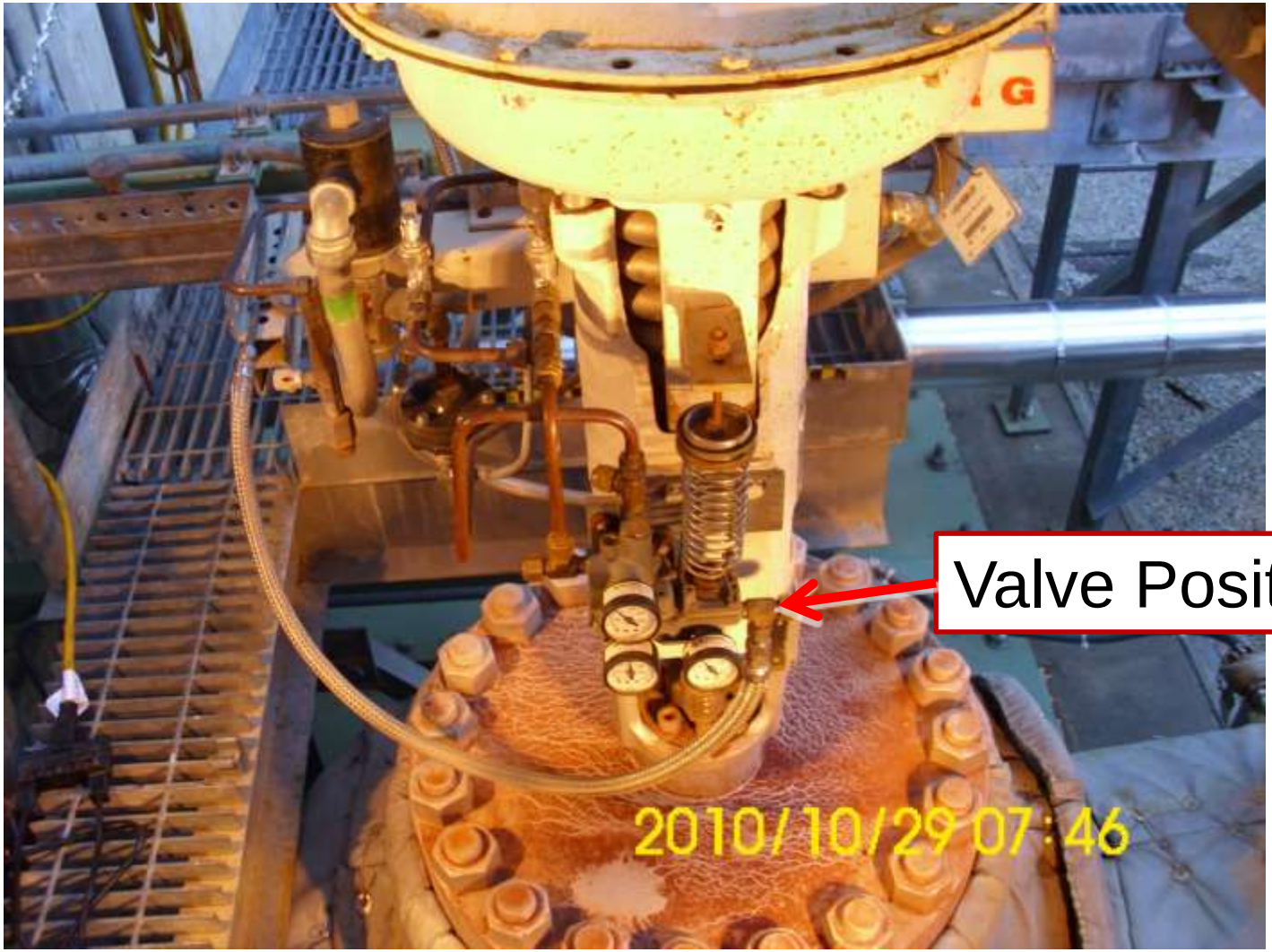
Manual Trip Entering 2RF15

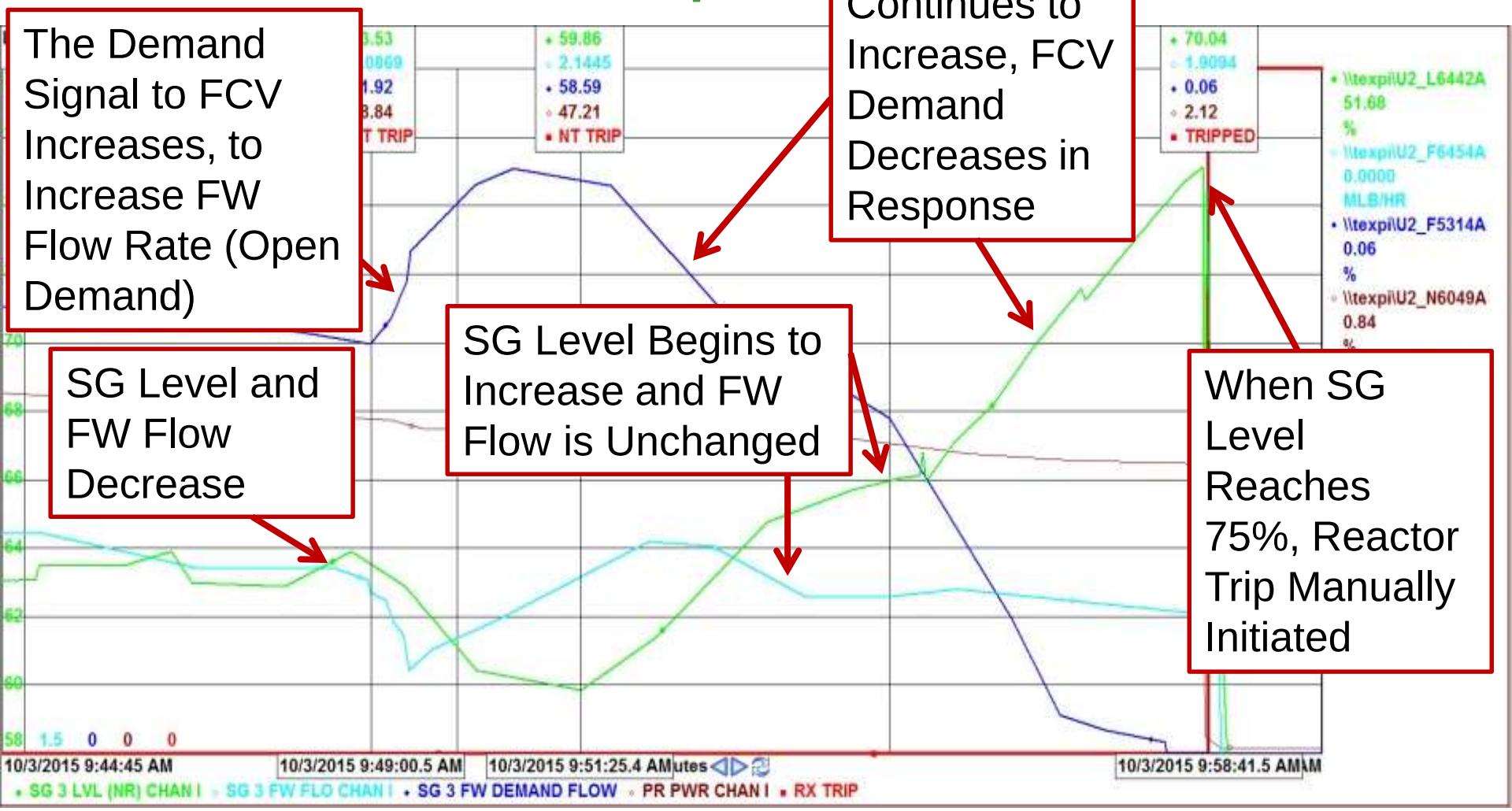
Inability to Control Steam Generator
2-03 Level Due to Unresponsive
2-FCV-0530

Luminant

Cause of the Trip



Cause of the Trip



Cause of the Trip

- 2-FCV-0530 is an identified Single Point Vulnerability.
- Erratic performance of SG FW demand flow and sensitivity to ambient temperature were not detected prior to the Unit 2 trip.
- The SG FW demand flow was not being trended by Engineering(Systems, Reliability, POC)leading up to the failure of the 2-FCV-0530
- Trending of this data could have provided early indication of an issue with the positioner on 2-FCV-0530

Cause of the Trip

- This O-ring found in 2-FCV-530 was found to be degraded in compression set, brittle, and had a lack of the nitrile chemical bond.

