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INDIANA UTILITY
REGULATORY COMMISSION

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

SUBDOCKET FOR REVIEW OF INDIANAPOLIS POWER & LIGHT COMPANY D/B/A AES INDIANA'S 2021 EXTENDED FORCED OUTAGE AT EAGLE VALLEY AND ITS RELATED IMPACT ON FUEL PROCUREMENT AND FUEL COSTS.	))))))	**CAUSE NO. 38703 FAC 133 S1**

<u>SUBMISSION OF REVISION TO</u>
<u>TECHNICAL CONFERENCE PRESENTATION - PUBLIC VERSION</u>

Indianapolis Power & Light Company d/b/a AES Indiana ("AES Indiana", "IPL" or "Company"), by counsel, respectfully submits the attached revised Technical Conference Presentation – Public Version. The revisions were made to Slide 19 (changing "2021" to "2022") and to Slide 34 (redacting a confidential phrase). A complete copy of the revised presentation is attached hereto.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing was served this 6th day of June, 2022, by email transmission, hand delivery or United States Mail, first class, postage prepaid to:

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Cause No. 38703 FAC 133S1

Eagle Valley CCGT

Technical Conference

CONFIDENTIAL TECHNICAL PREVIEW

June 6, 2022

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In Camera

Eagle Valley Technical Video – Confidential

Steam Handling System Overview - Confidential

[redacted]

Figure 1. Steam Handling System Overview

Cause No. 38703 FAC 133S1

Eagle Valley CCGT

Technical Conference

PUBLIC OVERVIEW

June 6, 2022

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AES Indiana Team

Presenters:

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President,
AES Indiana

John Bigalbal
Chief Operating Officer,
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Alex Halter
Operations Manager,
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Holcombe Baird
Senior Reliability Consultant,
Reliability Center, Inc.

Aaron Cooper
Chief Commercial Officer

David Jackson
Director, Regulated Operations

Other Team Members Present:

Legal & Regulatory
- Judi Sobecki – General Counsel
- Nick Grimmer – Indiana Regulatory Counsel
- Sharon Schroder – Senior Director
- Chad Rogers – Senior Manager, Regulatory Affairs
- Kim Aliff – Revenue Requirements Manager
- Kristi Figg – Senior Analyst, Regulatory Affairs
- Teresa Morton Nyhart, Barnes & Thornburg LLP – Counsel

Generation
- John Arose – Generation Complex Leader
- Mark Holbrook – Plant Manager, Eagle Valley

Communications
- Brandi Davis-Handy – Chief Public Relations Officer
- Kelly Young - Director

Agenda

- → Introductions
- → Eagle Valley Outage Summary
- → Control Systems Overview
- → Incident 1B
- → Controls Review
- → Root Cause Analysis
- → Action Plan & Recommendations
- → Fuel Cost Impacts
- → Non FAC Matters
- → Summary

Eagle Valley CCGT Overview

Eagle Valley CCGT

- → 671 MW Combined Cycle Gas Turbine
- → Modern Automated Plant
- → Commenced Commercial Operations on April 28, 2018
- → Portfolio benefits
  - Fast response and flexibility
  - High efficiency
  - Fuel source and technology diversification
  - Lower carbon emissions
- → Solid performance as Baseload Unit

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Extended Outage Overview

→ Extended outage caused by two high-impact incidents during start-ups in 2021:

- Incident 1A: April 25, 2021
- Incident 1B: November 10, 2021
- System controls failed to protect critical equipment in both events.

→ Management approach:

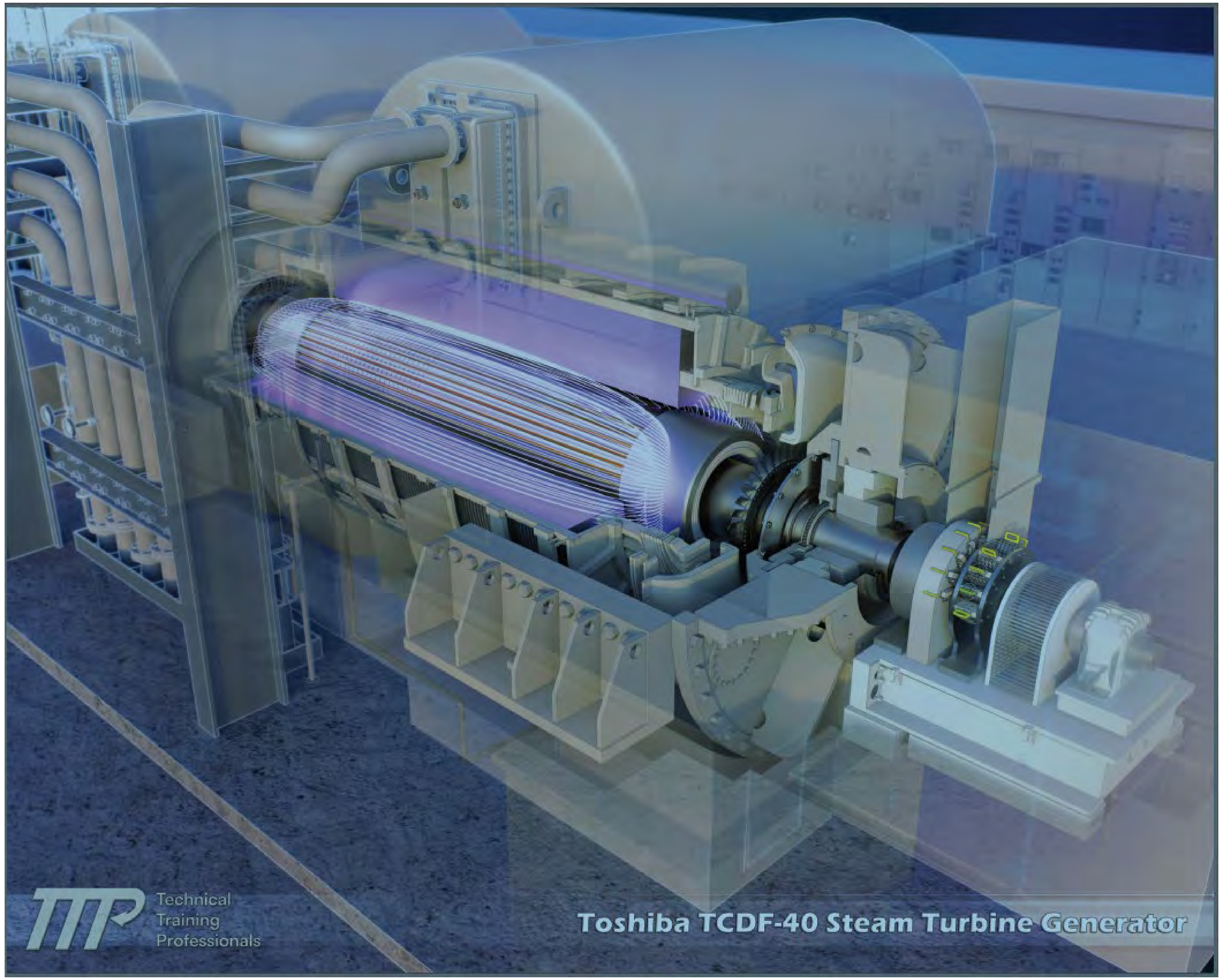
- Objective: Mitigate the cost impact to customers.
- Expedite Eagle Valley's return to service.
- Identify root causes and take corrective actions for the future.

