# 56

# TECO's Responses to OPC's First Set of Interrogatories, Nos. 3-6, 15, 16, 18-19, 22-25. Including Supplemental for Response No. 23.

**TAMPA ELECTRIC COMPANY**
**DOCKET NO. 20220001-EI**
**OPC'S FIRST SET OF INTERROGATORIES**
**INTERROGATORY NO. 3**
**BATES PAGE: 3**
**FILED: APRIL 8, 2022**

**Please reference the June 2021 GPIF Actual Unit Performance Data Report in responding to the following:**

**3.** Please explain in detail the unplanned forced outage that began on June 10, 2021.

**A.** As described in the company's response Interrogatory 2, above, Polk Unit 1 was scheduled for a planned outage that started on May 19, 2021. The primary activities during the outage were a combustion hardware inspection and generator heater replacement. The outage concluded on June 10, 2021. The company was not aware of any operational issues with the generator prior to the outage. The company last inspected the generator in 2015 and found no significant issues at that time. During the May 19, 2021 planned outage, when replacing the generator heaters, access into the generator was from the collector end only. Since both end-bells were off, the management team determined it would be prudent to remove the upper inner gas baffles on both ends to permit limited inspection of the stator winding end turns and rotor. The collector end of the machine appeared normal. Inspection of the turbine end revealed an object in the air gap between the stator and rotor that was black in color and tested as magnetic.

The discovery of debris required the rotor to be pulled which was unplanned. The purpose of the unplanned outage starting June 10, 2021 was to replace the winding as well as the damaged core iron that was discovered in the planned outage. The resulting unplanned outage commenced on June 10, 2021 and continued through October 2, 2021.

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**4.** Please identify all documents related to any and all root cause analyses (or the functional equivalent, regardless of title), including drafts and related commentary and/or correspondence, involving the unplanned forced outage occurring at Polk 1 beginning on June 10, 2021.

**A.** Tampa Electric has requested the final outage and repair report from General Electric regarding the unplanned forced outage of Unit 1 Generator. The documents listed below are related to the outage and produced in response to OPC's First Request for Production of Documents, Request No. 1:

- 7F Users Group Presentation, Generator Stator Core Discovery.pdf (BS pages 11 – 43)
- CT1 Generator Correspondence 6-10 through 10-2 (BS pages 44 – 243)
- PK Unit 1 GenSchedule.pdf (BS pages 244 – 247)
- TECO Polk CT1 Generator – ER case on Stator Damaged Noted.msg (BS pages 248 – 254)

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**INTERROGATORY NO. 5**
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**5.** Please identify the amount of replacement power cost attributable to unplanned forced outage(s) of Polk 1 in June 2021. Please also identify the workpapers calculating such replacement power costs.

**A.** To evaluate the Polk Unit 1 outage impact on fuel and purchased power costs, the Tampa Electric ("TEC") system was modeled using the Planning & Risk ("PaR") production cost model developed by Hitachi. The PaR production cost model is utilized at TEC in the evaluation of long-term planning, project evaluation and to prepare the annual, projected fuel and purchased power factor filing.

The evaluation compared a base case to a change case and the delta represents the TEC replacement power costs attributed to the Polk Unit 1 outages. The model includes unit heat rates, variable O&M, start costs and any operational parameters that impact the economic commitment and dispatch of the units. Actuals for fuel prices, power market pricing, load, solar generation, reserves, purchased power agreements and forced and planned outages were utilized as PaR inputs to best estimate replacement power costs from Polk Unit 1 not being available to run.

The base case includes Polk Unit 1 as available for commitment and dispatch from June 10, 2021 through December 31, 2021. The PaR model run for the period above includes the actual company generating resources previously stated and other resources that commit and dispatch economically, each hour, to meet load and reserves. The PaR model outputs were summed for each month and are displayed below, for the period June 10,2021 through October 31, 2021, as Base Case Fuel and Purchased Power Costs.

The change case includes Polk Unit 1 offline June 10, 2021 to October 2, 2021 and November 29, 2021 to December 31, 2021 to represent the combustion inspection and water induction outages. The PaR model outputs were summed for each month and are displayed below as Change Case Fuel and Purchased Power Costs. The cost delta between the two runs resulted in the monthly TEC Replacement Power Costs attributed to the Polk Unit 1 outages.

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The table below reflects the replacement power costs for the first period referenced above.

| **2021 (6/10/21-10/31/21)** | | | | | |
|---|---|---|---|---|---|
| **Base Case Fuel and Purchased Power Costs ($000)** | | | | | |
| June | July | August | September | October | Total |
| $ 63,192 | $ 76,706 | $ 83,925 | $ 81,354 | $ 94,967 | $ 400,144 |
| **Change Case Fuel and Purchased Power Costs ($000)** | | | | | |
| June | July | August | September | October | Total |
| $ 63,214 | $ 77,262 | $ 84,399 | $ 81,354 | $ 94,974 | $ 401,203 |
| **TEC Replacement Power Costs ($000)** | | | | | |
| June | July | August | September | October | Total |
| $ 22 | $ 556 | $ 474 | $ - | $ 7 | $ 1,059 |

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**INTERROGATORY NO. 6**
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**Please reference the July 2021 GPIF Actual Unit Performance Data Report in responding to the following:**

**6.** Please explain if the outage beginning on July 1, 2021 was a continuation of the outage that began on June 10, 2021.

**A.** The outage that began on July 1, 2021 is a continuation of the outage that started on June 10, 2021.

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**INTERROGATORY NO. 15**
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**15.** Please explain in detail the unplanned forced outages that began on September 1, 2021 and September 29, 2021.

**A.** September 1, 2021 to September 29, 2021 was a continuation of the outage that started on June 10, 2021. Start-up efforts commenced on September 29, 2021. During this process the HP drum level control valve began to leak at the body to bonnet joint. As a result, the previous forced outage was extended. The combustion turbine ("CT") was shut down until midnight on September 30, 2021 to facilitate a safe repair on the HRSG system.

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**INTERROGATORY NO. 16**
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**16.** Please identify all documents related to any and all root cause analyses (or the functional equivalent, regardless of title), including drafts and related commentary correspondence, involving the unplanned forced outages occurring at Polk 1 beginning on September 1, 2021 and September 29, 2021.

**A.** The documentation regarding the September 29, 2021 unrelated forced shutdown that extended the outage is listed below. This outage began when the HP drum level control valve began to leak at the body to bonnet joint. Due to the limited scope of work needed to make the repair a root cause analysis was not warranted.

- Work Order 2804521.pdf (BS pages 255 – 256)

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**INTERROGATORY NO. 18**
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**Please reference the October 2021 GPIF Actual Unit Performance Data Report in responding to the following:**

**18.** Please explain if any of Polk 1's unplanned forced outage events in the month of October were related in any way to the outage that began on June 10, 2021.

**A.** The cause of the forced shutdown on September 29, 2021, was unrelated to the outage that began on June 10, 2021 but led to the outage being extended. The forced shutdown occurred on plant start up, where the HP drum level control valve began to leak at the body to bonnet joint. The CT was shut down to facilitate safe repair. Due to the limited scope of work needed to make the repair a root cause analysis was not warranted.

The previous outage start-up resumed after the valve was repaired. The unit was made available at approximately 12 p.m. on October 2, 2021.

There was an un-related outage on October 23, 2021, where during Polk Unit 1 CT circuit breaker testing, the mechanical linkage that operates internal switches failed, and required replacement. Due to the limited scope of work needed to make the repair a root cause analysis was not warranted.

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**19.** Please explain in detail the reason for each of Polk 1's unplanned forced outage events in October 2021.

**A**. On October 23, 2021, during Polk Unit 1 CT circuit breaker testing, the mechanical linkage that operates internal switches failed, and required replacement.