- Three other associated o-rings that had been exposed to the same service environment and time were examined and did not show degradation of the same magnitude.

Potential Causes for O-Ring Compression Set Failure

- Low heat resistance of material.
- The FTIR for the failed O-ring varied from the other O-rings in that the nitrile peak was not clearly present.
- The vendor used standard issue positioner O-rings for non-safety related parts.
- Incomplete curing (vulcanization) of the O-ring material during production.
- The positioners are being sent to the manufacturer for further failure analysis.

Extent of Condition

- The only application for the Siemens (formerly Moore) model 74SG valve positioner is the Main Feedwater Flow Control Valves

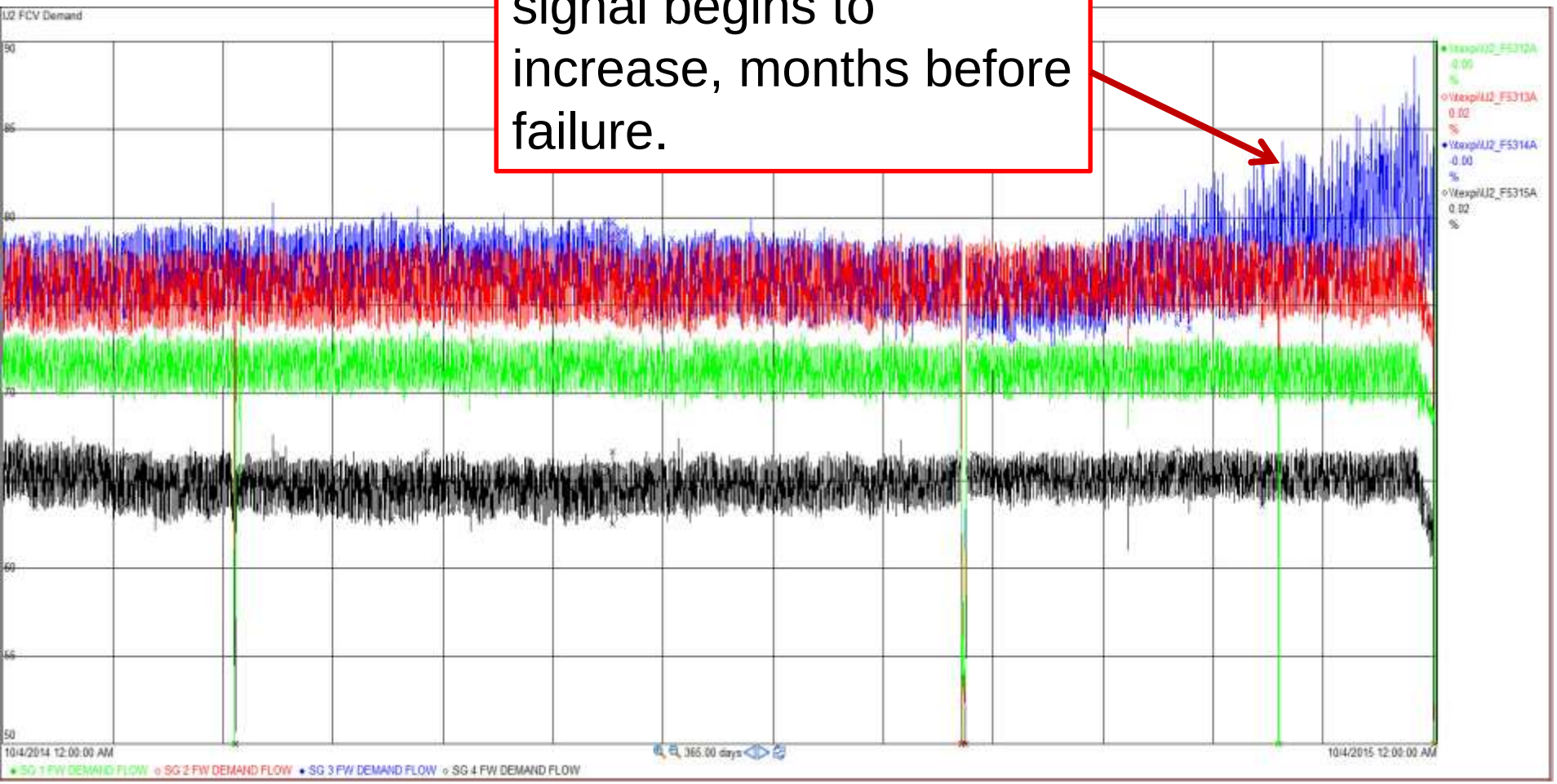
Positioner	Last Replaced
1-FCV-0510-PP1	October 2014
1-FCV-0520-PP1	October 2011
1-FCV-0530-PP1	October 2011
1-FCV-0540-PP1	October 2014
2-FCV-0510-PP1	October 2012
2-FCV-0520-PP1	October 2012
2-FCV-0530-PP1	October 2012
2-FCV-0540-PP1	April 2011