→ After Incident 1B, initiated comprehensive assessment to ensure safety and reliability.

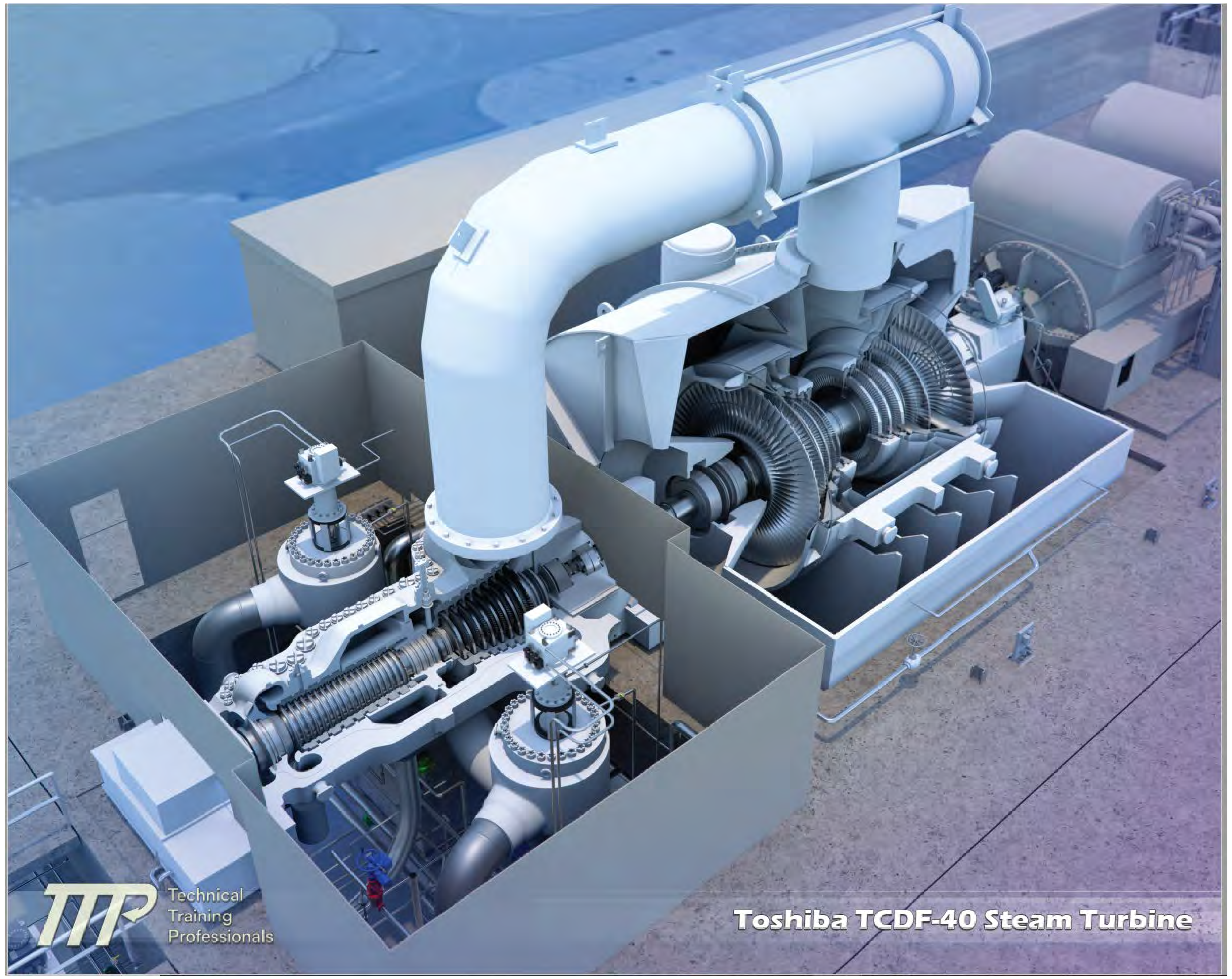
- Detailed review of control systems and logic, narratives and operational procedures for critical systems and equipment.