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**Please reference the November 2021 GPIF Actual Unit Performance Data Report in responding to the following:**

**22.** Please provide a detailed explanation for the unplanned forced outage beginning on November 29, 2021.

**A.** On November 29, 2021, Polk Unit 1 was called to start and during the process of putting Polk Unit 1 on-line, the combustion turbine experienced heavy vibrations and the unit shut down before going on-line. Upon inspection, damage was found on the 3rd stage buckets, exhaust frame, and associated hardware. The duration of the outage, to make reliable repairs, lasted until March 10, 2022. Upon returning the unit to service additional monitoring and data analysis was performed. Due to nature of the outage, the root cause analysis of this failure is still ongoing.

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**23.** Please identify all documents related to any and all root cause analyses (or the functional equivalent, regardless of title), including drafts and related commentary and/or correspondence, involving the unplanned forced outage occurring at Polk 1 in November 2021.

**A.** The root cause analysis of the Polk Unit 1 November 29, 2021 forced outage is still ongoing. The associated documents provided are in a draft state and are subject to change based on the final root cause analysis results. Additional data is now being captured and analyzed with the unit safely returned to service on March 10, 2022.

To that end, the following documents are listed below:

-CT1 RCA Daily Update Meeting correspondence (BS pages 259 – 260)

-RCA Correspondence (BS pages 261, 266 – 270, 272 – 274, 277)

-RCA Polk Unit 1 Turbine DRAFT.docx (BS pages 262 – 265)

-CT1 Water Ingestion Flow Path DRAFT.pdf (BS page 271)

-Root Cause Tree CT1 Solutions DRAFT.pdf (BS page 275)

-Root Cause Tree CT1v4 DRAFT.pdf (BS page 276)

-GE RCA proposal Confidential (BS pages 278 – 286)

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**INTERROGATORY NO. 24**
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**24.** Please identify the amount of replacement power cost attributable to unplanned forced outage(s) of Polk 1 in November 2021. Please also identify the workpapers calculating such replacement power costs.

**A.** The base case PaR run for December 2021 did not commit Polk Unit 1 during the month of November so the base and change case were the same resulting in no TEC Replacement Power Costs attributed to Polk Unit 1 outages during December.

The table below reflects the replacement power costs for the period November 1, 2021 through December 31, 2021, referenced in Tampa Electric's response to OPC's First Set of Interrogatories, No. 5 above.

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| **2021 (11/1/21-12/31/21)** | | |
|---|---|---|
| **Base Case Fuel and Purchased Power Costs ($000)** | | |
| November | December | Total |
| $ 76,290 | $ 71,838 | $ 148,129 |
| **Change Case Fuel and Purchased Power Costs ($000)** | | |
| November | December | Total |
| $ 76,290 | $ 71,838 | $ 148,129 |
| **TEC Replacement Power Costs ($000)** | | |
| November | December | Total |
| $ - | $ - | $ - |

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**Please reference the December 2021 GPIF Actual Unit Performance Data Report 2021 in responding to the following:**

**25.** Please explain if Polk 1's unplanned forced outage event in the month of December 2021 was related in any way to the outage that began on November 29, 2021.

**A.** The Polk Unit 1 unplanned forced outage in December 2021 was a continuation of the unplanned forced outage that started on November 29, 2021.

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**SUPPLEMENTED: MAY 25, 2022**

**23.** Please identify all documents related to any and all root cause analyses (or the functional equivalent, regardless of title), including drafts and related commentary and/or correspondence, involving the unplanned forced outage occurring at Polk 1 in November 2021.

**A.** The root cause analysis of the Polk Unit 1 November 29, 2021 forced outage is attached.


| PK1 – Forced Major Outage<br>High Potential |
| --- |
| Date: 11/29/2021 |

Polk Power Station

| | |
|---|---|
| Type: | CT 1 Forced Outage |
| Date: | November 29th, 2021 |
| Time: | 0748 |
| Location: | PPS Unit 1 Combustion Turbine |
| Contractor: | N/A |
| Job Task: | N/A |
| Environmental Conditions | Mild morning |

**Events Prior to the Incident**

- Planned Outage: 05/19/2021- 06/03/2021
  - Water Wash: 05/20/2021
  - Emergent Work (Generator stator): 06/03/2021
  - Return to service: 10/02/2021
- Start up: 10/02/2021
  - Shutdown: 10/20/2021
- Planned Outage (Relay Testing): 10/20/2021 – 10/23/2021
  - Emergent work (GCB linkage): 10/232021
  - Return to service: 10/27/2021
- Planned Outage (Relay Testing): 10/31/2021 – 11/04/2021
- Start up: 11/05/2021
  - Shutdown: 11/18/2021
- Planned Outage (Nat. Gas Yard): 11/18/2021 – 11/21/2021
  - Return to service: 11/21/2021
- Attempted start (Bucket liberation): 11/29/2021
  - Forced Outage 11/29/2021 – 03/04/2022
  - Return to Service 03/05/2021
- Start-up: 03/07/2022
  - Shutdown: 03/07/2022

**Incident - Sequence of Events**

During start up on Polk 1, the combustion turbine was firing and approaching FSNL when the Compressor Discharge Air (CPD) Block valves, VS13-1 and VS13-2, opened as designed to provide cooling air to the syngas nozzles. Shortly after the CPD block valves opened, the unit tripped on high vibration and coasted down at what appears to be a typical coast down curve. Turning gear engaged and unit cooled down and shut off for inspection.

**Events after the Incident**

After the unit tripped, investigations started immediately. A maintenance specialist recalled a similar 2012 incident when Polk CT1 tripped on high vibrations due to the presence of water in the syngas header. It was determined for this specific instance that the water injection utilized for liquid fuel operations leaked within the fuel nozzles and made its way into the header. With this recollection, the syngas header was the first location to be investigated for water - a significant amount of water was discovered. The discovered water was tested and contained a pH level like demineralized water (~5 pH). Continuing to back track the source, water was also found upstream in the P2 cavity of the syngas skid, which had to leak by two valves (VS4-2 and VGC-2) to enter the syngas header. The P1 and P2 cavities are vented to the flare header. During the initial investigation, it was believed water had leaked by through the HRSG HP drum into the Nitrogen Blanket System (NBS) system, and ultimately into the syngas skid by way of the flare header. With one successful start-up (03/07/2021) after the repair outage (11/29/2021 – 03/04/2021) water was found in the syngas header again, with further discovery, it was later determined that steam injection (used for NOx control) leaked into the syngas header.

**Observations (Facts)**

- Polk 1 was called to start on 11/29/2021 at 0700
- Polk 1 tripped on high vibrations
- Water was found in the low point on the syngas header inside the compartment
- Water was found in the flare header connection in the syngas skid
- Source of water was a demineralized source
- 3rd stage buckets liberated from the turbine rotor
- Water wash valve WW-23 was found closed after second investigation
    - The labeling of the valve was burned off from the heat in compartment
    - Valve color deviated from the labelling associated with normal Water wash practice (Blue; Normally Closed – Red; Normally Open)

**Injury / Damage**

- No injuries occurred due to this event.
- 3rd stage buckets, nozzles, and shrouds were damaged, exhaust frame was damaged.
- 2nd stage Nozzles and buckets were replaced

- 1st stage Buckets were replaced
- Compressor blades and stators needed blending for minor tip curl and rubbing.
- Stage 16 Stator Vanes were replaced due to heavy rubs
- Bearing seals were replaced and hydrogen seals required inspection.
- Turbine/Generator bearings are planned on being inspected and refurbished if needed

**Operational Factors**

- CPD cooling air was valved out and stop valves were leaking by allowing water to accumulate in flare header to a level significant enough that upon shut down water drained back and filled the syngas header

**Immediate Factors**

- The Syngas Block Valve (VS4-2) and Syngas Control Valve (VGC1) allowed steam injection to leak by which created a large reservoir of water with enough head pressure to leak back into the syngas header while unit was shut down. (If these valves were functioning as designed it would have eliminated the ability of a large reservoir of water to accumulate during operation.)
- Syngas Purge Air isolation valve (WW-23) did not seal properly allowing steam to back flow into the syngas line and leak past the block valves, ultimately building a water reservoir in the flare header

**Equipment Factors**

- Gasification has been in short term reserve since September 2018
- Valve VS4-2 and VGC-1 were leaking by