- In total 6 failures have occurred during the 13 years of service in 8 locations for the Siemens Model 74SG positioner.
- Of the 6 failures the 2-FCV-0530 was the only failure due to O-ring manufacturing issues.
- The positioners are currently scheduled for replacement on a 4.5 year frequency.

Corrective Actions

Trending

The valve demand signal begins to increase, months before failure.



Corrective Actions

- All four Unit 2 positioners were replaced.
- An EOC review was performed for the Unit 1 positioners to determine if any adverse SG FW demand flow trends were present.
- Trends of the Unit-1 components show no abnormalities.
- The System Monitoring Plan has been modified to identify the this trend potential (System Engineering).
- POC has modified their trending plan to assist with the identification and site notification of this trend.

Corrective Actions

Long Term: Consider Design Modifications

- Other sites have replaced single FCV positioners with dual digital positioners. This may eliminate the SPV for these components, as well as the I/P transducers.
- CPNPP will perform benchmarking and engage industry experts on the use of dual digital positioners.

Lessons Learned

- System Monitoring plans should be comprehensive enough to understand the importance of unique trending parameters.
  - The system monitoring plan did not include instructions or documentation of the potential trend.

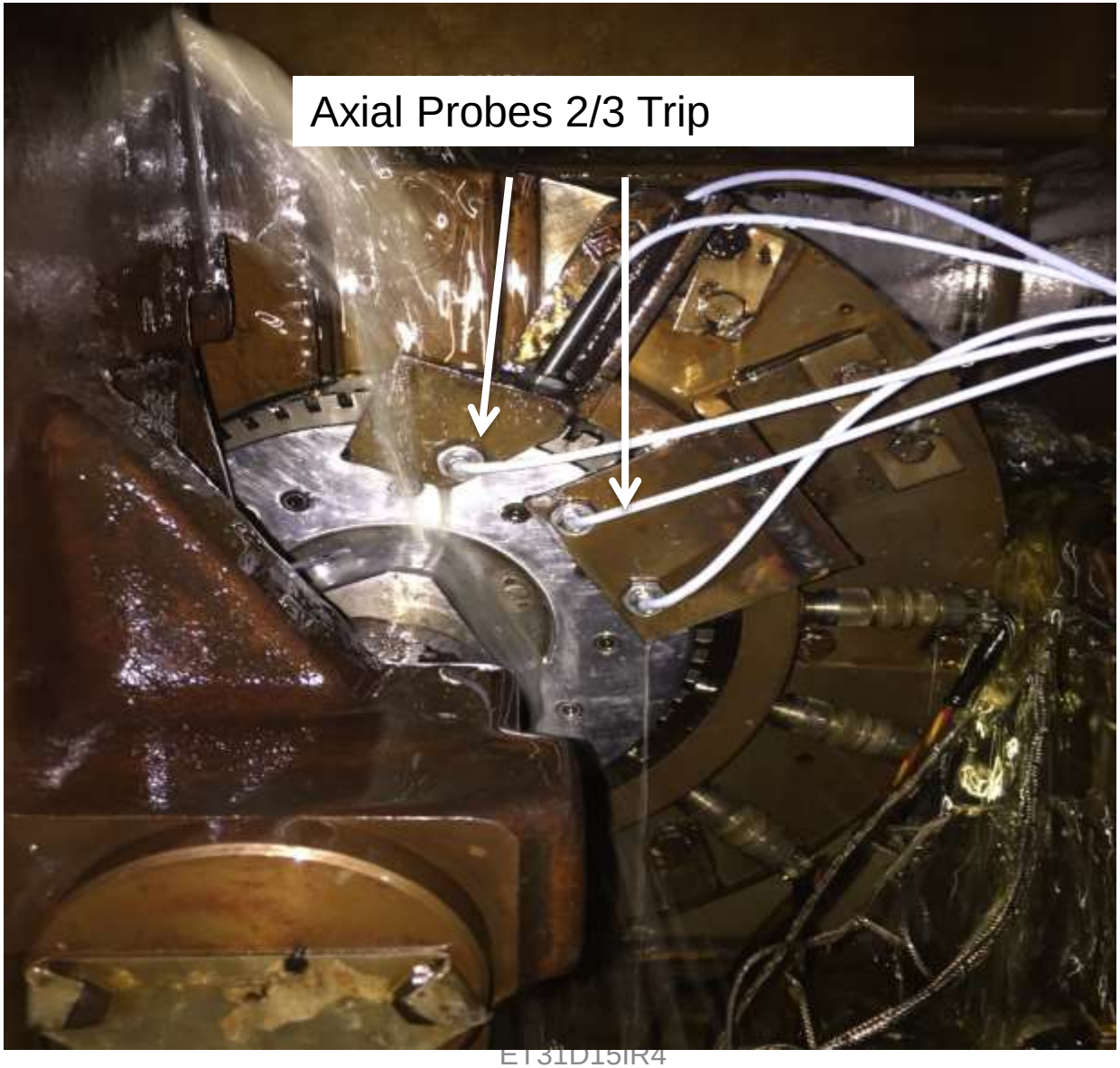
- System and Component Notebooks should be complete, stand-alone documents, so they can be understood without recourse to the originator.

