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Improvements to the SRS High Level Waste Tank Corrosion Control Program

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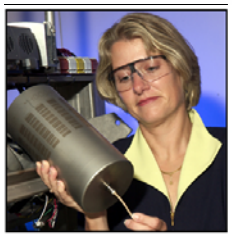
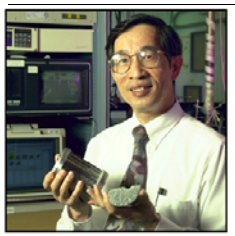
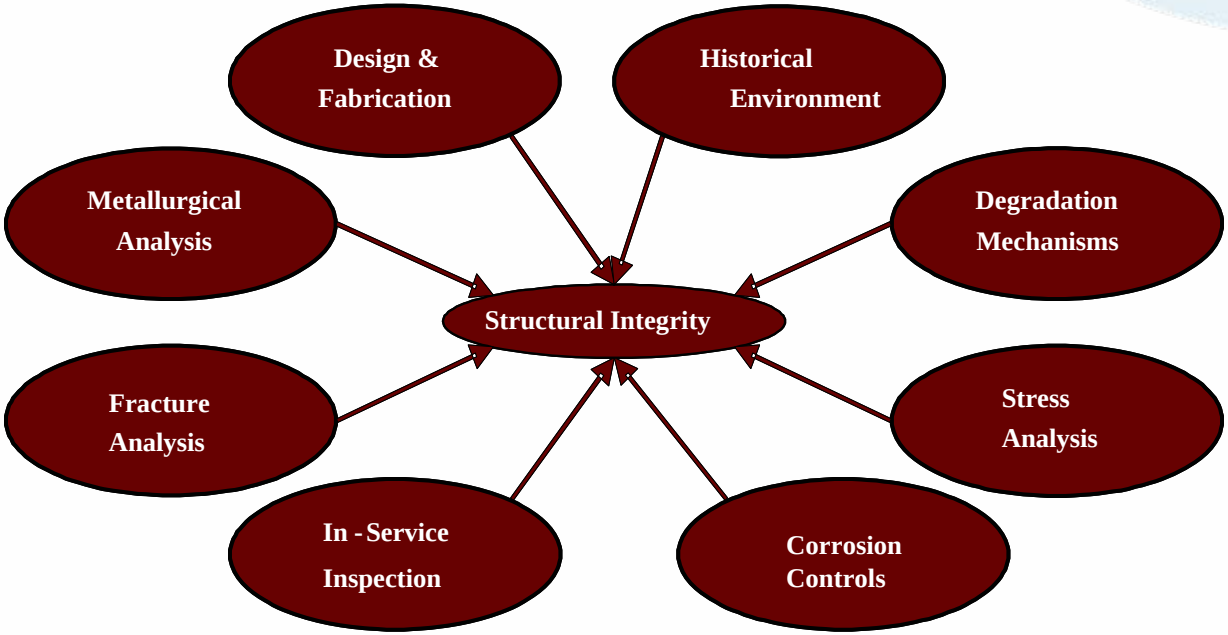



Outline

- Corrosion Control Program at SRS
  - Mechanisms
  - Waste Operations
- SRNL Corrosion Control Initiatives
- Future Improvements to Corrosion Control Program

