



National Aeronautics and Space Administration

The Value of a Sustained Maintenance Program

A Lesson Learned the Hard Way

Senior Management ViTS Meeting

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This and previous presentations are archived at
sma.nasa.gov/safety-messages

Overview

Transonic Dynamics Tunnel (TDT) Cooling Coil Breach/Water Intrusion

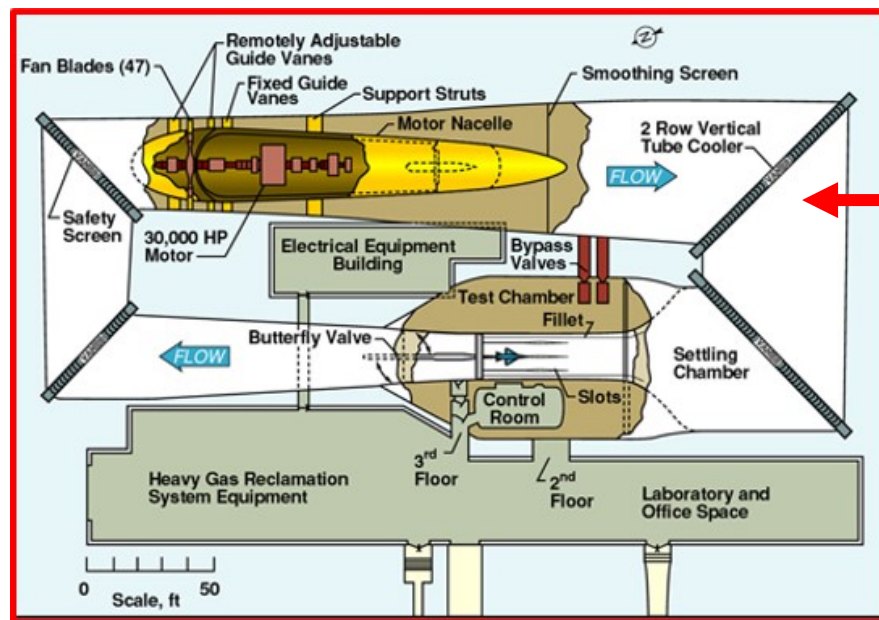
- Due to a series of tunnel cooling water systems failures coupled with unseasonably low temperatures, the TDT Cooling Coil was breached.
- The breach occurred during sub-atmospheric (R-134a) testing, therefore tunnel circuit could not be readily accessed.
- Cooling water was pumped and sucked into the tunnel circuit through breach and subsequently ingested in R-134a Reclamation System.
- Over 100,000 gallons of water was introduced into the tunnel circuit before the flow could be controlled.
- The tunnel was inoperative for almost two months after the mishap.



Facility: Building 648
Mishap Date: Jan. 23, 2014
Mishap Classification: Type C
NMIS: MIG-11549

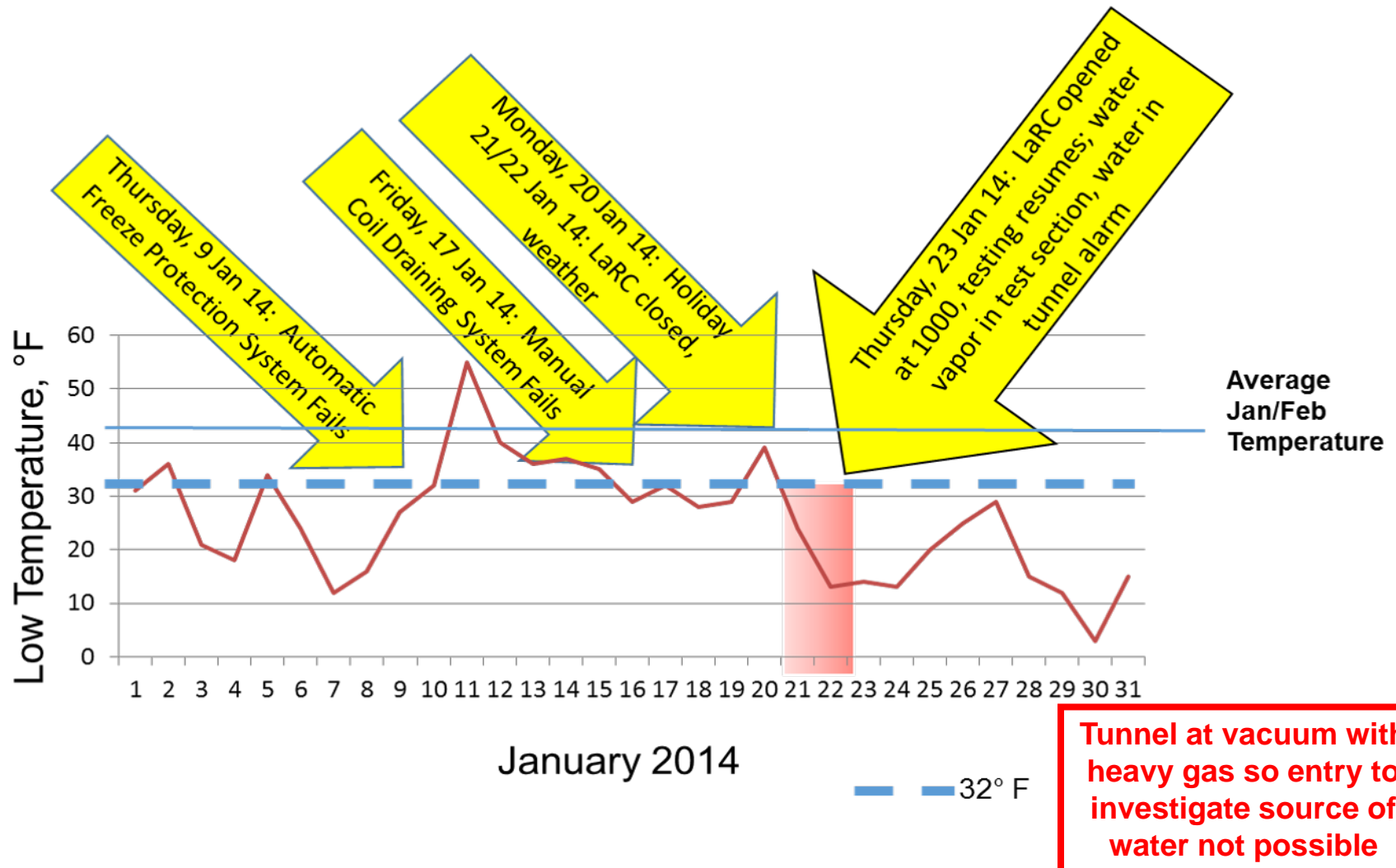
Investigation Team:
Roger Wagner, RD (Chair)
Scott Colbert, RD
Charles Poupard, SFAB

