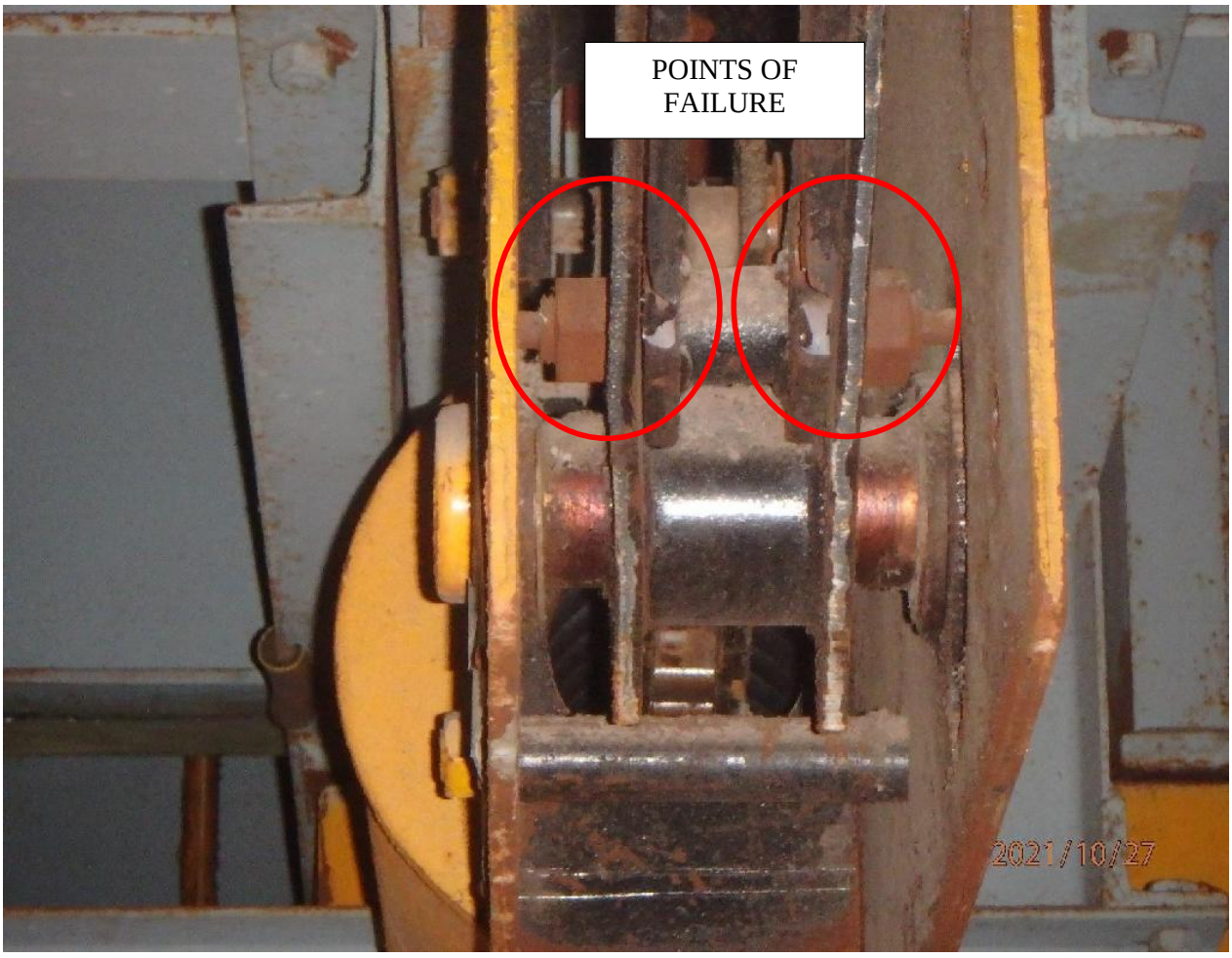
CRH Hanger CR14 failure (4th floor).

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 41/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 42/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 43/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 44/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 45/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

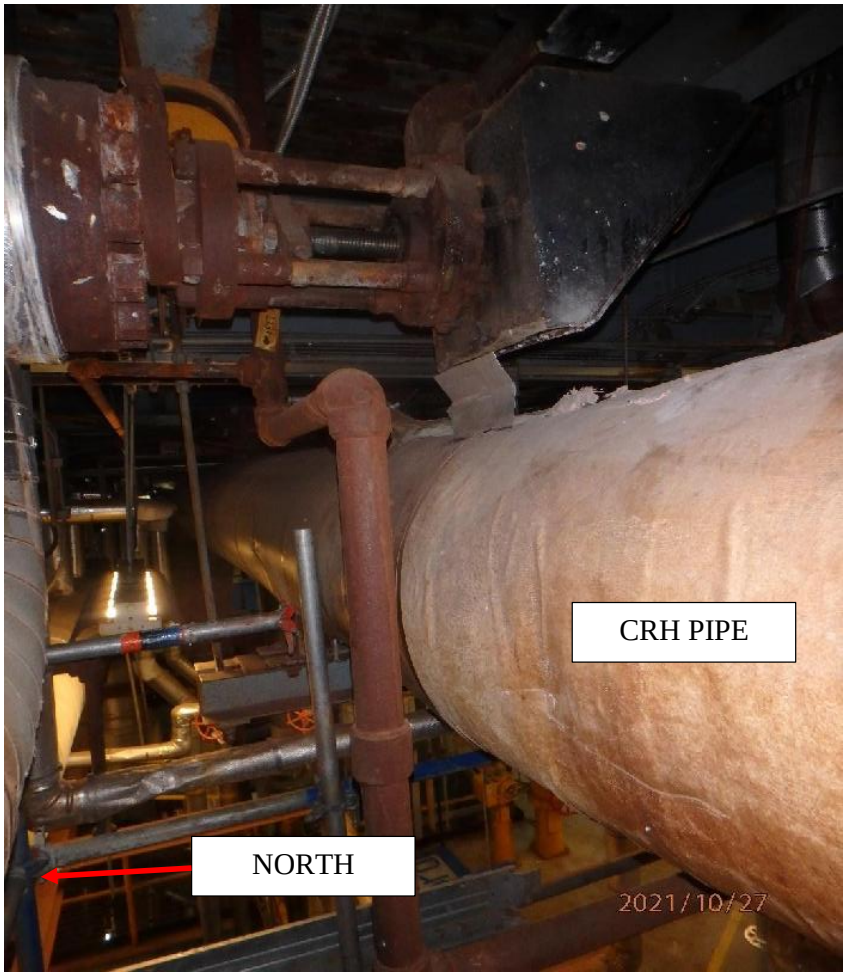
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 46/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 47/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

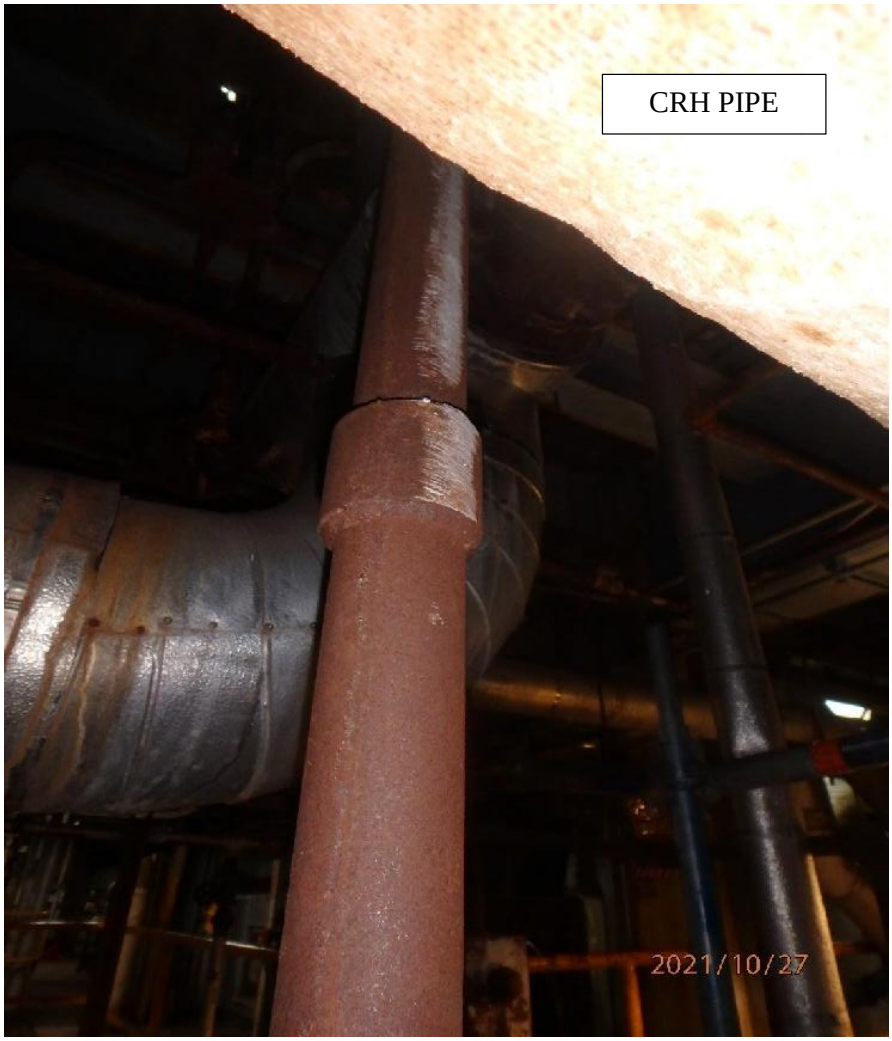
Location 17

CRH pipe contacted line # 1-HV-L125 (4th floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 48/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

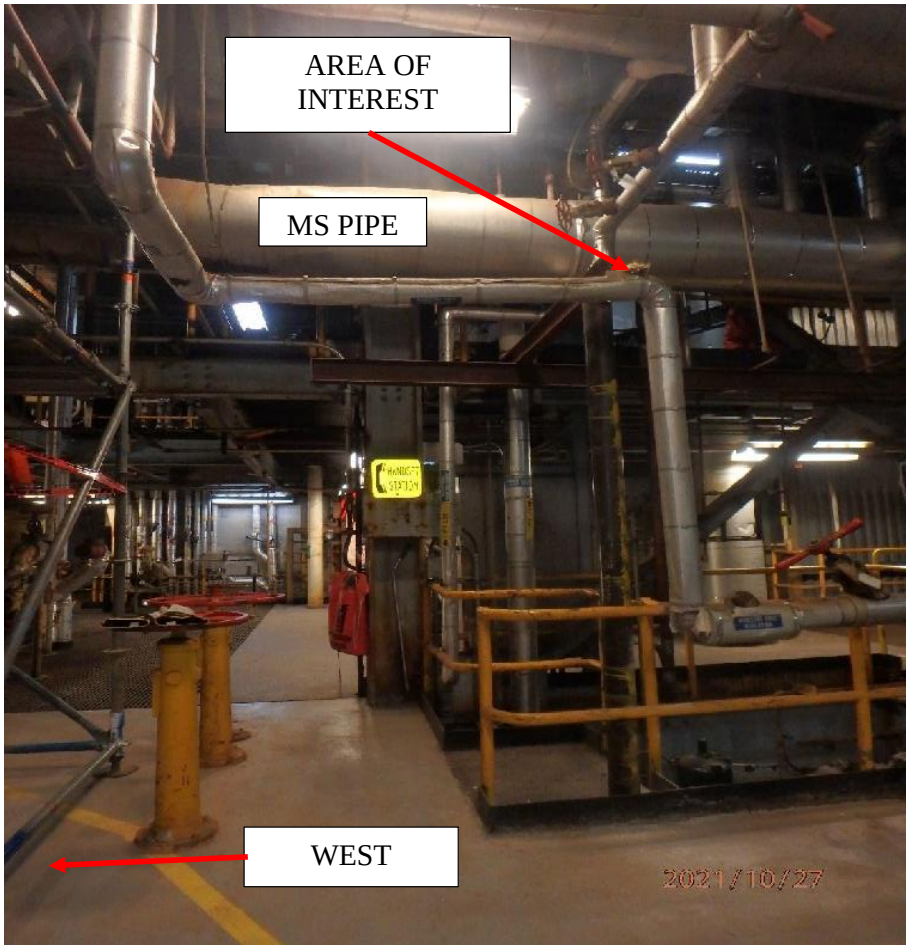


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 49/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

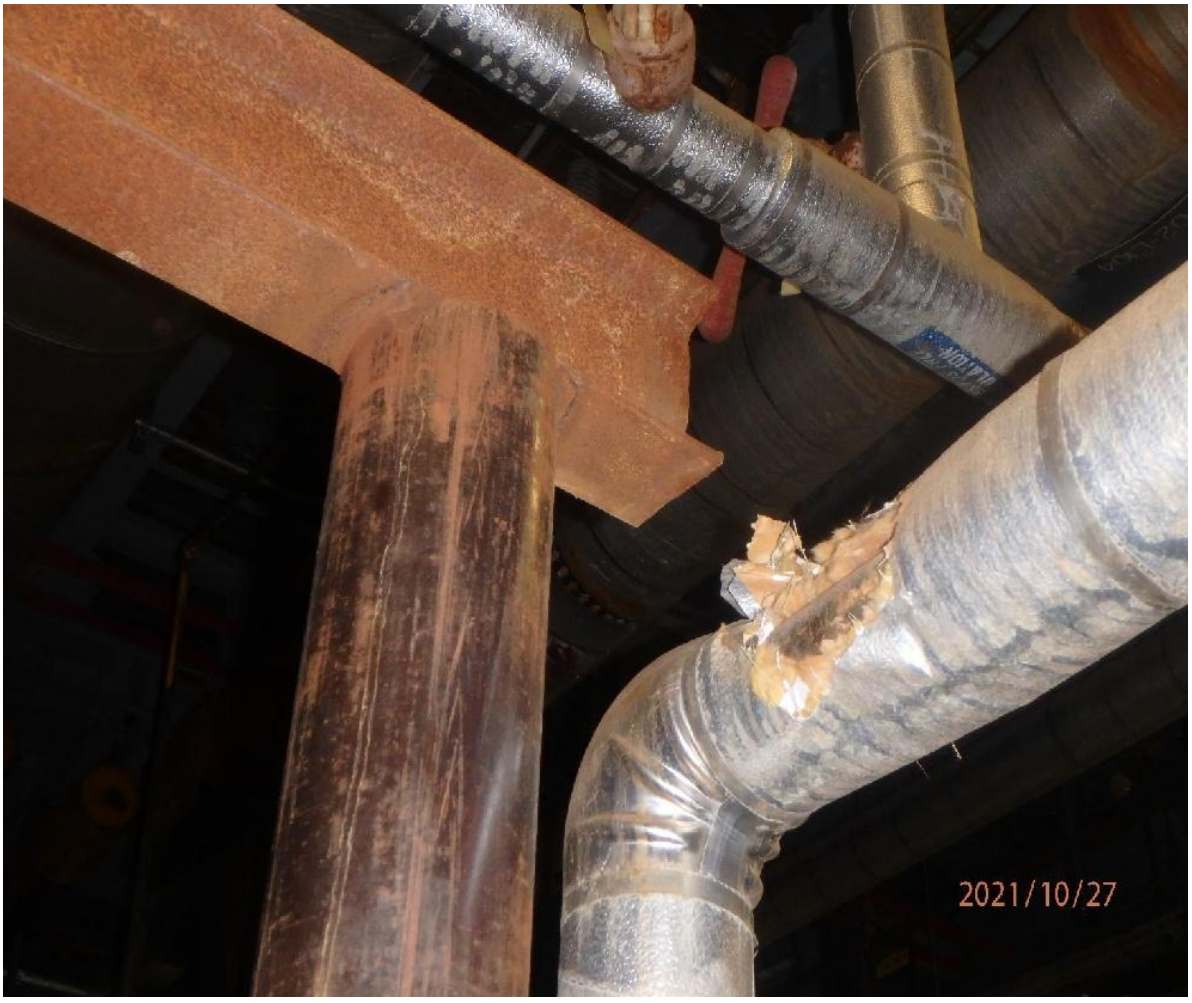
Location 18

Line # 1-HFW-L111 contacted support resulting in damaged insulation (3rd floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 50/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

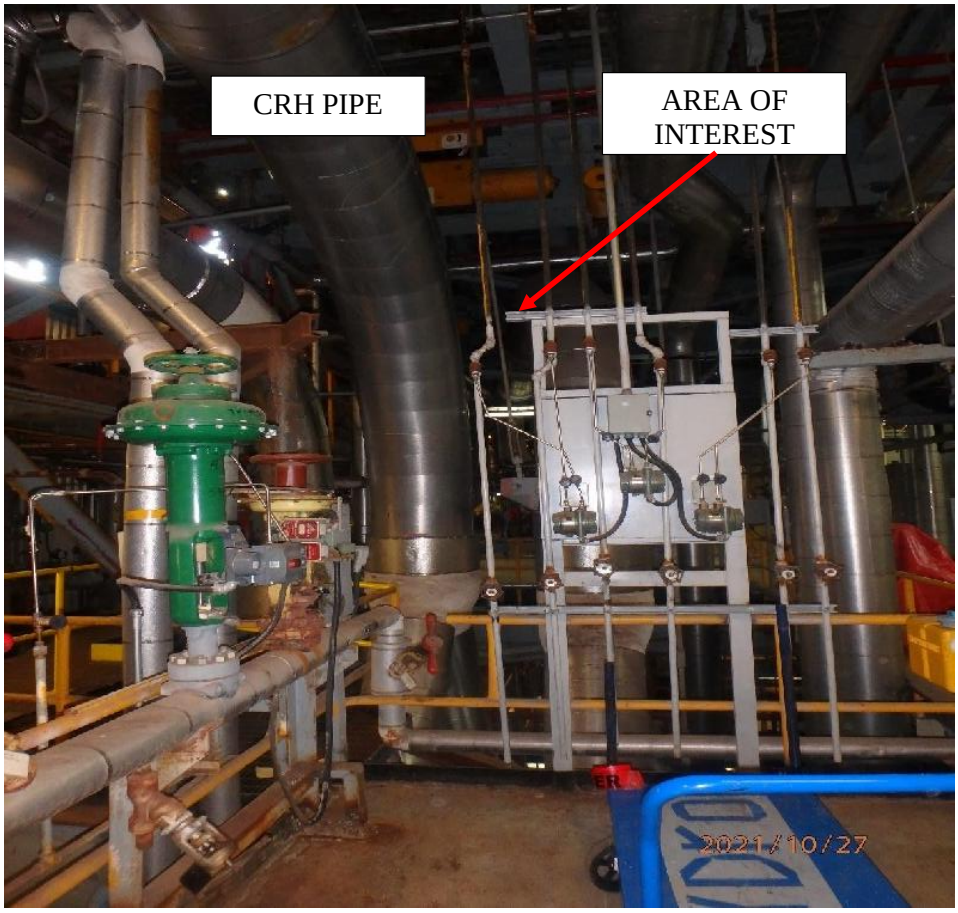


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 51/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Location 19

#6 HP Heater level LT 1469 line removed from bracket and hanger rods distorted (3rd floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 52/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

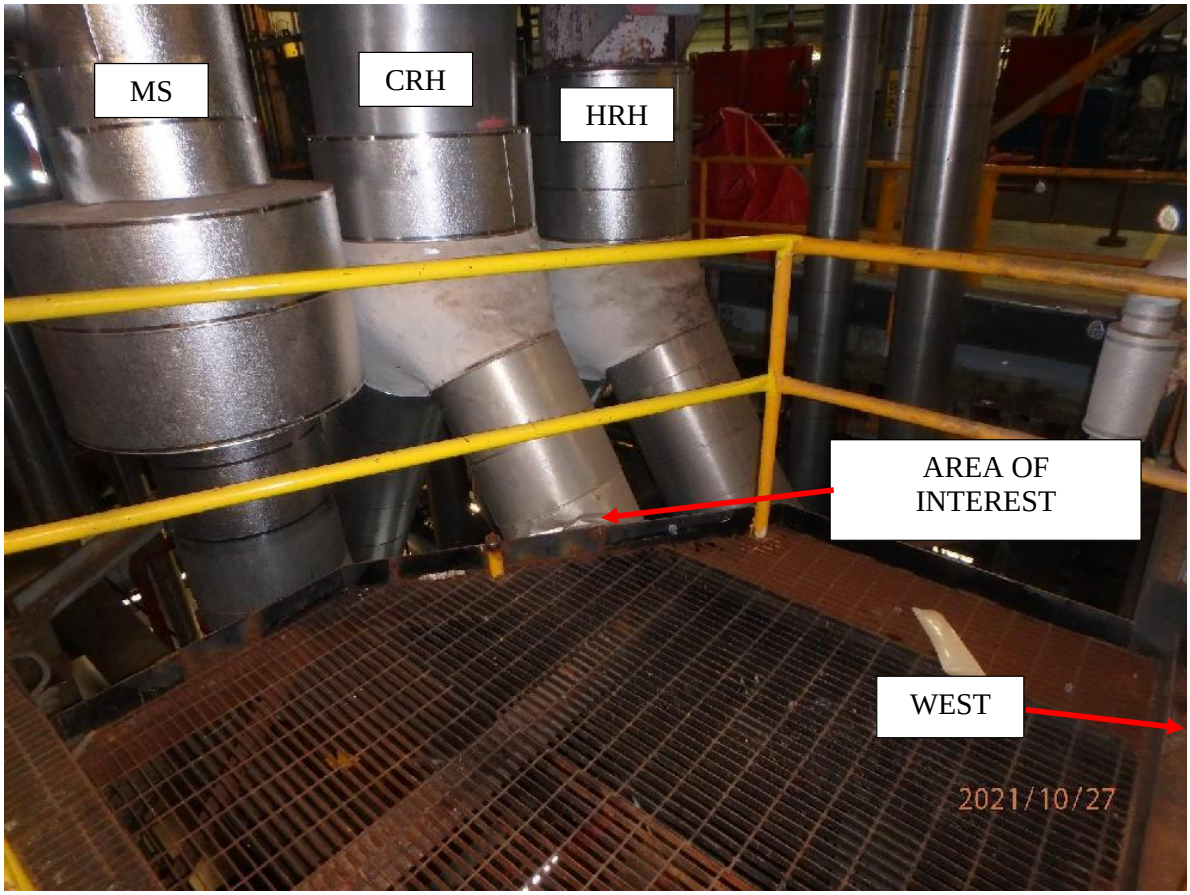
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 53/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 54/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Location 20

West CRH pipe contacted access deck causing distortion to structural steel (3rd floor).

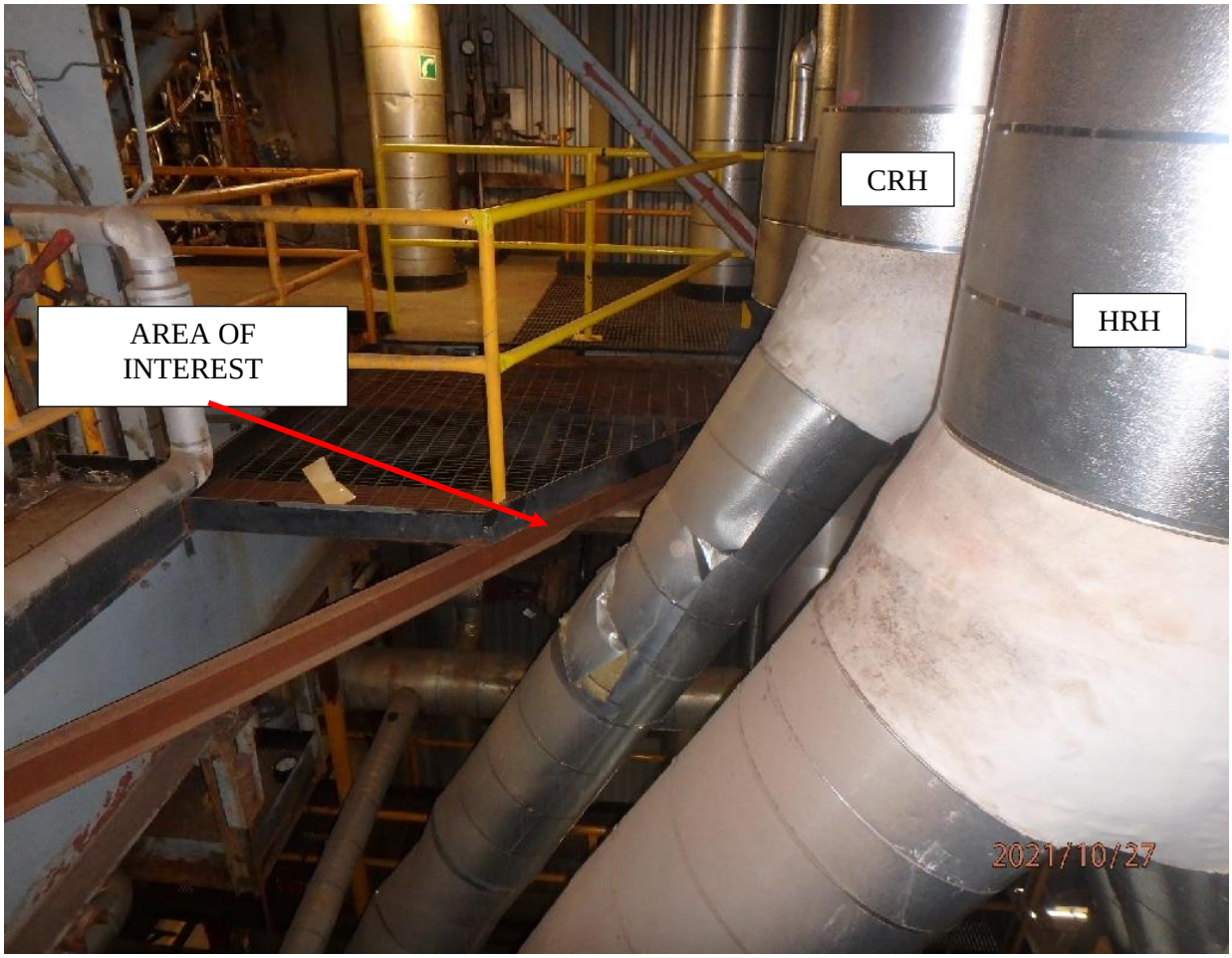


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 55/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

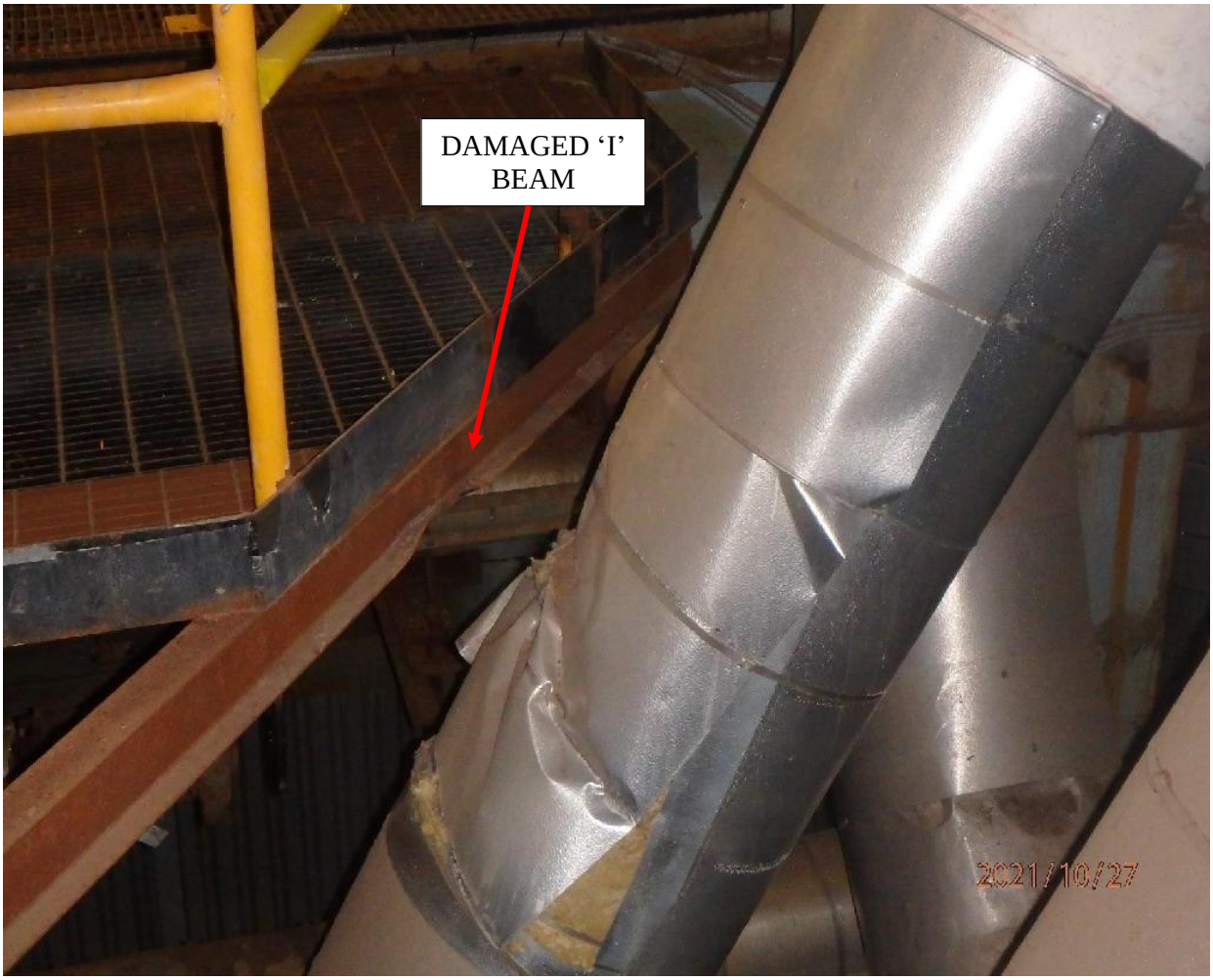
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 56/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 57/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

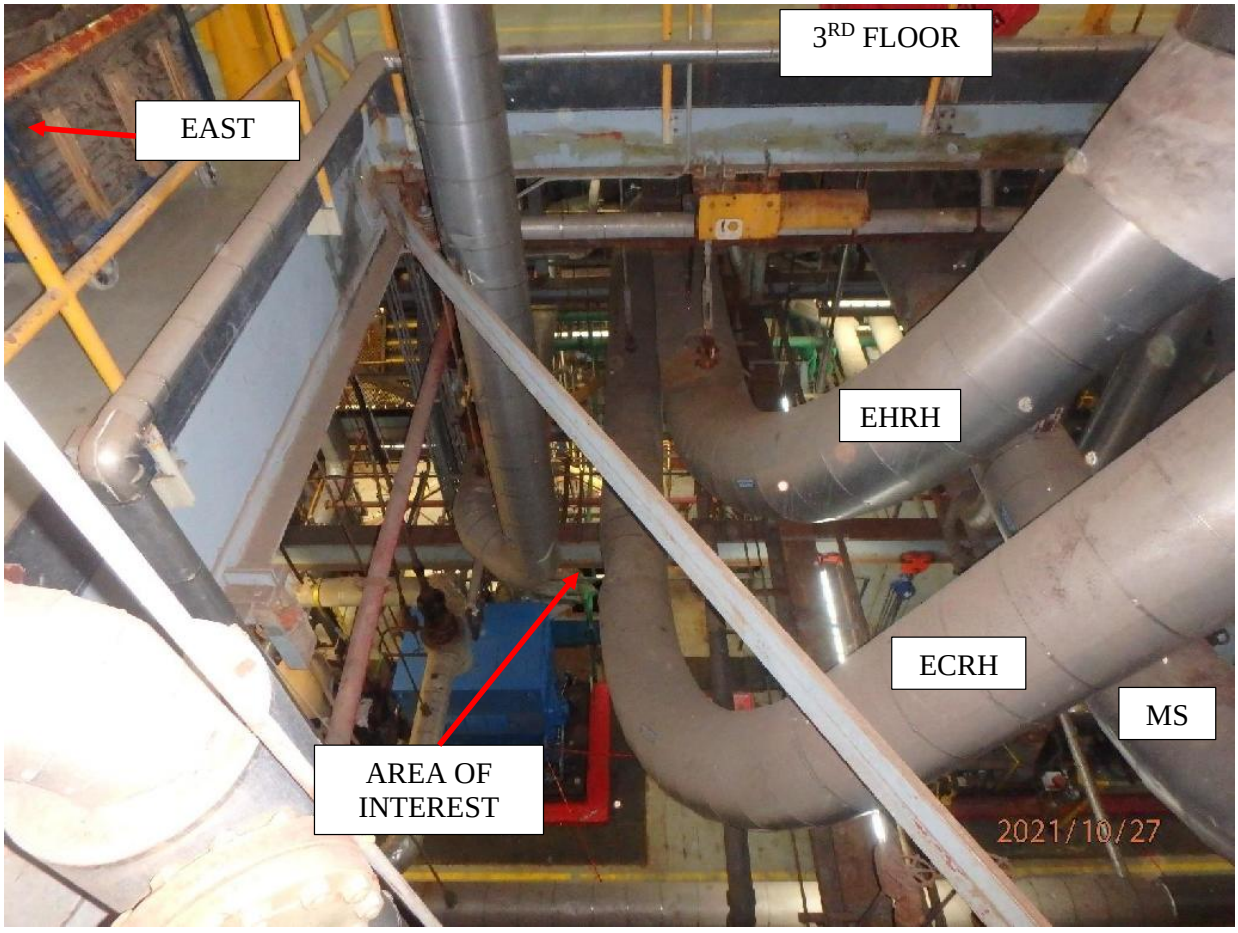
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 58/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 59/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