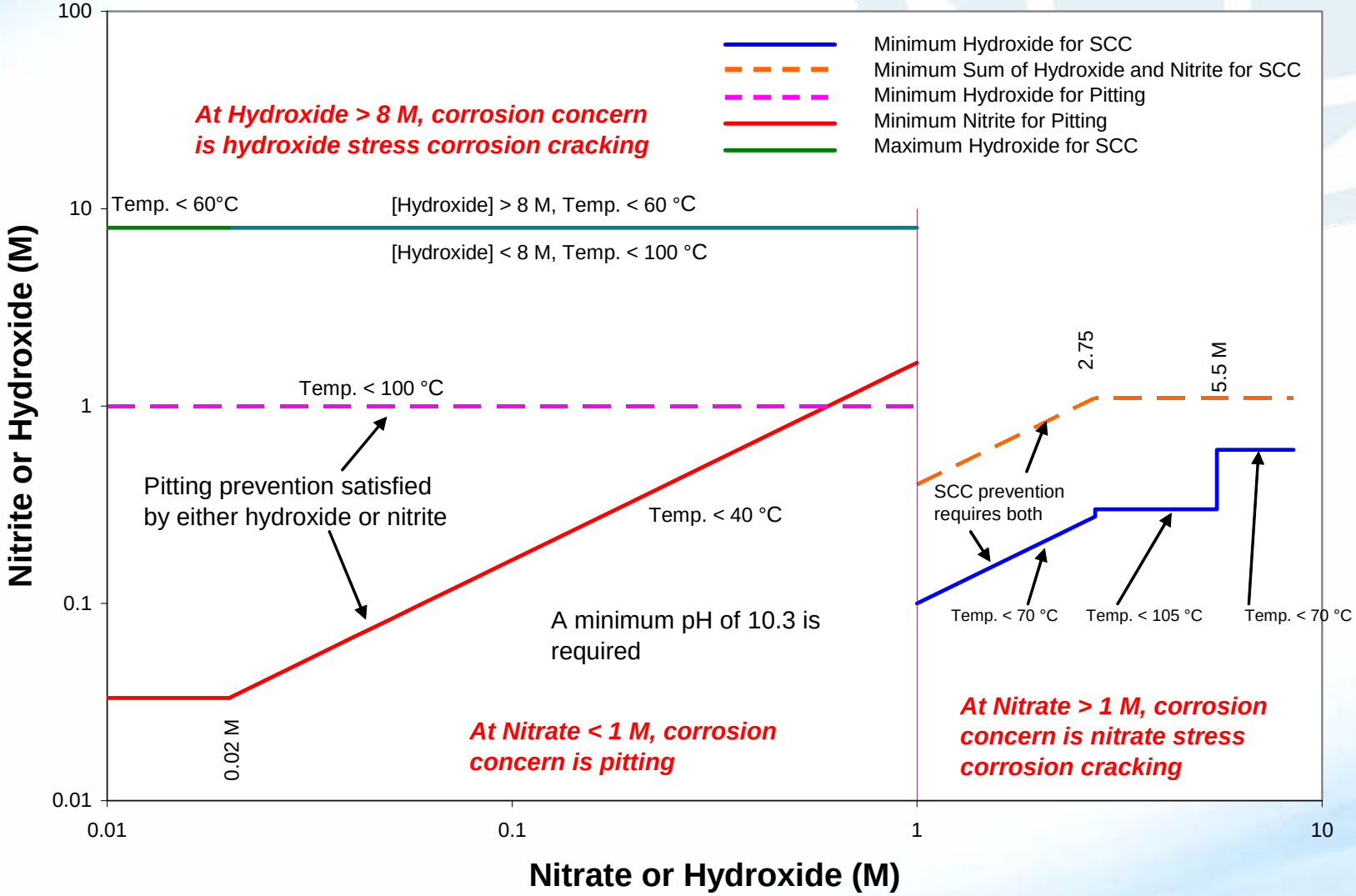
SRS Waste Tank Structural Integrity Program

Mission of Structural Integrity Program: To ensure continued safe management and operation of the waste tanks for whatever period of time these tanks are required.



Recognized as strategic for the DOE-EM Engineering and Technology Roadmap Structural Integrity Initiatives.

Corrosion Control at SRS



Corrosion Control and Waste Operations

	[Nitrate] < 1 M	1M < [Nitrate]< 5.5 M
Temperature < 40 °C	- Storage of DWPF Recycle - Waste removal and processing (sludge)	- Storage of aged waste
40 °C < Temperature < 70 °C	-Waste removal and processing (sludge) -Waste processing (sludge mass reduction, [hydroxide] < 8 M)	- Storage of fresh and aged wastes - Active and inactive evaporator feed and receipt tanks ([hydroxide] < 14 M)
70 °C < Temperature < 100 °C	- Active evaporator feed and receipt tanks (high hydroxide concentration, [hydroxide] > 8 M)	- Active evaporator feed and receipt tanks (high hydroxide concentration, [hydroxide] > 8 M)