Overview



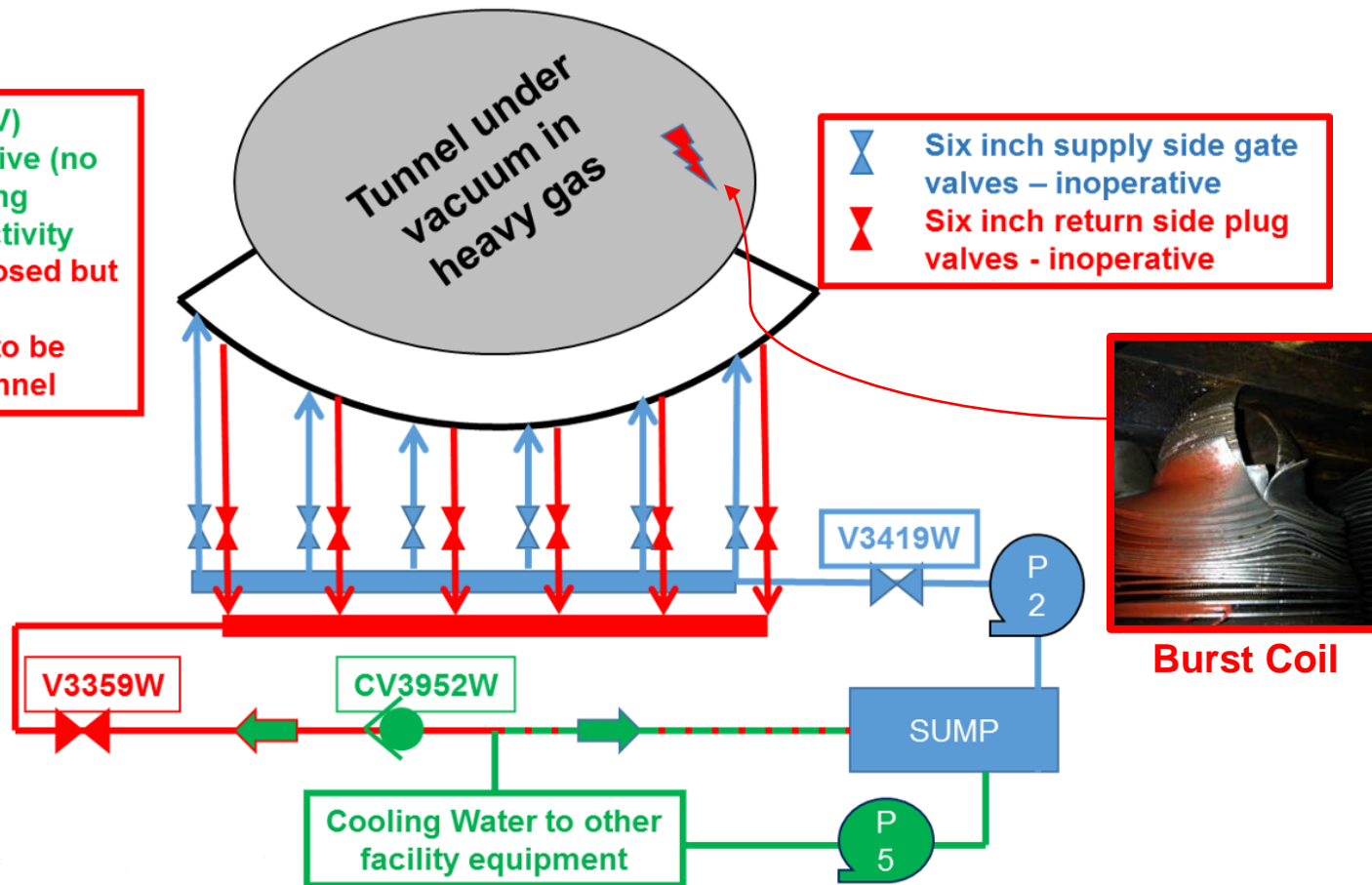
Cooling Coil (downstream view)