→ Eagle Valley returned to service on March 18, 2022 – full capacity and operating efficiently.

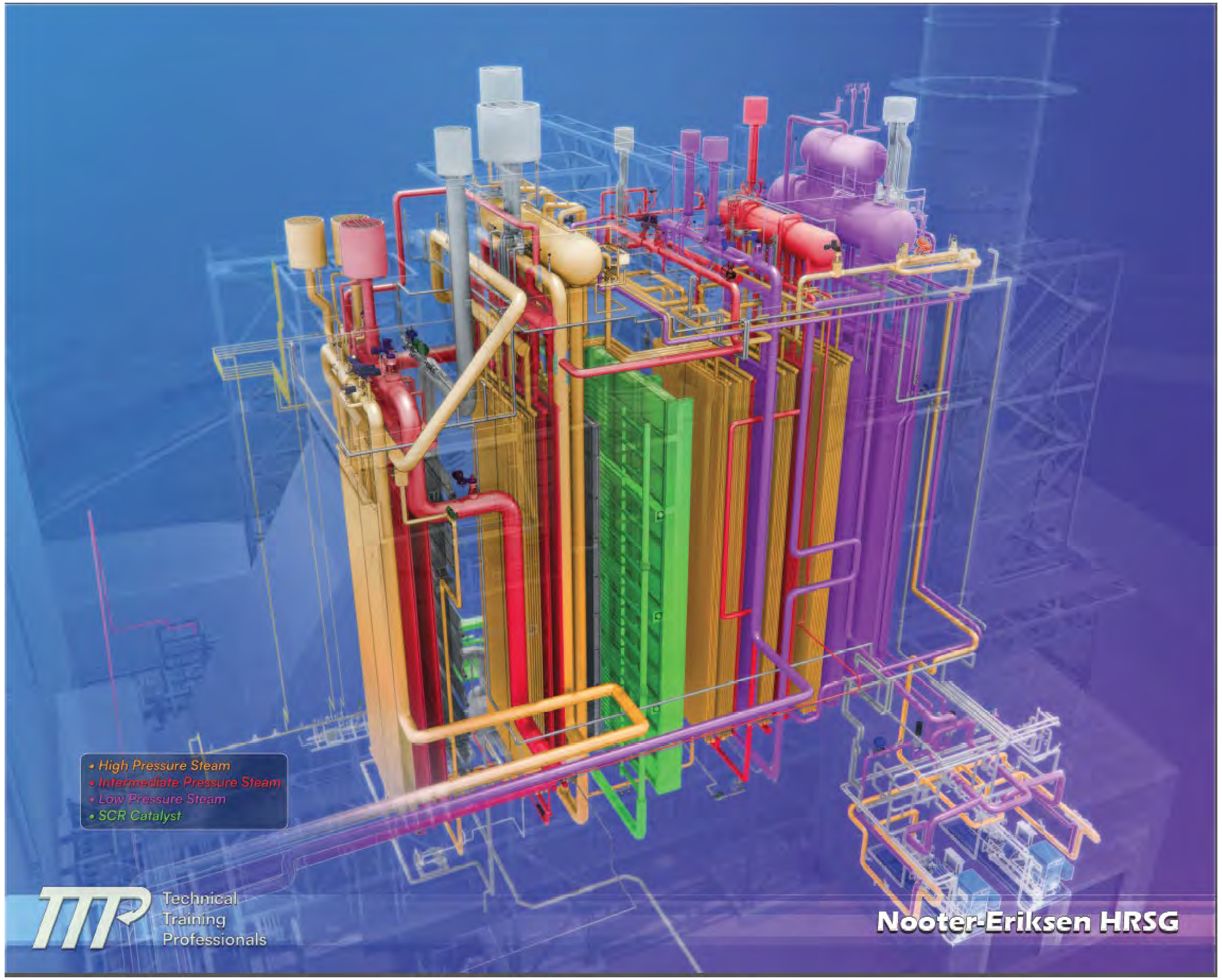
Steam Turbine's Generator



Steam Turbine

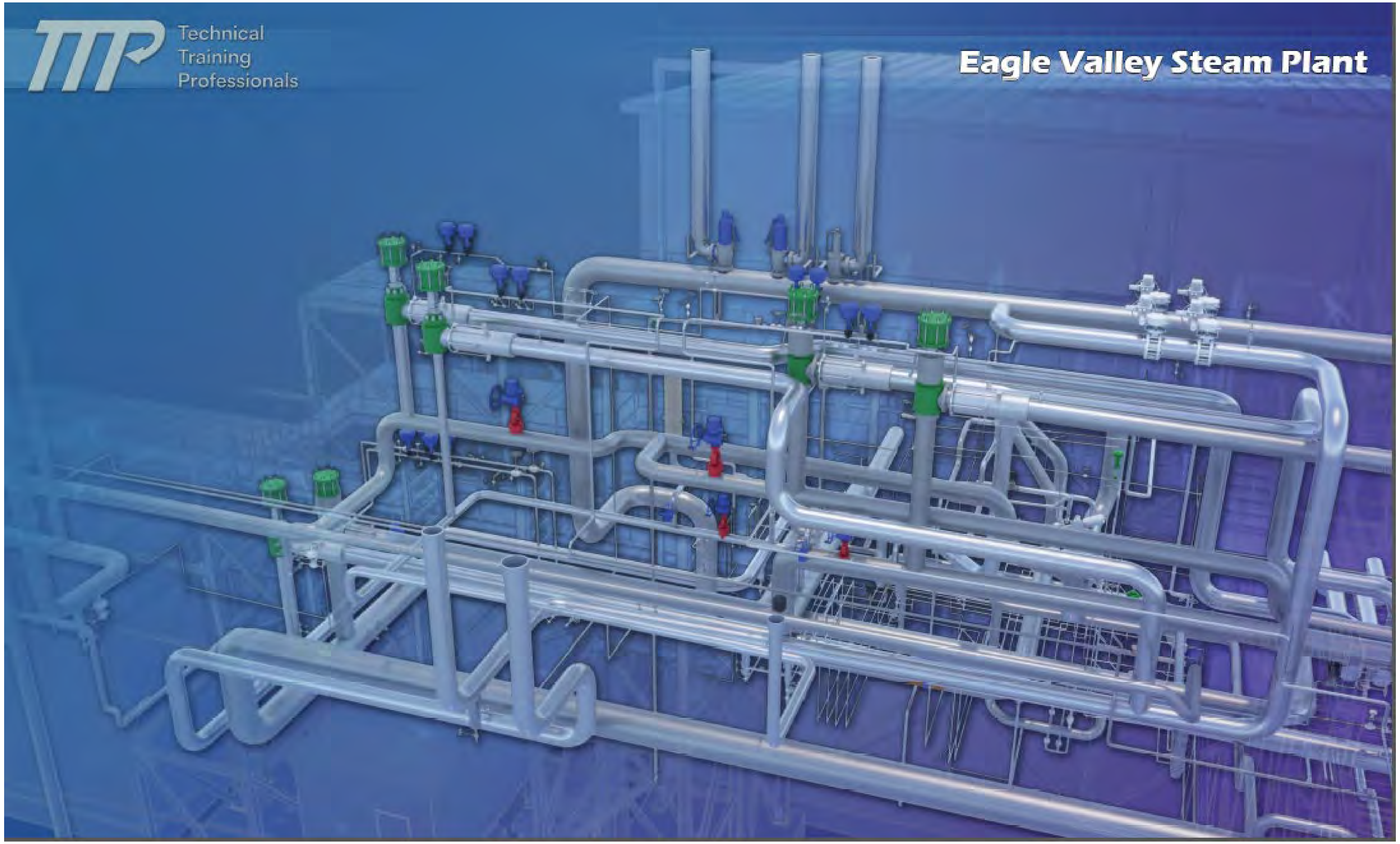


Heat Recovery Steam Generator (HRSG)



PUBLIC VERSION

Steam Handling System



Control Systems Overview

Importance of Control Logic

→ Modern plant with automated controls:

- Control systems should operate the plant automatically.
- The automated controls should perform the necessary startup and shutdown sequences as well as ramping up and down.
- Automated controls should monitor all processes and indicate deviations.
- Automated controls should perform trip functions for significant deviations to provide safety for personnel and protect equipment.
- Manual intervention should not defeat the automated protection systems and trips.

Summary of Control Systems

→ Eagle Valley CCGT has three main control systems that should be designed to operate the plant automatically.

- **General Electric Mark VIe** – controls the gas turbines and gas turbine generators.
- **Toshiba Microprocessor Aided Power (TOSMAP)** – controls the steam turbine and steam turbine generators.
- **Emerson Ovation** – controls the generation output and the remainder of the plant, including the heat recovery steam generator (HRSG) and steam handling system.

EPC Contract Technical Specifications

[redacted]

EPC contract technical specifications required control systems that will trip equipment in order to protect personnel and equipment prior to failure.

[redacted]

Incident 1B: November 10, 2021

Cold Reheat Pipe Failure and Steam Turbine Damage

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Summary of Incident 1B

→ Eagle Valley completed repairs related to Incident 1A.

→ November 8, 2021 – Gas Turbine 2 (GT2) was started but the steam turbine could not start.

- There was a communications issue inside Toshiba's control system (TOSMAP) responsible for providing the communication between the field sensors and the control processors.