Corrosion Control and Waste Operations

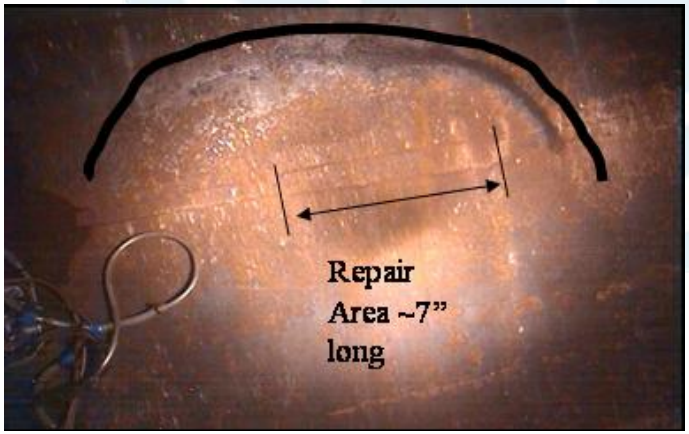
	5.5 M < [Nitrate] < 8.5 M
Temperature < 40 °C	- Waste removal (salt cake, density gradient)
40 °C < Temperature < 70 °C	- Waste removal (salt cake, pumps)
70 °C < Temperature < 100 °C	

SRNL Corrosion Control Initiatives

- Risk Based Corrosion Control
  - Pitting at Nitrate < 1 M and Temperature < 40 °C;
  - Waste Removal (sludge) and Waste Processing
- Corrosion Inhibitor Criteria for Type III/IIIA Tanks During Salt Dissolution
  - Stress Corrosion Cracking at Nitrate > 5.5 M and Temperature < 50°C;
  - Waste Removal (salt cake, density gradient)
- Vapor Space Corrosion and Liquid Air Interface
  - At anticipated vapor and meniscus conditions
- Caustic Stress Corrosion Cracking of Type III High Level Nuclear Waste Storage Tanks
  - Stress Corrosion Cracking at Hydroxide > 8 M and Temperature > 60 °C;
  - Evaporator Feed and Receipt Tanks

Corrosion Control and Waste Operations

- Vapor Space Corrosion (VSC)
  - Stress Corrosion Cracking (non-compliant tanks)
  - Potential for pitting (compliant tanks)
- Liquid Air Interface Corrosion
  - Pitting Corrosion
- Applicable over a range of compositions and temperatures.