- System trending should include long-term trends, not just weekly trends.

- The use of different methods such as remote monitoring should be used when possible for dealing with Single Point Vulnerabilities.

Main Feed Pump Turbine (MFPT)
1-A Trip due to Loss of Axial Position Probes

Normal configuration of axial position probes



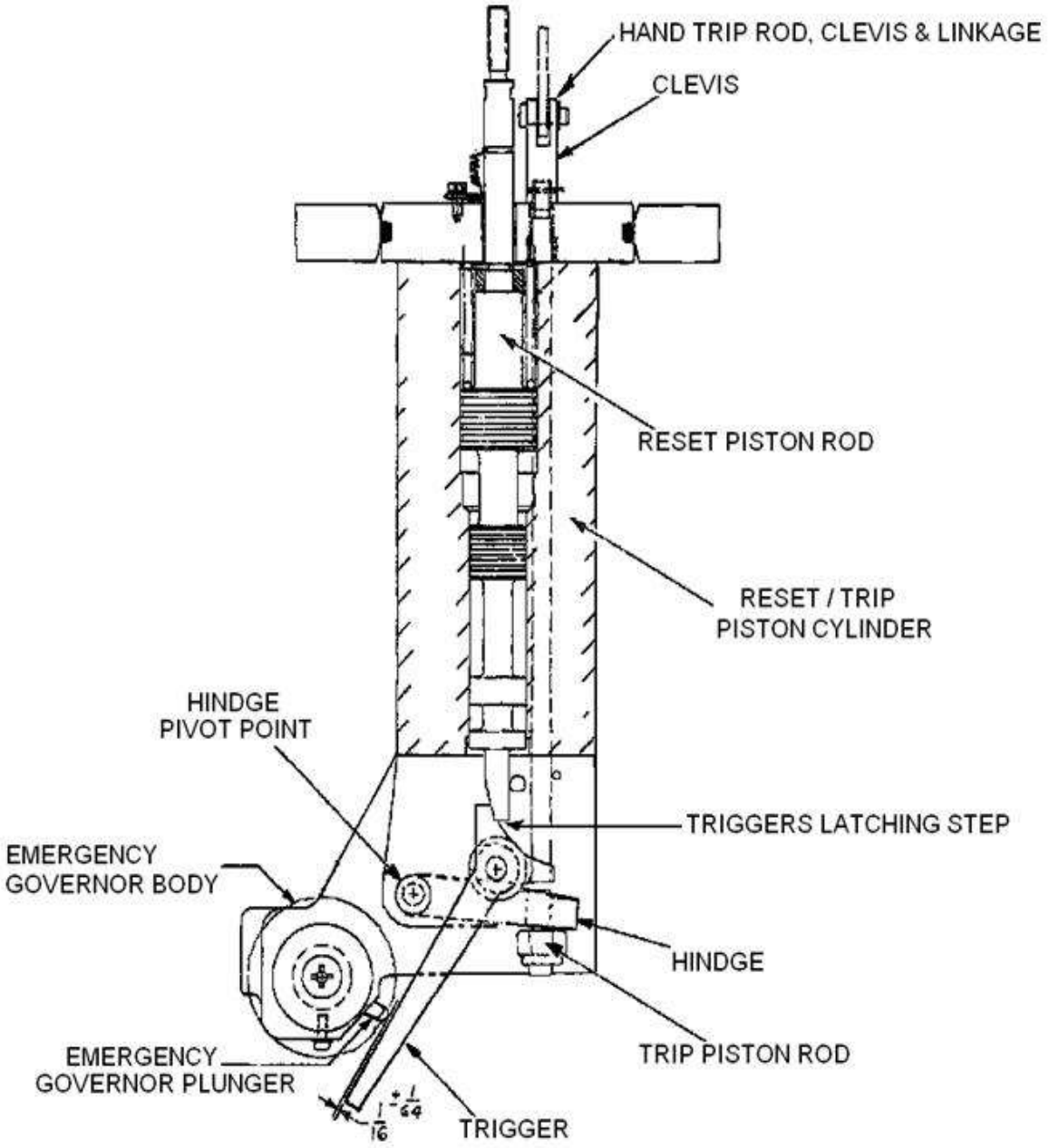
As Found condition of Axial Position Probes