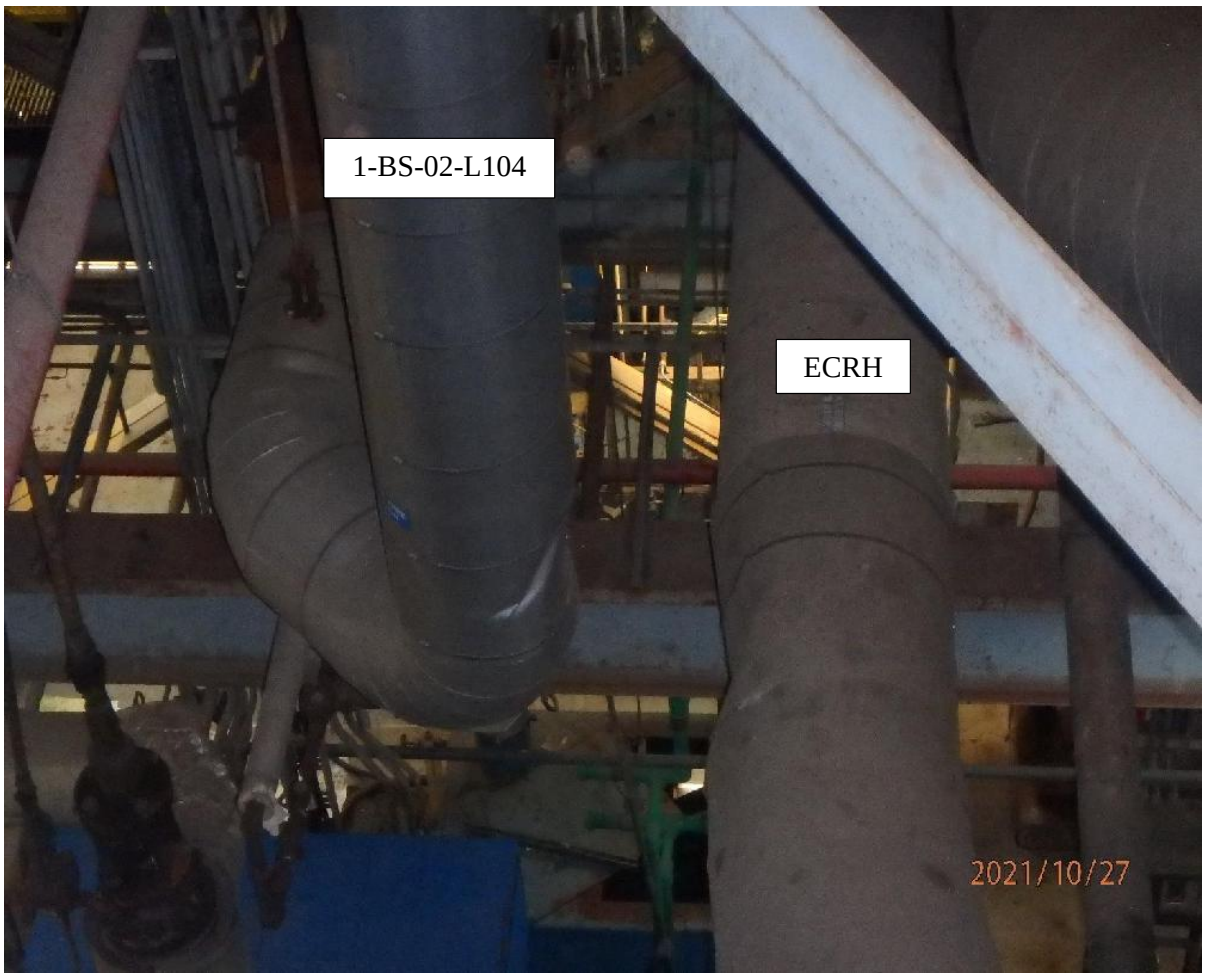
Location 21

East CRH pipe contacted line # 1-BS-02-L104 causing damage to insulation (2nd floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 60/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

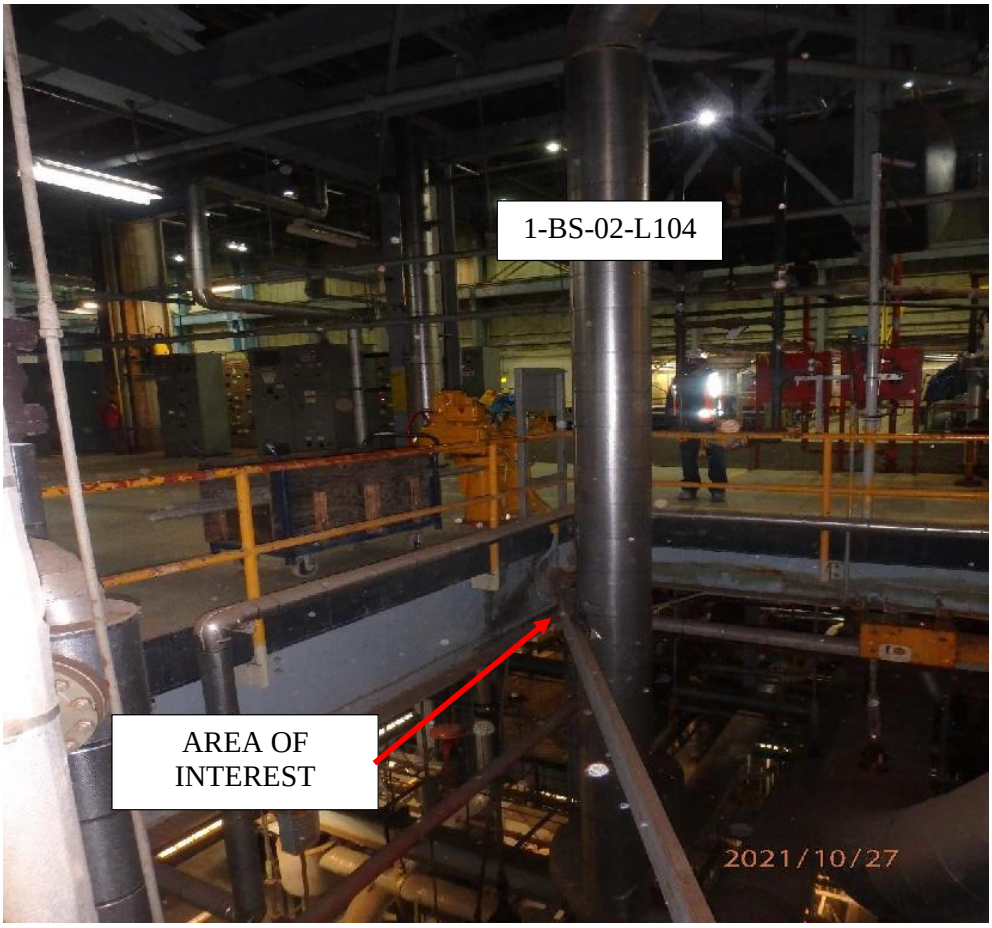


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 61/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Location 22

Line # 1-BS-02-L104 contacted cross member causing distortion and damage to insulation (3rd floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

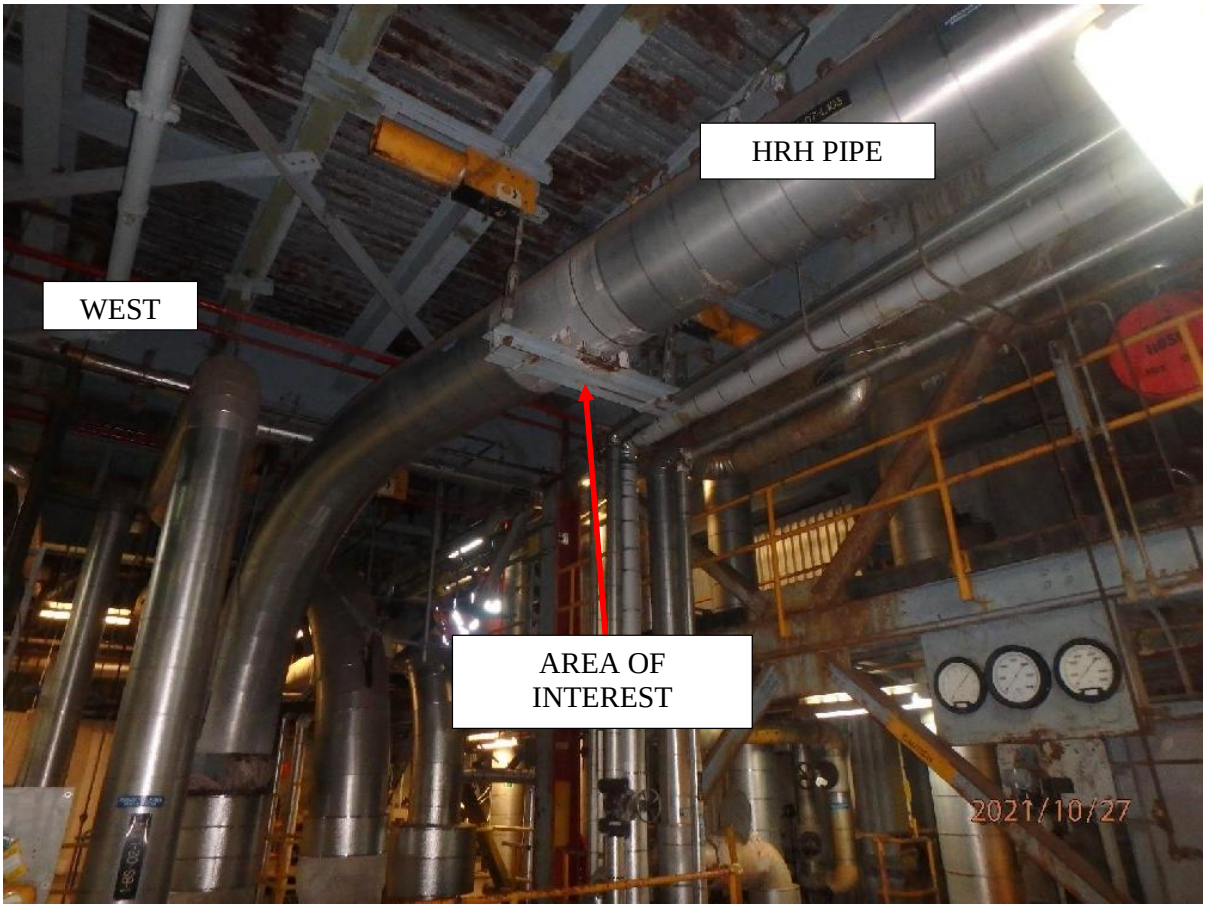
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 62/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 63/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

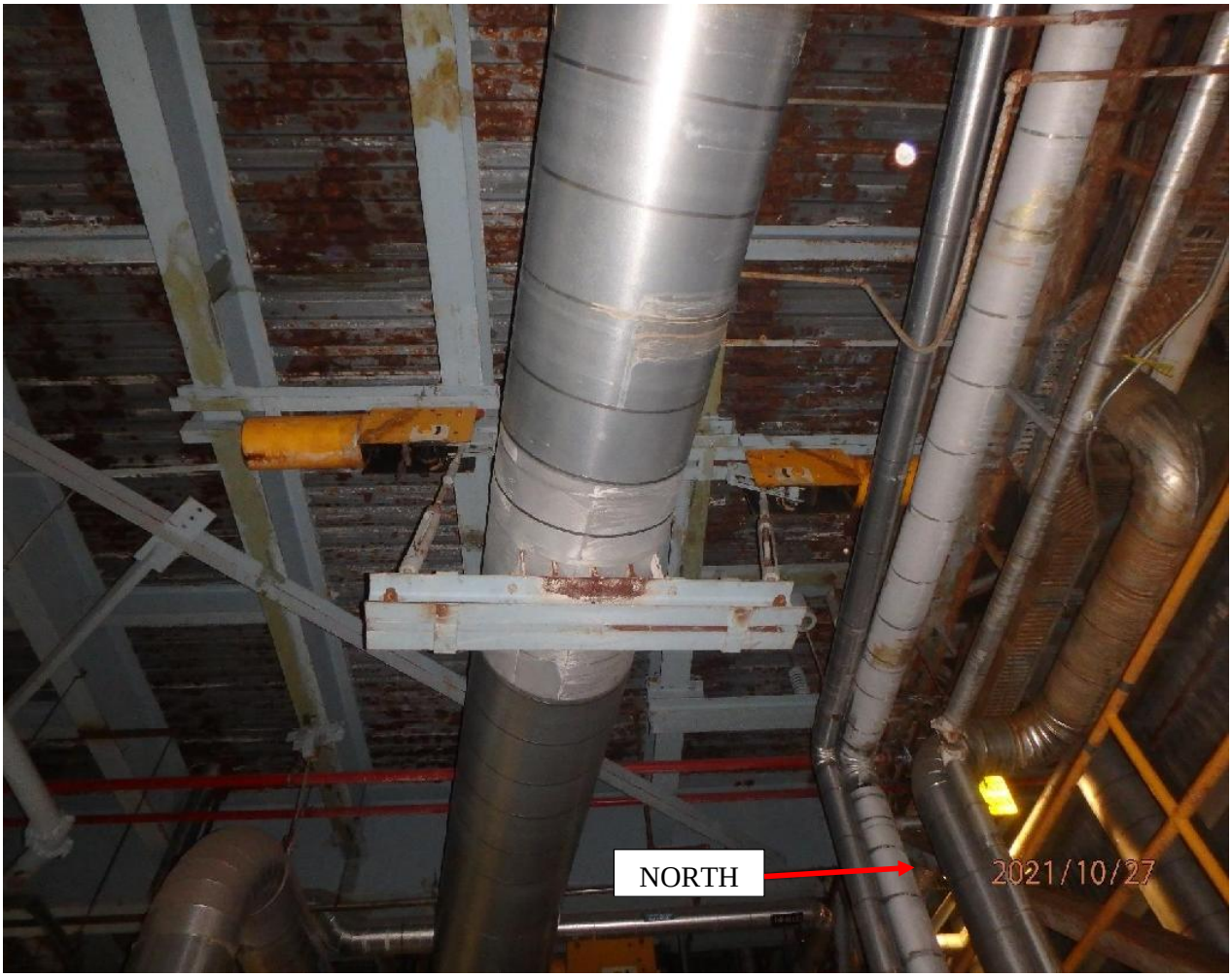
Location 23

HRH pipe hanger offset and rods not plum (3rd floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 64/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

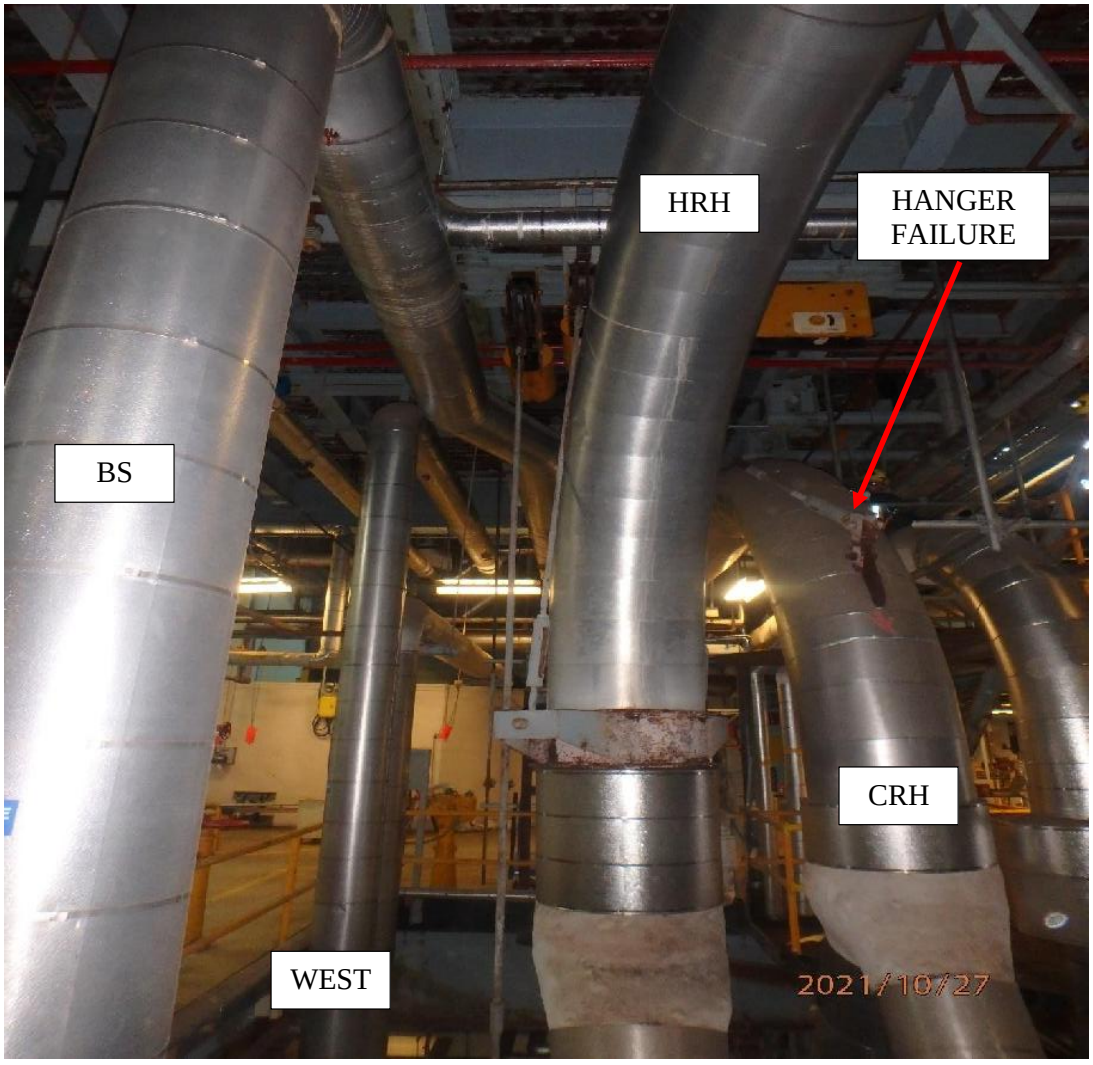
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 65/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 66/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

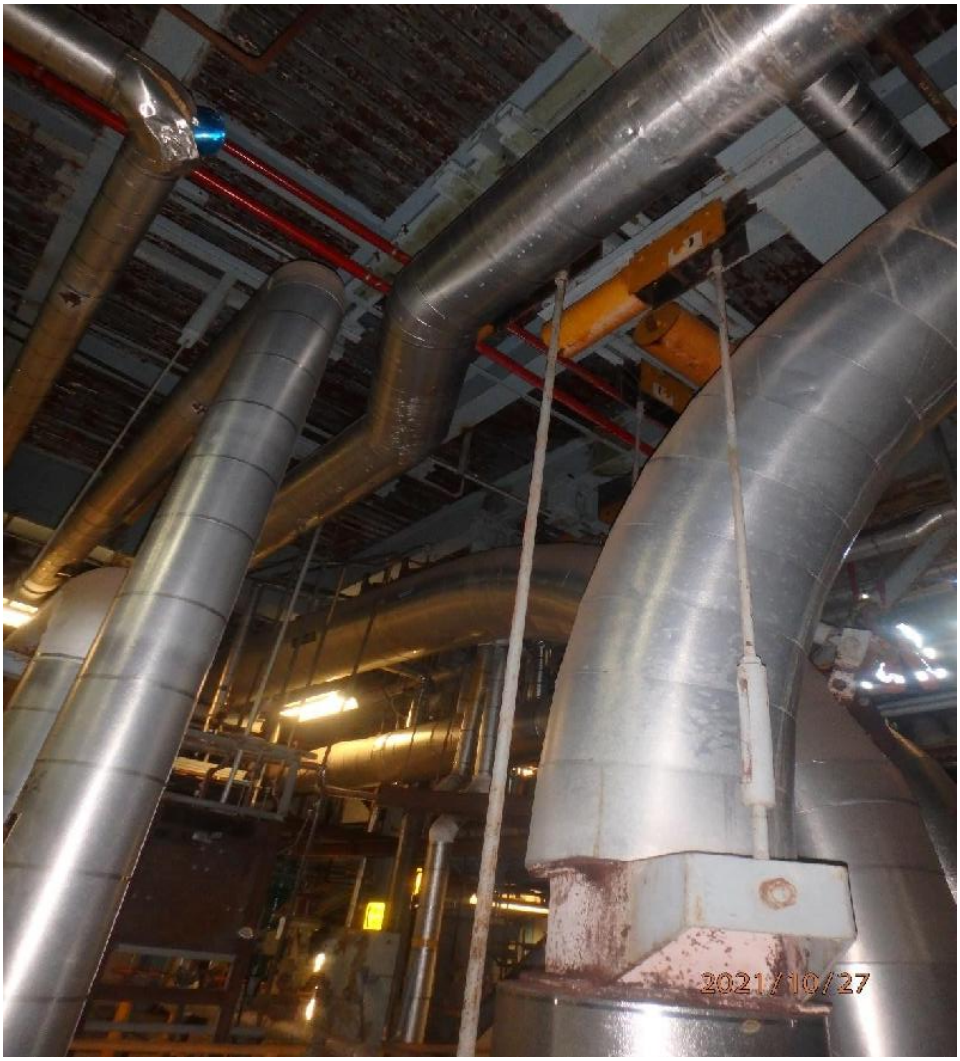
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 67/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 68/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

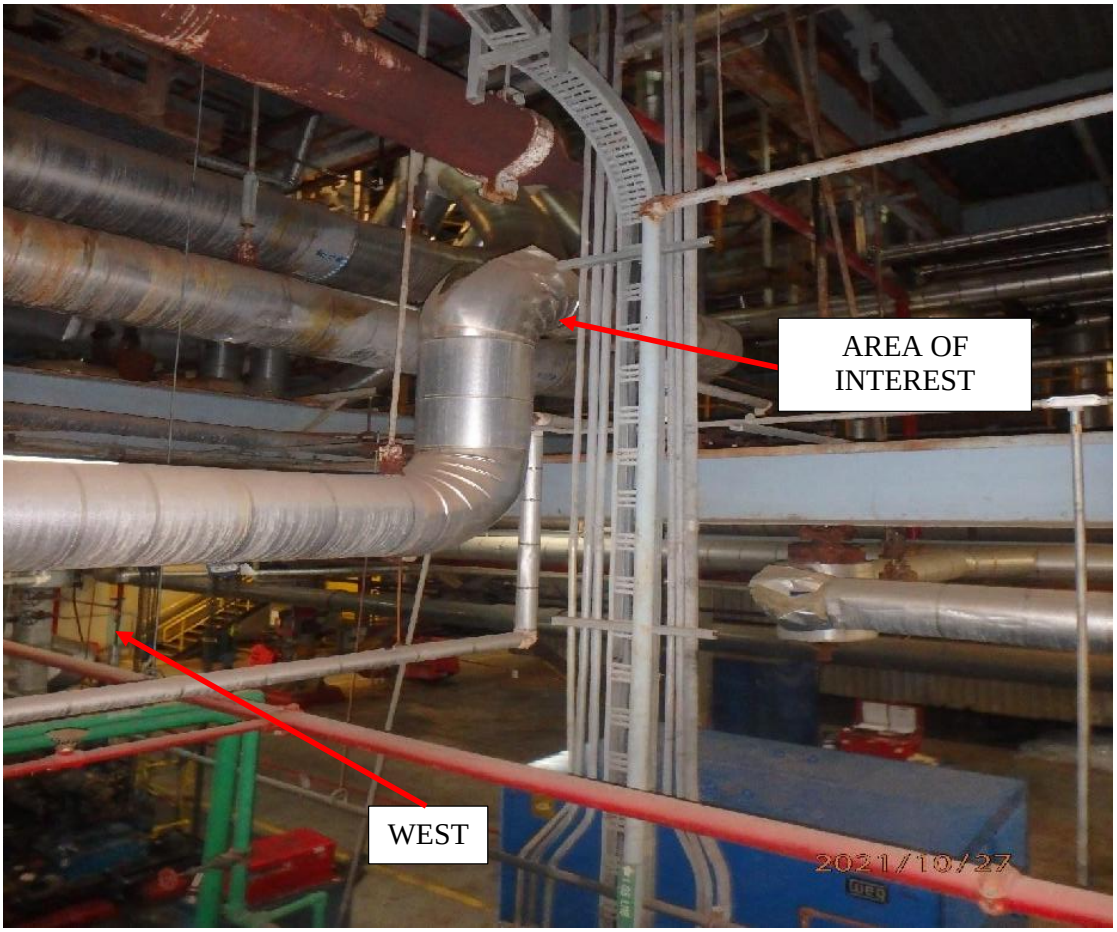


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 69/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Location 24

Line # 1-BS-02-L104 contacted cable tray support bracket resulting in damage to insulation (2nd floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

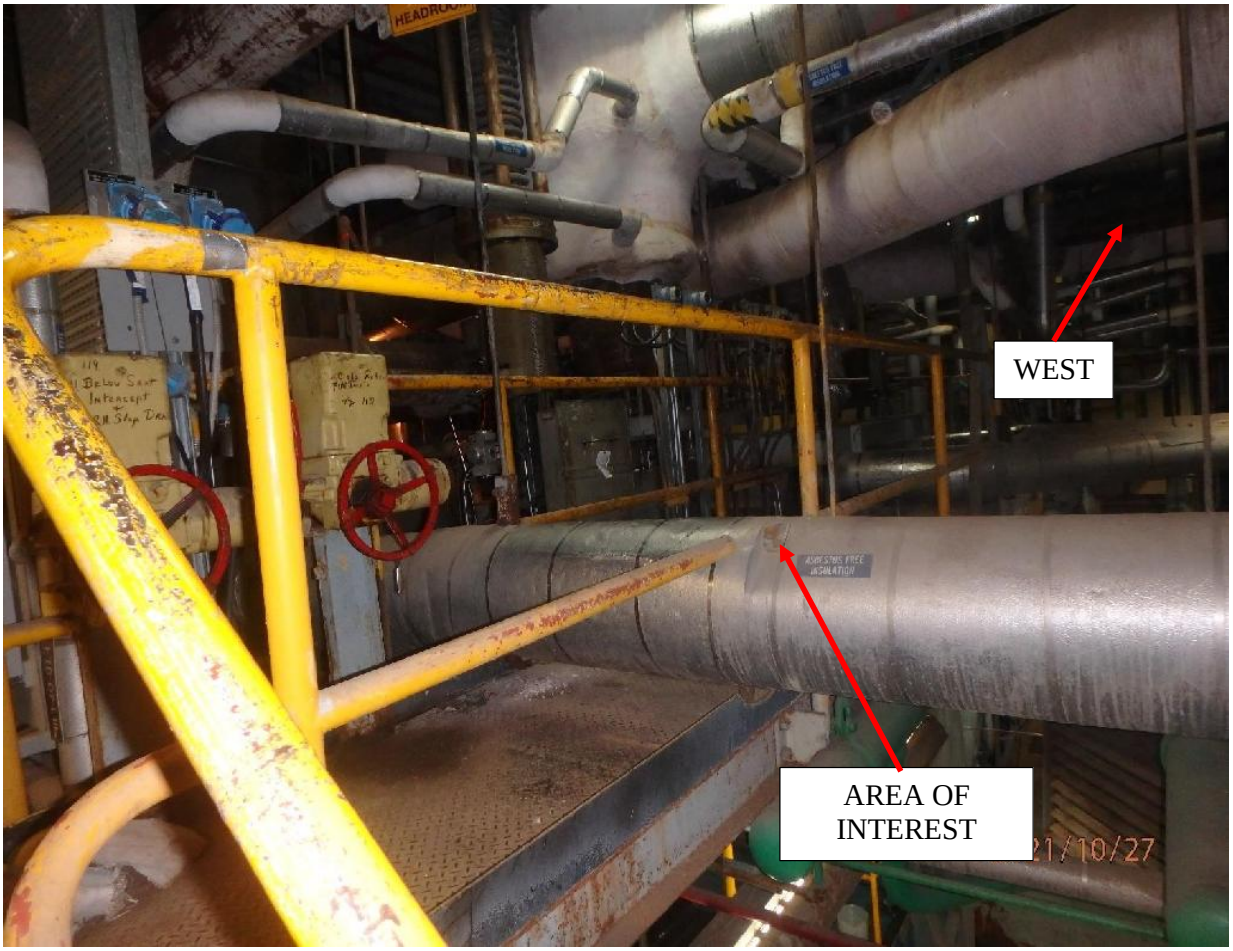
	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 70/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 71/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Location 25

Line # 1-BS-02-L-104 contacted handrail resulting in damage to insulation (2nd floor).

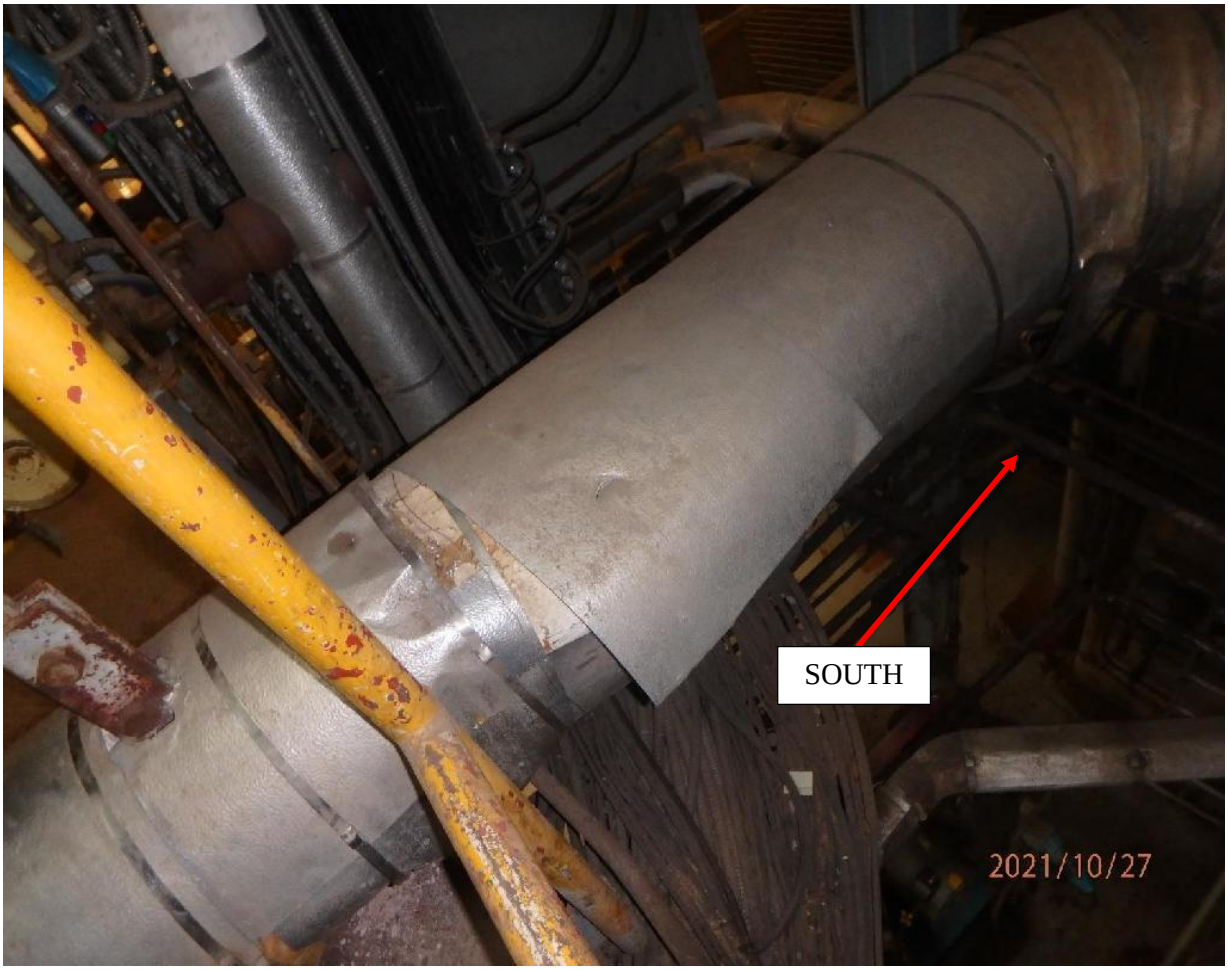


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 72/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

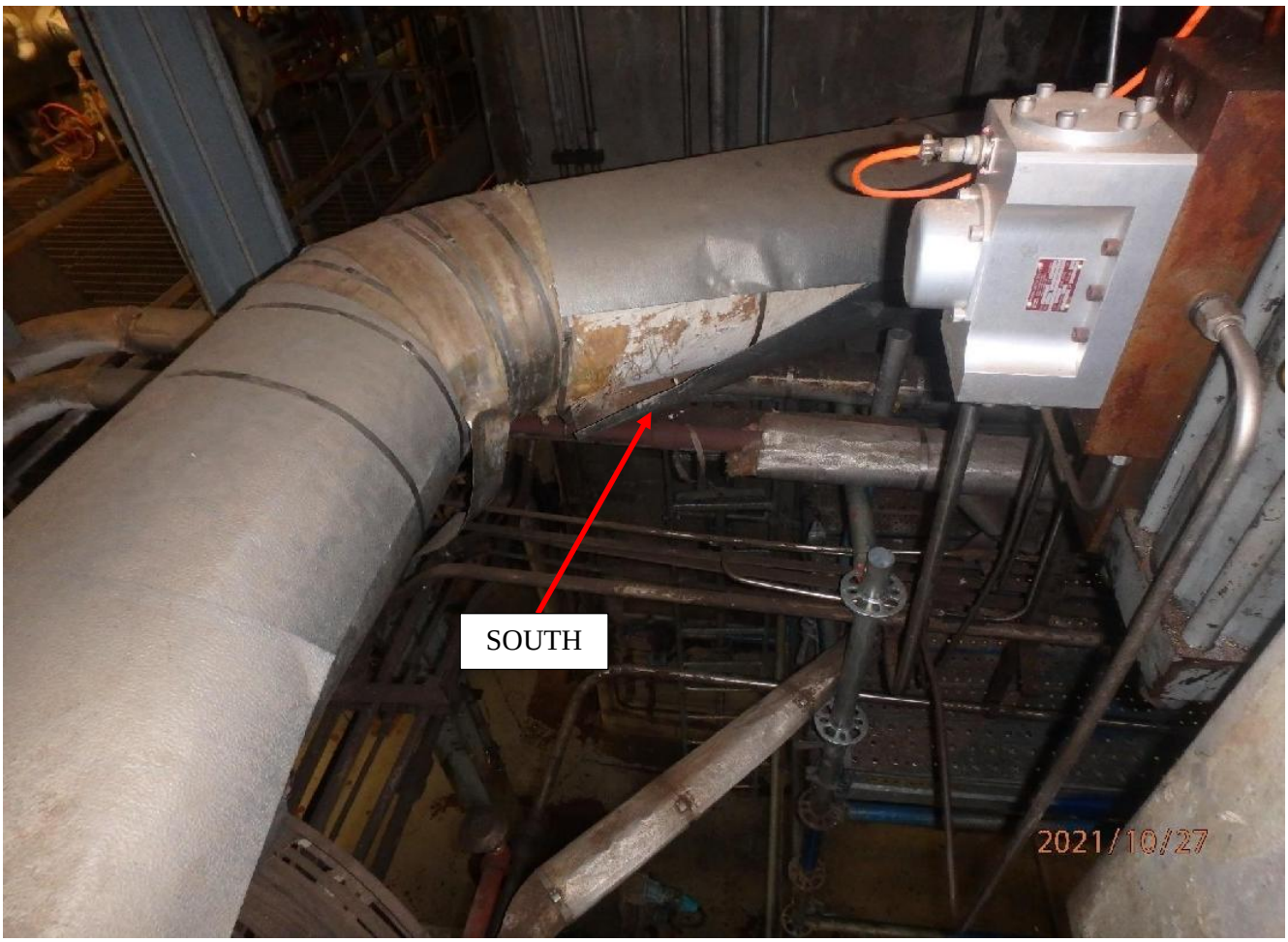
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 73/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 74/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