→ GT2 was loaded to 90MW to enter Dry Low NOx Mode to reduce emissions while troubleshooting of the steam turbine continued.

→ November 10, 2021 – the TOSMAP issues were repaired, and the steam turbine is started.

→ The steam turbine could not synchronize due to an issue with the field breaker (41E).

- The 41E printed circuit board inside the control system had a failed relay.

→ Once the printed circuit board was replaced, the generator breaker (52G) failed to close, leaving the generator unable to connect to the grid.

→ While troubleshooting the 52G breaker, the cold reheat (CRH) pipe ruptured.

→ Both units, the STG1 and GT2, were tripped manually and plant was shutdown.

Incident 1B Actions

Actions immediately identified by AES Indiana prior to RCA:

→ Repair the High-Pressure Steam Turbine components.

→ Replace the damaged Cold Reheat piping.

→ Complete troubleshooting 52G and perform breaker testing.

→ Perform a review on the control systems, control narratives, and plant procedures.

→ Modify the control systems, control narratives, and plant procedures based on review findings.

→ Perform operator training using a third-party technical trainer.

Comprehensive Controls Review

Incident 1B Controls Review

→ Control Systems experts hired to review the control narratives, logic, and loops, identify issues, and make recommendations:

- Kiewit
- Stag Control
- AES control system experts

→ The use of three independent reviews provided insight into the control systems contributions to Incident 1B.

→ The review teams provided recommendations to the control narratives, control logic, and plant operating procedures.

→ Emerson, the manufacturer of the Distributed Control System, was hired to help with the control design changes and implemented them into the Distributed Control System.

	Discrepancies
[redacted]	
TOTAL	258

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Incident 1B Controls Findings

→ HP Bypass Valve incorrectly programmed.

- [redacted]

→ IP Bypass Valve incorrectly programmed.