Why were they seared off?

- The Emergency Governor Plunger experienced a fatigue failure of the perforated disk that holds the plunger in place by a spring. This fatigue failure caused the bolt to be no longer restrained within the trip housing, shearing off the proximity probes. The fatigue failure was enabled due to a failed solenoid that did not allow the Reset/Trip Piston to fall which allowed excessive contact to the trip trigger during overspeed testing.

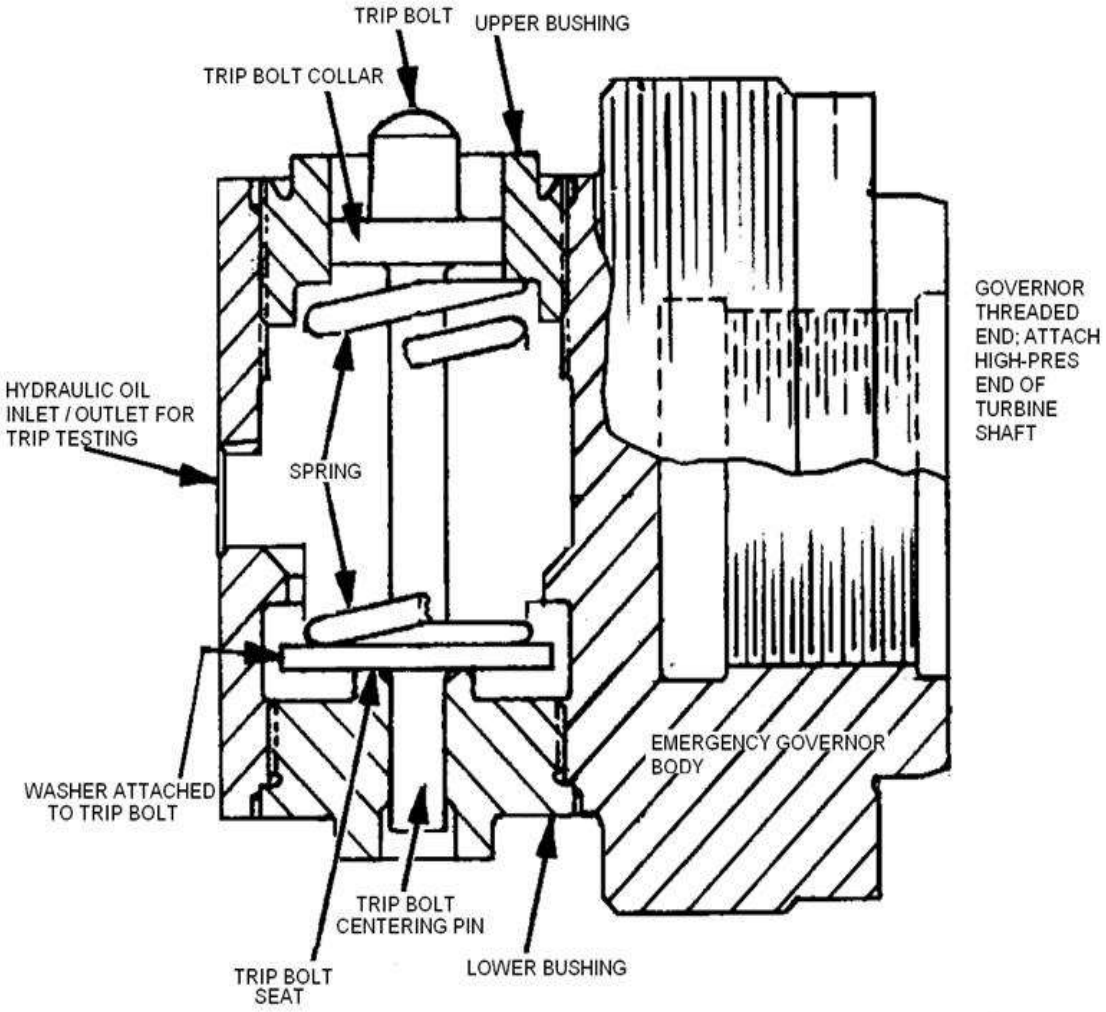
How it works

Trip Mechanism and Emergency Governor Set Up,
-Shown in reset position.
A Trip causes the trigger mechanism to rotate, unlatching the Reset Piston Rod from the step located on its trigger, which causes the reset piston rod to drop. Movement of the reset piston rod within the trip mechanism will open up drains within the cylinder initiating a pressure drop across the EHC system. This pressure drop is what causes the turbine stop valves to close stopping the MFPT.



Mechanical Trip Bolt Config

The overspeed trip is located at the MFPT front standard on the high-pressure end of the turbine shaft. The governor components consist of a trip bolt that is held within its seat by a spring which is set up to move the trip bolt off its seat in an overspeed condition. The governor works on the principle of centrifugal force that moves the trip bolt off its seat. The overspeed trip bolt is set to extend from its housing at a speed of 5663-5777 rpm's, which is adjusted by its upper bushing.