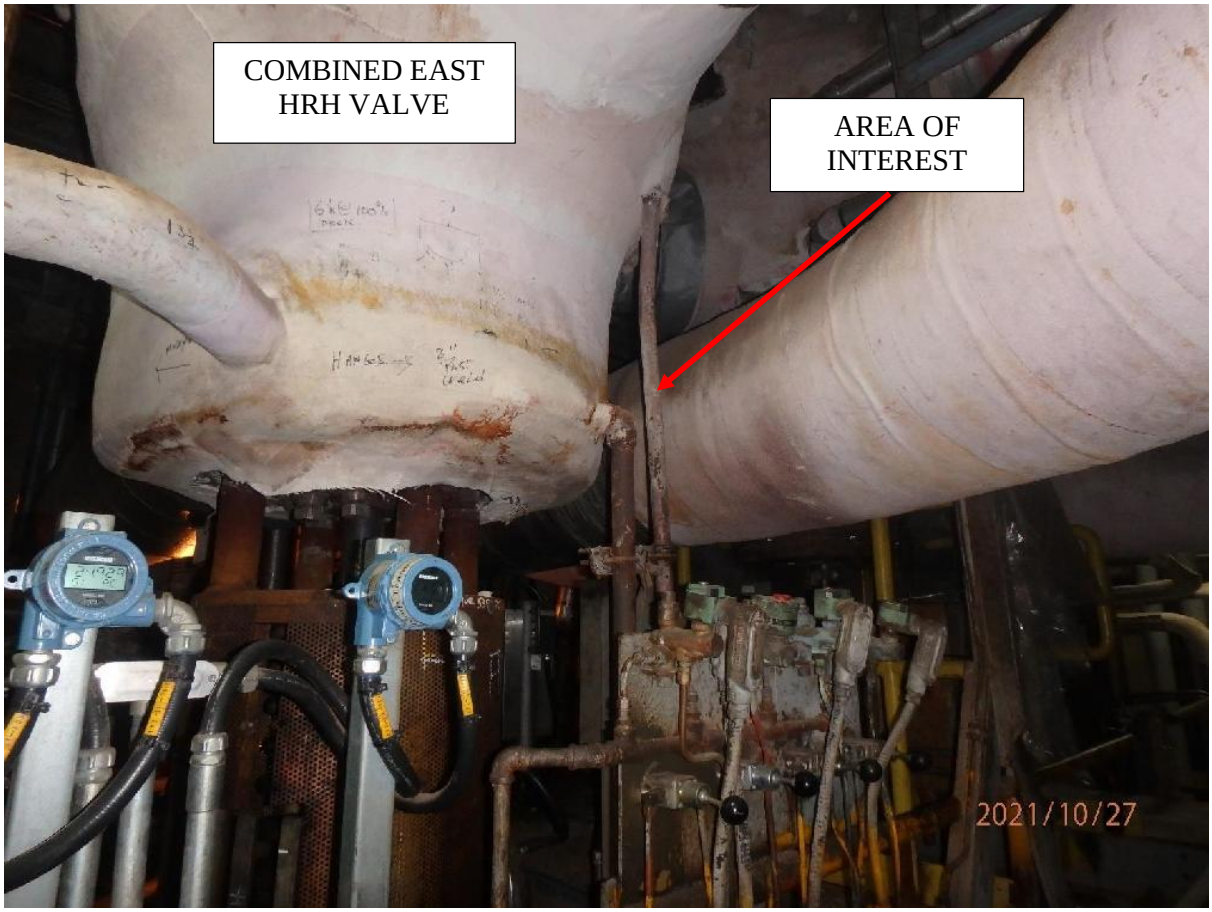


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 75/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

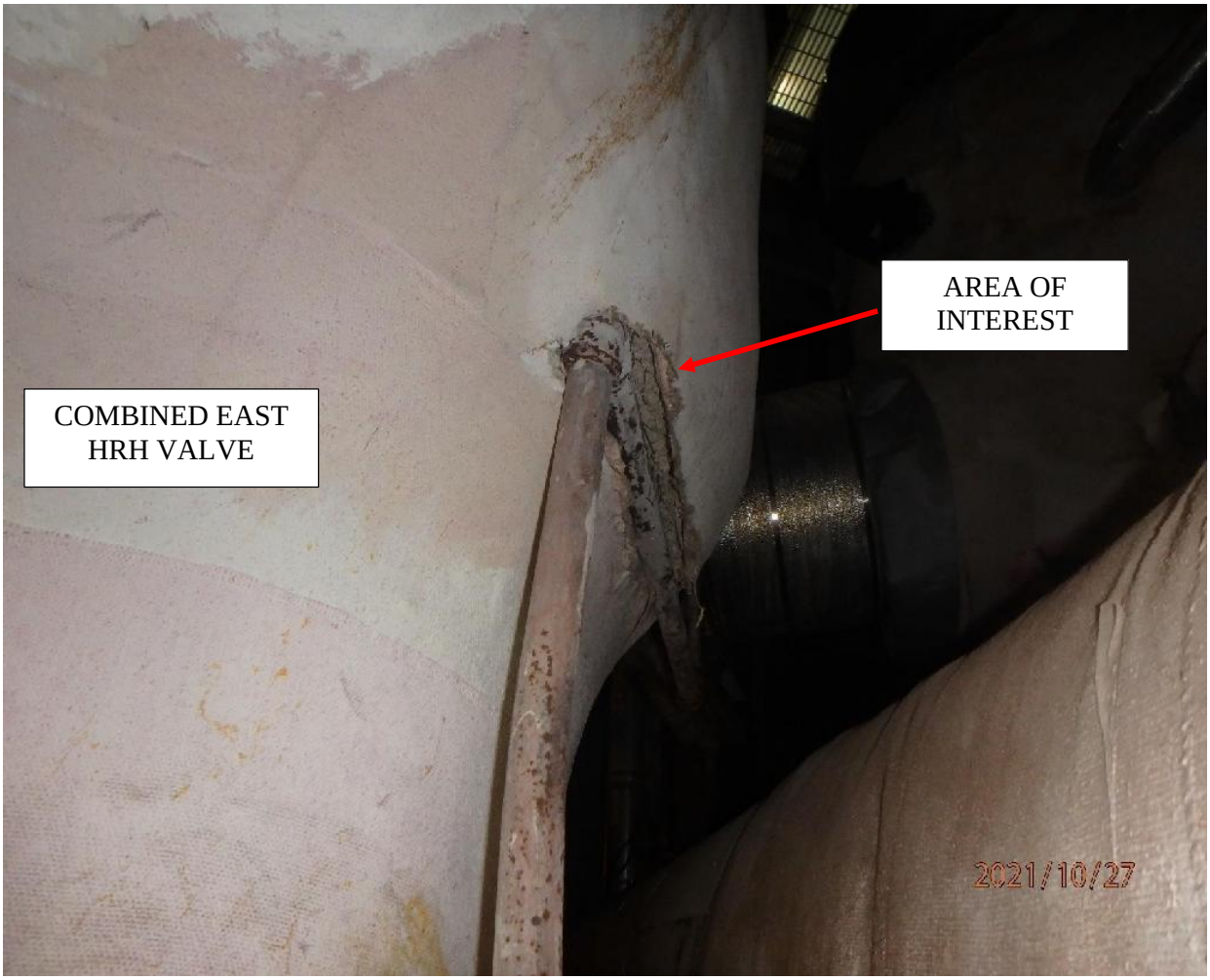
Location 26

East CRH pipe appeared to have contacted drain line causing distortion and insulation damage (2nd floor).



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 76/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 77/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Location 27

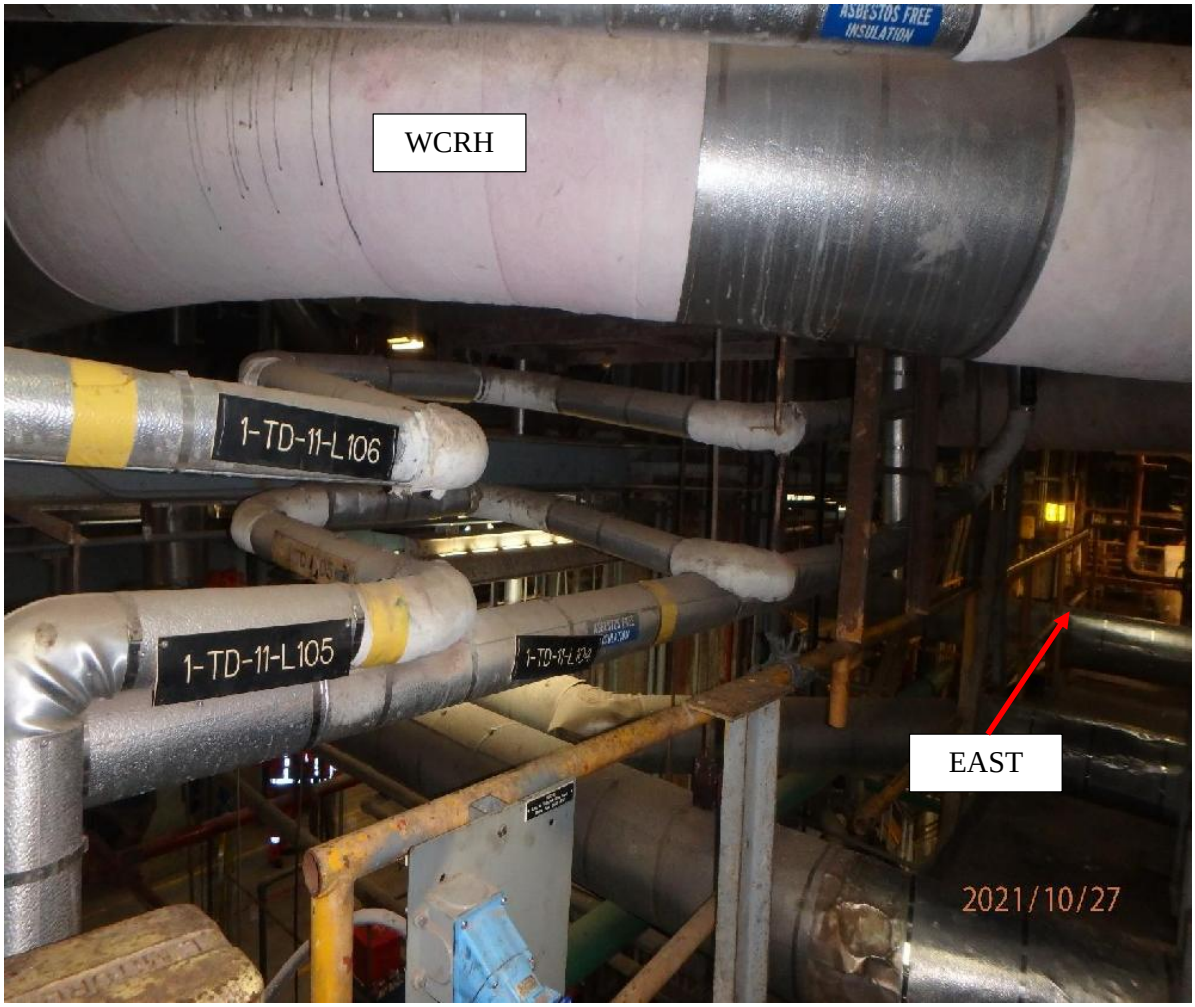
West CRH pipe contacted line #'s 1-TD-11-L105 & L106 hanger rods and walkway resulting in broken hanger rods and damaged insulation (2nd floor).

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 78/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

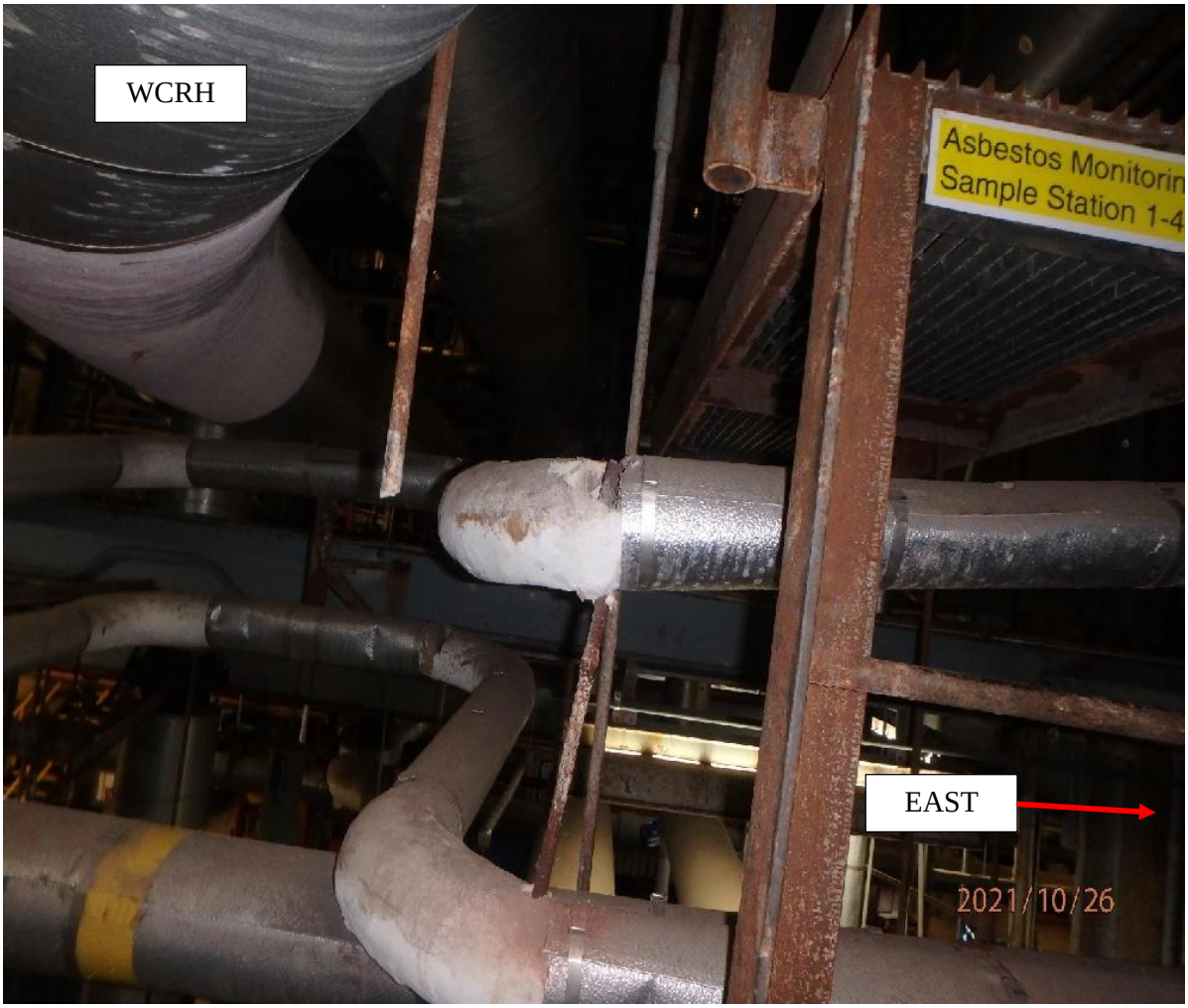
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 79/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 80/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 81/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Location 28

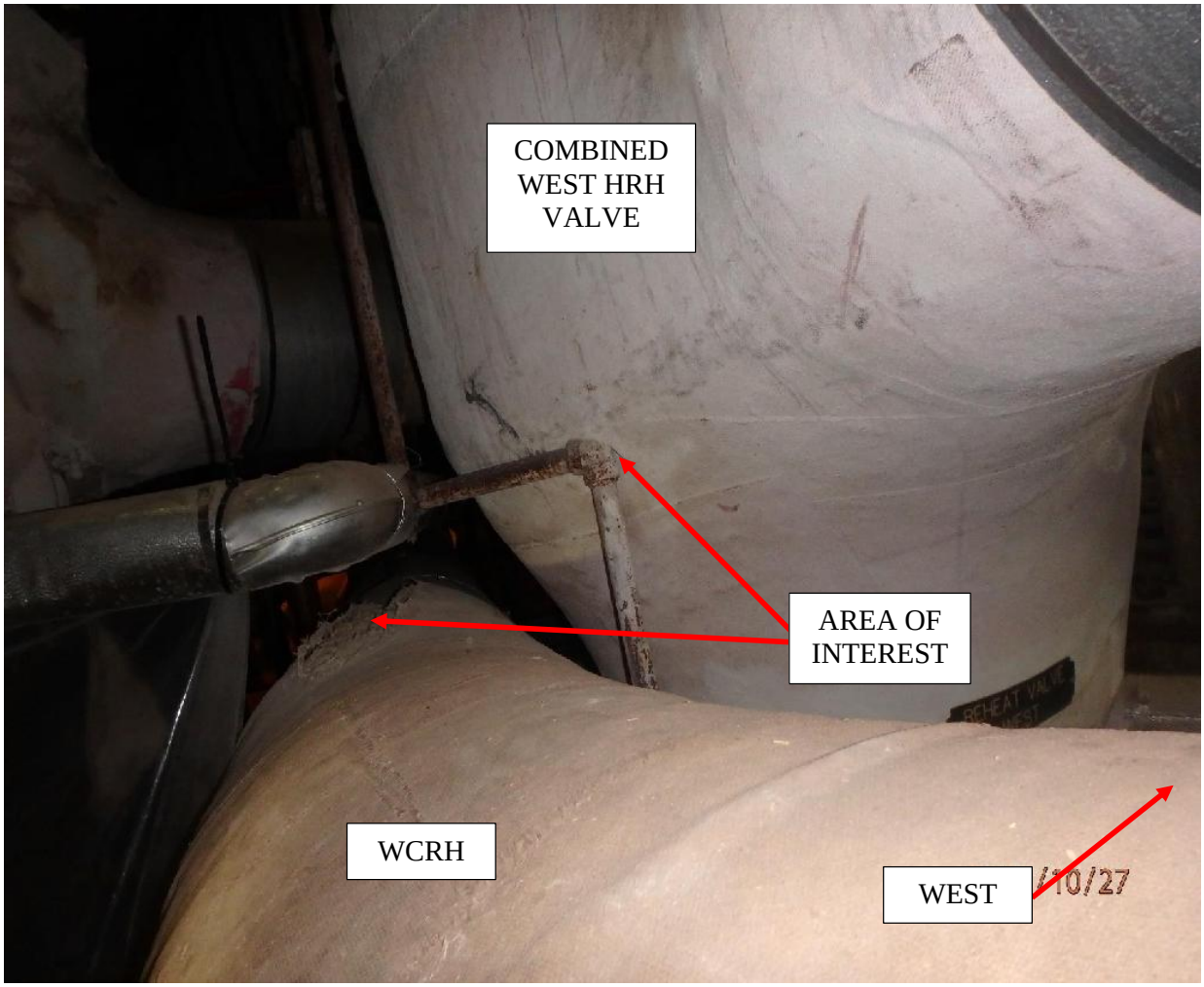
West CRH pipe contacted West HRH pipe and drain lines (2nd floor).

Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 82/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

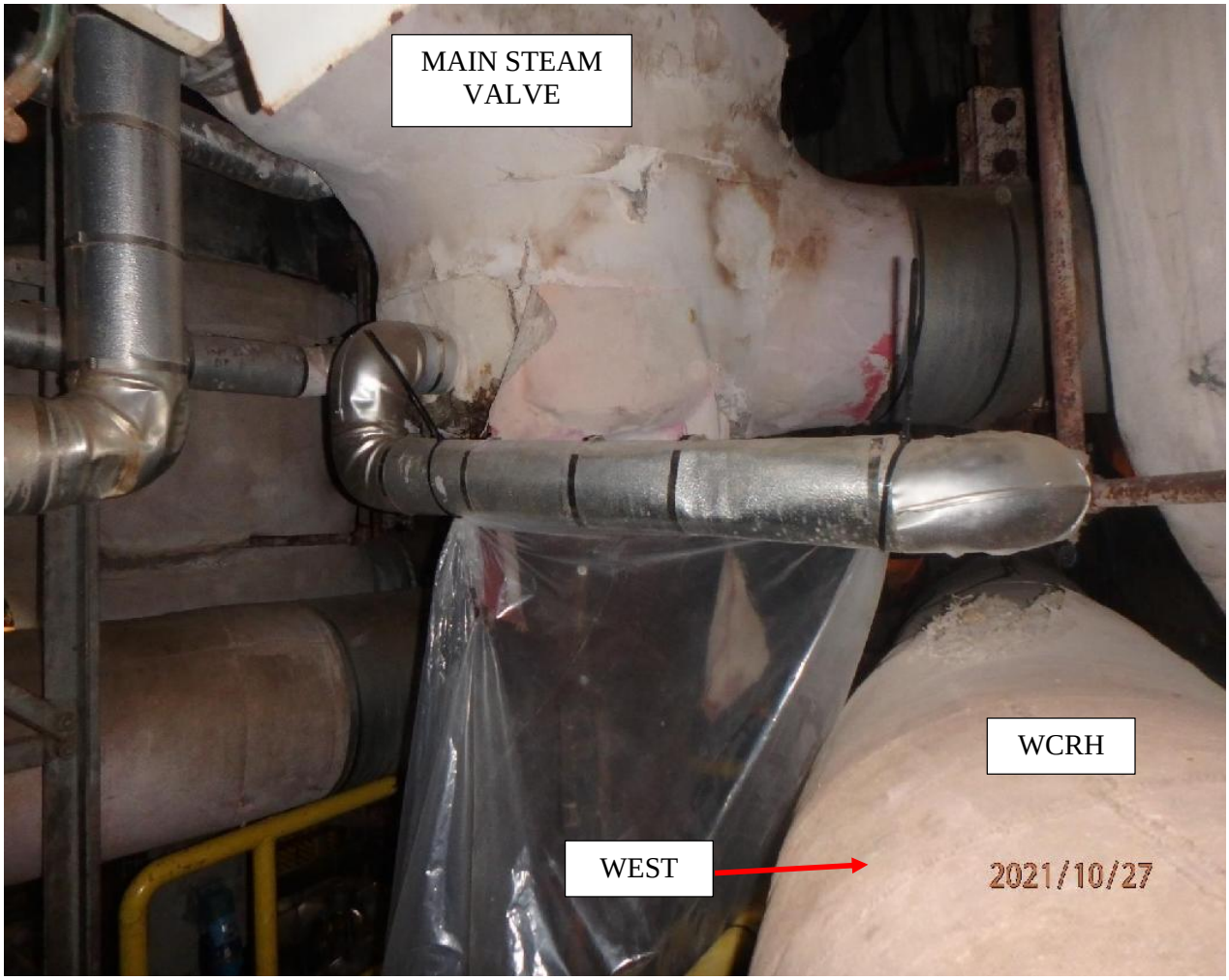
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 83/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



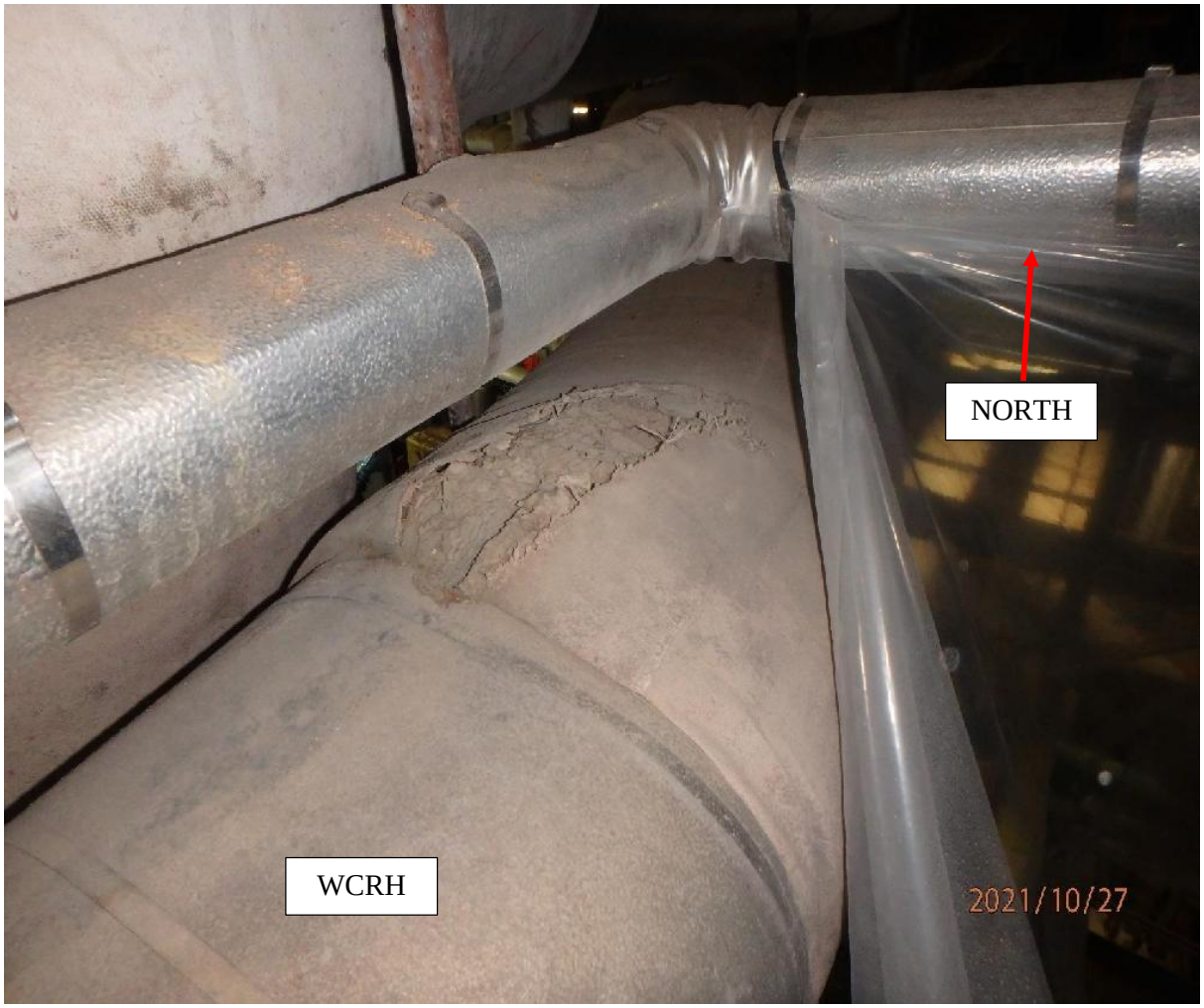
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 84/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 85/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		

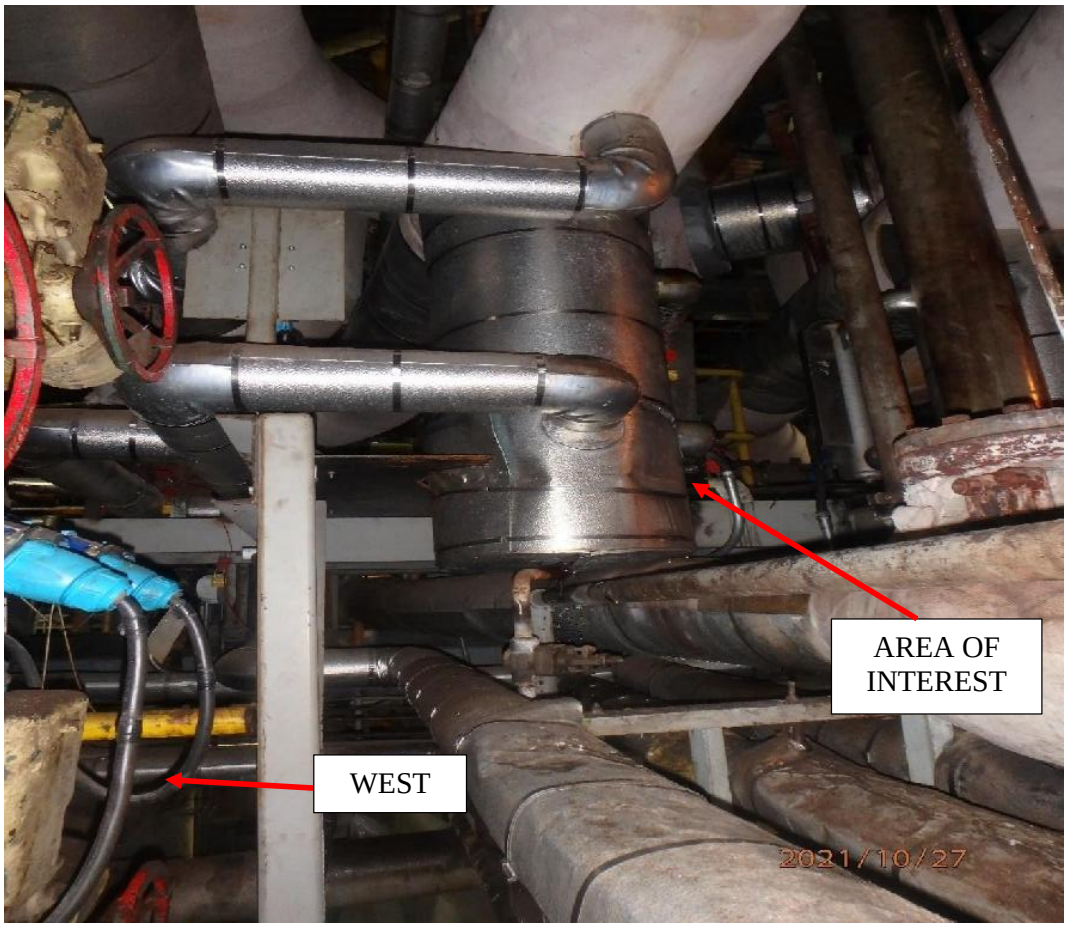


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 86/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

Location 29

West CRH condensate drain pot leak (2nd floor under turbine).