- [redacted]

→ CRH condensate drain valves incorrectly programmed.

- [redacted]

→ Gas Turbine temperature matching mode incorrectly programmed and procedurally incorrect.

- [redacted]

→ SCR not programmed to operate during startup.

- [redacted]

Root Cause Analysis

RCA Incident 1B

→ Immediately following incident, AES Indiana mobilized an RCA team.

→ Team facilitated by third party – Holcombe Baird – Senior Reliability Consultant, Reliability Center, Inc.

→ Additional personnel mobilized from other AES Indiana facilities to support the RCA process.

→ RCA is complete.

→ RCA recommended action plan is complete.

Role of Root Cause Analysis (RCA)

→ RCA is a systematic process to identify all aspects of a system failure or identified problem.

→ RCA documents what happened, how it happened and why to identify factors, that when addressed, would have the highest probability of preventing a reoccurrence.

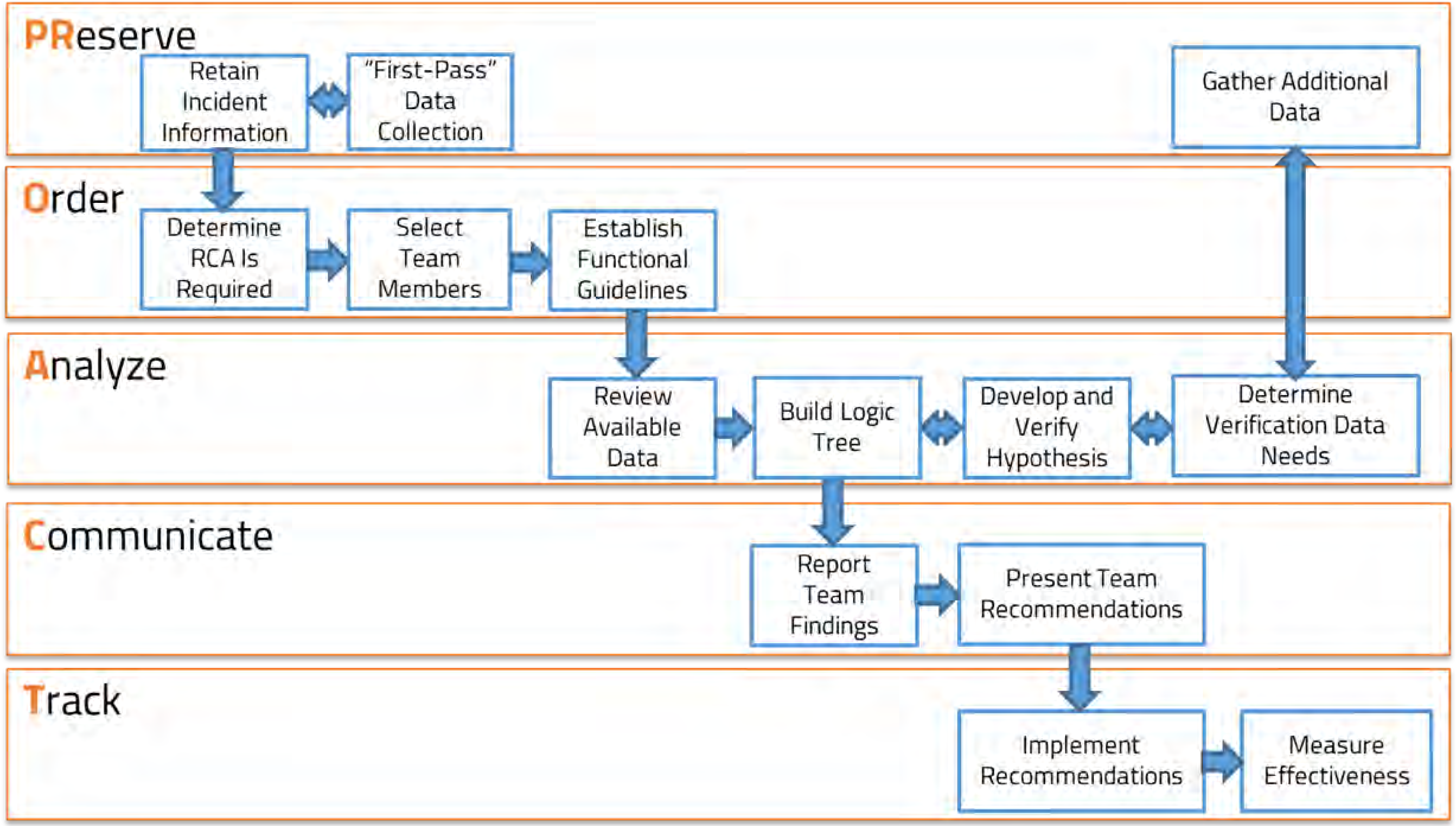
→ While an important tool, an RCA reviews an event after the fact and outside the plant environment – it is a hindsight analysis.

→ The RCA process allows us to learn through hindsight analysis how to improve our business on a going forward basis so we can better serve our customers.

Reliability Center Inc. ("RCI") RCA Process

- → RCI facilitated RCA for Incident 1A and 1B.
- → RCI follows its PROACT® RCA process when conducting or facilitating a root cause analysis.
- → RCA facilitator ensures the team's adherence to the PROACT® RCA process and compiles the team's findings into a written report.
- → The technical complexity of the failure event of Incident 1B required technical expertise in control systems and a separate controls system review was performed.