**Conclusion**

- Several barriers were broken down to allow water to be ingested into the turbine
- Steam was able to leak by the syngas valves and create a reservoir of water in the P2 cavity and flare header
- During shut down water was able to then leak into the syngas header to allow water ingestion into CT1 while at FSNL operation.
- The flow around WW-23 was enough to push water from the syngas header into the turbine
- When water was introduced to the CT nozzles, the sudden expansion to steam significantly increased the system's mass flow, causing severe stress and catastrophic failure to the 3rd stage buckets

**Recommendations**

- See additional information

**Additional Information**


**Pictures**

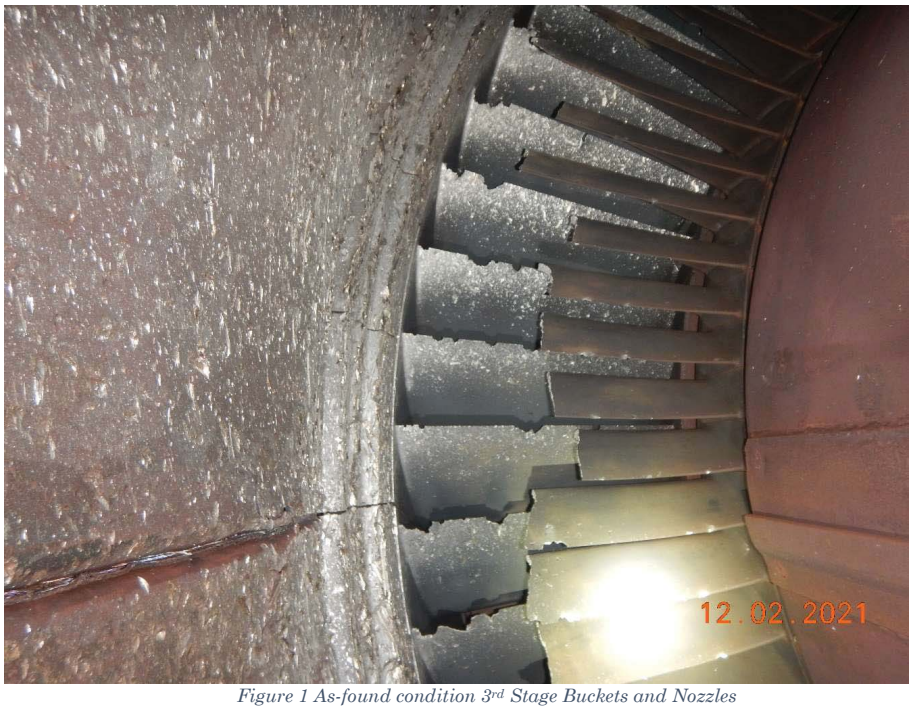


*Figure 1 As-found condition 3rd Stage Buckets and Nozzles*


*Figure 2 Metal fragments from 3rd stage buckets and nozzles*

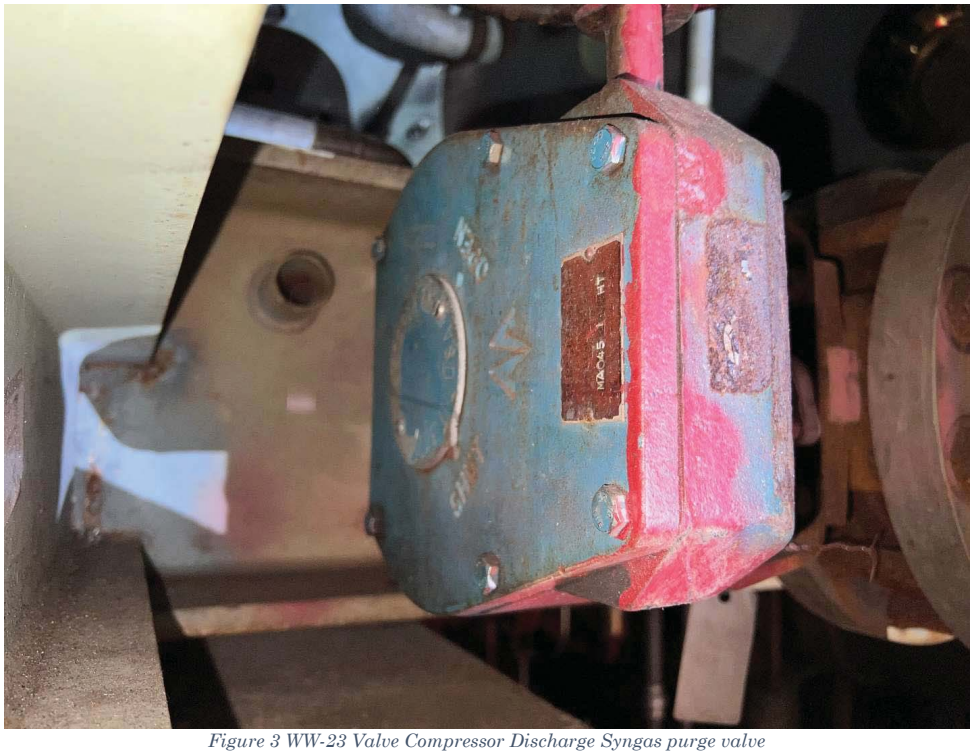

*Figure 3 WW-23 Valve Compressor Discharge Syngas purge valve*

# Polk 1 Forced Outage

TECO AN EMERA COMPANY

Cause Mapping®
Problem Solving • Incident Investigation • Root Cause Analysis • Risk Mitigation
**Investigation File**

| | |
|---|---|
| Location of Incident: | Polk Power Sation |
| Date of Incident: | 11/29/2021 |
| Version Number: | 4 |
| Version Date: | December 9, 2021 |

| Area | Worksheet | Description |
|---|---|---|
| Investigation Information | Title Page | This worksheet |
| | Versions | Evolution of this workbook and contributors |
| | Contacts | People / Contact info. of those involved with the analysis |
| | **CM Steps** | Cause Mapping method, steps and tools |
| **Step 1. Define the Problem** | 1. Problem | Define the problem with the problem outline |
| **Step 2. Conduct the Analysis** | 2. Cause Map | 5-Why basic Cause Map to get started |
| **Step 3. Select the Solutions** | 3. Solutions | Action Items table listing solutions, owner, due dates |
| Additional Information & Tools | Matrix | Evaluate possible solutions for implementation |
| | Timeline | Sequence of events with date, time, description |
| | Diagram | Diagrams, drawings and images |
| | Photos | Photographs and pictures |
| | Work Process | Steps of related work processes written as a flowchart |
| | Notes | Notes, emails, documents |
| | Info To Get | Information to collect during the investigation |
| | END | Extra material past this worksheet |
| Examples & Resources | Excel Tips | Tips for using the template in Microsoft® Excel® |
| | Examples | Example Cause Maps |

**Problem Outline**

Use the problem outline to define the problem. The problem outline provides a structured checklist to start an investigation. The outline format moves the focus from individual perspectives to how the organization sees the problem (goals impacted).

| | | |
|---|---|---|
| **What** | Problem(s) | CT1 Turbine 3rd stage nozzles and buckets liberated |
| **When** | Date | November 29, 2021 |
| | Time | 8:00 AM |
| | Different, unusual, unique | Plant was Starting Up |
| **Where** | Facility, site | Polk Power Station |
| | Unit, area, equipment | Powerblock, Unit 1, CT |
| | Task being performed | CT was approaching FSNL |

**Impact to each GOAL**

| | | |
|---|---|---|
| **Safety** | | |
| **Environment** | | |
| **Customer** | | |
| **Production, Schedule** | 92 days of Forced Outage at 200MW | |
| **Property, Equipment** | CT1 Turbine HGP Hardware, Exhaust Frame, Bearings, Compressor Blending | TBD |
| **Labor, Time** | | |
| | This incident | $0 |
| Frequency | Annualized Cost | $0 |