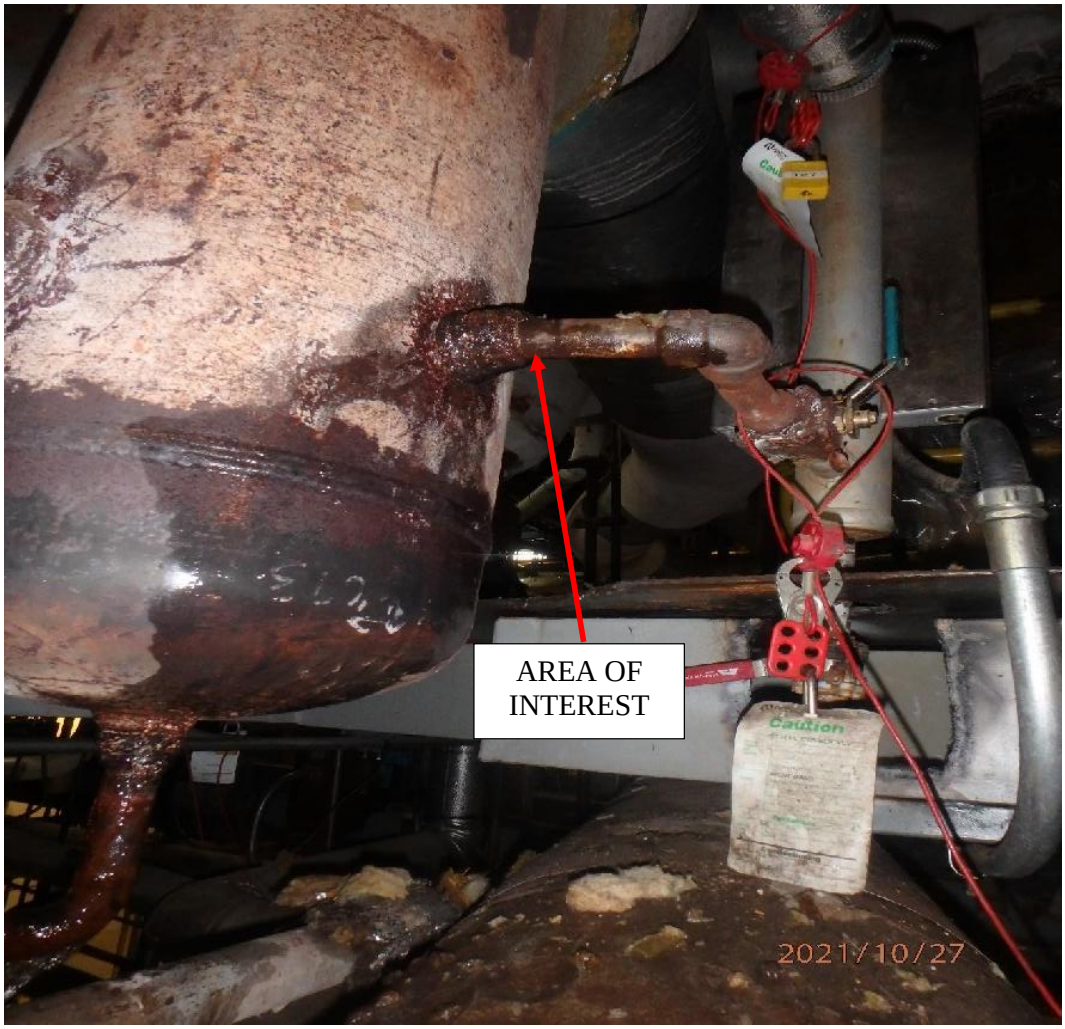


Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 87/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:

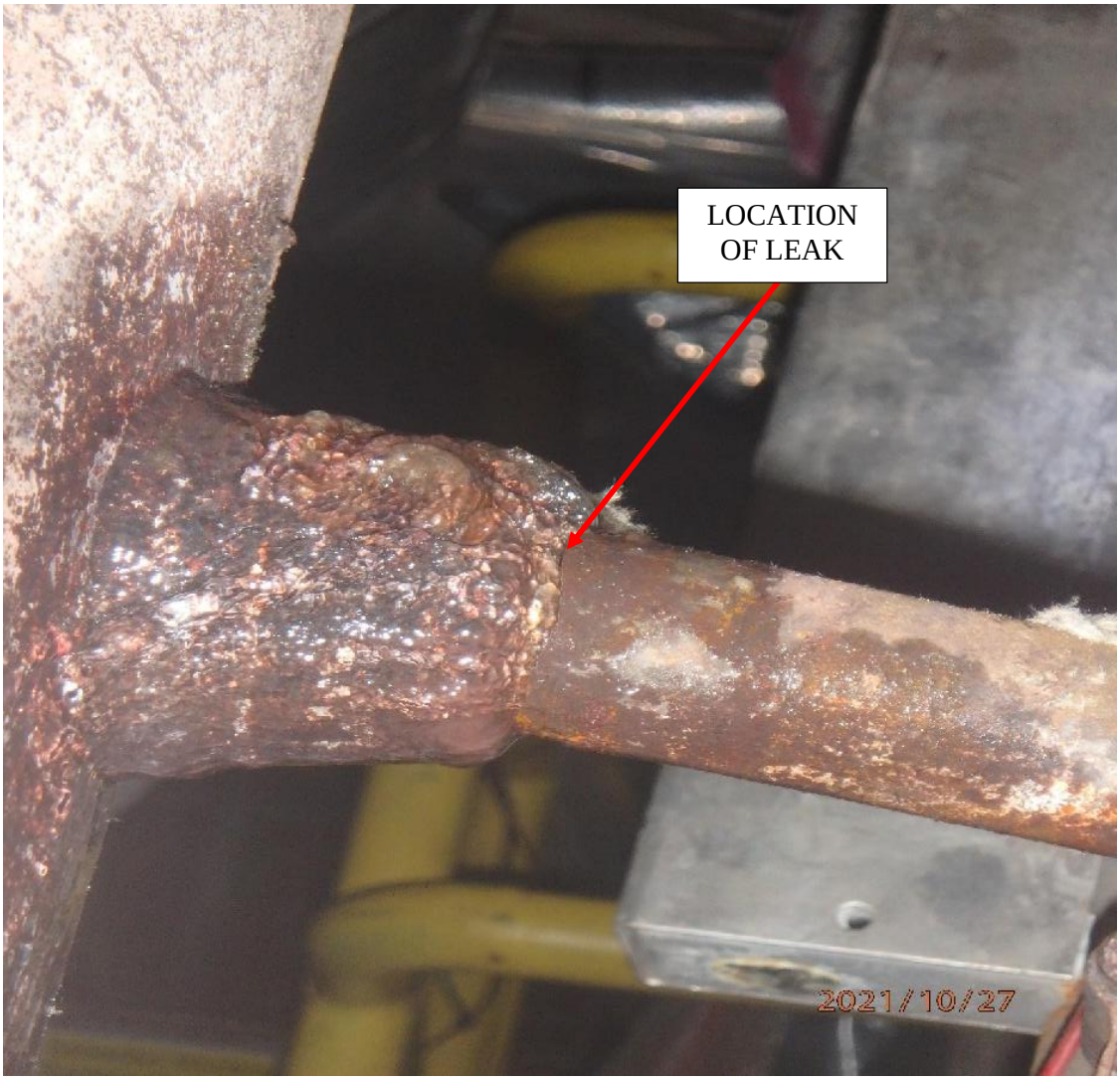
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 88/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		Signature: Date:



Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

	PRELIMINARY INSPECTION REPORT (PIR)	PIR # U1-006-KJ
Subject: Unit # 1 Cold Reheater Piping Event		Sheet 89/89 ISSUE # 1
Station: NALCOR Holyrood Thermal Generating Station	Unit # 1	CLIENT Client Accepts Recommendation: Yes ☐ No ☐ Client Accepts 'As Found': Yes ☐ No ☐ Signature: Date:
Component Inspected: U1 Cold Reheater Piping and Adjacent Piping Systems / Supports Component Serial Number: N/A		



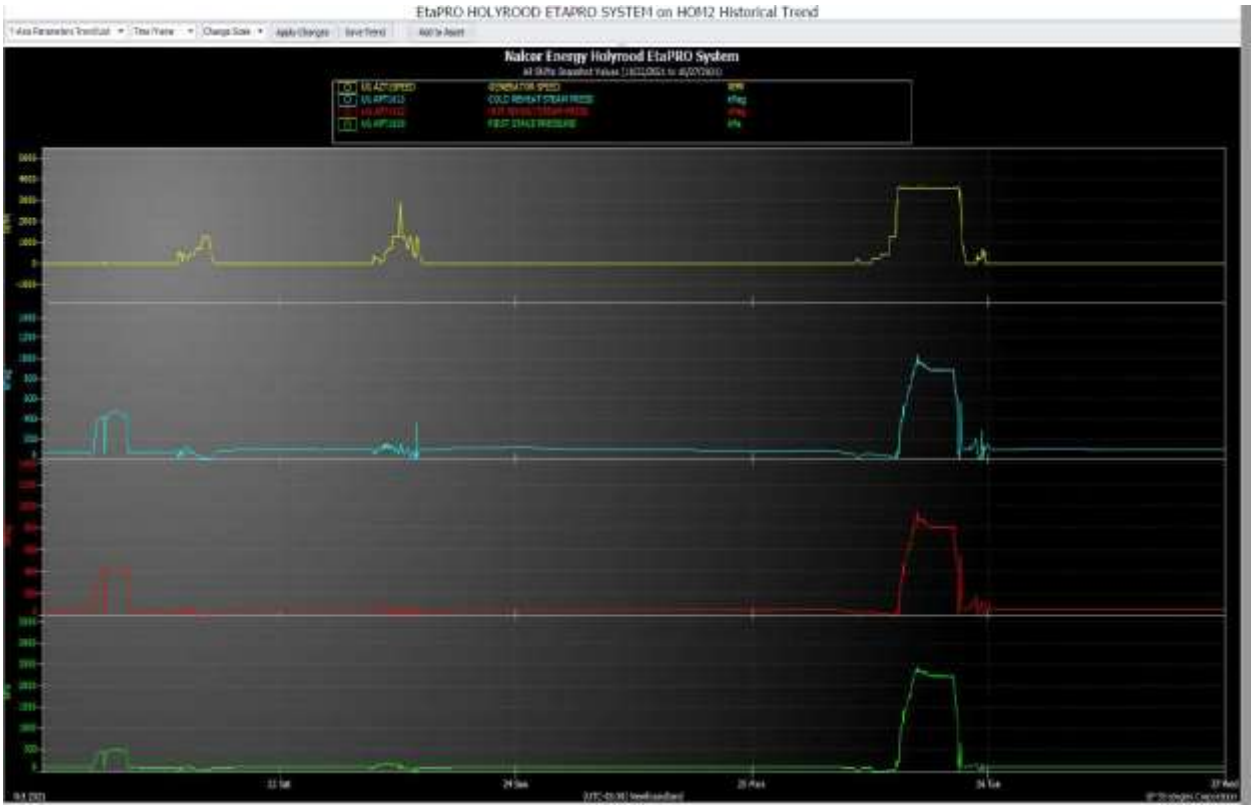
Written By:	Kristofer Jacobs	Position: Resident Technical Field Advisor	Date: 2021/OCT/27
Distribution For Action:	Client ☒	Engineering ☒	Customer Service Leader☒
Distribution For Information:	Client ☒	Engineering ☒	Customer Service Leader☒

Appendix F

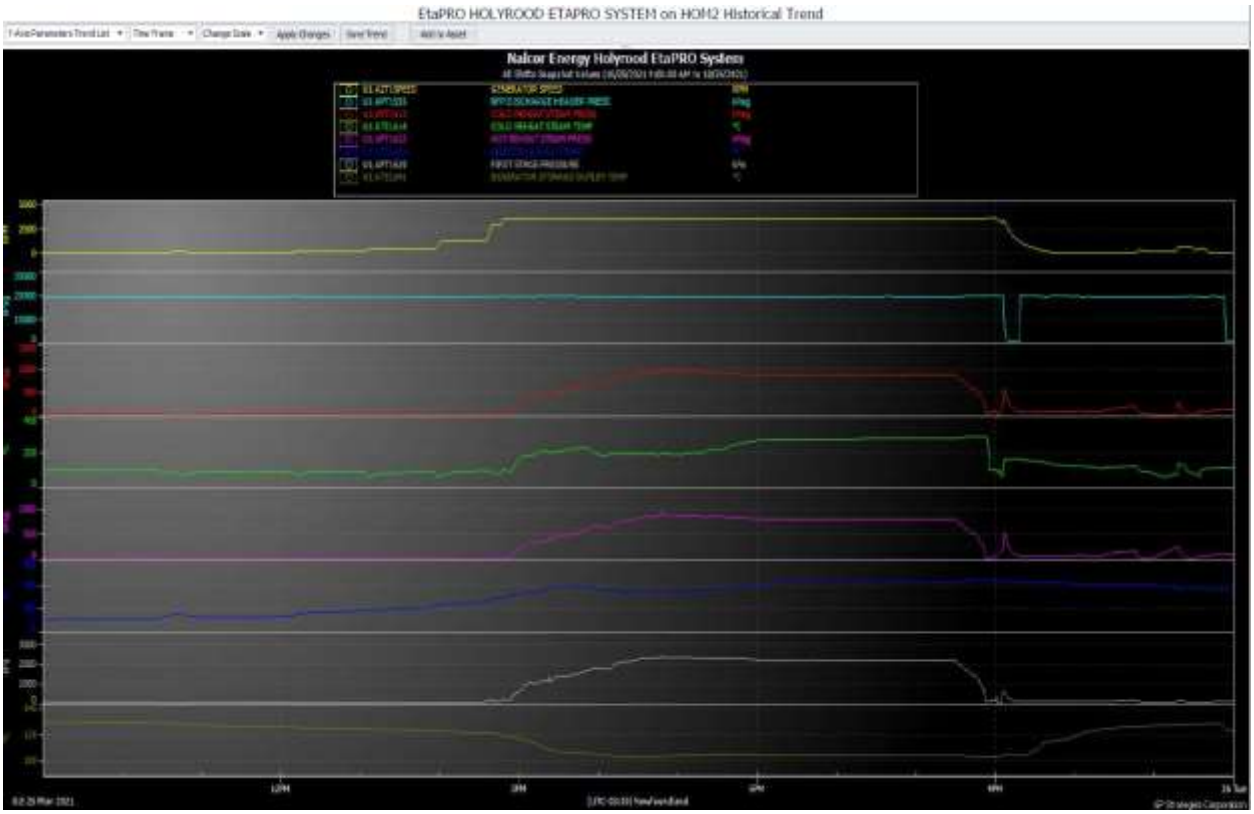
Trend Data

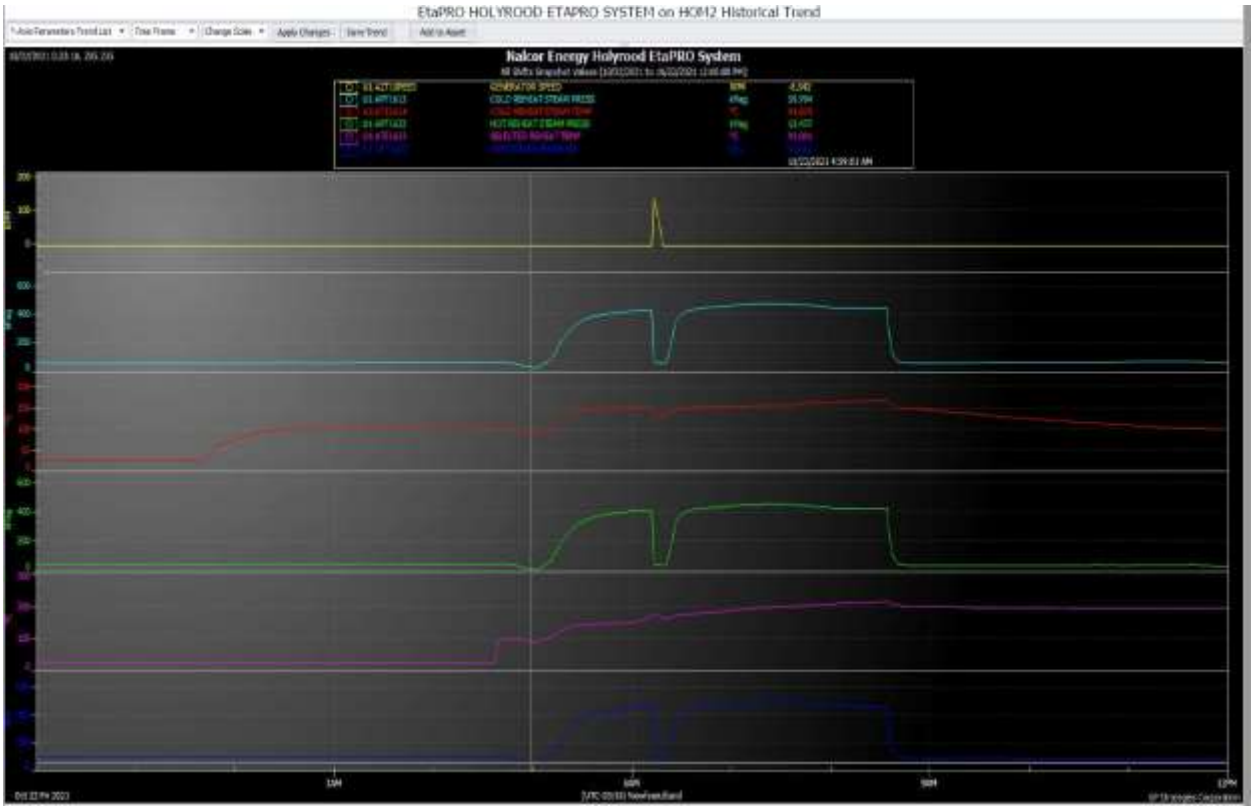
newfoundland labrador hydro


EtaPRO HOLYROOD ETAPRO SYSTEM on HOM2 Historical Trend
Nalcor Energy Holyrood EtaPRO System


EtaPRO HOLYROOD ETAPRO SYSTEM on HOM2 Historical Trend
Nalcor Energy Holyrood EtaPRO System


EtaPRO HOLYROOD ETAPRO SYSTEM on HOH2 Historical Trend
Nalcor Energy Holyrood EtaPRO System


EtaPRO HOLYROOD ETAPRO SYSTEM on HOM2 Historical Trend
Nalcor Energy Holyrood EtaPRO System


EtaPRO HOLYROOD ETAPRO SYSTEM on HOM2 Historical Trend
Nalcor Energy Holyrood EtaPRO System

Appendix G

GE's Troubleshooting Report – Holyrood TGS

newfoundland labrador hydro

Troubleshooting Report

Holyrood Thermal Generation Station

Equipment Serial #: 940310 | SY0019256

Job Start Date: 11/28/2021

Report Issued: 12/05/2021

Prepared By

Albert Lamee

Controls TA

Approved By

Ghanshyam Patel

Senior Customer Service Manager

FieldCore
a GE company

Troubleshooting Report

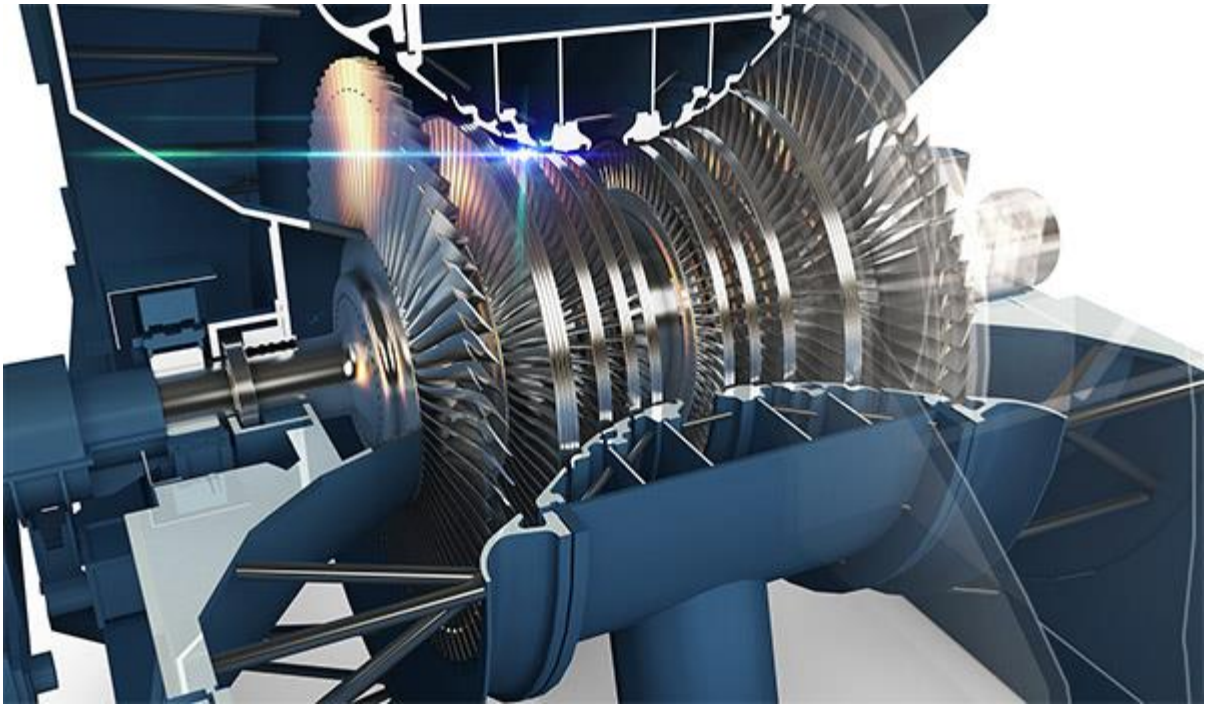
November 28, 2021

For

Holyrood Thermal Generation Station

Unit 1
ESN 940310

Customer Representative: Todd Collins
Controls Technical Advisor: Albert Lamee



FieldCore
a GE company

DETAILS AND DATA

Purpose of Visit:

The purpose of this visit was to Support Site starting up Unit#1 after investigation and repairs cause by October 25th, 2021 incident

All EHS including COVID-19 Protocol and Quality procedures have been followed lead to successfully completing the following Tasks:

- MSV Steam Seal Test
- Unit Start-up
- Unit Loading to 150 MW
- Unit Operation at 70 MW for 48 Hrs

Main Stop Valve Steam Seal Test

Step 0 – Initial Condition and Stroking MCV

We started by recording all parameters at initial conditions

By Forcing all Valves to Close position, requested operation team to select Pre-Warm OFF, ensuring all valves stayed at Close Position. Took Control of Main Control Valve (MCV) using Calibration mode and opened the valve in steps to 5% ensuring valve under full control

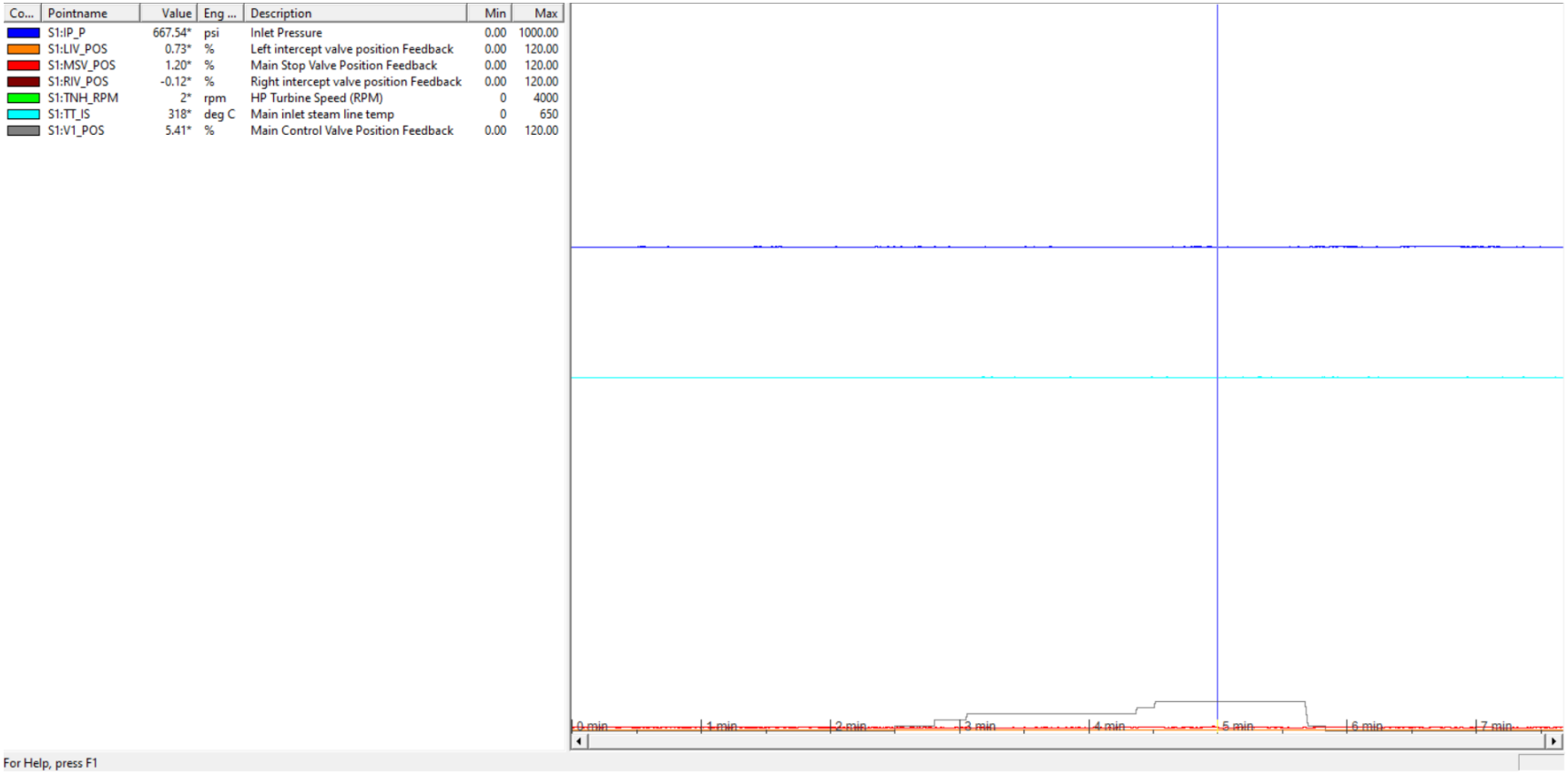


Figure 1: Step 0 – Main Stop Valve Steam Seal Test

Checked Inlet Pressure and Turbine speed for any indication of Steam Leak, confirmed no steam leak by observing delta inlet pressure of Zero (0) psi

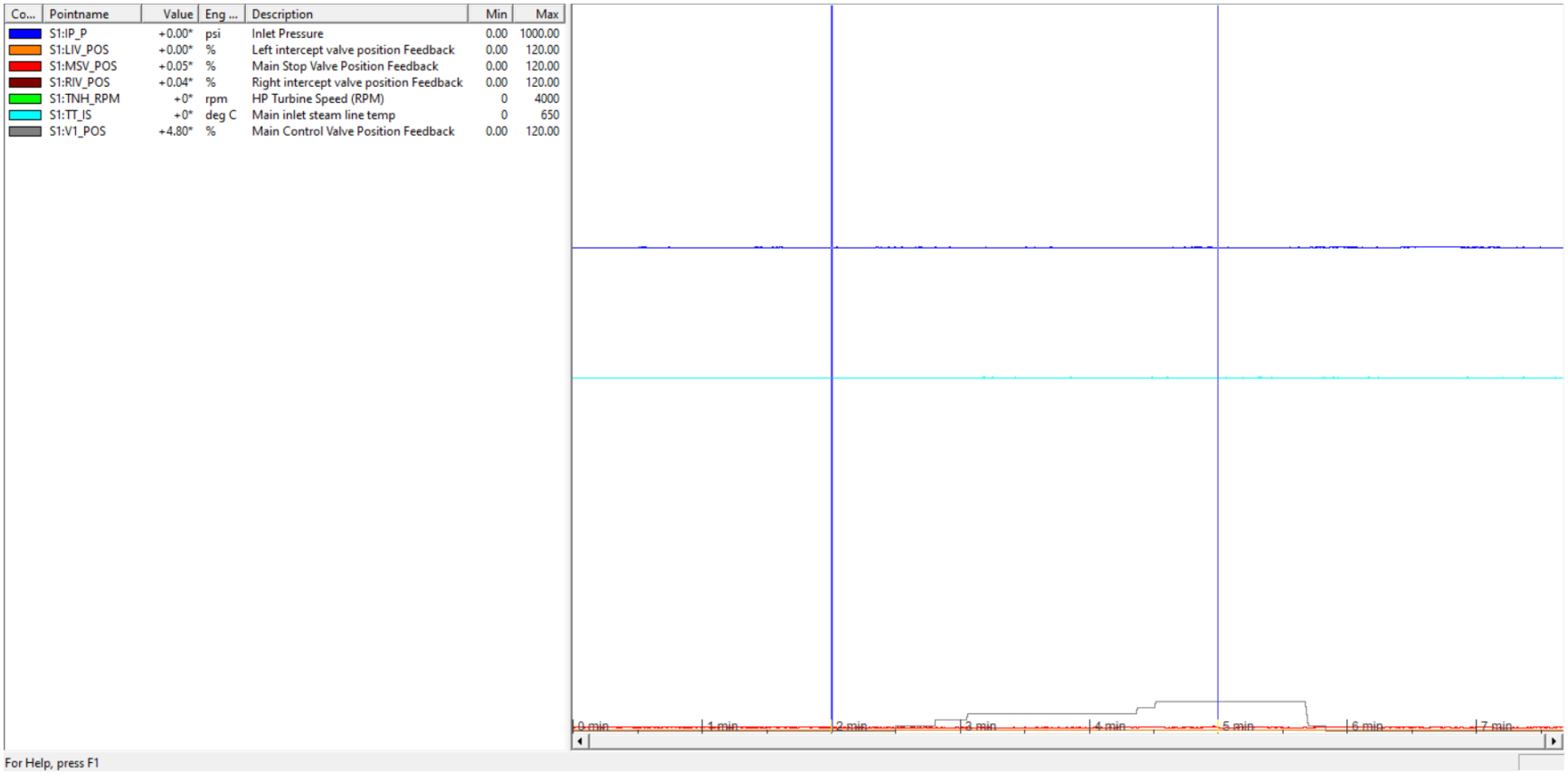


Figure 2 – MCV Open 5% - Delta Values confirmed No change in Inlet Pressure

Step 1 – Manually open LIV followed by RIV

After the success of Step 0, we proceeded by setting up Step 1 where we will open Left Intercept Valve followed by Right Intercept Valve in steps while forcing MCV fully Close

Manually open LIV then RIV while forcing MCV fully Close

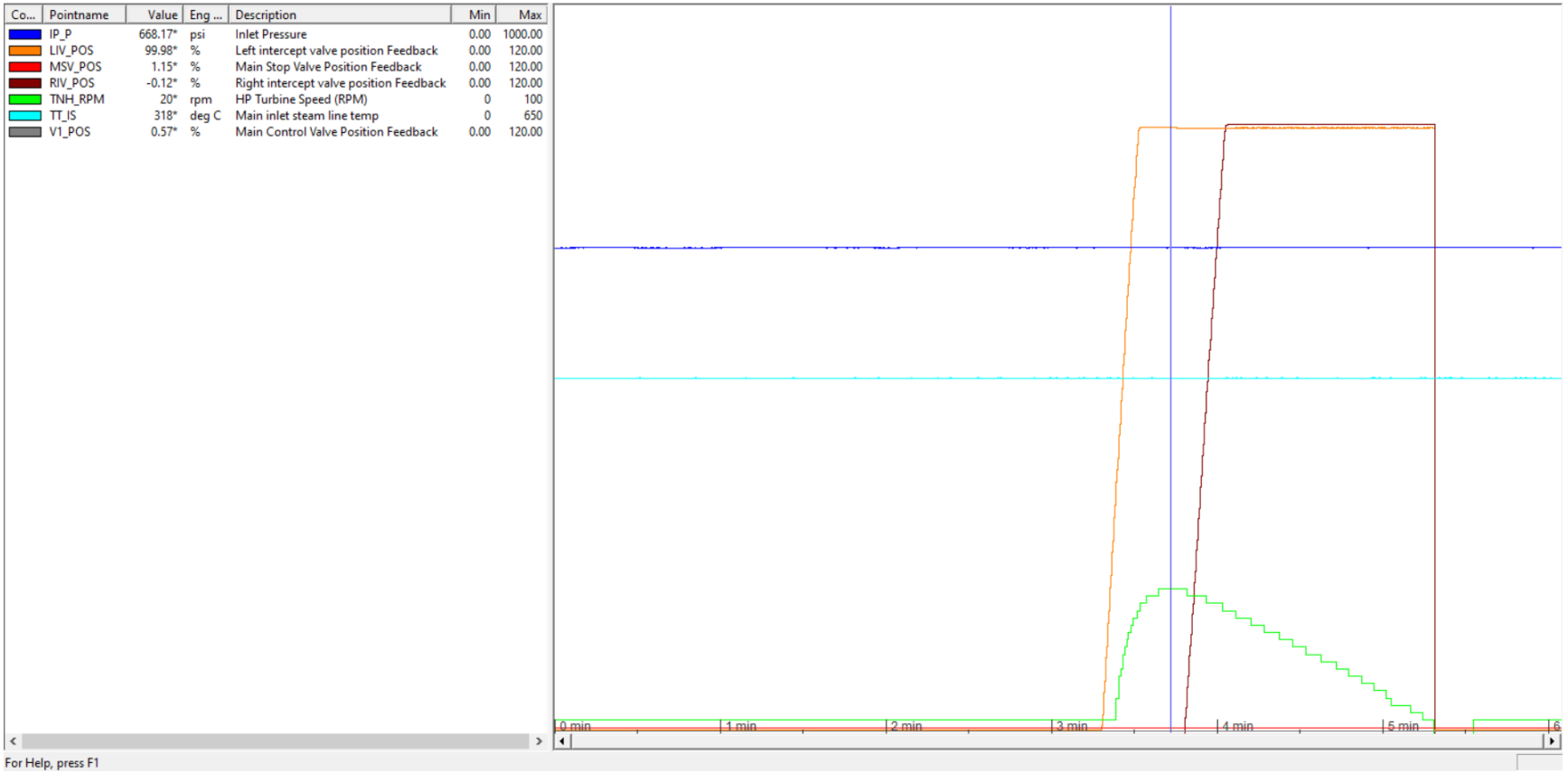


Figure 3: Step 1 – Manually Open LIV then RIV Step 1

Checked Inlet Pressure and Turbine speed for any indication of Steam Leak, confirmed no steam leak by observing delta inlet pressure of Zero (0) psi