RCI PROACT® Process Flowchart



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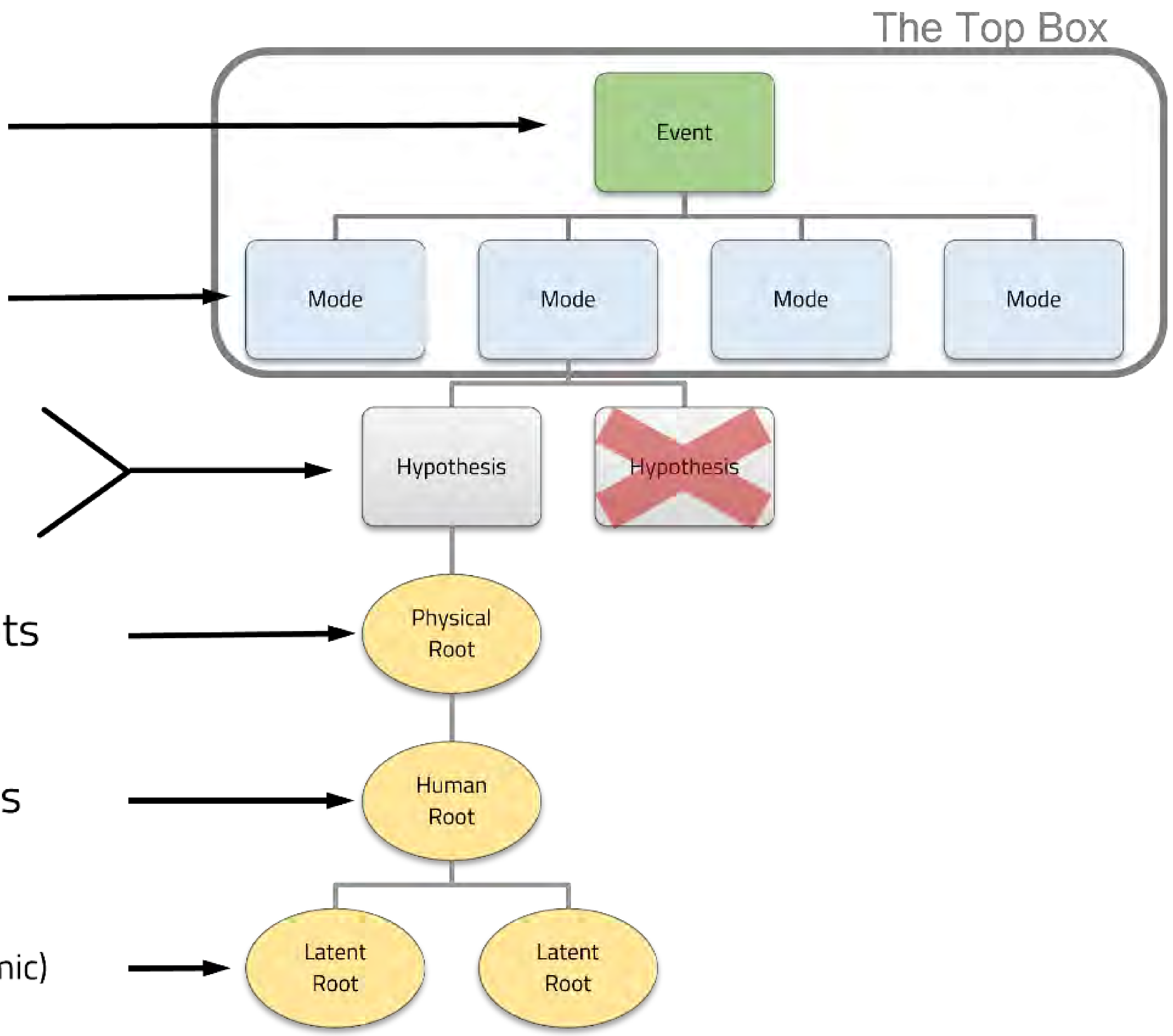
RCI PROACT® Logic Tree

1. Describe the Event
2. Describe the Modes
3. Hypothesize
4. Verify the Hypotheses
5. Determine Physical Roots and verify
6. Determine Human Roots and verify
7. Determine Latent (Systemic) Roots and verify



RCA Incident 1B

→ Analysis broken down into two separate investigative efforts:

1. Why did the Cold Reheat (CRH) Piping rupture and HP Steam Turbine components get damaged?

2. What caused the high HP Exhaust Temperature?

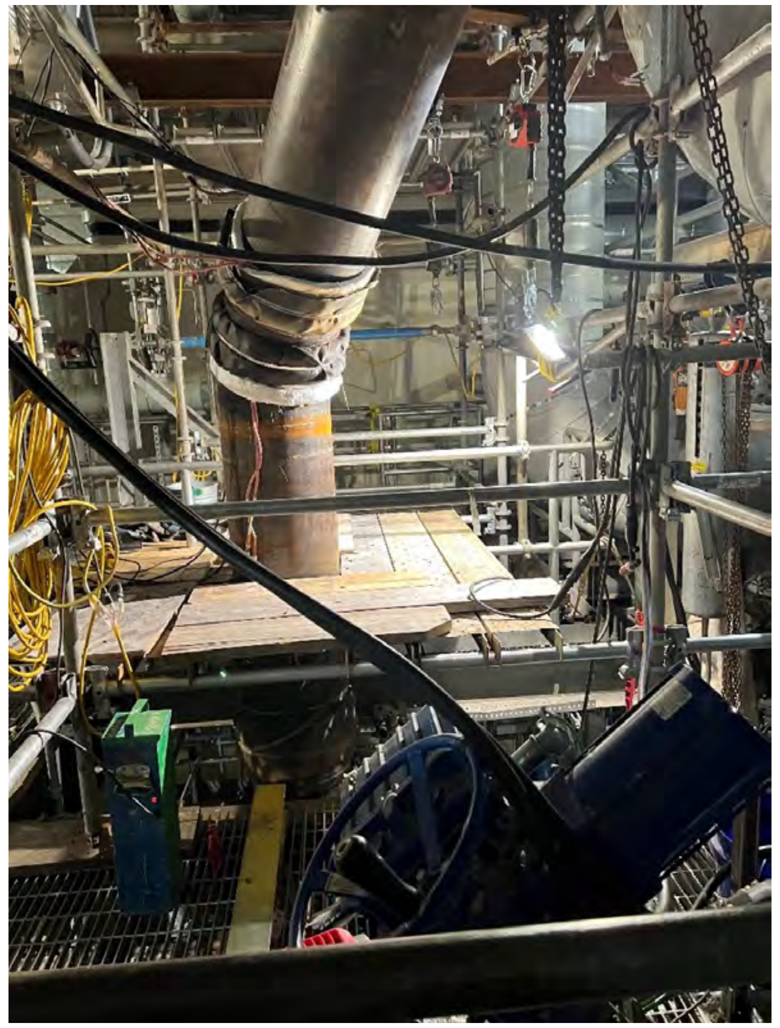
RCA Findings Incident 1B

1 Why did the Cold Reheat (CRH) Piping rupture and HP Steam Turbine components get damaged.

→ The CRH piping and exhaust end of the High Pressure Steam Turbine experienced high temperature estimated to be approximately 1500F.

→ The piping is rated for 1150F.

→ The steam turbine components are rated for approximately 1250F.



RCA Findings Incident 1B

2 **What caused the high HP Exhaust Temperature.**

A. Insufficient flow of steam through the HP Turbine to remove heat generated by windage.

B. HP Steam pressure and temperature supplied to the HP Turbine exceeded [redacted]

C. Insufficient notification and response to high HP Exhaust temperature condition.

D. The steam turbine operated for an extended period of time (5 hours and 9 minutes) at Full Speed No Load (FSNL) condition.

As stated previously, these control system findings have been corrected.

RCA Findings Incident 1B

A **Insufficient flow of steam through the HP Turbine to remove heat generated by windage.**

→ Turbine Bypass system improperly programmed in the control system increased the backpressure on the HP Exhaust which attributed to insufficient steam flow through the HP Steam Turbine.

→ Cold Reheat condensate drain valve was not open which attributed to less steam flow through the HP Steam Turbine.

- In auto, the valve opens to drain the valve's condensate (water) collection pot when it is full or when turbine is tripped to provide a path for condensate as the unit cools.
- The CRH drain was placed in auto on November 8 and remained in auto.
- There was no manual intervention to assess the extent to which the valve was opened enough.

RCA Findings Incident 1B

B **HP Steam pressure and temperature supplied to the HP Turbine exceeded** [redacted]

→ GT2 had been running at 90MW for two days prior to starting the steam turbine.

- The GT2 loading produced higher exhaust temperature and therefore higher HP steam temperature and pressure.

→ GT2 was not switched to temperature matching mode.

- Temperature matching mode reduces the GT exhaust temperature for starting the steam turbine.

→ TOSMAP allowed startup of the steam turbine [redacted]

- [redacted]
- The operators were unaware of the need to take actions [redacted]

RCA Findings Incident 1B

C **Insufficient notification and response to high HP Exhaust temperature condition.**

→ The inaudible high HP exhaust temperature alarm activated on the operation monitor.

- Alarm was acknowledged.
  - No further action was taken by operators to lower the HP Exhaust temperature.
  - Historical trend data shows that the high HP exhaust temperature alarm activated almost every startup.
  - The alarm was considered normal and would clear soon after the steam turbine synchronize.
  - This was the case even during commissioning.
- There was no controls protection to automatically trip the process.

RCA Findings Incident 1B

D **The steam turbine operated for an extended period of time (5 hours and 9 minutes) at Full Speed No Load (FSNL) condition.**

→ 41E breaker failed to close to excite the steam turbine generator.

- The failed circuit board relay resulted in the 41E failure to close.
- During troubleshooting the steam turbine operated at Full Speed No Load (FSNL) for over 4 hours.

→ 52G breaker failed to close to synchronize the steam turbine generator.

- A missing wire on the synchronization relay circuit resulted in the 52G failure the close.
- During troubleshooting the steam turbine operated at FSNL for an additional hour until the CRH piping rupture.

→ [redacted]

- The DCS logic was not programmed to provide a final protection by tripping the steam turbine if the operator's response to the alarm is ineffective.

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RCA Action Plan Incident 1B

AES Indiana has completed the RCA Immediate Corrective Actions

Action	Status
Inspect, evaluate, and repair damaged steam piping and related components.	Complete
Inspect, evaluate, and repair damaged HP Turbine components.	Complete
Implement recommendations of Toshiba TTIL for [redacted]	Complete
Restore and test wiring for synchronization signal to close 52G.	Complete
Correct identified discrepancies in DCS controls programming.	Complete
Perform operational training with specifics on DCS automation and manual control	Complete

Recommendations Incident 1B

AES Indiana has completed the RCA Recommendations

Recommendation	Status
Conduct an independent engineering review of controls narratives, and DCS programming logic for continuity and accuracy.	Complete
Construct a virtual model of the Bypass steam handling system to confirm engineering design and DCS programming provide correct functional operation.	Complete
Review the maintenance work order system (CMMS) for any incomplete work orders pertaining to nuisance alarms.	Complete
Perform an environmental audit to clarify emission requirements for startup.	Complete
Perform a recommissioning of Eagle Valley plant after repairs and program corrections are completed.	Complete