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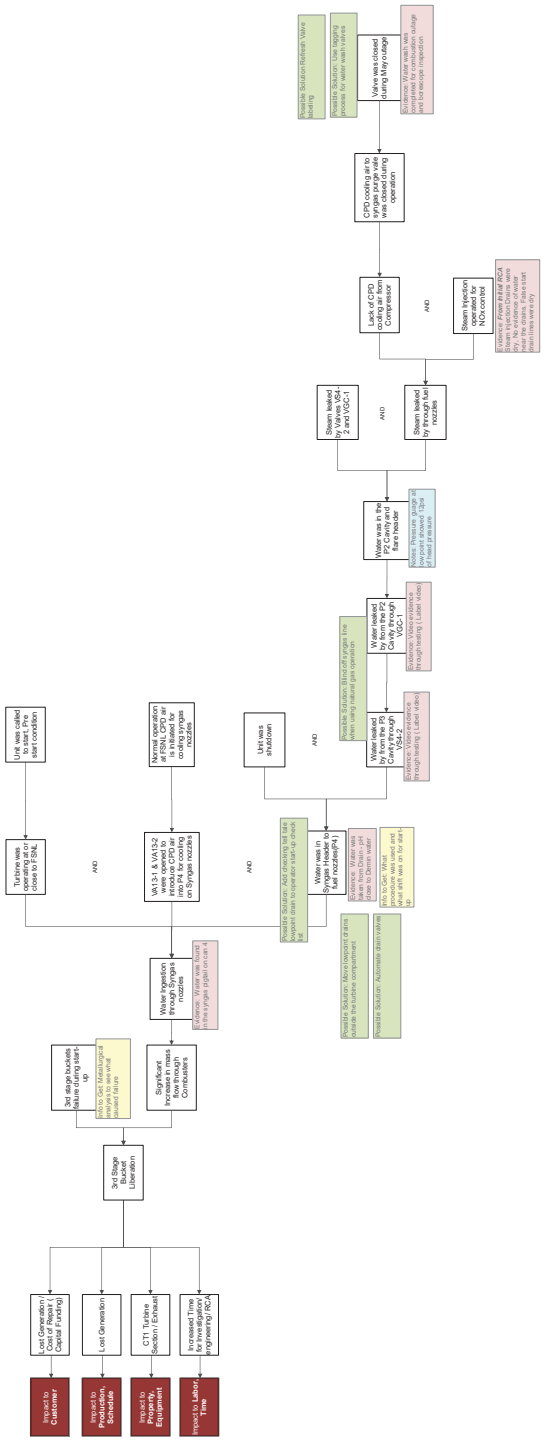


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**Solutions**

- ✓ Possible solutions proposed on the Cause Map control specific causes. For each solution, identifying the cause controlled provides continuity from the analysis.
- ✓ Preventive solutions must make changes to your work process. Identify the process that will be changed or affected by the proposed solution.

**Possible Solutions for Consideration**

| Ref. | Possible Solution | Cause Controlled |
|---|---|---|
| 1 | Add a Prestart walkdown or procedure for operators to visually look for water | Water leaked by from the P3 Cavity through VS4-2 |
| 2 | Put a WO request for all work | Water leaked by from the P3 Cavity through VS4-2 |
| 3 | Blind off syngas line when using natural gas operation | Water leaked by from the P3 Cavity through VS4-2 |
| 4 | Add checking tell tale lowpoint drain to operator start-up check list | Water was in Syngas Header to nozzles(P4) |
| 5 | Move lowpoint drains outside the turbine compartment | Water was in Syngas Header to nozzles(P4) |
| 6 | Automate drain valves in P4 cavity | Water was in Syngas Header to nozzles(P4) |
| 7 | Signoff on all operator rounds / electronic logs of operator rounds | Valve was left closed |
| 8 | Use tagging process for water wash valves | Valve was left closed |
| 9 | Refresh Valve labeling | Valve was left closed |

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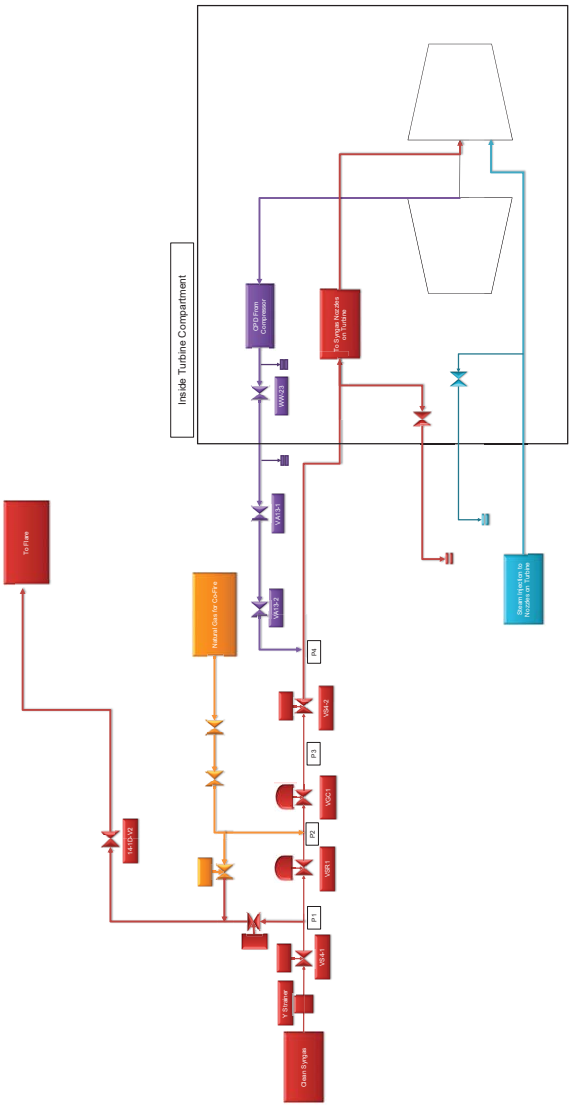