Event Timeline Relative to Daily Low Temperature

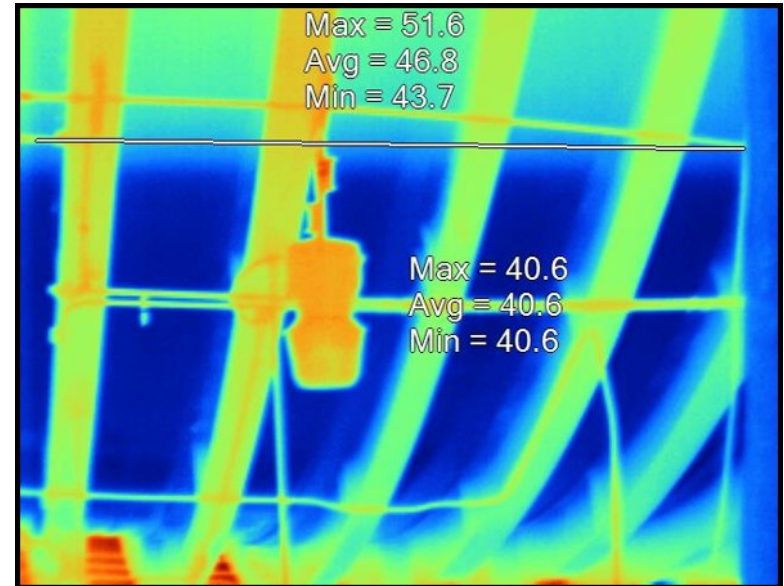


Jan. 26, 2014: Introduction of Water

- Check Valve (CV) 3952W inoperative (no flappers) pending maintenance activity
- Valve 3359W closed but leaked by valve allowing water to be pumped into tunnel



Jan. 27, 2014: Water Intrusion Evidence



Thermal imaging used to show water levels in the tunnel

Water in the tunnel was quickly recognized; however, mitigating the leak was challenging due to cold temperatures compounded by the sub-atmospheric state of the tunnel.



Impact: Type C Mishap, Significant Delay, Lost Opportunity

Maintenance and Repair (Type C Mishap)

- Over \$60,000 was spent to repair the tunnel and return it to service.
- Approximately \$250,000 was spent to return facility to normal operational status:
 - Repairs involved the cooling coil, freeze protection system, valves and associated piping, and evaluating deteriorating components (water box, thermal study, etc.)

Customer testing impacted

- The NASA/Boeing Truss Braced Wing Test was delayed 60 days.
- The result was 60 days of potential revenue lost due to the non-operational facility:
 - A 12-hour testing day is equivalent to approximately \$37,000 of lost daily revenue.
 - With the facility operational five to six days per week, the potential lost revenue ranged between \$1,600,000 to \$1,900,000.
 - *No additional tests for revenue were proposed during this period.*

Follow-on schedule

- All check standard testing was cancelled in FY 2014 in order to accommodate the remainder of customer testing.
- Normally, four check standard tests are conducted per year in order to validate tunnel health and data acquisition systems.

Summary

The root cause of the TDT cooling coil breach and associated water intrusion was a lack of facility preventative maintenance caused by a reduction in budget.

- Independent and piecemeal maintenance decisions increased risk.
 - Over time, fiscally sound decisions to not perform maintenance (i.e., run-to-fail strategy) caused degradation in a low-risk system.
 - The increased risk of the accumulation of individual minor maintenance problems was recognized. But reduced funding did not provide for action, resulting in more risk to the facility than desired.
- Unseasonably cold temperatures contributed to exposing the risk of decreased maintenance on a low risk system.
 - Langley Research Center is exposed to this environment less than five percent of an average year.



Freeze Protection Piping



Six-Inch Plug Valve



Six-Inch Gate Valve