Recommendations Incident 1B cont'd

AES Indiana has completed the RCA Recommendations

Recommendation	Status
Perform a review of alarm history, sorting critical alarms from nuisance alarms to provide improved operator notifications of critical alarms and resolve issues causing nuisance alarms.	Complete
Acquire a high-fidelity process simulator for operator training.	Complete
Perform a gap analysis of the current operating procedures and revise the procedures based on the analysis findings.	Complete
Implement a skills and knowledge assessment as well as a training program for Leaders, Operators and Technicians.	Complete
Perform a recommissioning of Eagle Valley plant after repairs and program corrections are completed.	Complete

Fuel Cost Impacts

Fuel Costs Attributable to Eagle Valley Outage

→ Fuel costs attributable to Eagle Valley forced outage:

- Methodology
- Fuel Costs
- Purchased Power Costs attributable to outage
- Purchased power costs above the benchmark attributable to the Eagle Valley Outage net of the hedge

→ In total, the peak power and natural gas hedges resulted in reduced fuel costs of $8.2 million

Fuel Costs Attributable to Eagle Valley Outage

→ Methodology - AES Indiana modeled what fuel and purchased power costs may have been had Eagle Valley been available.

- Model Eagle Valley generation with new commodity prices.
- Enter modeled Eagle Valley generation, Day Ahead Awards and fuel prices into the OATI system (Open Access Technology International, Inc.).
- OATI results determined the change in fuel and purchased power costs.

Fuel Costs Attributable to Eagle Valley Outage

→ The estimated impact to fuel related costs using the methodology previously described is estimated to be $41.5M for the outage period, which is approximately 8% of the total fuel related costs included in the four FAC periods.

	Eagle Valley Impact
FAC133	$ 6,650,735
FAC134	$ 4,925,159
FAC135	$23,592,486
FAC 136 (1)	$ 6,350,096
	$ 41,518,476

(1) Outage ended on March 18, 2022, therefore only includes the months of February and March 2022.

→ Actual fuel costs were higher than forecast during the historical FAC period due to rising commodity (natural gas & coal) prices. These factors resulted in fuel cost increases unrelated to the Eagle Valley outage.

Purchased Power over the Benchmark

- → The Purchased Power Order (CN 43414) applies to purchased power that flows through the FAC including purchased power resulting from forced outage which is not the result of imprudence, malfeasance, nonfeasance, or other inappropriate acts.
- → To provide context, most of the fuel costs attributable to the Eagle Valley outage fall below the benchmark in the Purchased Power Order.
- → Using the Purchased Power Order methodology, all of the purchased power is recoverable, including the amounts over the benchmark during the outage period.
- → The peak power hedge value exceeded the amount over the benchmark.

	Total Purchased Power over Benchmark		Eagle Valley Impact		Non-Outage Purchases over Benchmark
FAC133	$1,198,183		$1,037,085		$161,097
FAC134	$1,183,609		$1,050,260		$133,349
FAC135	$2,487,937		$2,214,496		$273,441
FAC136	$482,182		$293,356		$188,826
	$5,351,911	-	$4,595,198	=	$756,713

Eagle Valley Energy Hedges

→ AES Indiana transacted hedges to safeguard customer price risk as detailed in the table below.

→ The $41,518,476 identified previously is NET of the value of the hedges shown below.

Month	Type	Realized Gain/(Loss)	Totals
June	Peak Power	$758,807	
July	Peak Power	$832,167	
August	Peak Power	$2,080,504	
September	Peak Power	$1,953,922	
October	Peak Power	$1,601,046	
December	Peak Power	$(482,546)	
SUBTOTAL			$6,743,900
January	Natural Gas	$287,437	
February	Natural Gas	$1,148,630	
SUBTOTAL			$1,436,067
TOTAL			**$8,179,967**

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Proposed Recovery of Eagle Valley Outage Fuel Costs

Total Unrecovered Eagle Valley Outage Fuel Costs	$41,518,474
Recovery over four FAC Periods	$10,379,619 in each FAC

Non FAC Matters

Off System Sales Rider Impact

→OSS-4 and OSS-5 OSS Period May 2021 to March 2022:

- Forecasted margin $15,054,550
- Actual margin received $4,799,406

Capacity

→Purchased capacity to address outage impact on MISO Capacity accreditation for planning years 2022-2026 capacity.

→Uncleared capacity also mitigated the outage impact.

→Details included in Confidential Testimony Attachment.

AES Indiana's actions will provide benefits in the next four MISO planning years through improved unit capacity ratings. Moreover, incorporating the updated forecast in this filing allows AES Indiana's customers to realize the significant value they will see from this more recent auction now, rather than waiting two years. In addition, incorporating the factor changes in this filing will benefit customers by avoiding a large overcollection variance in OSS-8, helping to mitigate potential rate volatility. – Order in Cause No. 44795 OSS-6

Summary

→ Eagle Valley is a modern plant with automated controls.

→ Control systems automate, integrate and protect people & equipment with limited human intervention.

→ Eagle Valley control systems failed to protect the steam turbine generator.

- Questionable generator and field breaker logic (event 1A).
- Lack of turbine trip on high pressure turbine exhaust (event 1B).

→ To remediate deficiencies, we performed an in-depth review and have successfully corrected:

- Wiring and as-built drawings (1A).
- Control narratives and logic (1B).
- Operating Procedures.
- Retrained our people and procured a simulator to be delivered later this year.

→ We also took proactive steps to minimize impact to our customers.

- Hedging power and fuel.

In Camera

Before and After – HP Steam Temperature - CONFIDENTIAL

[redacted]

Before and After – HP Steam Pressure-CONFIDENTIAL

[redacted]

Before and After – HP Exhaust Pressure-CONFIDENTIAL

[redacted]

Before and After – HP Exhaust Temperature-CONFIDENTIAL

[redacted]

Discussion & Questions