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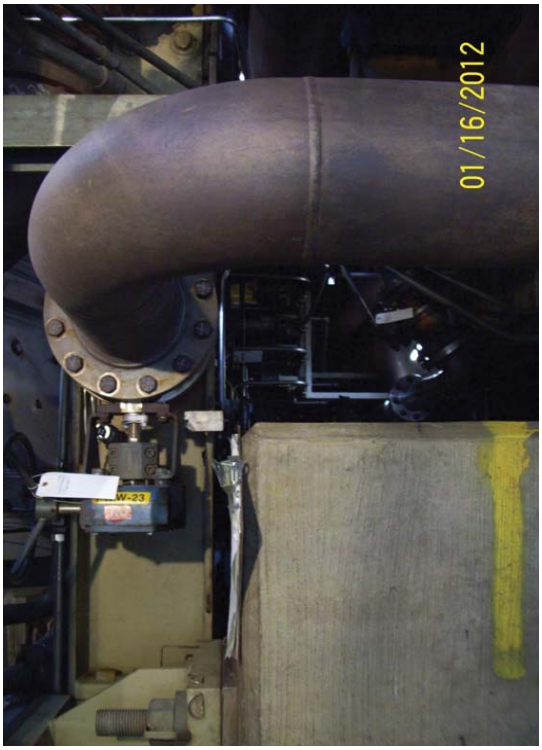
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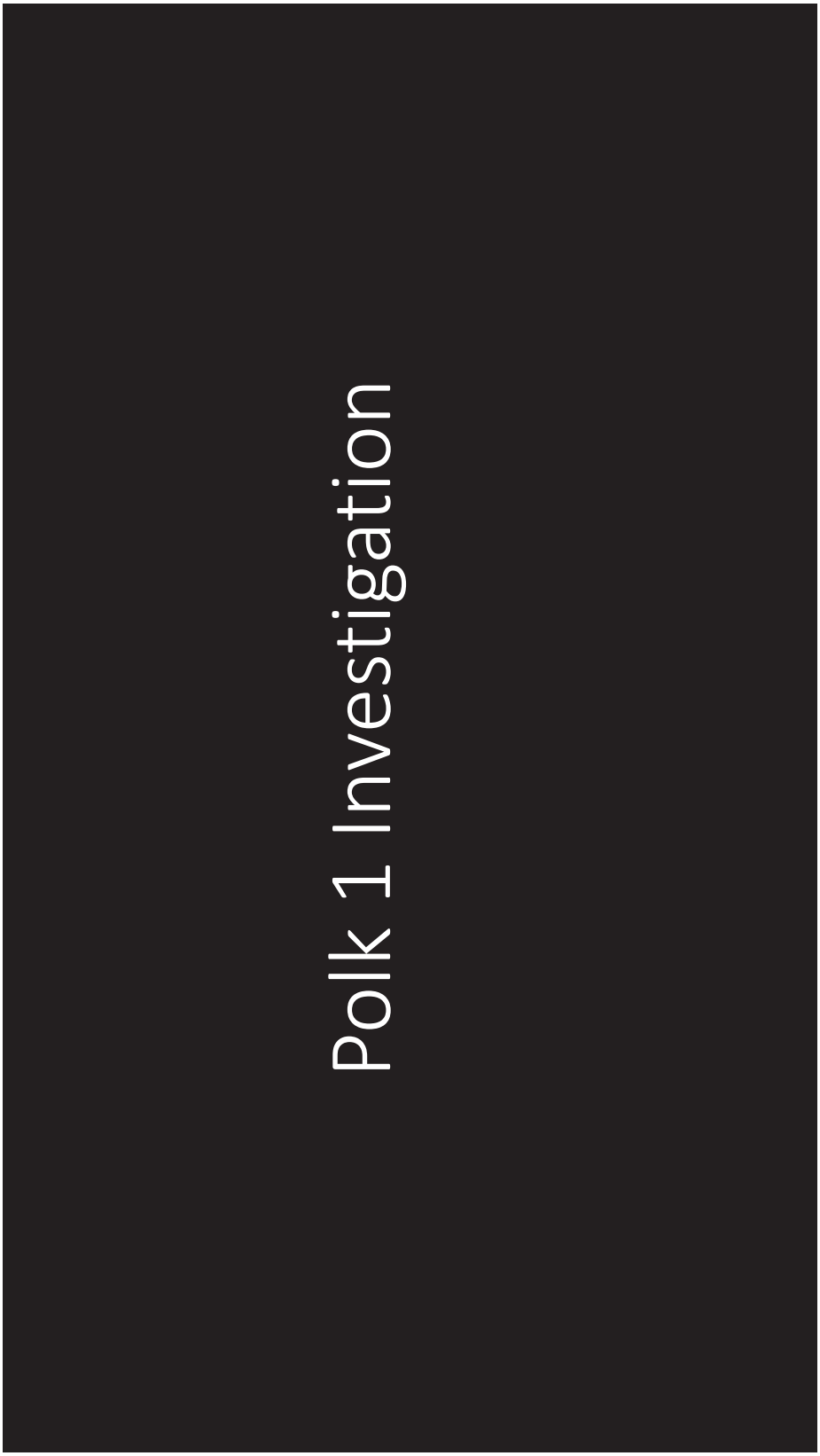
Polk 1 Investigation


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**Sup_24 - aa**

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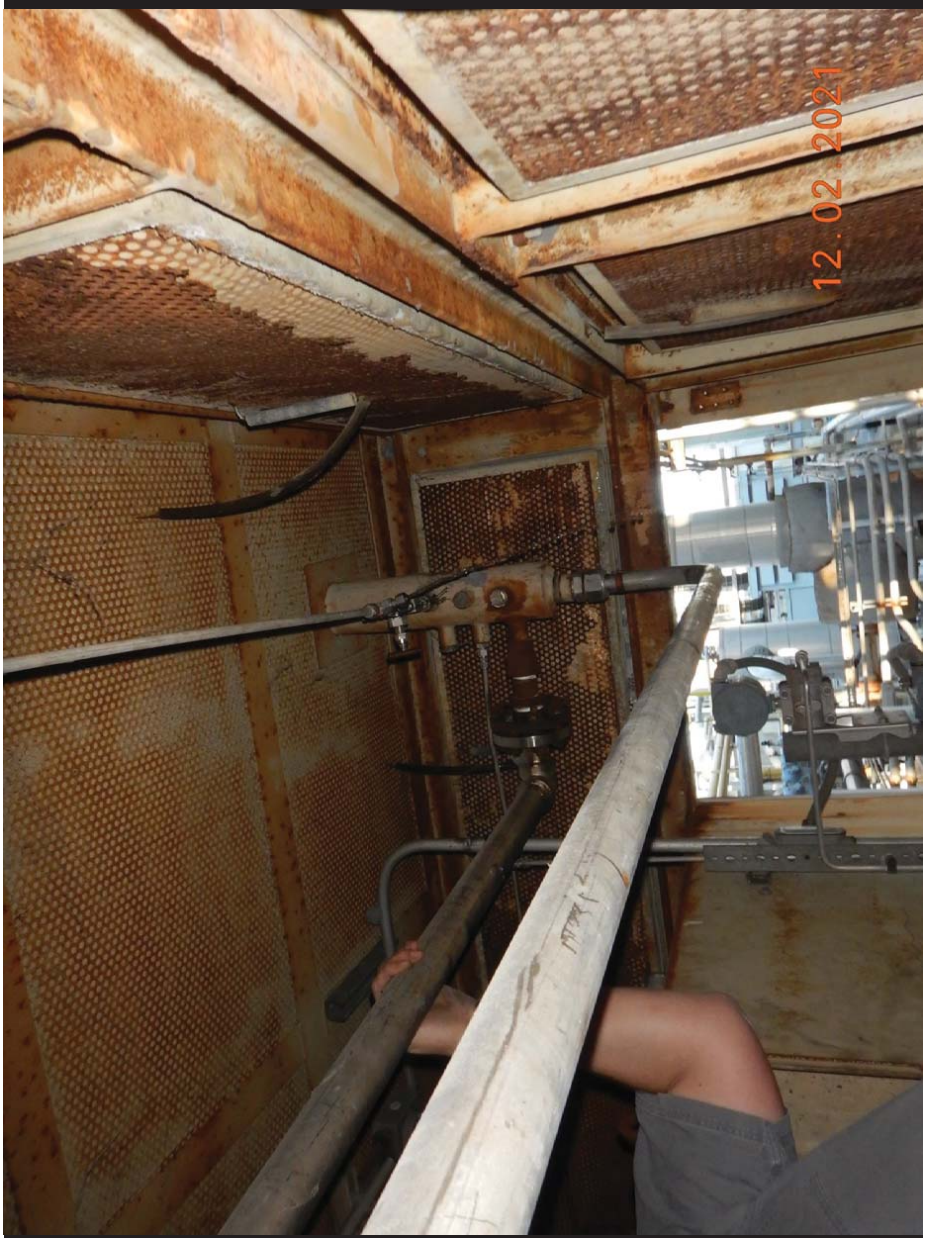