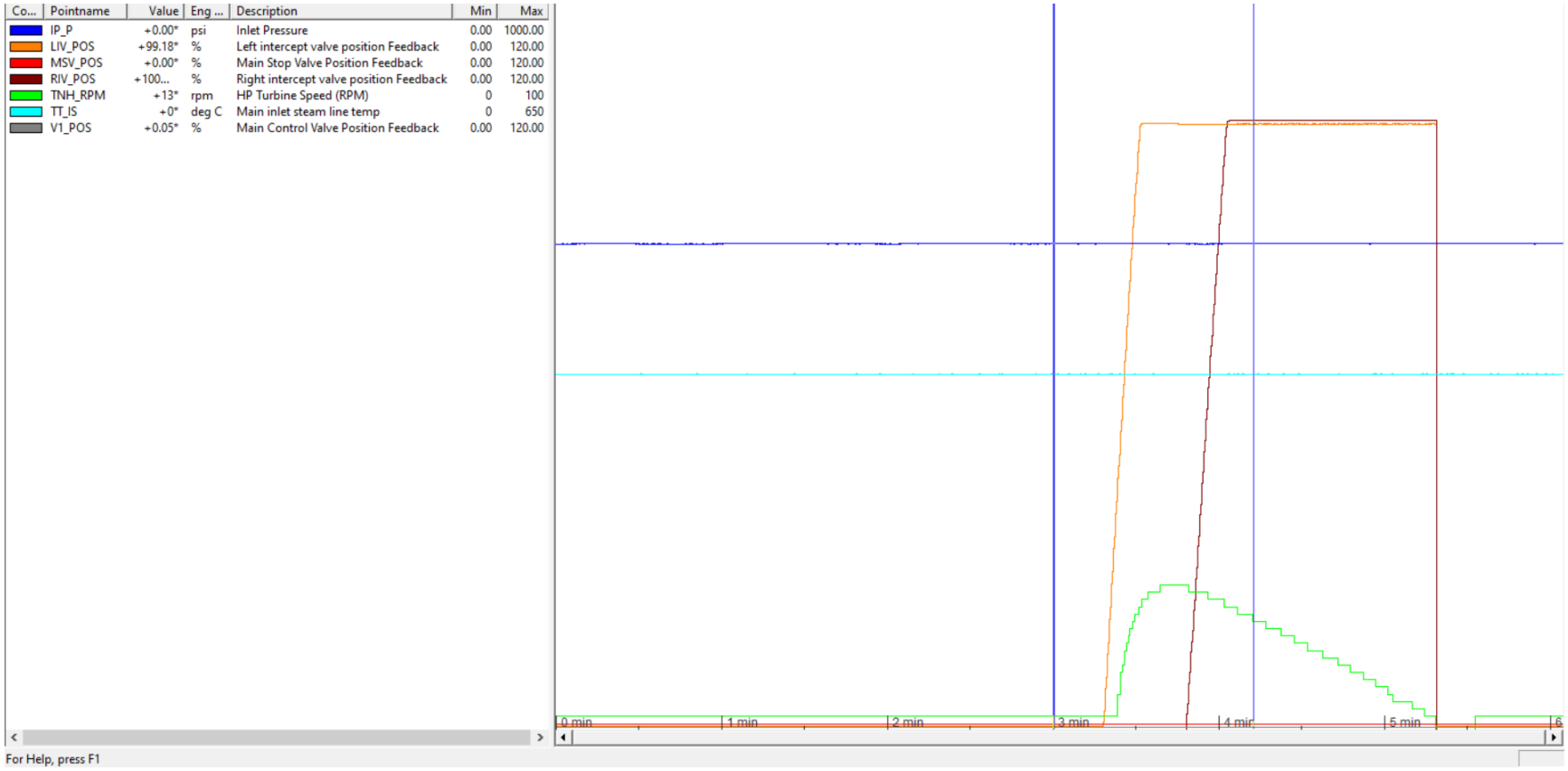


Figure 4: Manually Open LIV then RIV - No Change in inlet pressure

Step 2 – Automatically Open LIV and RIV

After the success of Step 1, we proceeded by setting up Step 2 where we will open Left Intercept Valve and Right Intercept Valve automatically while forcing Main Control Valve fully Close

Automatically open LIV and RIV while forcing MCV fully Close

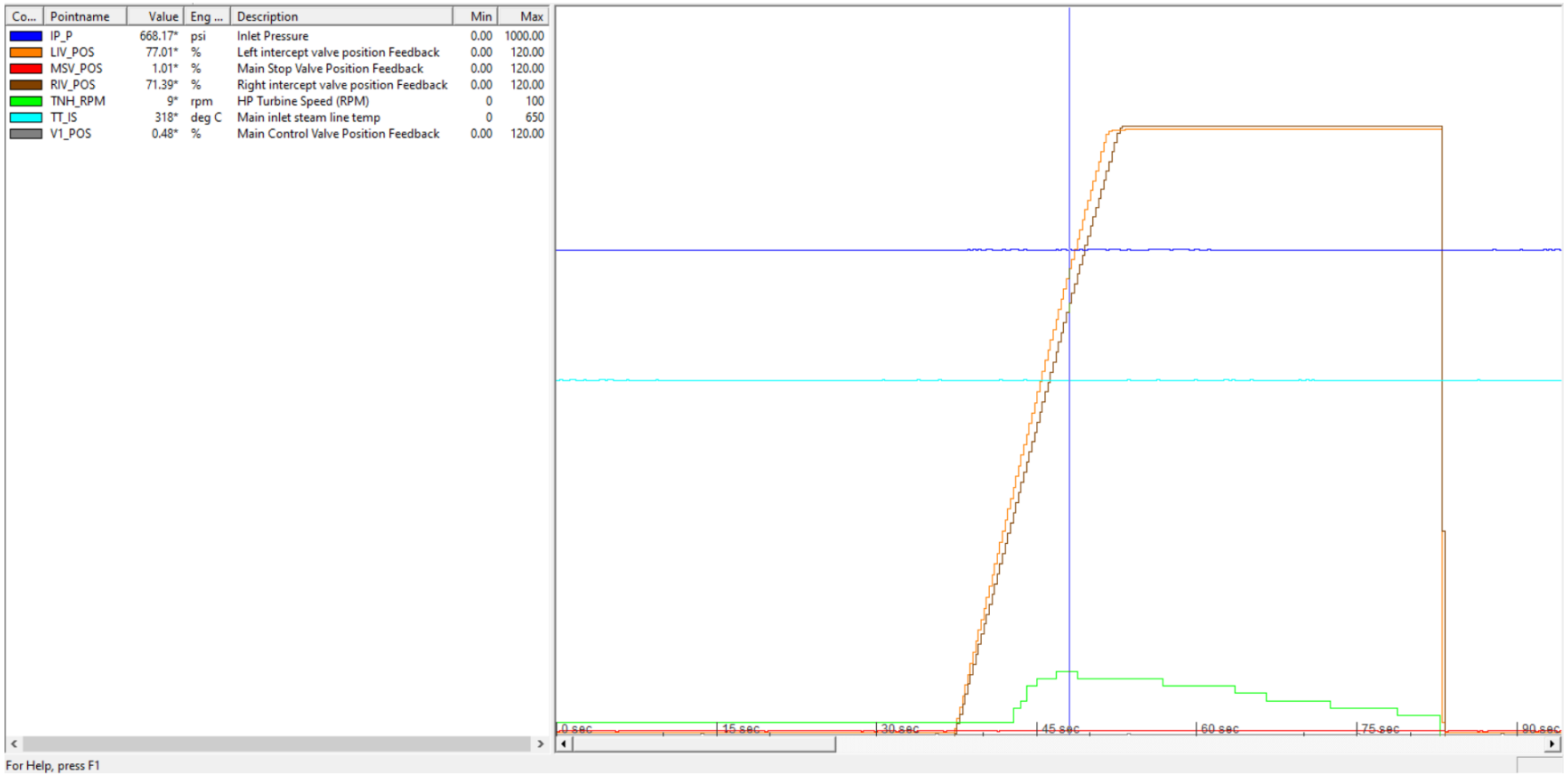


Figure 5: Step 2 – Automatically Open LIV and RIV

Checked Inlet Pressure and Turbine speed for any indication of Steam Leak, confirmed no steam leak by observing delta inlet pressure of Zero (0) psi

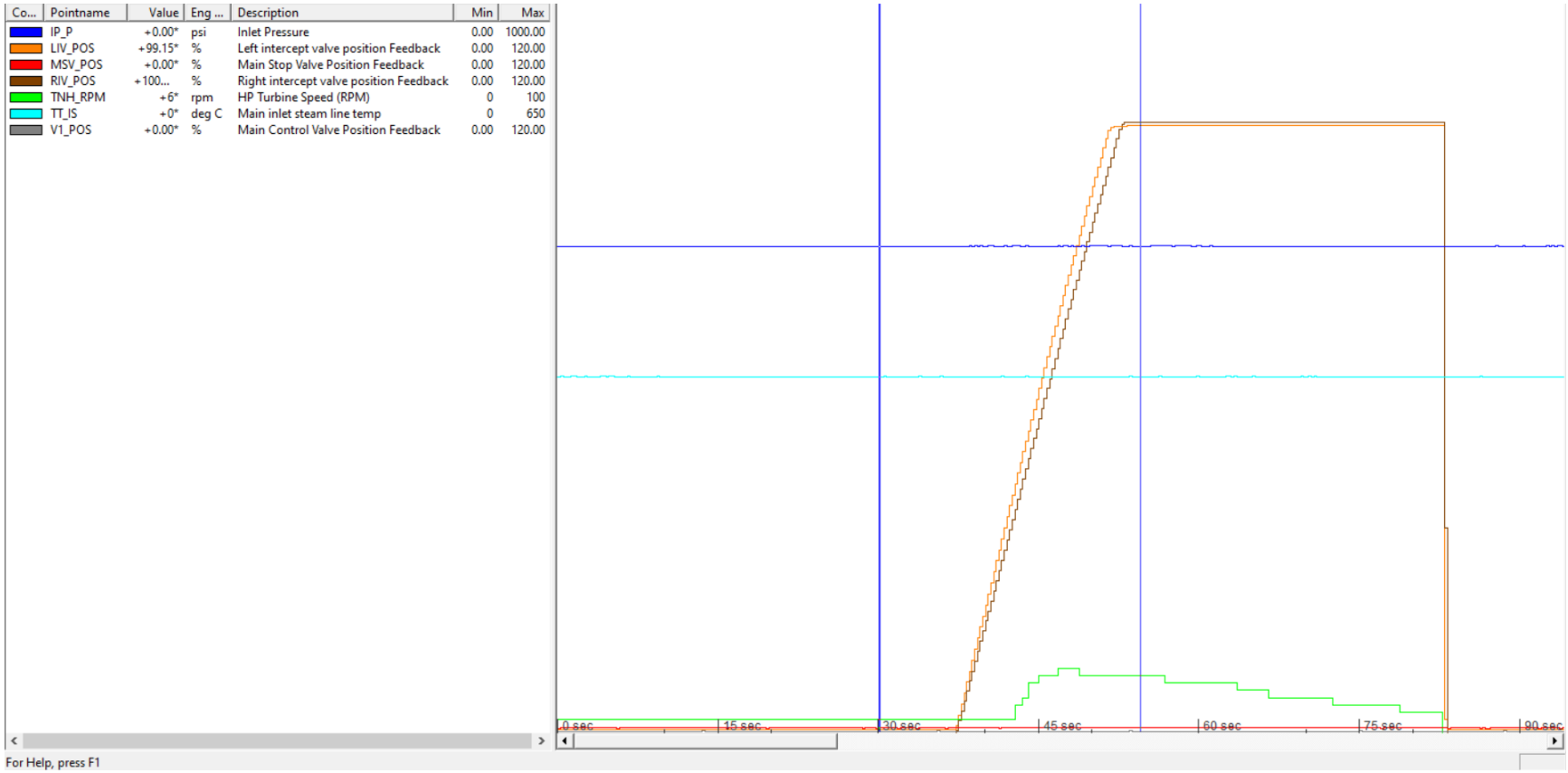


Figure 6: Step 2 – Automatically Open LIV and RIV - No Change in inlet pressure

Step 3 – Automatically Open LIV, RIV and MCV

After the success of Step 2, we proceeded by setting up Step 3 where we will switch all valves in Automatic and reset the system Automatically open LIV, RIV and MCV

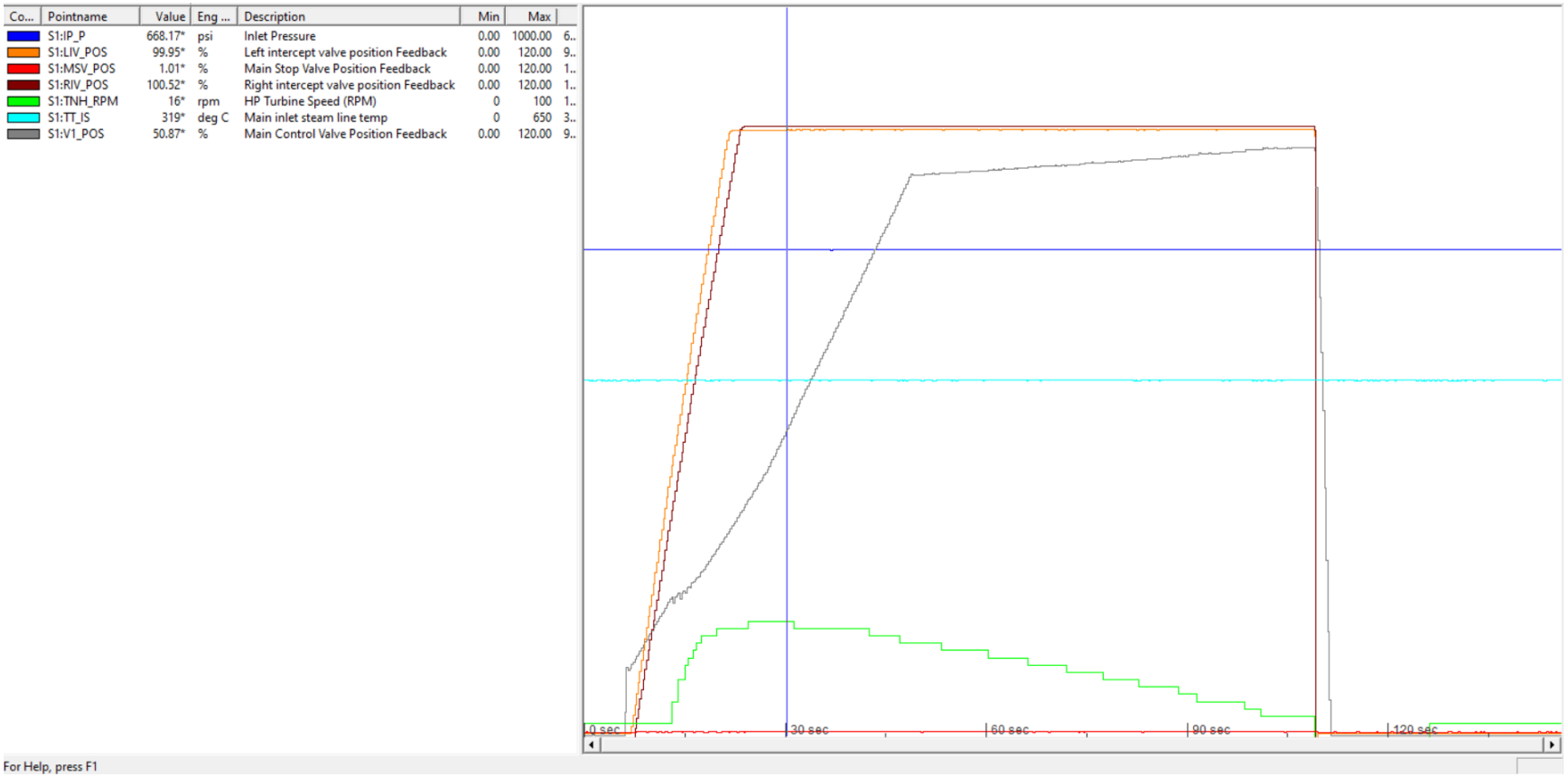


Figure 7: Step 3 – Normal Operation - All Valves on Auto Mode

Checked Inlet Pressure and Turbine speed for any indication of Steam Leak, confirmed no steam leak by observing delta inlet pressure of Zero (0) psi between values before opening the valves and at MCV 50% where Turbine Speed at 16 RPM

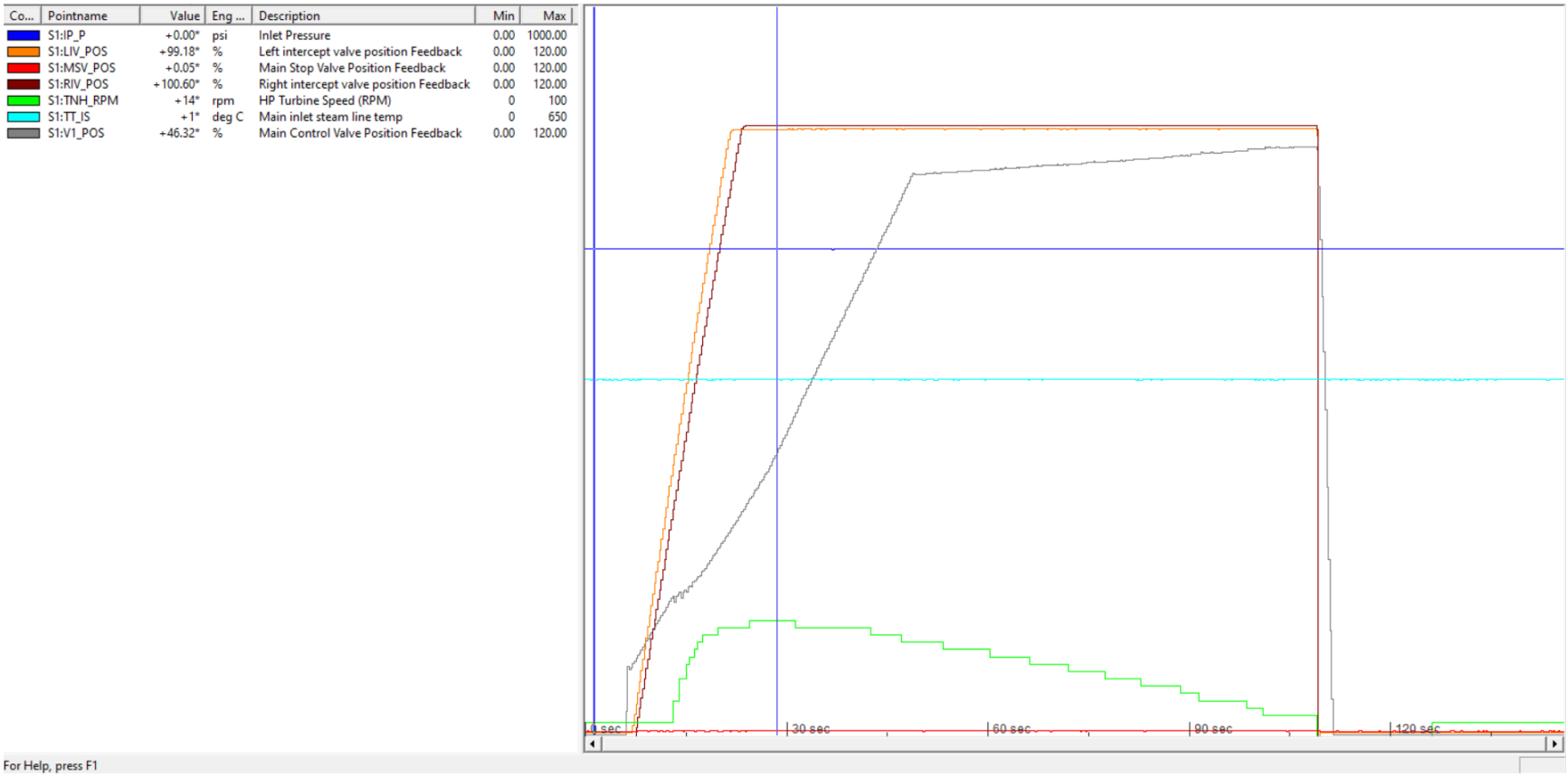


Figure 8: Step 3 – Normal Operation - All Valves on Auto - No Change in Inlet Pressure

Checked Inlet Pressure and Turbine speed for any indication of Steam Leak, confirmed no steam leak by observing delta inlet pressure of Zero (0) psi between values before opening the valves and at MCV 100% where Turbine Speed settled down to 3 RPM

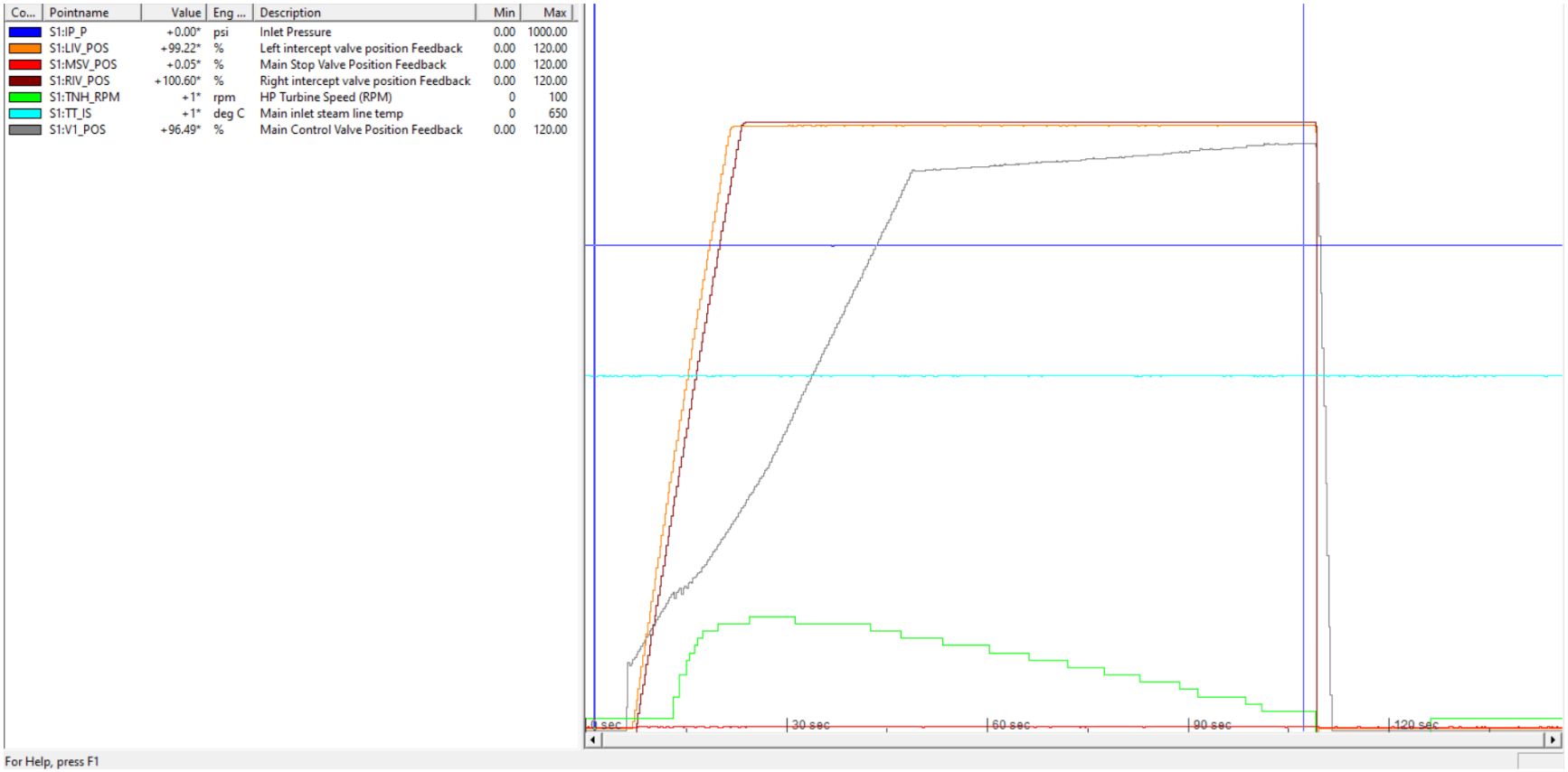


Figure 9: Step 3 – Normal Operation - MCV Valve Full Open - No Change in inlet pressure

Conclusion:

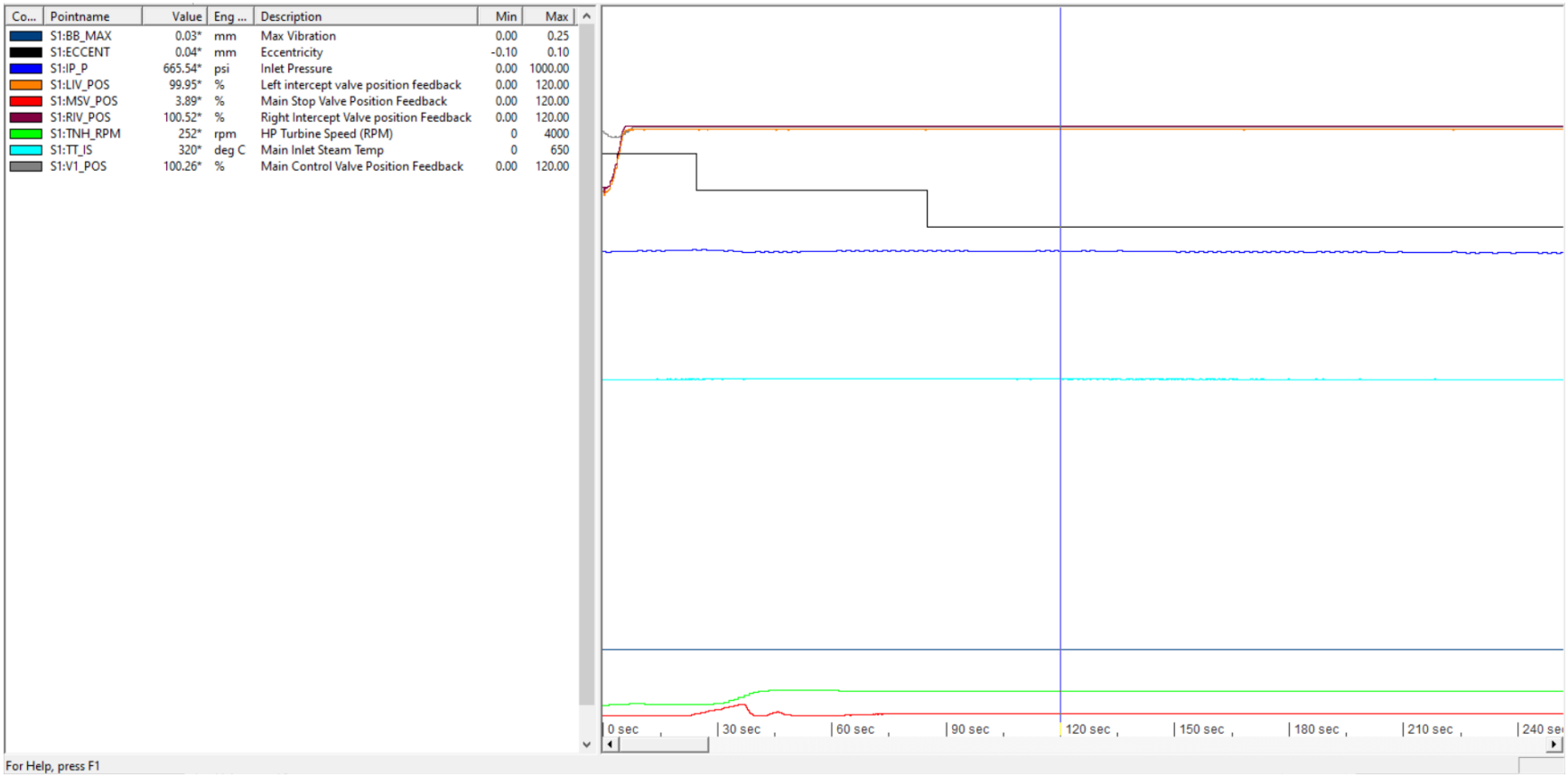
Main Stop Valve showed good characteristics and complete seal for any steam leak

Unit Start-Up

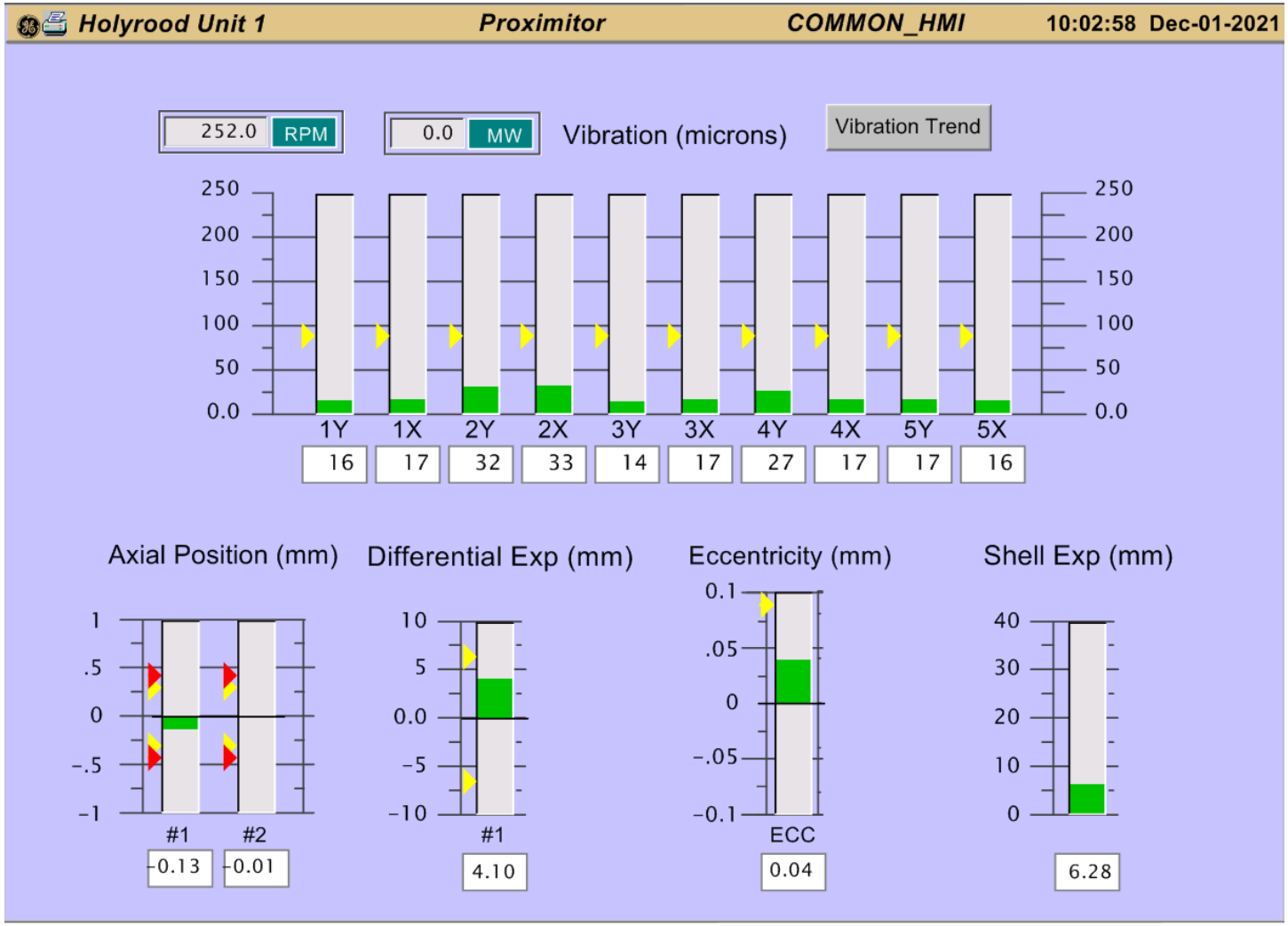
It was recommended and agreed upon to utilize Dark NL procedure developed by the customer for the first run of the unit after the late incident.

Unit Started up with no issues showing good parameters

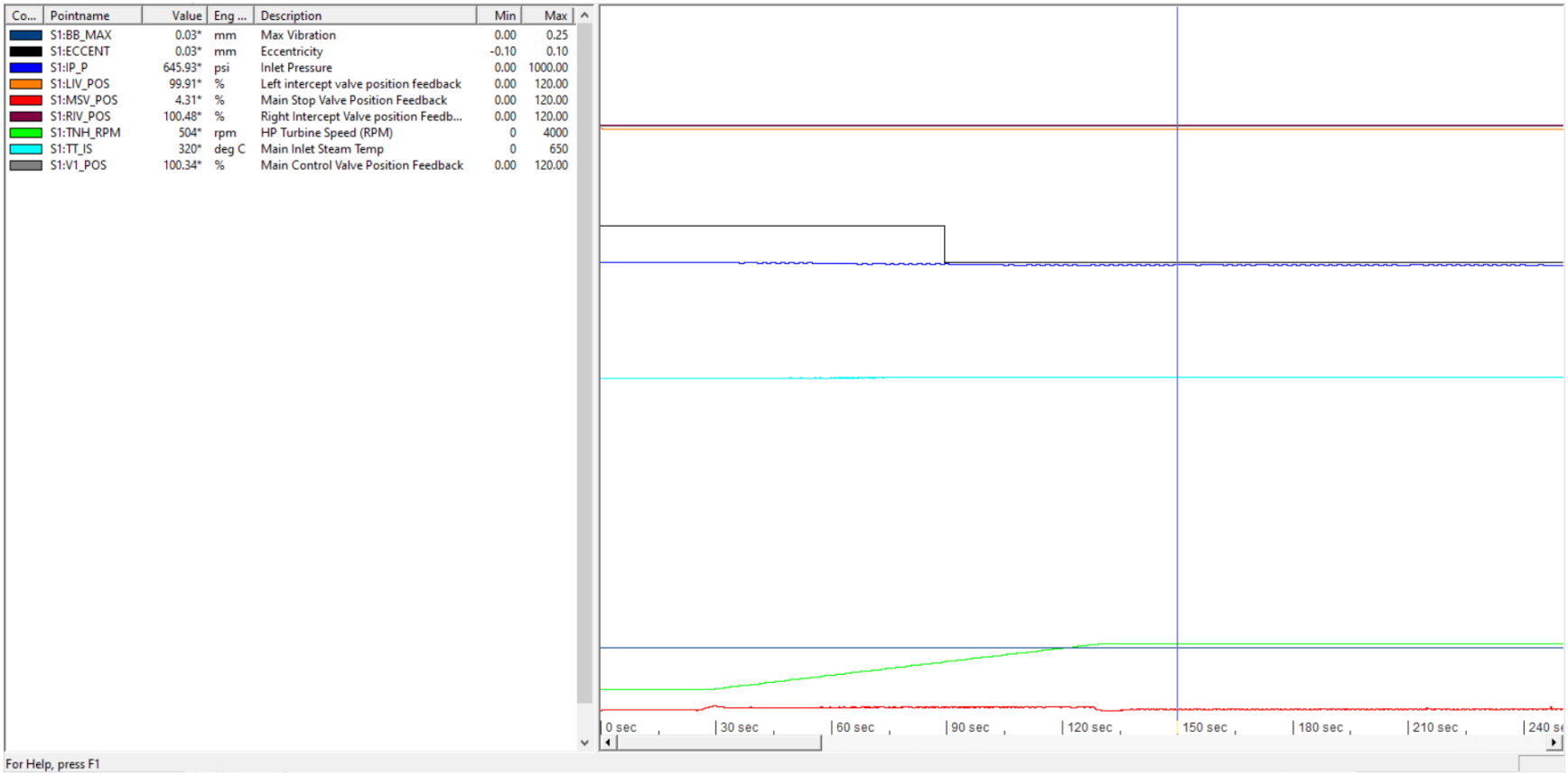
Unit Ramp to 250 RPM Data



Unit ramped up from turning gear speed of 2 RPM to 252 RPM smoothly with minimal overshooting speed of 261 RPM that quickly settled down to controlled 252 RPM, Main Stop Valve was stable and controlling smoothly the speed.