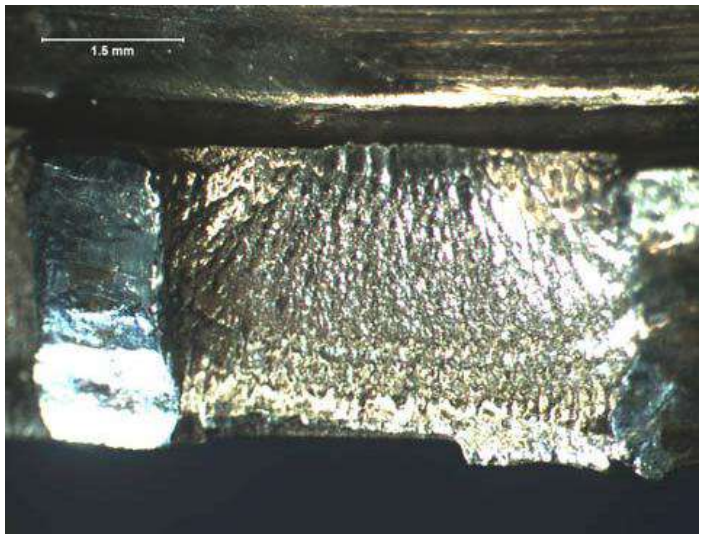
What Went Wrong

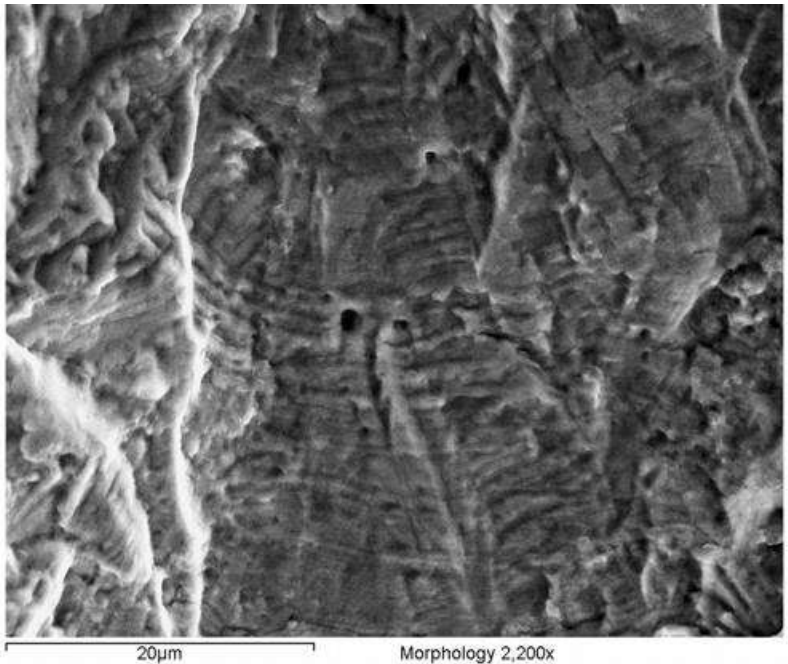
- Unit 1 had an automatic runback to 60% power due to a Main Feed Pump Trip (1-A). While conducting a mechanical overspeed test operations could not get the mechanical trip exercise to actuate. The trip exercise button was held down for an excessive amount of time 3-4 Min on the first qtr test and 16 min on the second quarter test. Causing a fatigue failure of the emergency governor trip bolt. During this time a chattering noise was heard during the time the button was pressed.
- A few days later trouble shooting was asked to be performed on the MFP to determine cause of no trip indication. The trouble shooting consisted of operations performing the trip exercise per procedure so the equipment response could be observed. During this evolution the trip bolt was ejected out of the housing and sheared all three thrust proximity probes resulting in a loss of signal of all probes and electrically tripping the MFP 1-A.