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**Sup_24 - ab**

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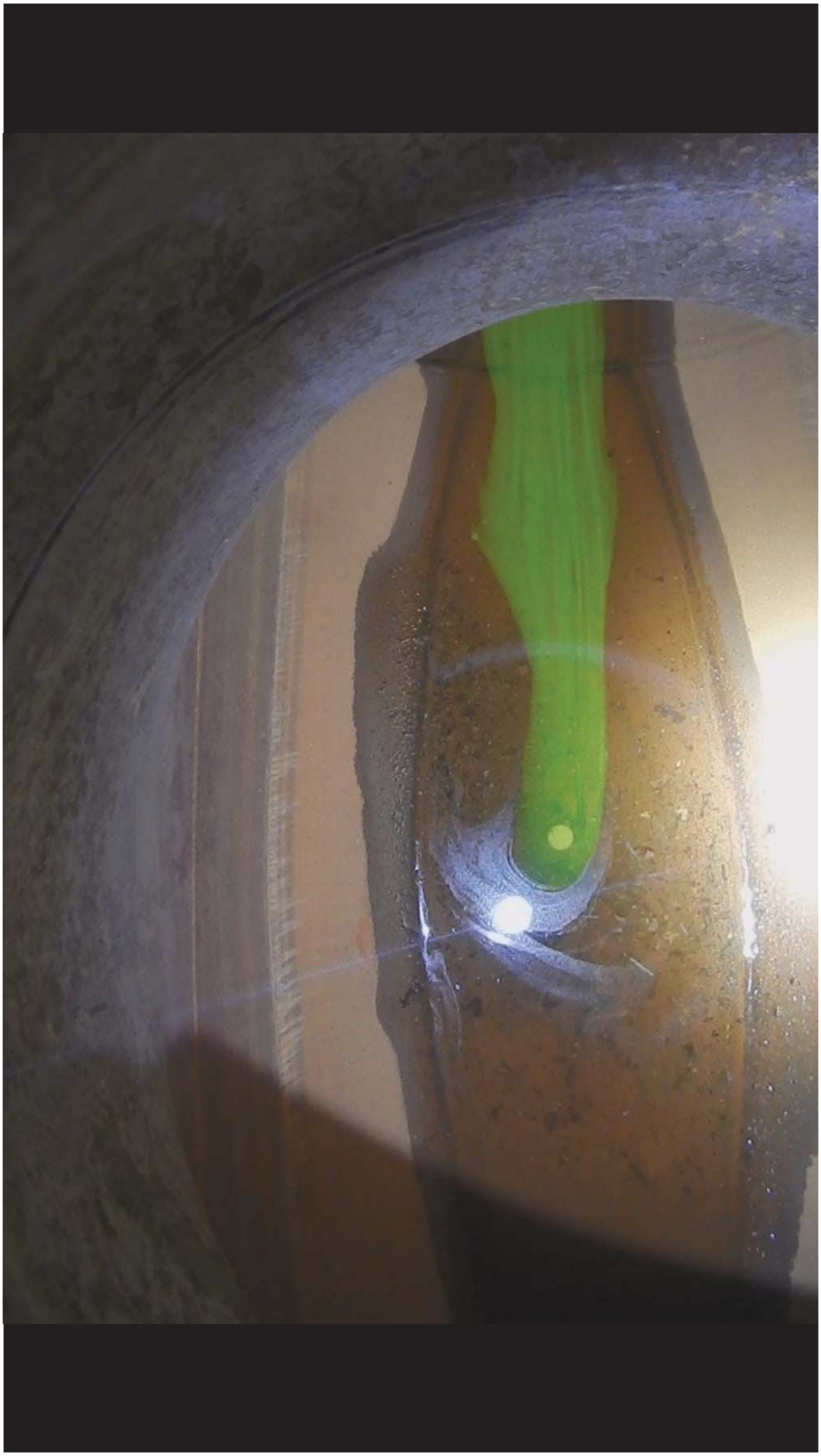
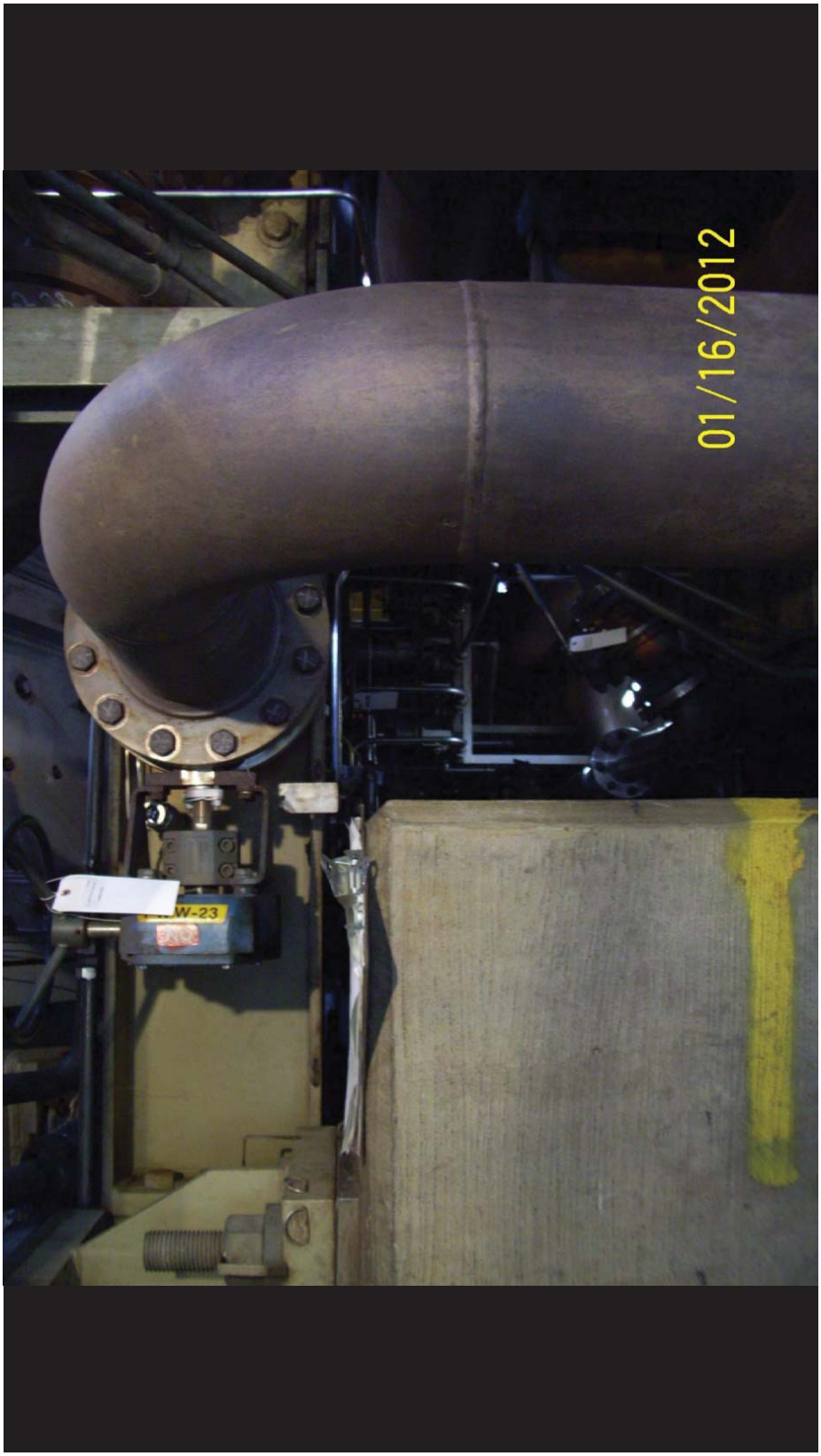
Sup_24 - ac



Sup_24 - ad

Sup_24 - ae




Sup_24 - af

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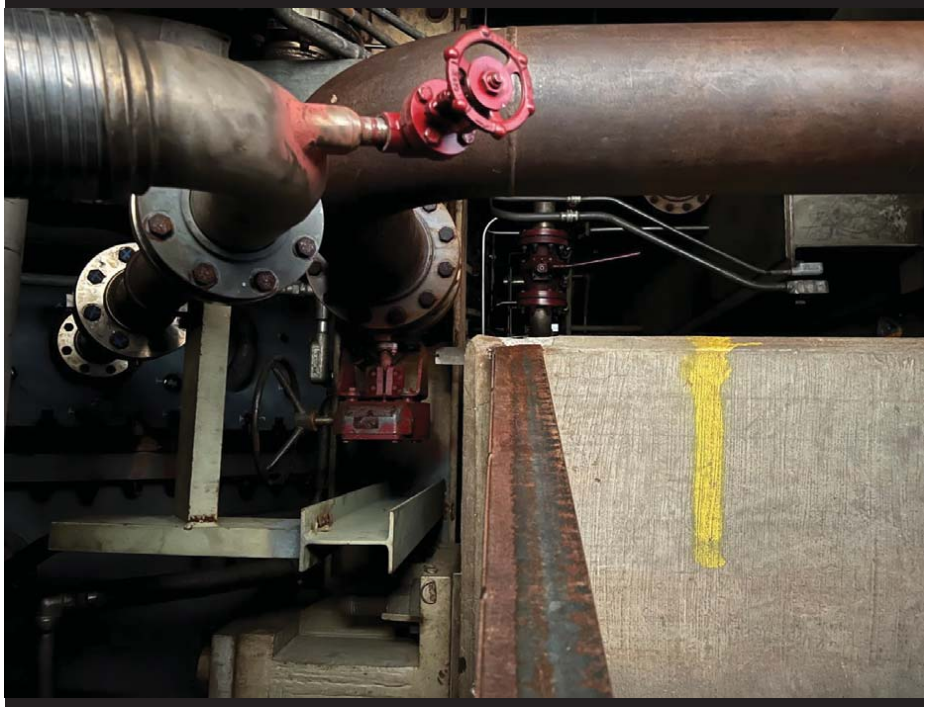