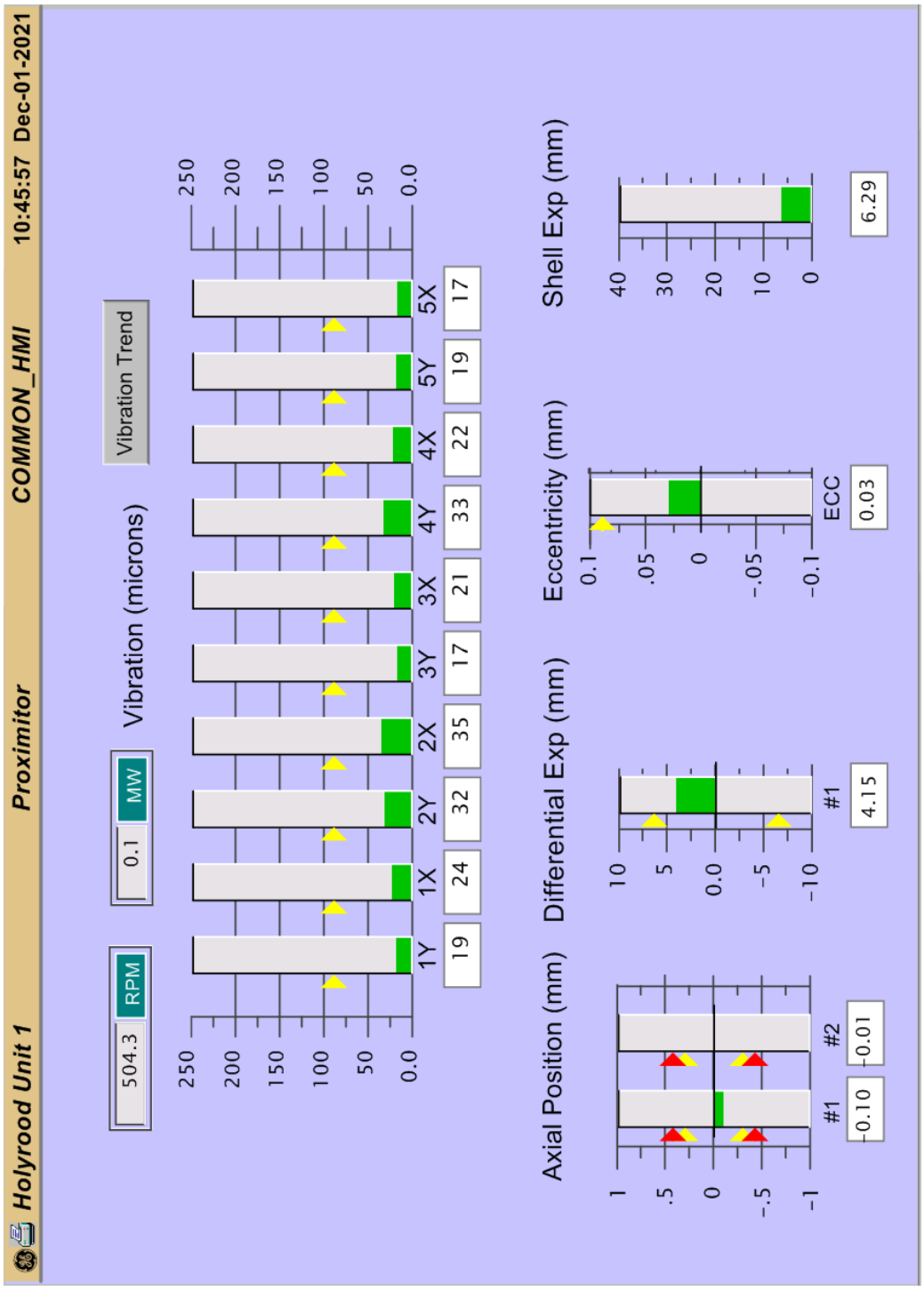


Unit Ramp to 500 RPM Data

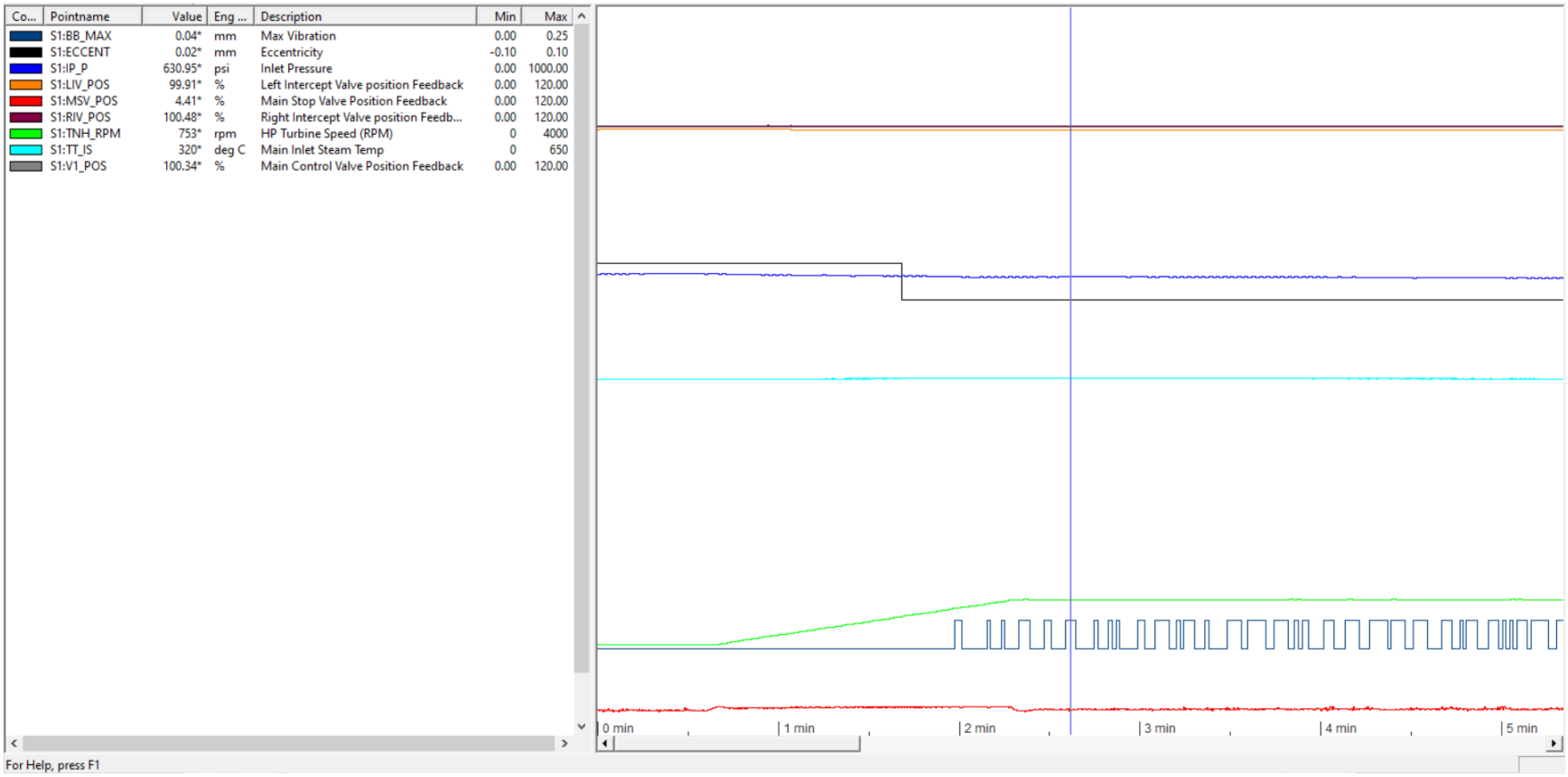


Co...	Pointname	Value	Eng ...	Description	Min	Max
	S1:BB_MAX	0.03*	mm	Max Vibration	0.00	0.25
	S1:ECCENT	0.03*	mm	Eccentricity	-0.10	0.10
	S1:IP_P	645.93*	psi	Inlet Pressure	0.00	1000.00
	S1:LIV_POS	99.91*	%	Left intercept valve position feedback	0.00	120.00
	S1:MSV_POS	4.31*	%	Main Stop Valve Position Feedback	0.00	120.00
	S1:RIV_POS	100.48*	%	Right Intercept Valve position Feedb...	0.00	120.00
	S1:TNH_RPM	504*	rpm	HP Turbine Speed (RPM)	0	4000
	S1:TT_IS	320*	deg C	Main Inlet Steam Temp	0	650
	S1:V1_POS	100.34*	%	Main Control Valve Position Feedback	0.00	120.00

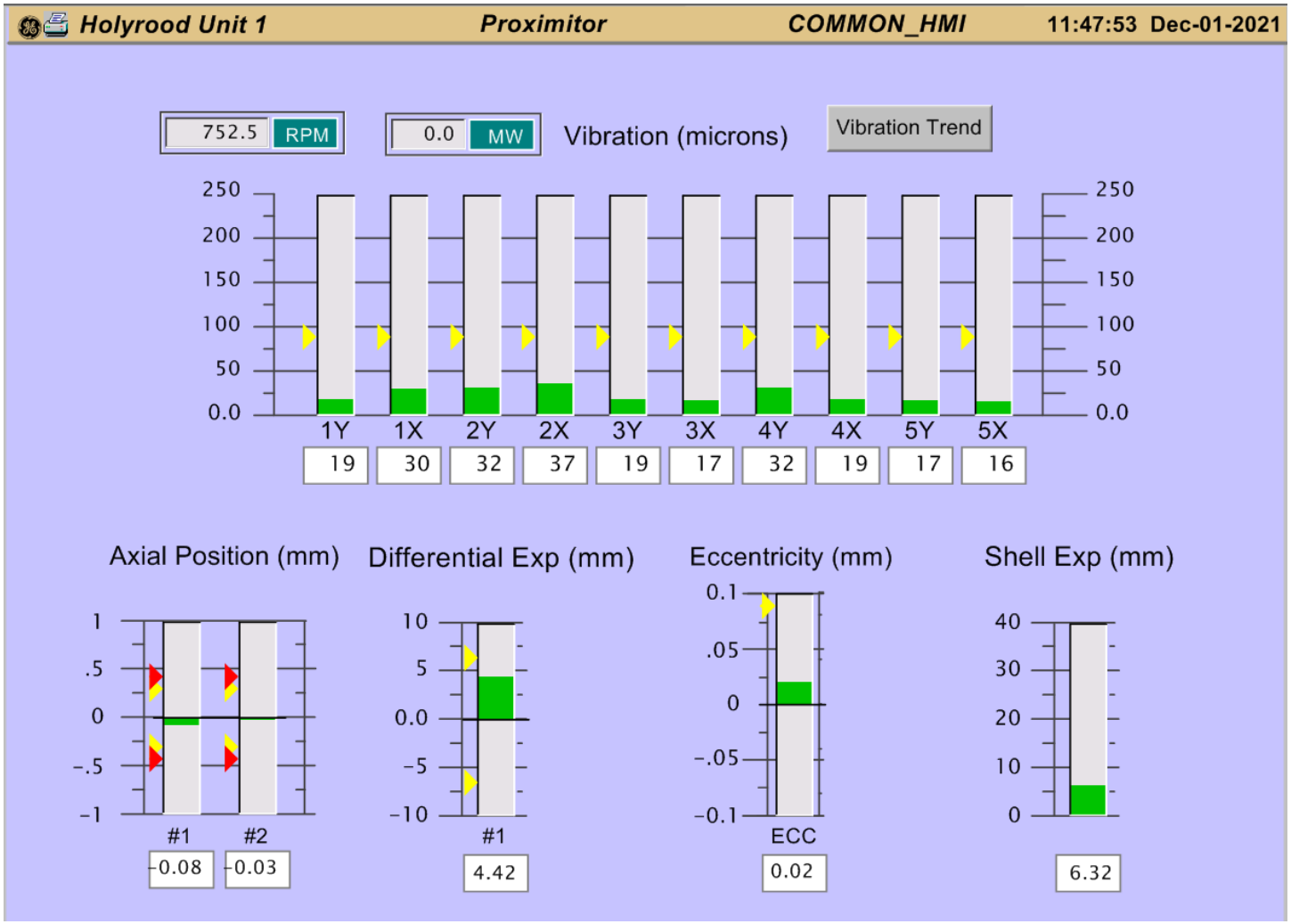
Unit ramped up from 252 RPM to 504 RPM smoothly with no overshooting and kept controlling at 504 RPM, Main Stop Valve was stable and controlling smoothly the speed.


Holyrood Unit 1
Proximitor
COMMON_HMI
10:45:57 Dec-01-2021
504.3
RPM
0.1
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y
1X
2Y
2X
3Y
3X
4Y
4X
5Y
5X
19
24
32
35
17
21
33
22
19
17
Axial Position (mm)
#1
#2
-0.10
-0.01
Differential Exp (mm)
#1
4.15
Eccentricity (mm)
ECC
0.03
Shell Exp (mm)
6.29

Unit Ramp to 750 RPM Data

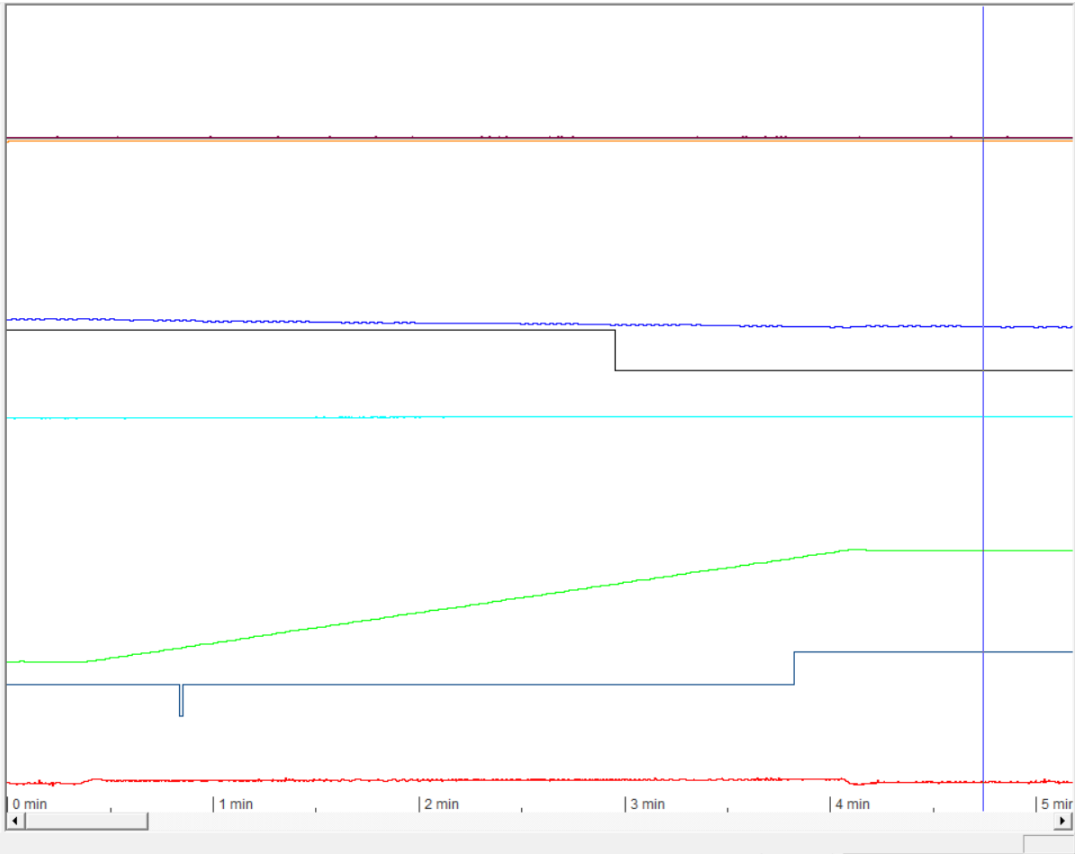


Unit ramped up from 504 RPM to 753 RPM smoothly with no overshooting and kept controlling at 703 RPM, Main Stop Valve was stable and controlling smoothly the speed.


Holyrood Unit 1
Proximitor
COMMON_HMI
11:47:53 Dec-01-2021
752.5 RPM
0.0 MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
19 30 32 37 19 17 32 19 17 16
Axial Position (mm)
1
.5
0
-.5
-1
#1 #2
-0.08 -0.03
Differential Exp (mm)
10
5
0.0
-5
-10
#1
4.42
Eccentricity (mm)
0.1
.05
0
-.05
-0.1
ECC
0.02
Shell Exp (mm)
40
30
20
10
0
6.32

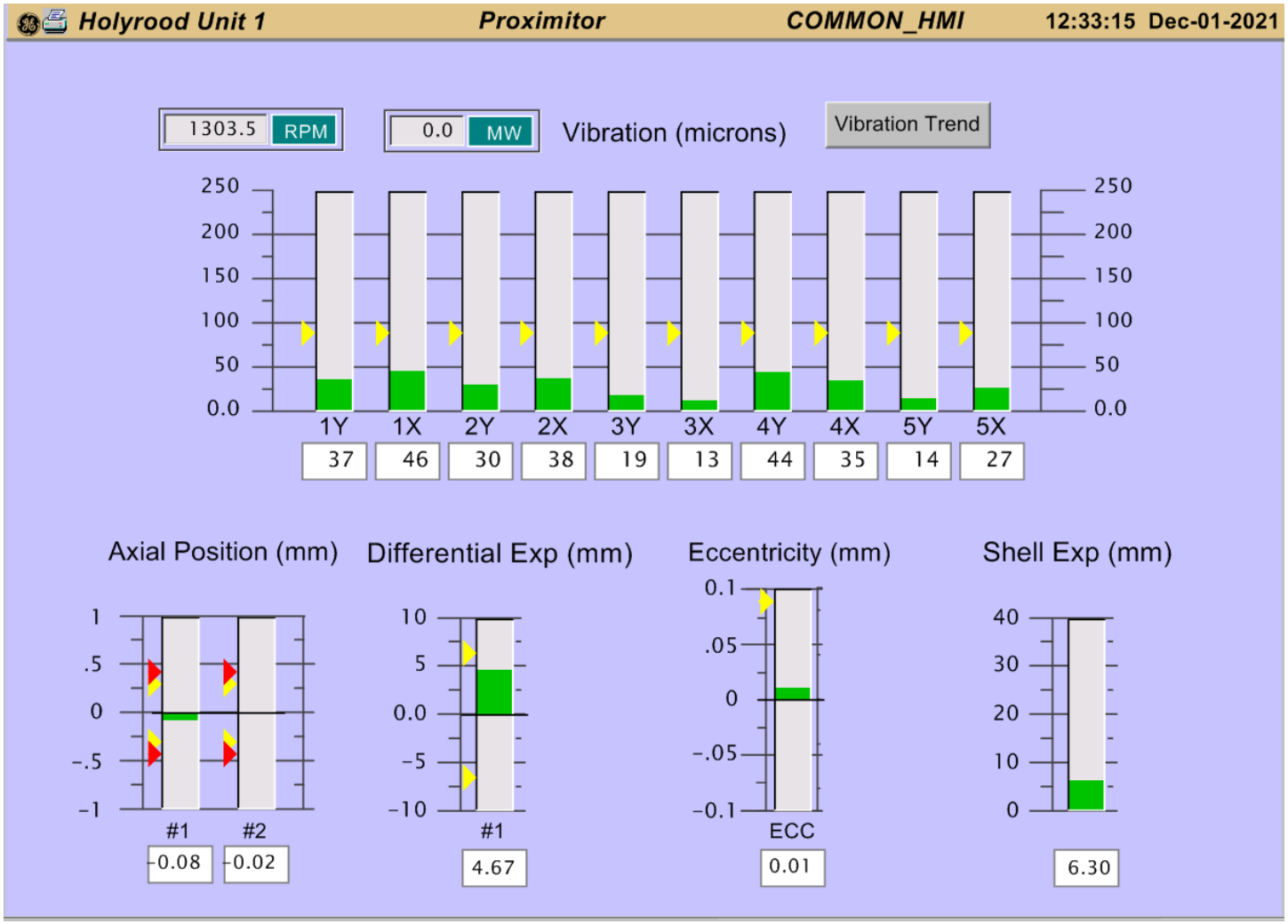
Unit Ramp to 1300 RPM Data

Co...	Pointname	Value	Eng ...	Description	Min	Max
	S1:BB_MAX	0.05*	mm	Max Vibration	0.00	0.25
	S1:ECCENT	0.01*	mm	Eccentricity	-0.10	0.10
	S1:IP_P	603.47*	psi	Inlet Pressure	0.00	1000.00
	S1:LIV_POS	99.98*	%	Left Intercept Valve position Feedback	0.00	120.00
	S1:MSV_POS	4.64*	%	Main Stop Valve Position Feedback	0.00	120.00
	S1:RIV_POS	100.56*	%	Right Intercept Valve position Feedb...	0.00	120.00
	S1:TNH_RPM	1304*	rpm	HP Turbine Speed (RPM)	0	4000
	S1:TT_IS	320*	deg C	Main Inlet Steam Temp	0	650
	S1:V1_POS	100.30*	%	Main Control Valve Position Feedback	0.00	120.00

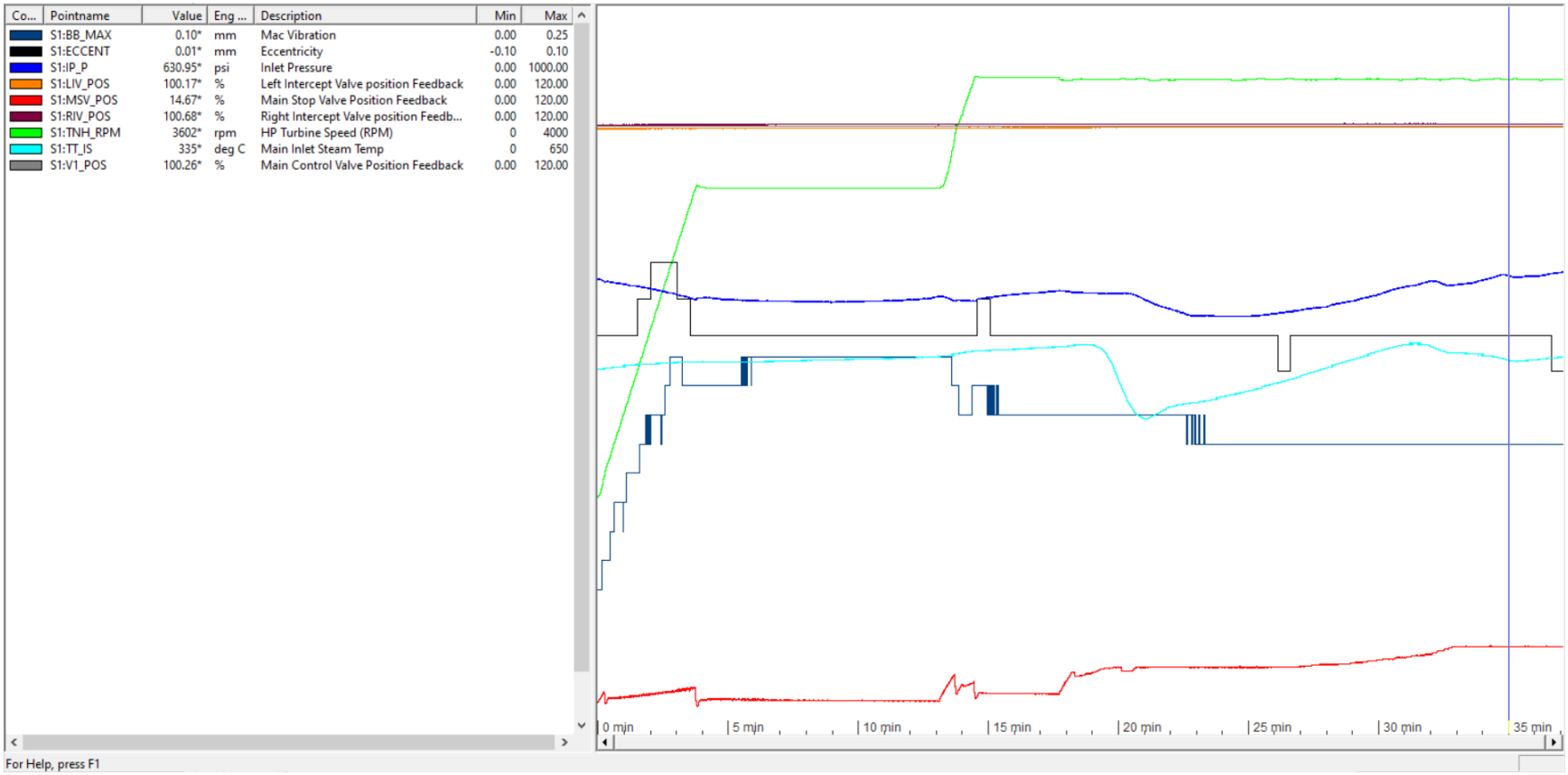


For Help, press F1

Unit ramped up from 753 RPM to 1304 RPM smoothly with minimal overshooting speed of 1308 RPM that quickly settled down to controlled 1304 RPM, Main Stop Valve was stable and controlling smoothly the speed.


Holyrood Unit 1
Proximitor
COMMON_HMI
12:33:15 Dec-01-2021
1303.5 RPM
0.0 MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
37 46 30 38 19 13 44 35 14 27
Axial Position (mm)
1
.5
0
-.5
-1
#1 #2
-0.08 -0.02
Differential Exp (mm)
10
5
0.0
-5
-10
#1
4.67
Eccentricity (mm)
0.1
.05
0
-.05
-0.1
ECC
0.01
Shell Exp (mm)
40
30
20
10
0
6.30

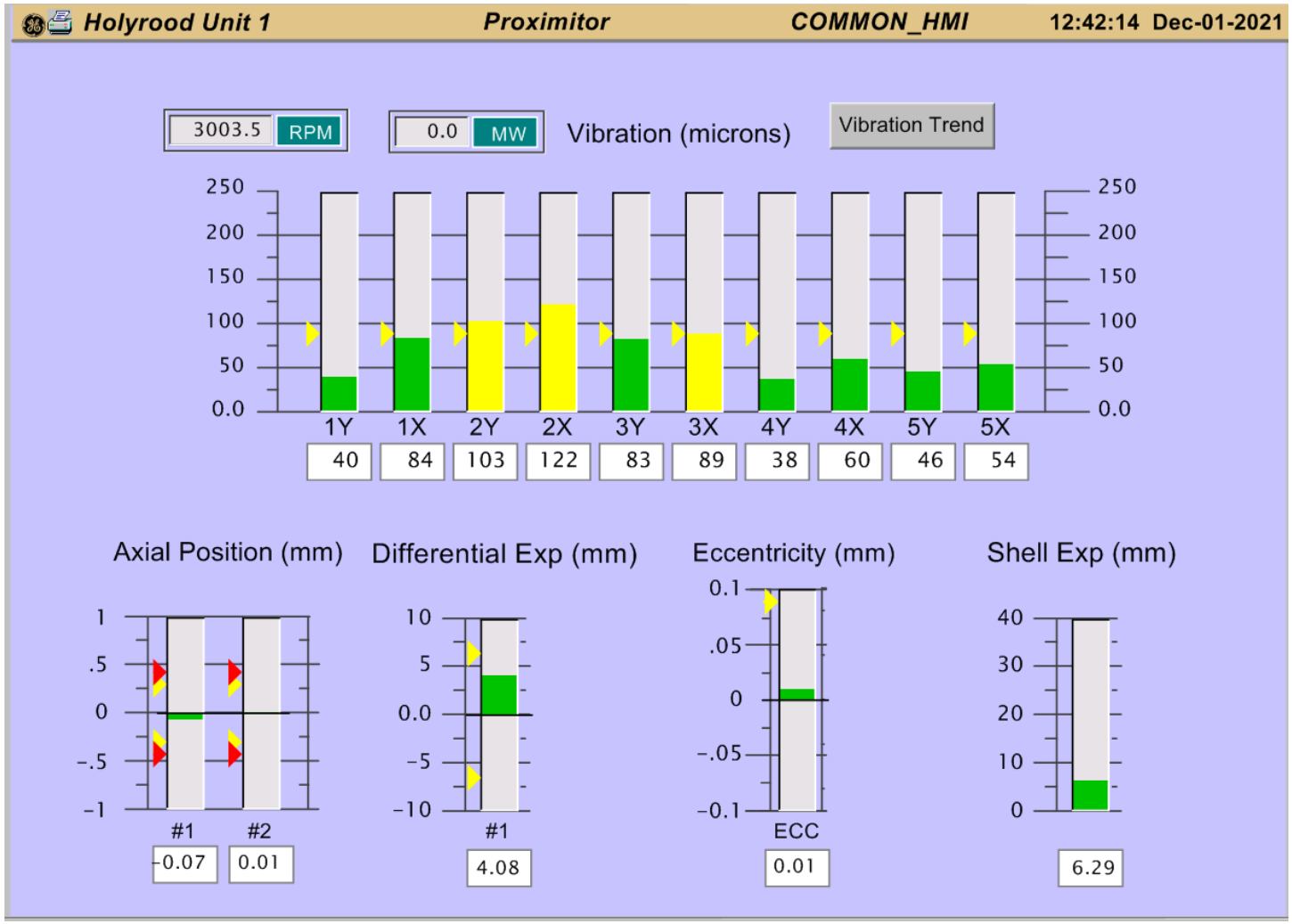
Unit Ramp to Synch Speed Data

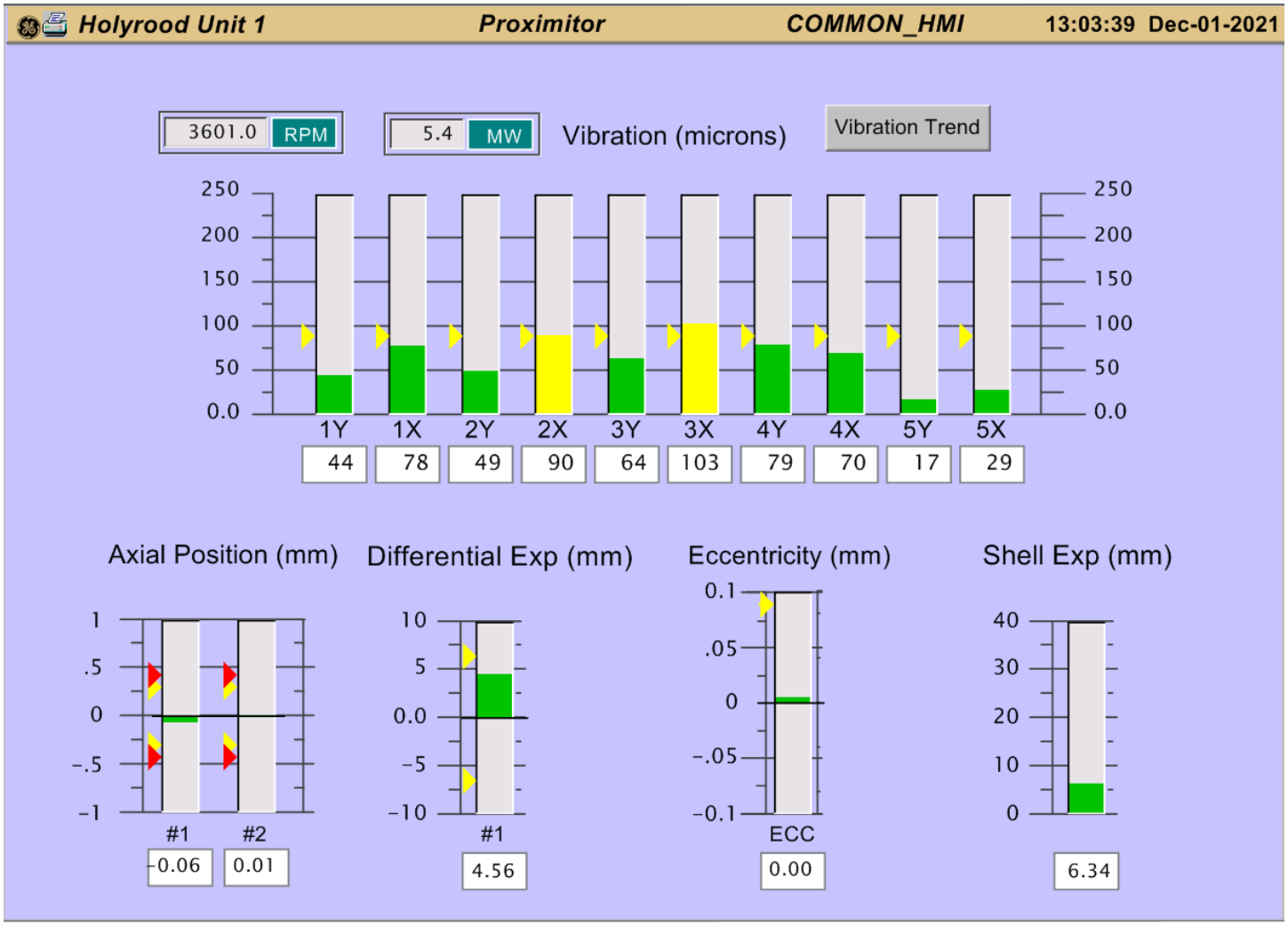


Co...	Pointname	Value	Eng ...	Description	Min	Max
	S1:BB_MAX	0.10*	mm	Mac Vibration	0.00	0.25
	S1:ECCENT	0.01*	mm	Eccentricity	-0.10	0.10
	S1:IP_P	630.95*	psi	Inlet Pressure	0.00	1000.00
	S1:LIV_POS	100.17*	%	Left Intercept Valve position Feedback	0.00	120.00
	S1:MSV_POS	14.67*	%	Main Stop Valve Position Feedback	0.00	120.00
	S1:RIV_POS	100.68*	%	Right Intercept Valve position Feedb...	0.00	120.00
	S1:TNH_RPM	3602*	rpm	HP Turbine Speed (RPM)	0	4000
	S1:TT_IS	335*	deg C	Main Inlet Steam Temp	0	650
	S1:V1_POS	100.26*	%	Main Control Valve Position Feedback	0.00	120.00

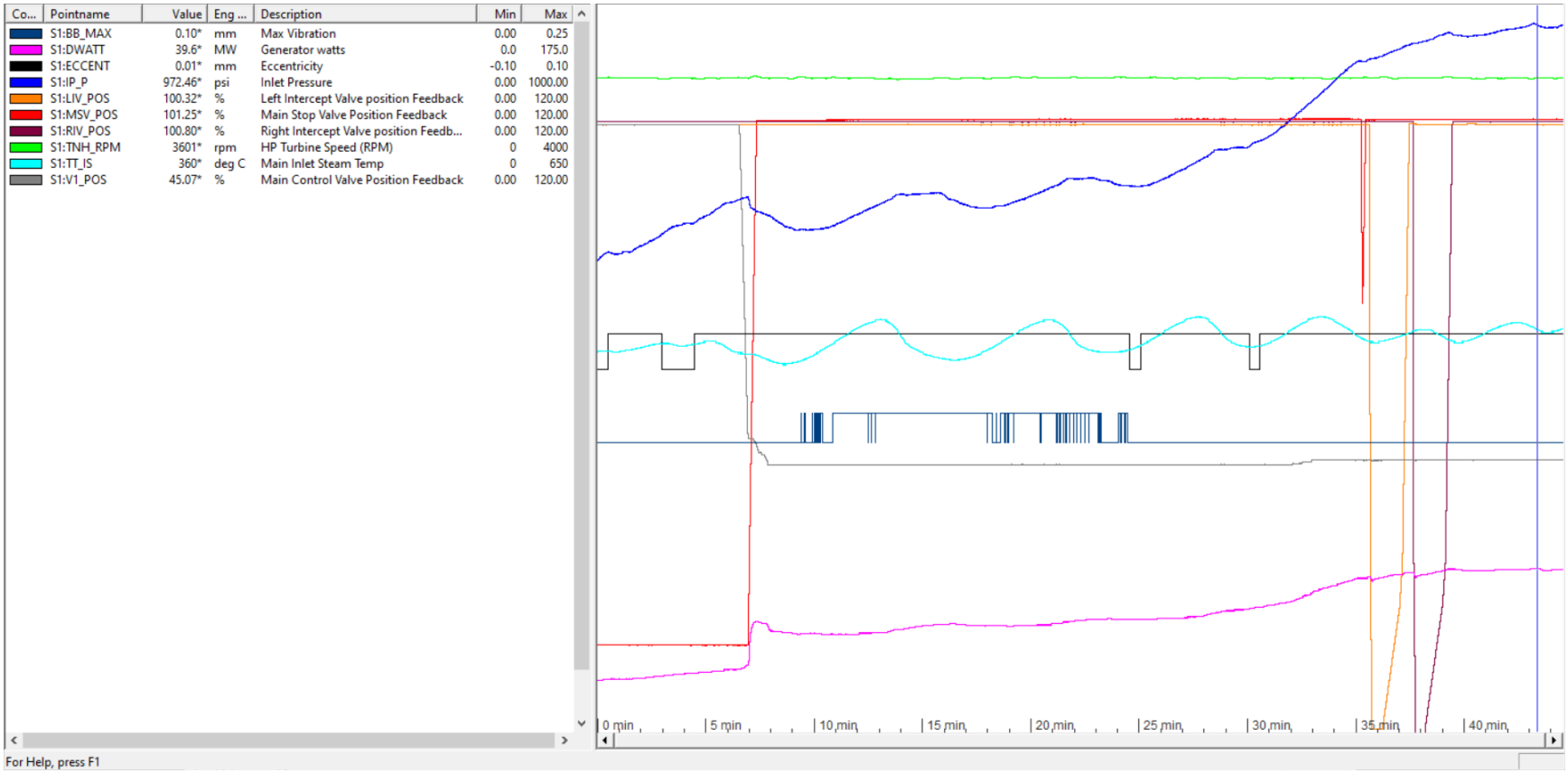
Unit ramped up from 1304 RPM to Synch speed of 3602 RPM smoothly with minimal overshooting speed of 3620 RPM that quickly settled down to controlled 3614 RPM, Main Stop Valve was stable and controlling smoothly the speed.