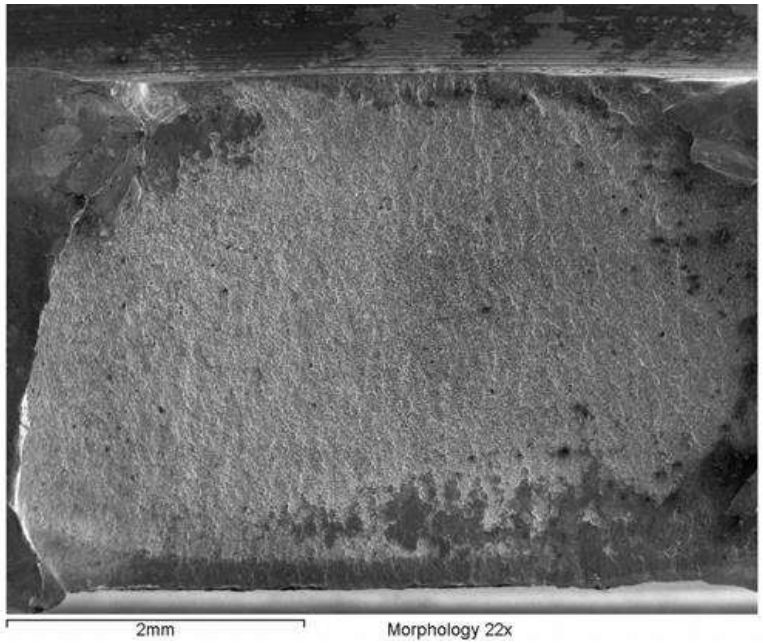
Why and What we Learned

- Failure analysis found that the trip plunger experienced fatigue failure from the tens of thousands of impacts it experienced from holding the trip exercise down for that amount of time. The cause of the MFP not tripping on demand was the reset solenoid was mechanically stuck in the reset position preventing the trip cylinder from falling

Fatigue Failure







Why and What we Learned

- The Reset Solenoid failed in the energized state and did not have a PM
- (Non-Crit RTF)

Corrective Actions

- CA1 (CAPR): Create PM to replace SV-8 during major teardown inspection (~7-1/2 yr) For 1/2-MSTDFP-01/02
- CA2: Revise ETP-302 series procedures to include the following:
  - 1. Add a Note or a Caution concerning the instantaneous trip of the device that should occur during this PM.
  - 2. Add abort criteria and additional monitoring instructions for conduct of the PM.
  - 3. Reinstitute the <900 MWe