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Sup_24 - ah

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**DOCKET NO. 20220001-EI**
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**INTERROGATORY NO. 23**
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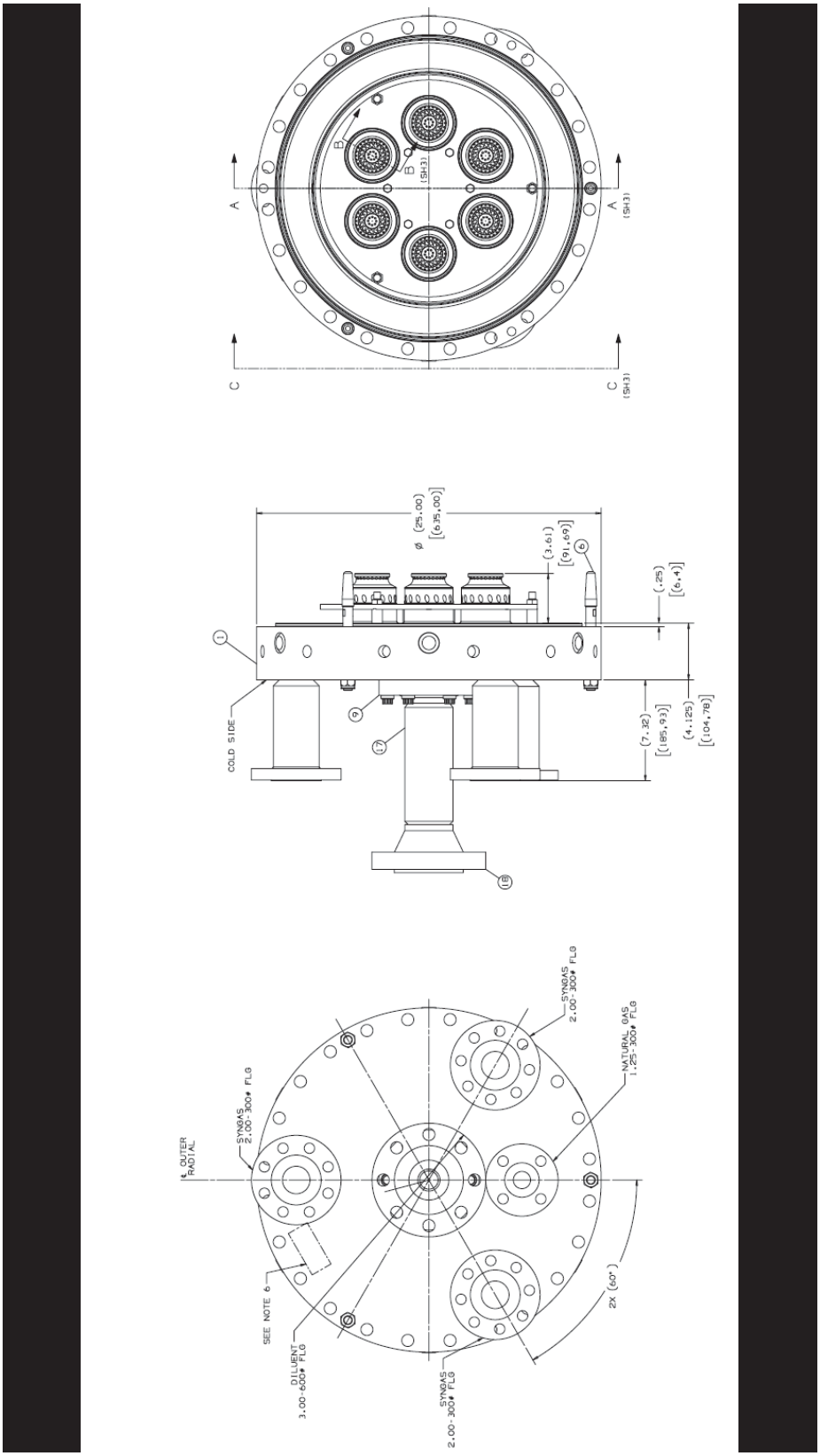
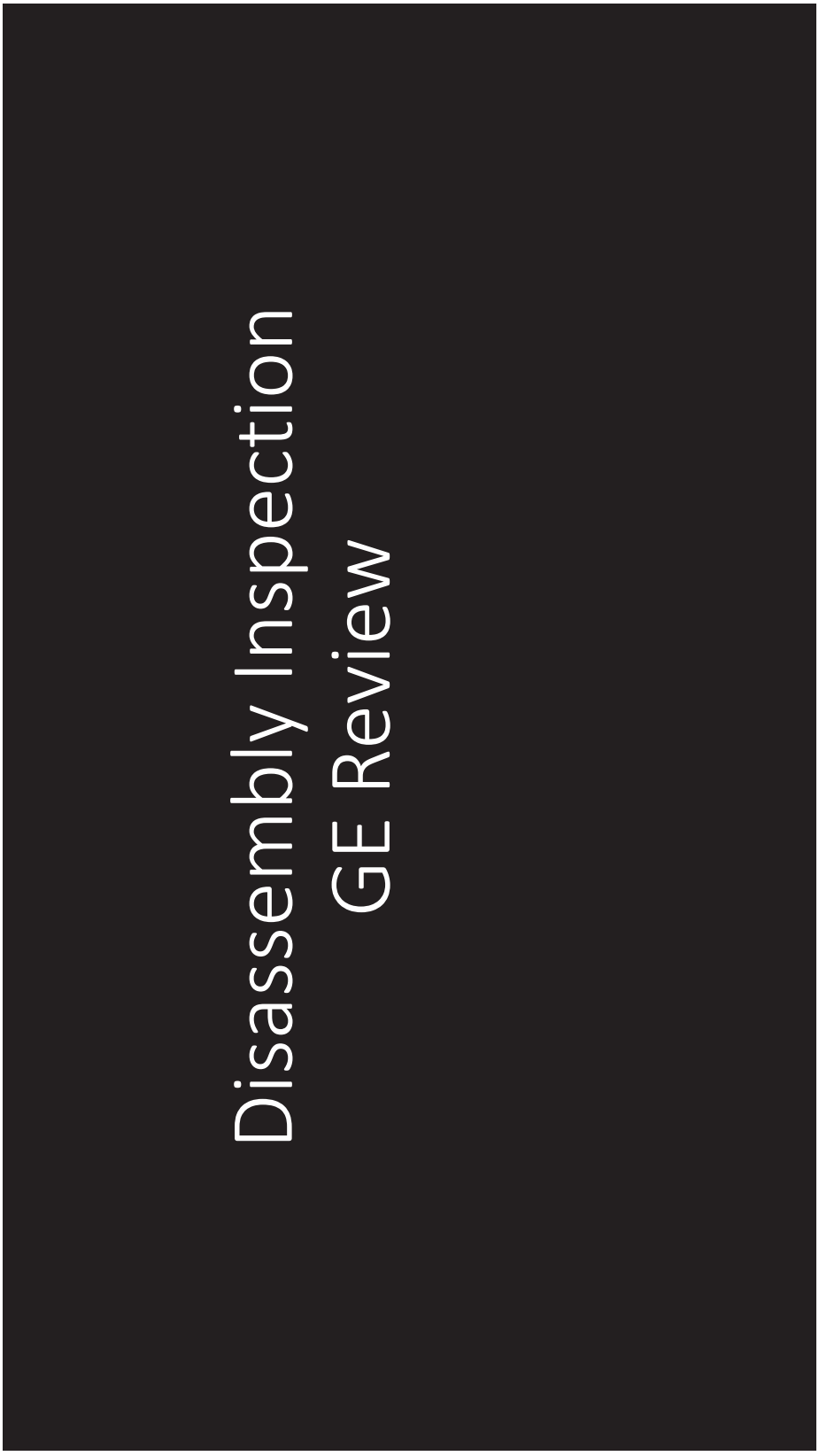