Maximum Vibration during critical speed of 2600 RPM and during acceleration from 3000 RPM to 3450 RPM was 130 Microns that settled down to 100 Microns



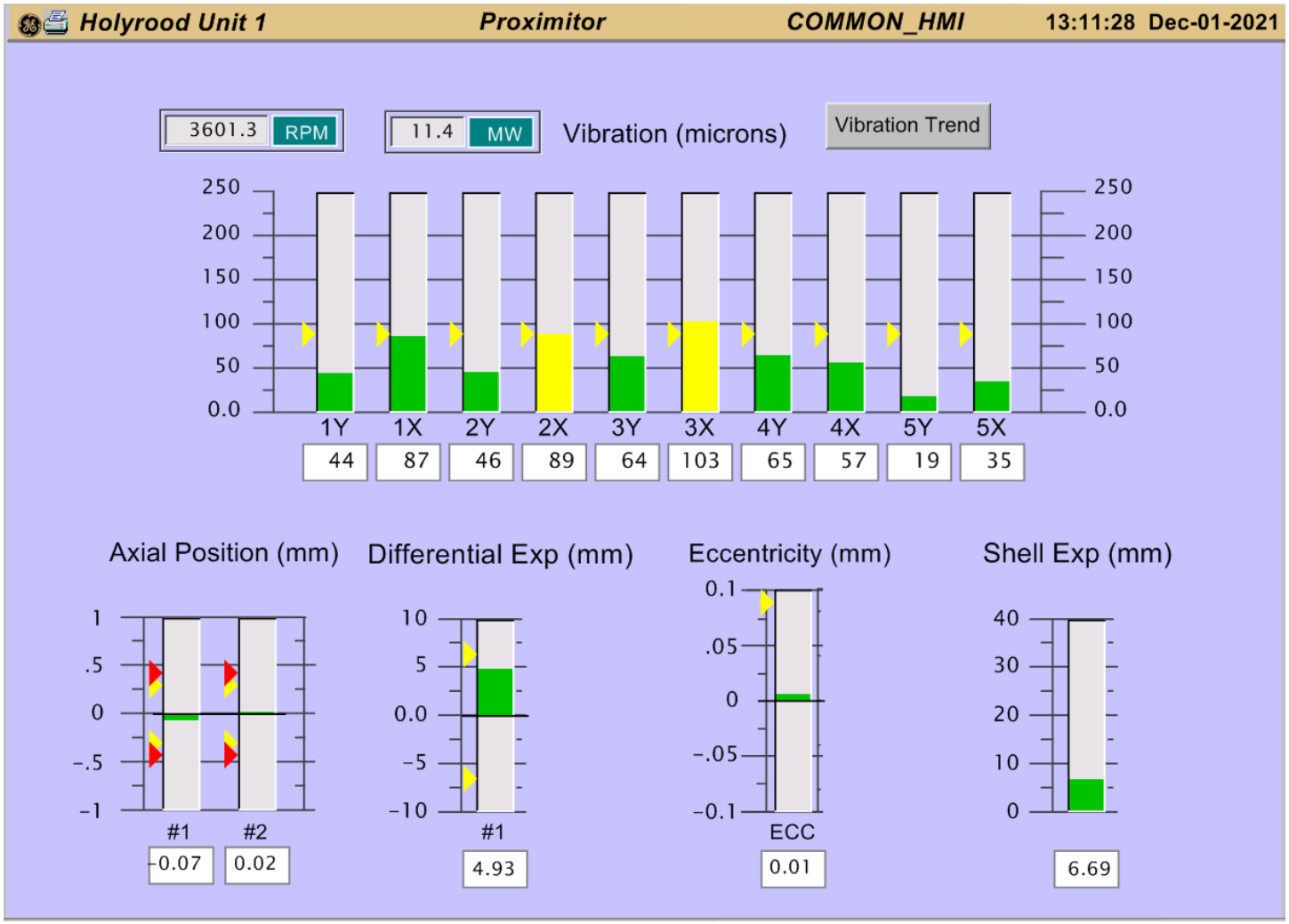

Holyrood Unit 1
Proximitor
COMMON_HMI
13:03:39 Dec-01-2021
3601.0 RPM
5.4 MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
44 78 49 90 64 103 79 70 17 29
Axial Position (mm)
1
.5
0
-.5
-1
#1 #2
-0.06 0.01
Differential Exp (mm)
10
5
0.0
-5
-10
#1
4.56
Eccentricity (mm)
0.1
.05
0
-.05
-0.1
ECC
0.00
Shell Exp (mm)
40
30
20
10
0
6.34

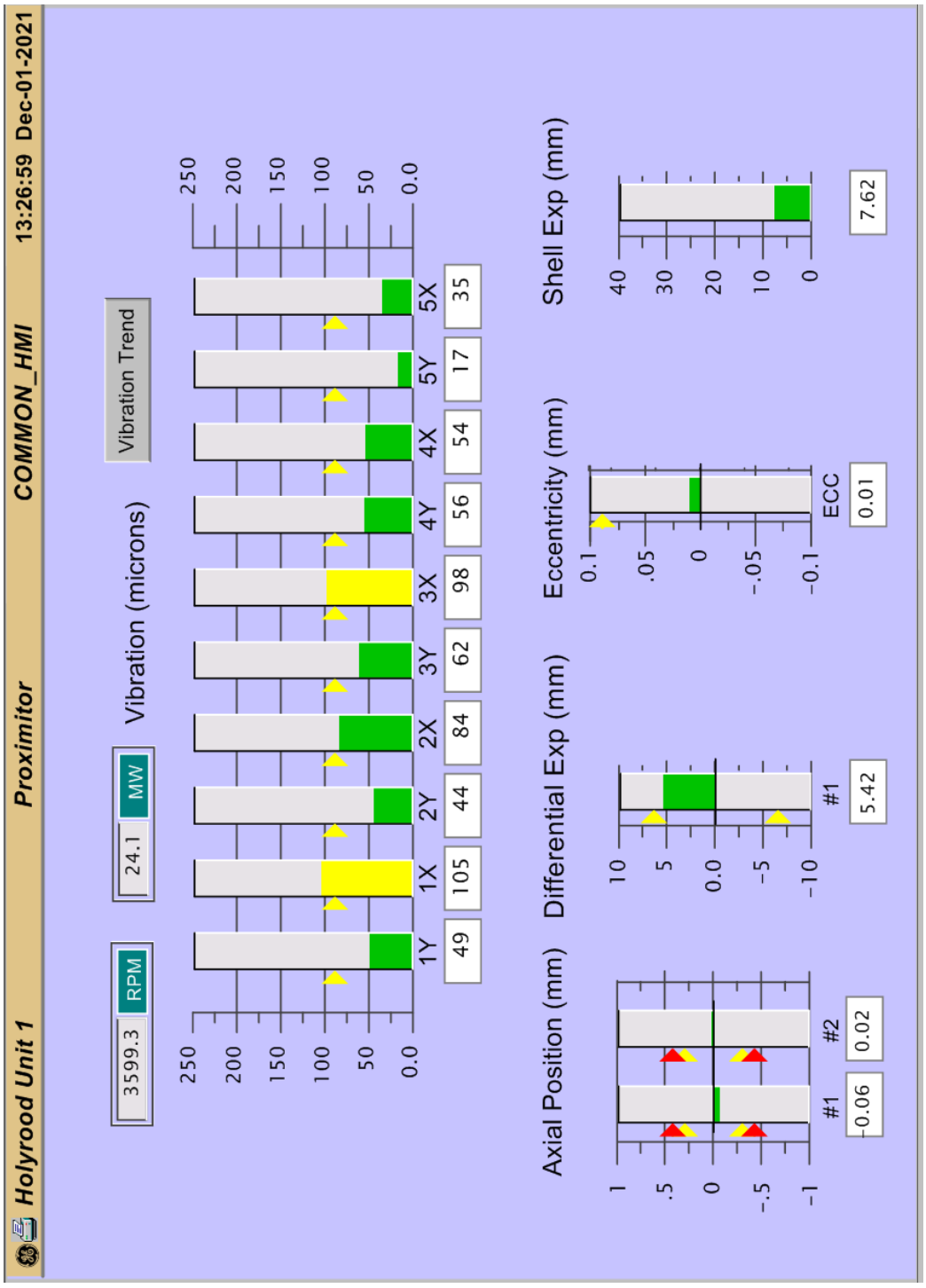
Unit Loading to 40 MW Data and Valve Test

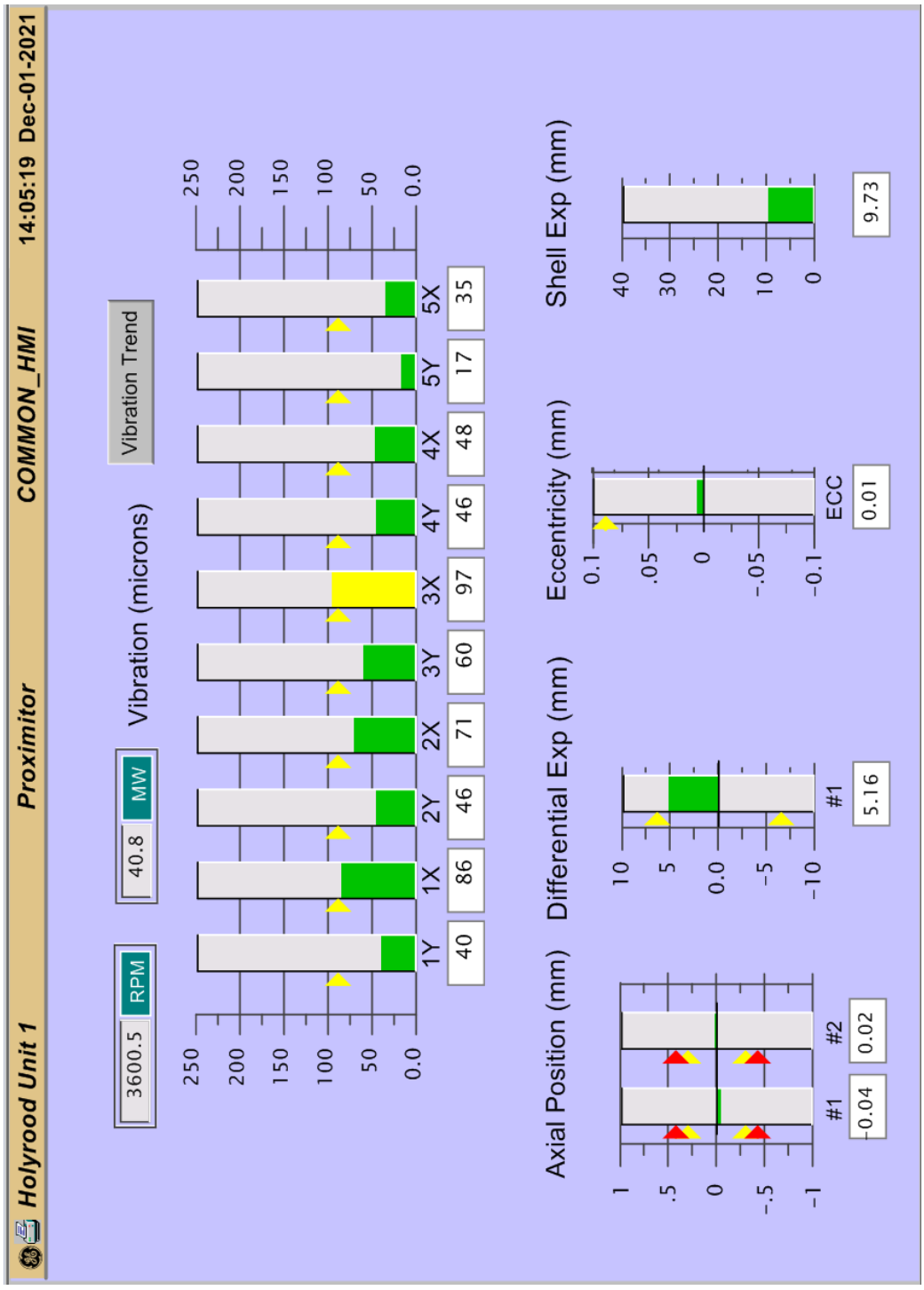


Co...	Pointname	Value	Eng ...	Description	Min	Max
	S1:BB_MAX	0.10*	mm	Max Vibration	0.00	0.25
	S1:DWATT	39.6*	MW	Generator watts	0.0	175.0
	S1:ECCENT	0.01*	mm	Eccentricity	-0.10	0.10
	S1:IP_P	972.46*	psi	Inlet Pressure	0.00	1000.00
	S1:LIV_POS	100.32*	%	Left Intercept Valve position Feedback	0.00	120.00
	S1:MSV_POS	101.25*	%	Main Stop Valve Position Feedback	0.00	120.00
	S1:RIV_POS	100.80*	%	Right Intercept Valve position Feedb...	0.00	120.00
	S1:TNH_RPM	3601*	rpm	HP Turbine Speed (RPM)	0	4000
	S1:TT_IS	360*	deg C	Main Inlet Steam Temp	0	650
	S1:V1_POS	45.07*	%	Main Control Valve Position Feedback	0.00	120.00

Unit was synchronized and loaded to 40 MW where Valve Test and on-line ETD test successfully completed.

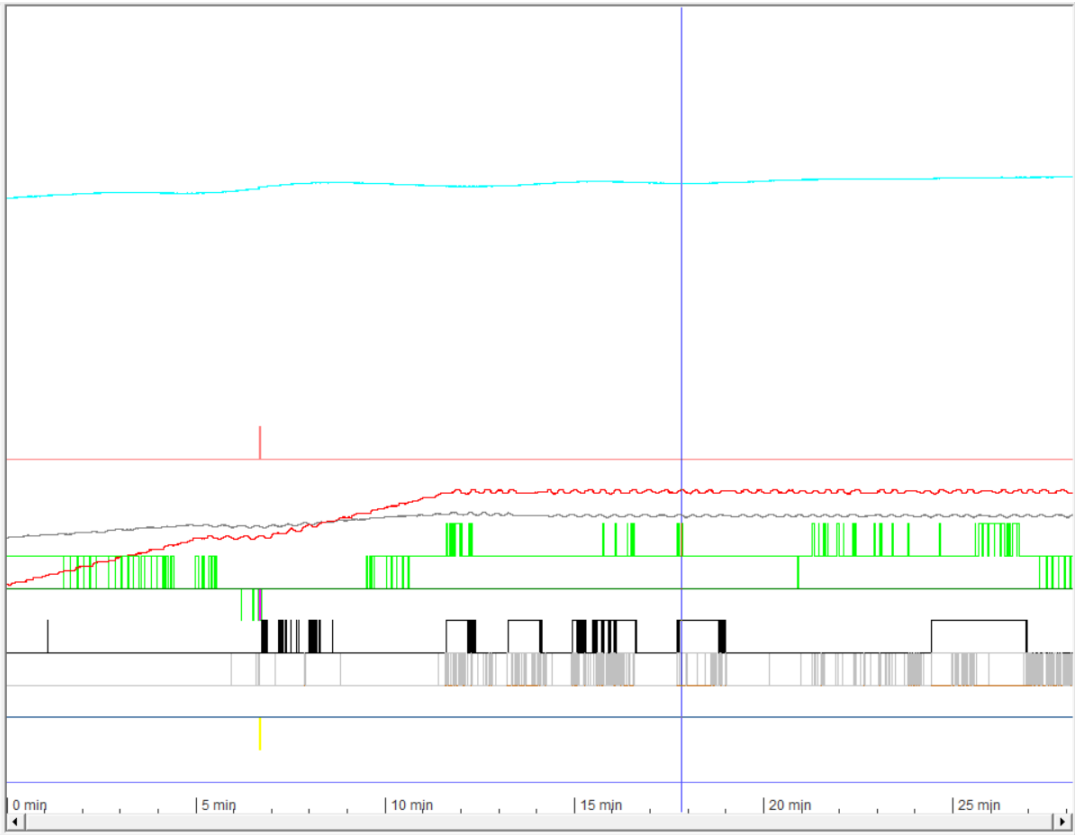

Holyrood Unit 1
Proximitor
COMMON_HMI
13:11:28 Dec-01-2021
3601.3
RPM
11.4
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y
1X
2Y
2X
3Y
3X
4Y
4X
5Y
5X
44
87
46
89
64
103
65
57
19
35
Axial Position (mm)
Differential Exp (mm)
Eccentricity (mm)
Shell Exp (mm)
1
.5
0
-.5
-1
#1
#2
-0.07
0.02
10
5
0.0
-5
-10
#1
4.93
0.1
.05
0
-.05
-0.1
ECC
0.01
40
30
20
10
0
6.69


Holyrood Unit 1
Proximitor
COMMON_HMI
13:26:59 Dec-01-2021
3599.3
RPM
24.1
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 49
1X 105
2Y 44
2X 84
3Y 62
3X 98
4Y 56
4X 54
5Y 17
5X 35
Axial Position (mm)
1
.5
0
-.5
-1
#1 -0.06
#2 0.02
Differential Exp (mm)
10
5
0.0
-5
-10
#1 5.42
Eccentricity (mm)
0.1
.05
0
-.05
-0.1
ECC 0.01
Shell Exp (mm)
40
30
20
10
0
7.62

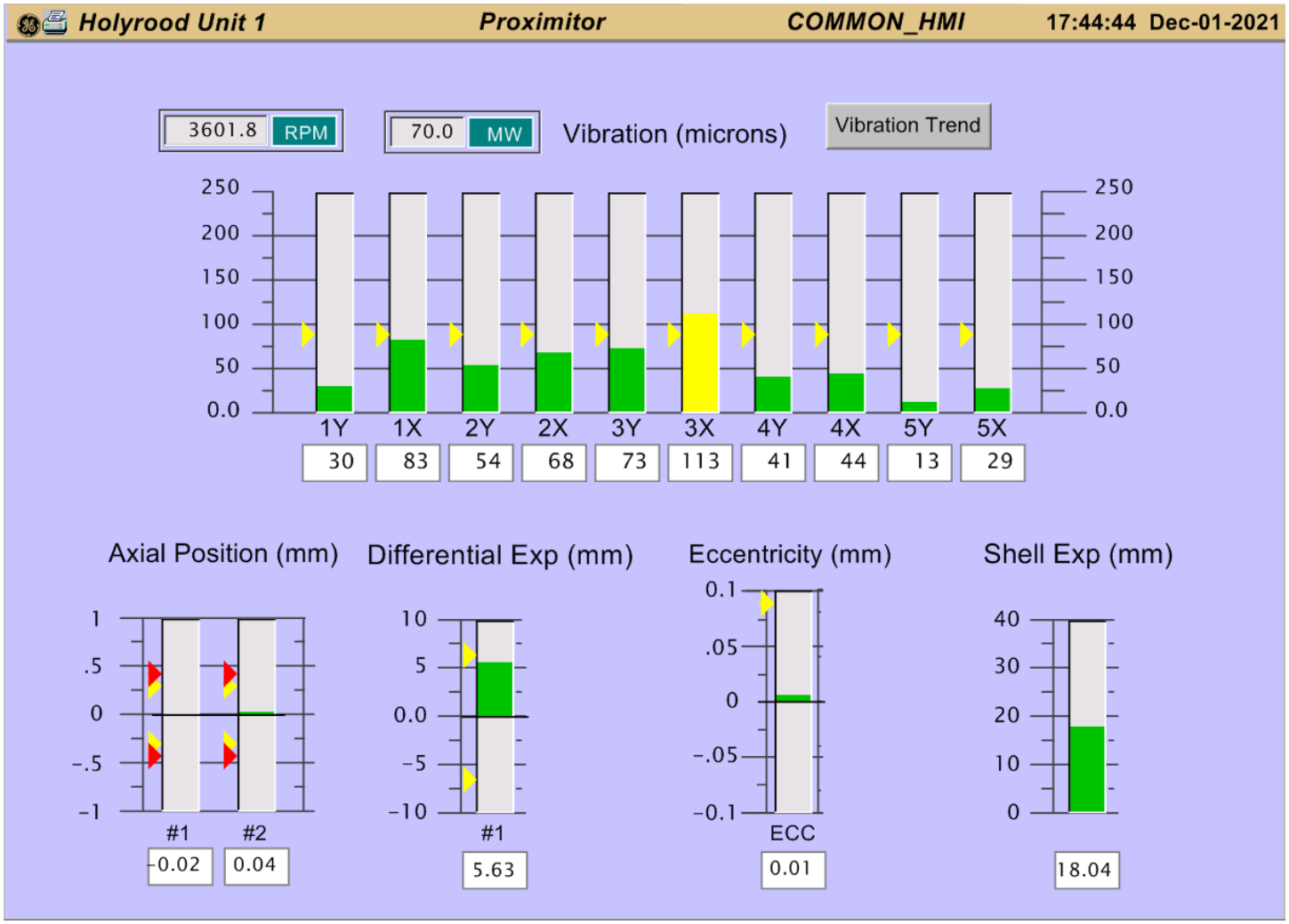

Holyrood Unit 1
Proximitor
COMMON_HMI
14:05:19 Dec-01-2021
3600.5
RPM
40.8
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y
1X
2Y
2X
3Y
3X
4Y
4X
5Y
5X
40
86
46
71
60
97
46
48
17
35
Axial Position (mm)
#1
#2
-0.04
0.02
Differential Exp (mm)
#1
5.16
Eccentricity (mm)
ECC
0.01
Shell Exp (mm)
9.73

Unit Loading to 70 MW Data

Co...	Pointname	Value	Eng ...	Description	Min	Max
	S1:BB1X	0.03*	mm	Vibration 1X - bearing #1	0.00	0.25
	S1:BB1Y	0.09*	mm	Vibration 1Y - bearing #1	0.00	0.25
	S1:BB2X	0.06*	mm	Vibration 2X - bearing #2	0.00	0.25
	S1:BB2Y	0.07*	mm	Vibration 2Y - bearing #2	0.00	0.25
	S1:BB3X	0.07*	mm	Vibration 3X - bearing #3	0.00	0.25
	S1:BB3Y	0.11*	mm	Vibration 3Y - bearing #3	0.00	0.25
	S1:BB4X	0.04*	mm	Vibration 4X - bearing #4	0.00	0.25
	S1:BB4Y	0.05*	mm	Vibration 4Y - bearing #4	0.00	0.25
	S1:BB5X	0.01*	mm	Vibration 5X - bearing #5	0.00	0.25
	S1:BB5Y	0.03*	mm	Vibration 5Y - bearing #5	0.00	0.25
	S1:DWATT	70.3*	MW	Generator watts	0.0	175.0
	S1:IP_P	1741.66*	psi	Inlet Pressure	0.00	1000.00
	S1:TT_IS	508*	deg C	Main Inlet Steam Temp	0	650
	S1:V1_POS	44.46*	%	Main Control Valve Position Feedback	0.00	120.00

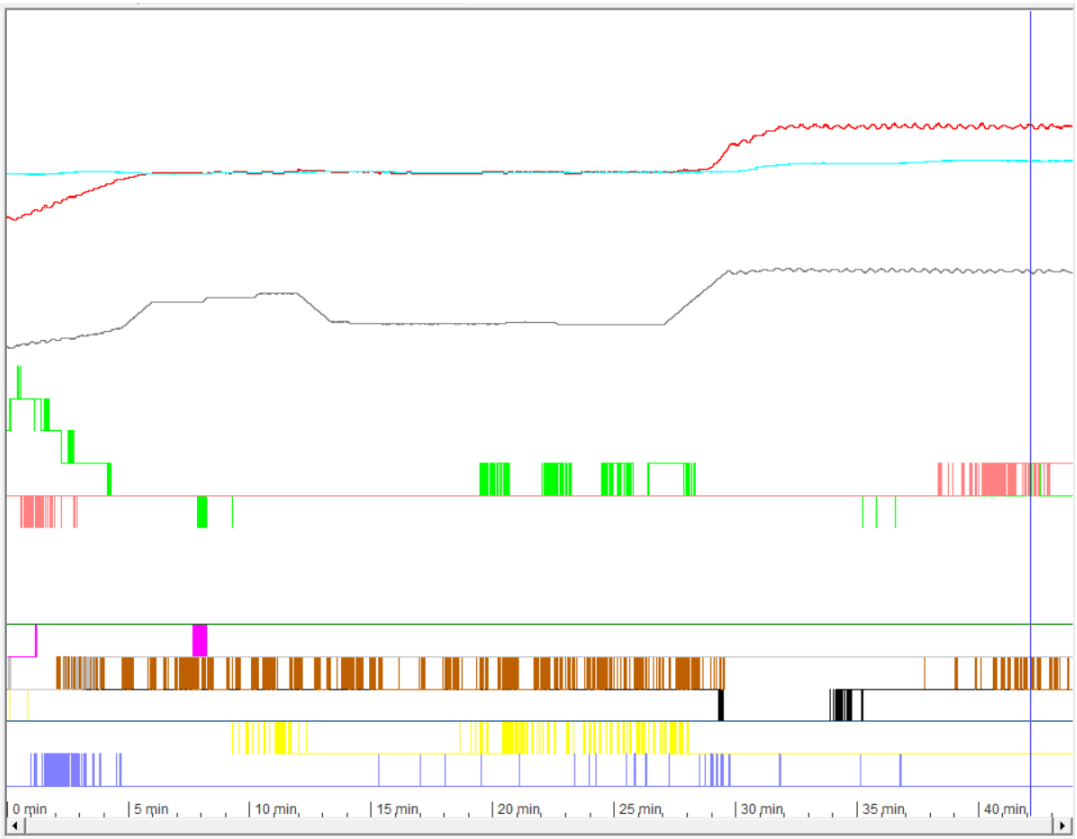


For Help, press F1

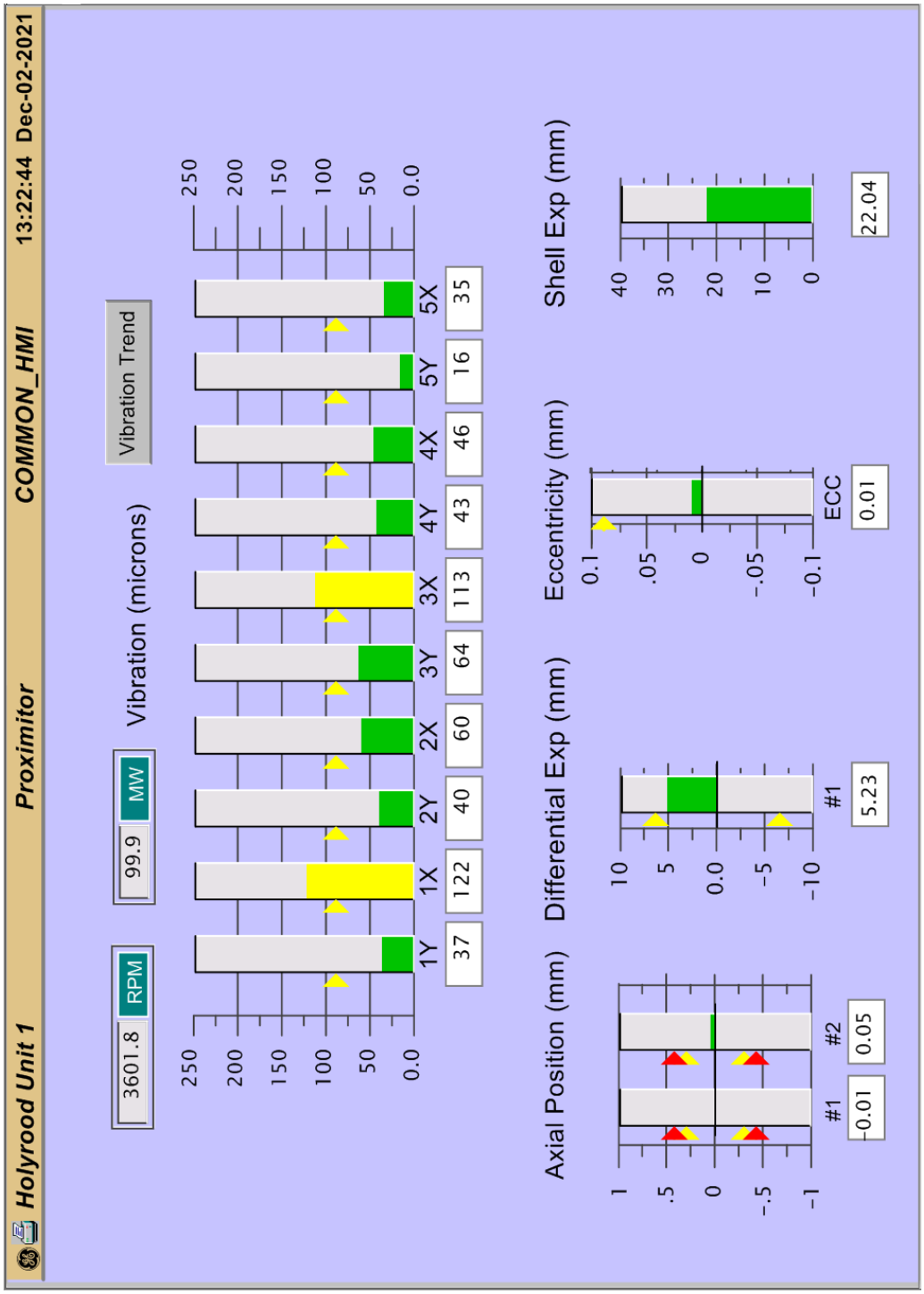

Holyrood Unit 1
Proximitor
COMMON_HMI
17:44:44 Dec-01-2021
3601.8 RPM
70.0 MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
30 83 54 68 73 113 41 44 13 29
Axial Position (mm)
1
.5
0
-.5
-1
#1 #2
-0.02 0.04
Differential Exp (mm)
10
5
0.0
-5
-10
#1
5.63
Eccentricity (mm)
0.1
.05
0
-.05
-0.1
ECC
0.01
Shell Exp (mm)
40
30
20
10
0
18.04