**Sup_24 - aj**


Disassembly Inspection
GE Review

TAMPA ELECTRIC COMPANY
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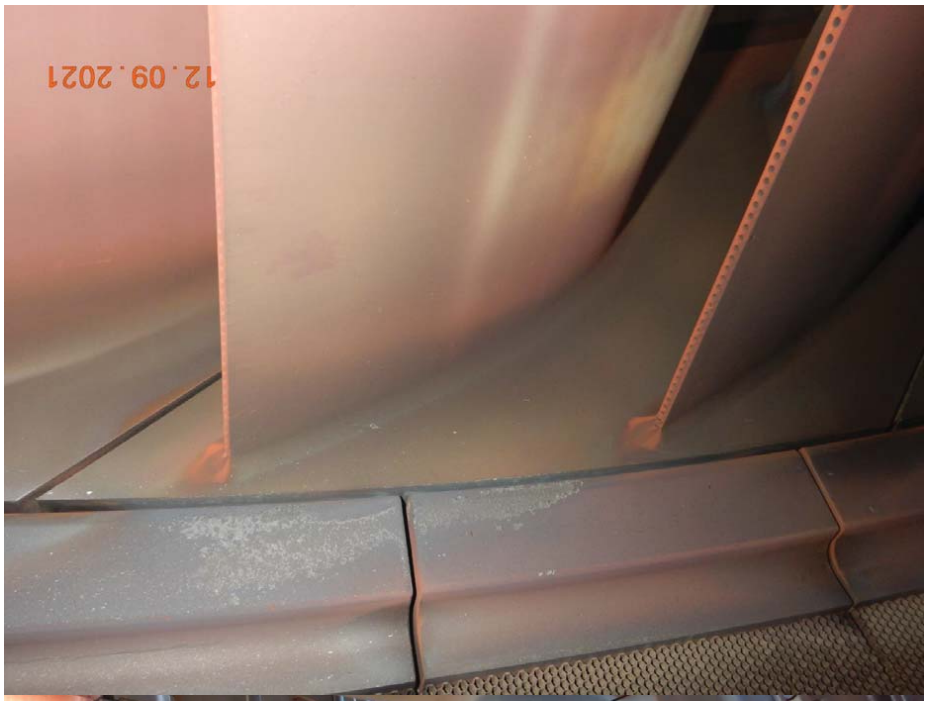
**Sup_24 - al**


12.09.2021


12.09.2021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12.02.2021


Sup_24 - ap


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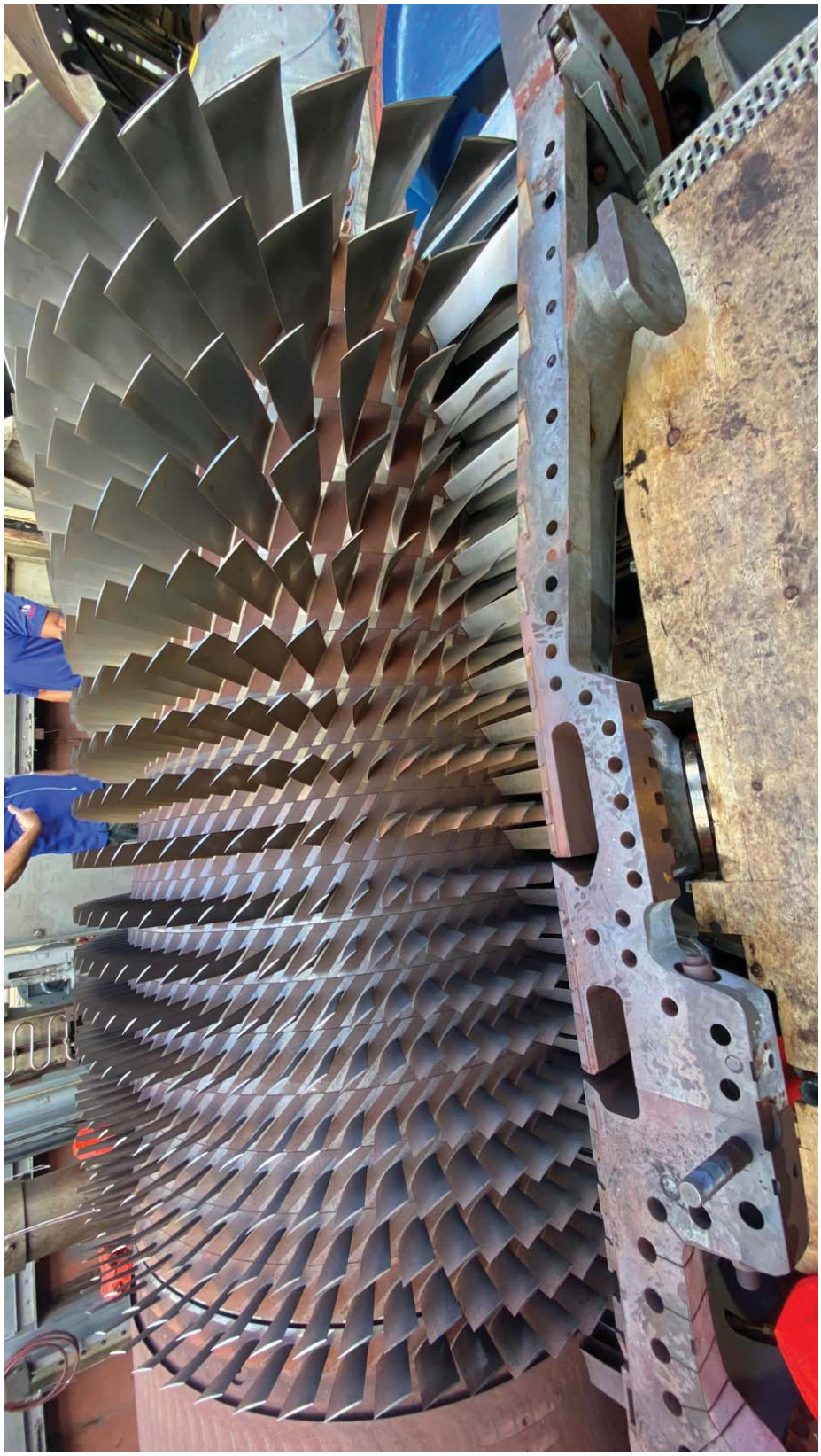

Sup_24 - as

# AFFIDAVIT

**STATE OF FLORIDA )**
**)**
**COUNTY OF HILLSBOROUGH )**

Before me the undersigned authority personally appeared M. Ashley Sizemore who deposed and said that she is a Manager, Regulatory Affairs, Tampa Electric Company, and that the individuals listed in Tampa Electric Company's response to OPC's First Set of Interrogatories, (Nos. 1-28) prepared or assisted with the responses to these interrogatories to the best of her information and belief.

Dated at Tampa, Florida this 8th day of April, 2022.

M. Ashley Sizemore

Sworn to and subscribed before me this 8th day of April, 2022.

T. C. V.

Notary Public State of Florida
Tison C Vega
My Commission GG 950315
Expires 02/01/2024

My Commission expires _____