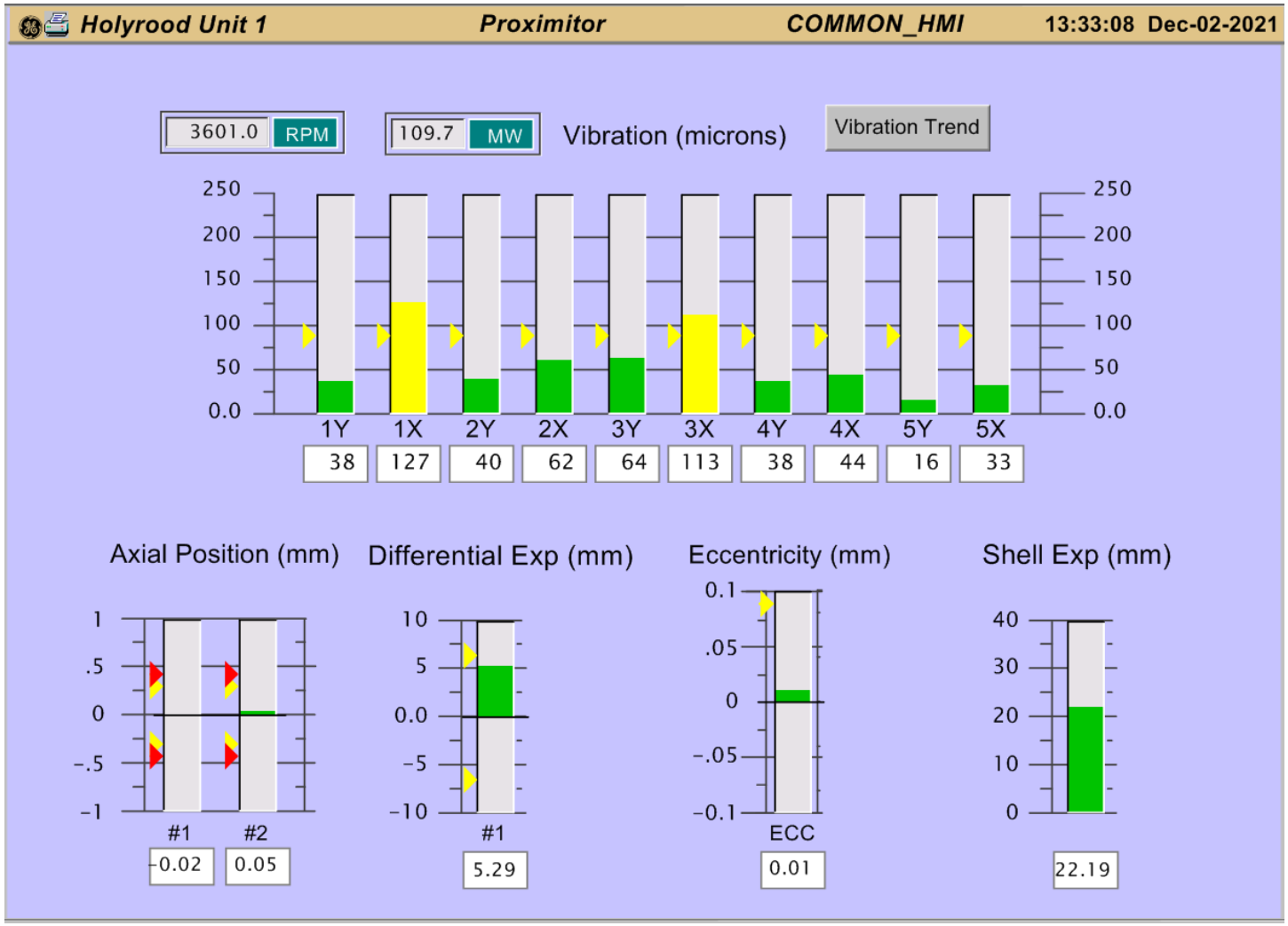
Unit Loading to 150 MW Data

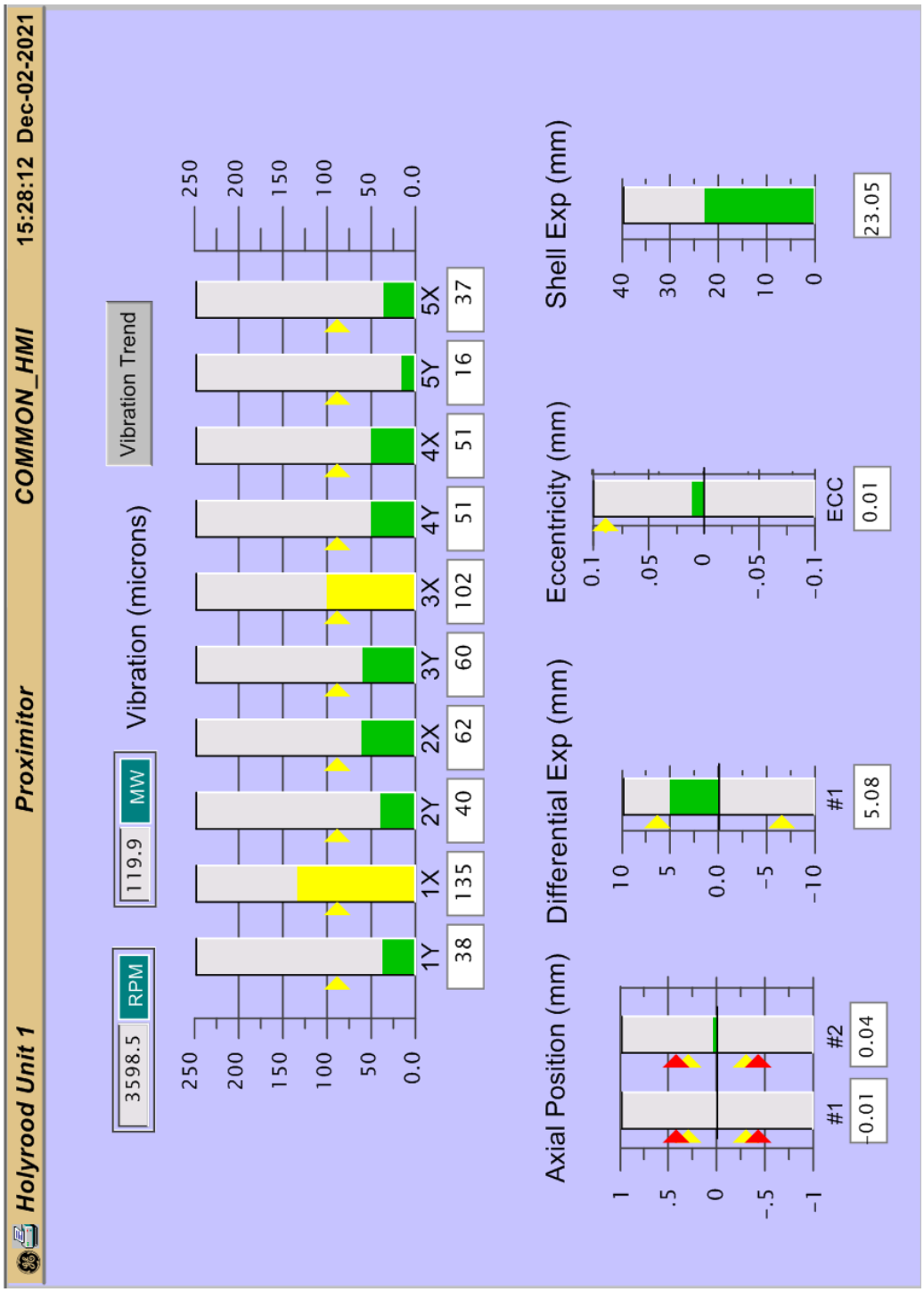
Co...	Pointname	Value	Eng ...	Description	Min	Max
	S1:BB1X	0.02*	mm	Vibration 1X - bearing #1	0.00	0.25
	S1:BB1Y	0.11*	mm	Vibration 1Y - bearing #1	0.00	0.25
	S1:BB2X	0.04*	mm	Vibration 2X - bearing #2	0.00	0.25
	S1:BB2Y	0.05*	mm	Vibration 2Y - bearing #2	0.00	0.25
	S1:BB3X	0.06*	mm	Vibration 3X - bearing #3	0.00	0.25
	S1:BB3Y	0.10*	mm	Vibration 3Y - bearing #3	0.00	0.25
	S1:BB4X	0.04*	mm	Vibration 4X - bearing #4	0.00	0.25
	S1:BB4Y	0.05*	mm	Vibration 4Y - bearing #4	0.00	0.25
	S1:BB5X	0.01*	mm	Vibration 5X - bearing #5	0.00	0.25
	S1:BB5Y	0.03*	mm	Vibration 5Y - bearing #5	0.00	0.25
	S1:DWATT	150.5*	MW	Generator watts	0.0	175.0
	S1:IP_P	1741.66*	psi	Inlet Pressure	0.00	1000.00
	S1:TT_IS	529*	deg C	Main Inlet Steam Temp	0	650
	S1:V1_POS	81.18*	%	Main Control Valve Position Feedback	0.00	120.00

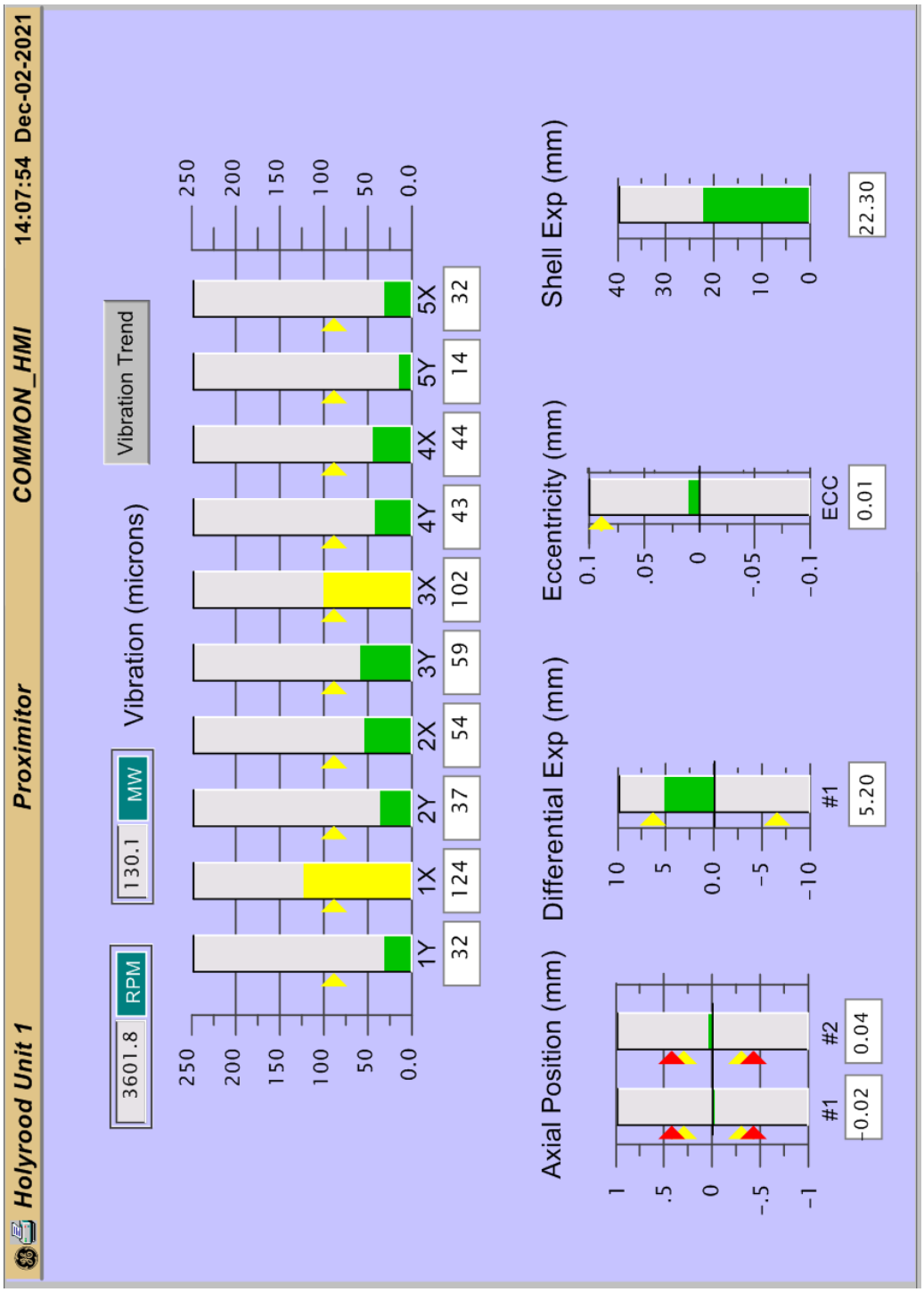


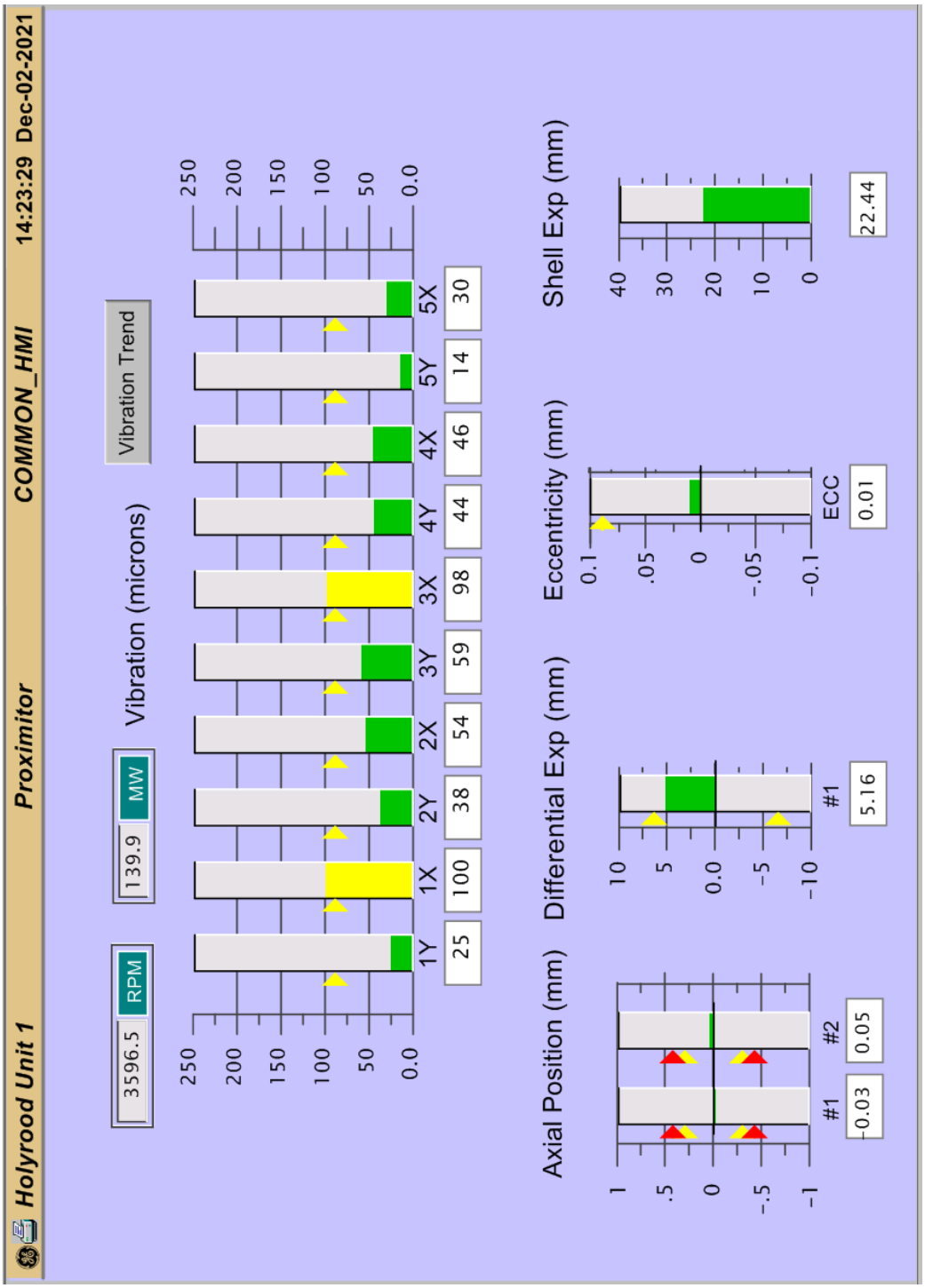
For Help, press F1

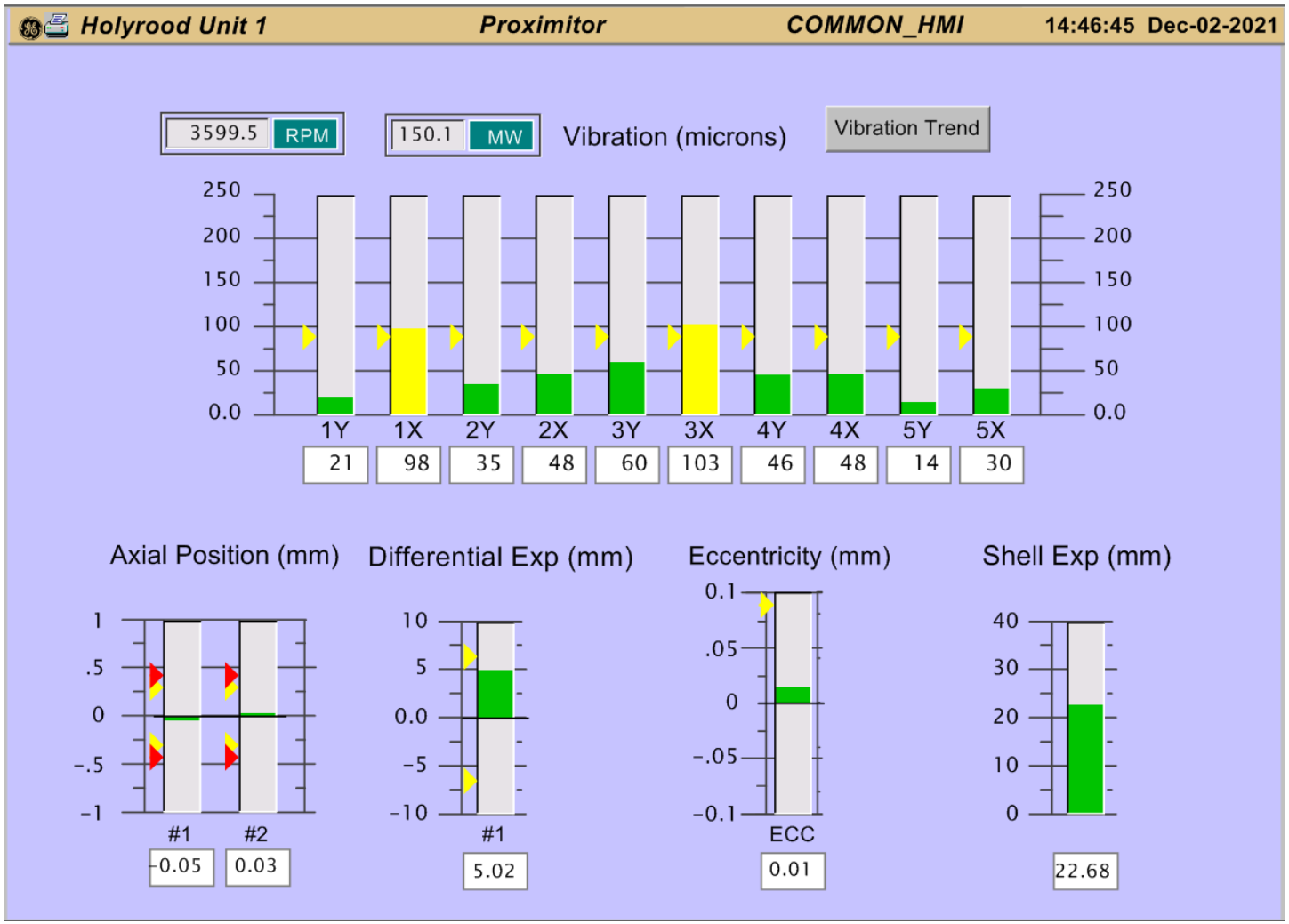

Holyrood Unit 1
Proximitor
COMMON_HMI
13:22:44 Dec-02-2021
3601.8
RPM
99.9
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y
1X
2Y
2X
3Y
3X
4Y
4X
5Y
5X
37
122
40
60
64
113
43
46
16
35
Axial Position (mm)
#1
#2
-0.01
0.05
Differential Exp (mm)
#1
5.23
Eccentricity (mm)
ECC
0.01
Shell Exp (mm)
22.04

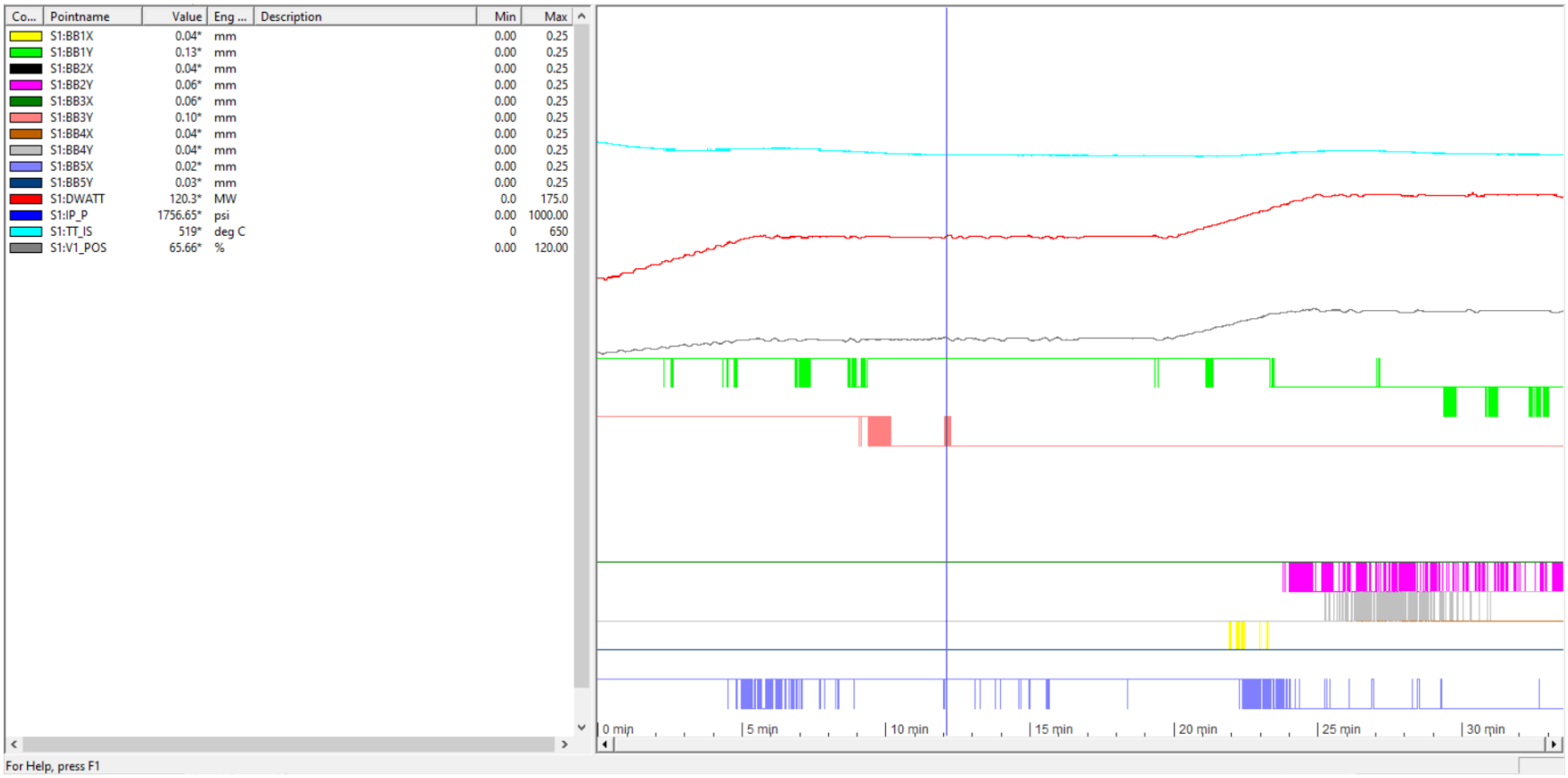

Holyrood Unit 1
Proximitor
COMMON_HMI
13:33:08 Dec-02-2021
3601.0 RPM
109.7 MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
38 127 40 62 64 113 38 44 16 33
Axial Position (mm)
1
.5
0
-.5
-1
#1 #2
-0.02 0.05
Differential Exp (mm)
10
5
0.0
-5
-10
#1
5.29
Eccentricity (mm)
0.1
.05
0
-.05
-0.1
ECC
0.01
Shell Exp (mm)
40
30
20
10
0
22.19

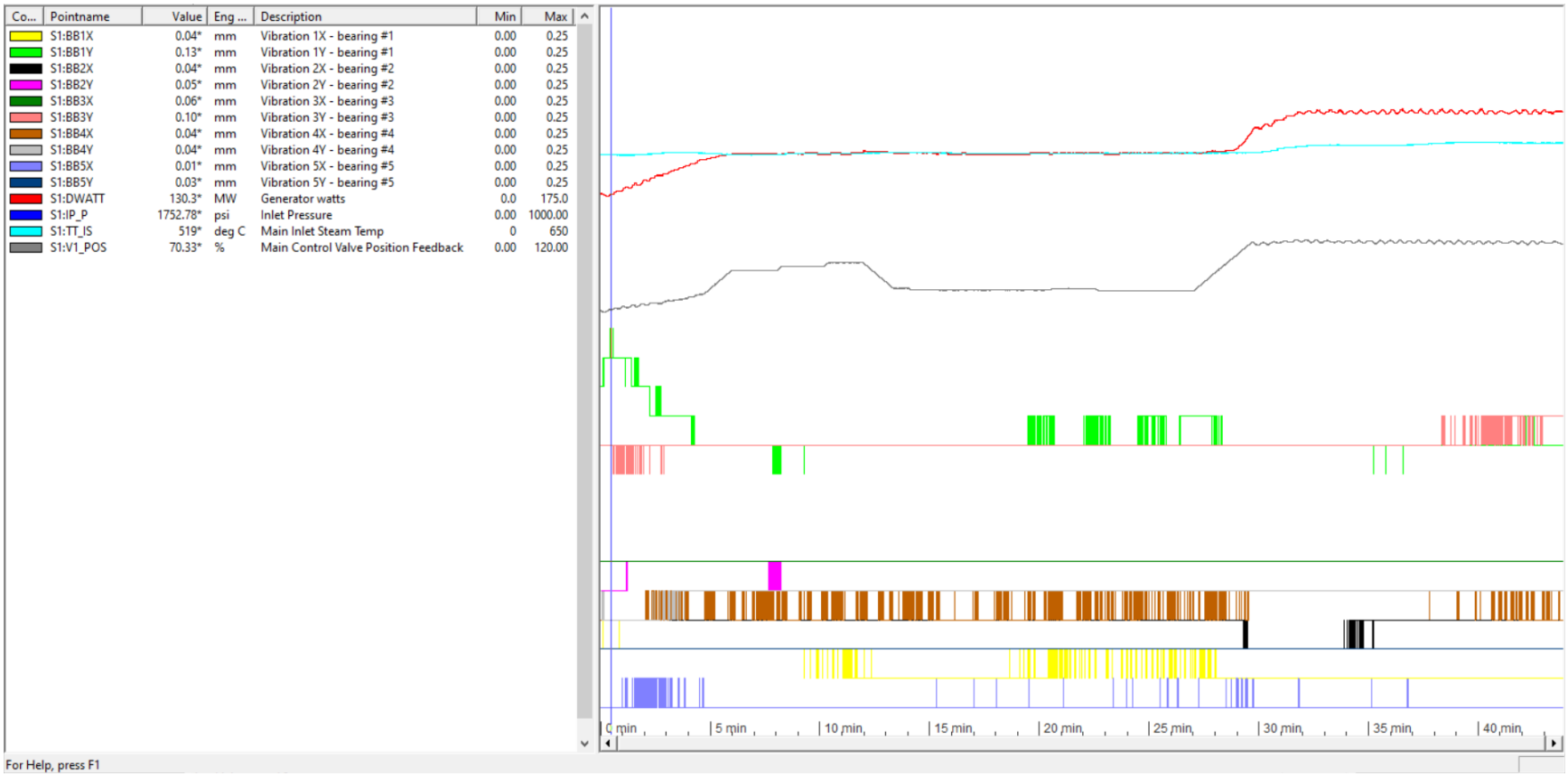

Holyrood Unit 1
Proximitor
COMMON_HMI
15:28:12 Dec-02-2021
3598.5
RPM
119.9
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
38 135 40 62 60 102 51 51 16 37
Axial Position (mm)
#1 #2
-0.01 0.04
Differential Exp (mm)
#1
5.08
Eccentricity (mm)
ECC
0.01
Shell Exp (mm)
23.05


Holyrood Unit 1
Proximitor
COMMON_HMI
14:07:54 Dec-02-2021
3601.8
RPM
130.1
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y
1X
2Y
2X
3Y
3X
4Y
4X
5Y
5X
32
124
37
54
59
102
43
44
14
32
Axial Position (mm)
#1
#2
-0.02
0.04
Differential Exp (mm)
5.20
Eccentricity (mm)
ECC
0.01
Shell Exp (mm)
22.30


Holyrood Unit 1
Proximitor
COMMON_HMI
14:23:29 Dec-02-2021
3596.5
RPM
139.9
MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
25 100 38 54 59 98 44 46 14 30
Axial Position (mm)
#1 #2
-0.03 0.05
Differential Exp (mm)
#1
5.16
Eccentricity (mm)
ECC
0.01
Shell Exp (mm)
22.44


Holyrood Unit 1
Proximitor
COMMON_HMI
14:46:45 Dec-02-2021
3599.5 RPM
150.1 MW
Vibration (microns)
Vibration Trend
250
200
150
100
50
0.0
1Y 1X 2Y 2X 3Y 3X 4Y 4X 5Y 5X
21 98 35 48 60 103 46 48 14 30
Axial Position (mm)
1
.5
0
-.5
-1
#1 #2
-0.05 0.03
Differential Exp (mm)
10
5
0.0
-5
-10
#1
5.02
Eccentricity (mm)
0.1
.05
0
-.05
-0.1
ECC
0.01
Shell Exp (mm)
40
30
20
10
0
22.68


Co... Pointname Value Eng ... Description Min Max
S1:BB1X 0.04* mm 0.00 0.25
S1:BB1Y 0.13* mm 0.00 0.25
S1:BB2X 0.04* mm 0.00 0.25
S1:BB2Y 0.06* mm 0.00 0.25
S1:BB3X 0.06* mm 0.00 0.25
S1:BB3Y 0.10* mm 0.00 0.25
S1:BB4X 0.04* mm 0.00 0.25
S1:BB4Y 0.04* mm 0.00 0.25
S1:BB5X 0.02* mm 0.00 0.25
S1:BB5Y 0.03* mm 0.00 0.25
S1:DWATT 120.3* MW 0.0 175.0
S1:IP_P 1756.65* psi 0.00 1000.00
S1:TT_IS 519* deg C 0 650
S1:V1_POS 65.66* % 0.00 120.00
0 min
5 min
10 min
15 min
20 min
25 min
30 min
For Help, press F1



Co...	Pointname	Value	Eng ...	Description	Min	Max
	S1:BB1X	0.04*	mm	Vibration 1X - bearing #1	0.00	0.25
	S1:BB1Y	0.13*	mm	Vibration 1Y - bearing #1	0.00	0.25
	S1:BB2X	0.04*	mm	Vibration 2X - bearing #2	0.00	0.25
	S1:BB2Y	0.05*	mm	Vibration 2Y - bearing #2	0.00	0.25
	S1:BB3X	0.06*	mm	Vibration 3X - bearing #3	0.00	0.25
	S1:BB3Y	0.10*	mm	Vibration 3Y - bearing #3	0.00	0.25
	S1:BB4X	0.04*	mm	Vibration 4X - bearing #4	0.00	0.25
	S1:BB4Y	0.04*	mm	Vibration 4Y - bearing #4	0.00	0.25
	S1:BB5X	0.01*	mm	Vibration 5X - bearing #5	0.00	0.25
	S1:BB5Y	0.03*	mm	Vibration 5Y - bearing #5	0.00	0.25
	S1:DWATT	130.3*	MW	Generator watts	0.0	175.0
	S1:IP_P	1752.78*	psi	Inlet Pressure	0.00	1000.00
	S1:TT_IS	519*	deg C	Main Inlet Steam Temp	0	650
	S1:V1_POS	70.33*	%	Main Control Valve Position Feedback	0.00	120.00

Max vibration was noticed around 130 MW on Bearing #1 of 130 Microns

Recommendation

It is highly recommended to upgrade the control system to gain the power of Triple Module Redundancy which will improve unit reliability and availability, as well as allow access to high-speed trends and data & event logger. Such upgrade will facilitate more decisive troubleshooting in case of any incidents or trips.

It is highly recommended installing NTP and reference all HMI's and Controllers to it, to maintain one clock for the whole plant, it was noticed that events were logged with different timestamp on the Unit Control than DCS which creates confusion when troubleshooting an incident or a trip.

END