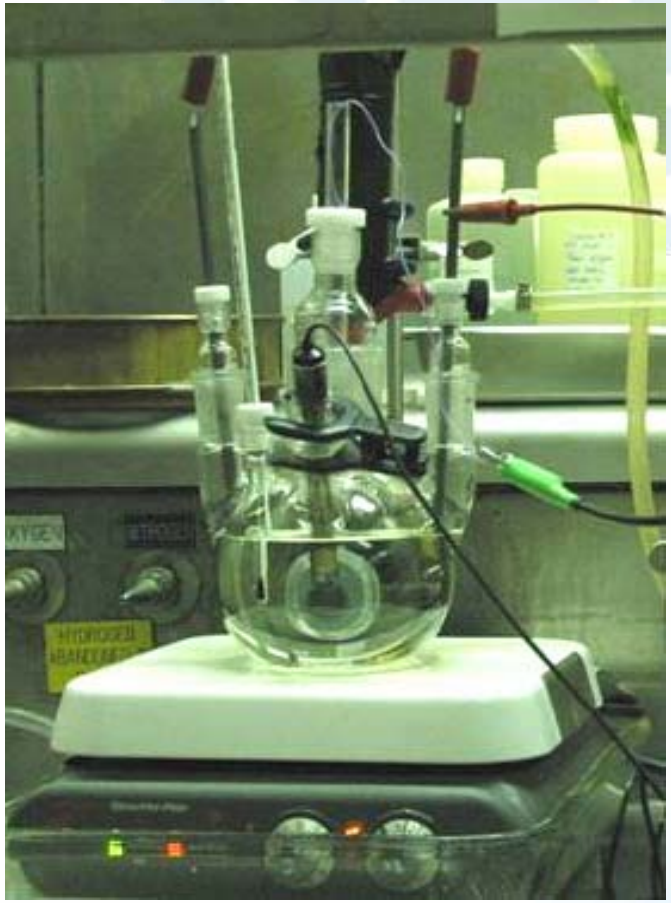
Tank 15 VSC

Laboratory Pitting at LAI

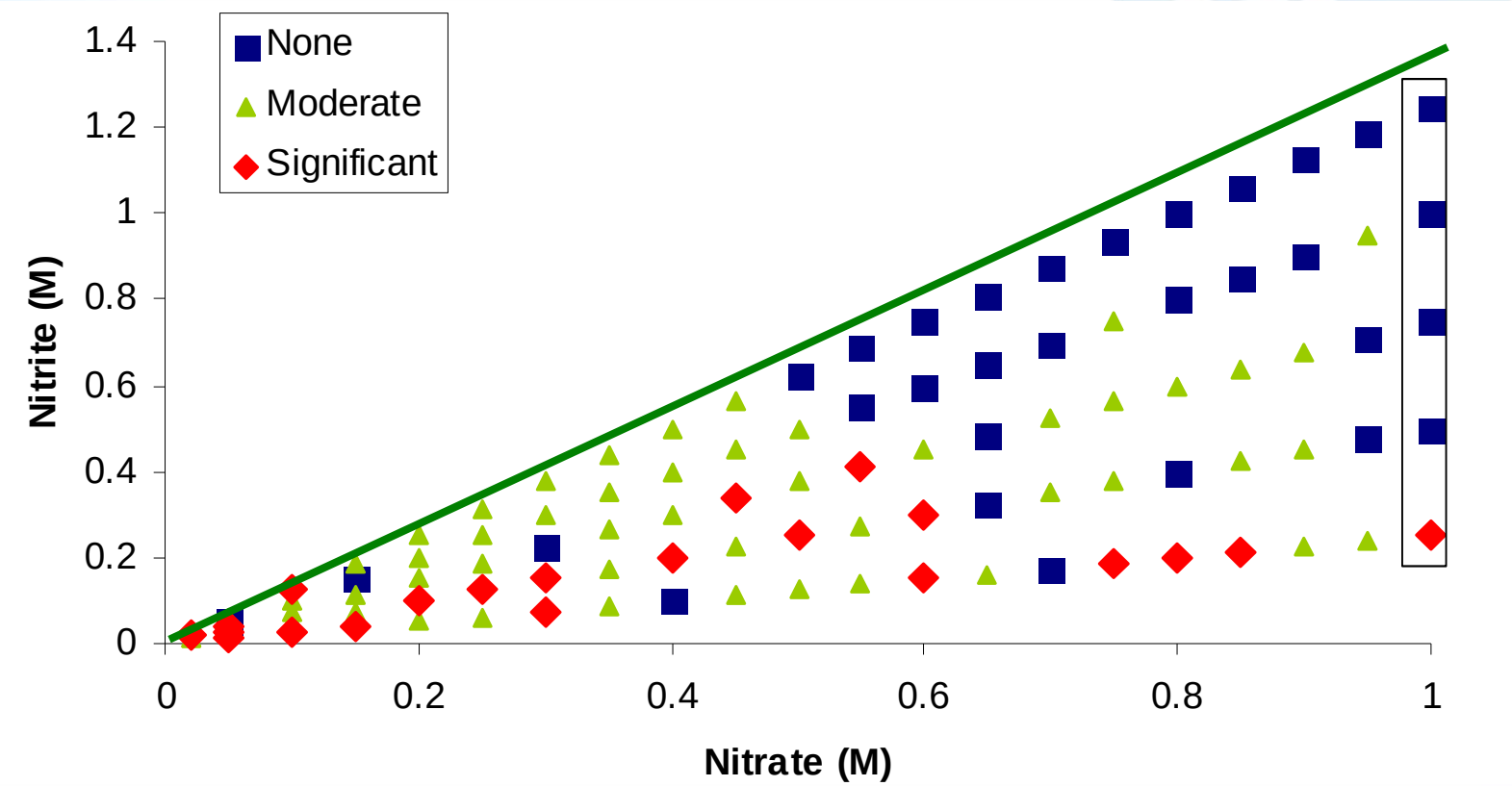
Risk Based Corrosion Control

- **Objectives:**
  - **Investigate reduction of disconnect of inhibitor concentration limit at 1.0 M nitrate concentration.**
  - **Optimize inhibitor requirements.**
  - **Quantify the probability of pitting for a given nitrite/nitrate ratio.**

- **Approach**
  - **Cyclic Potentiodynamic Polarization (CPP) and Coupon Immersion tests for pitting susceptibility.**
  - **Statistically designed test matrix.**



Risk Based Corrosion Control



Past a certain nitrite concentration, further nitrite addition does not add value.

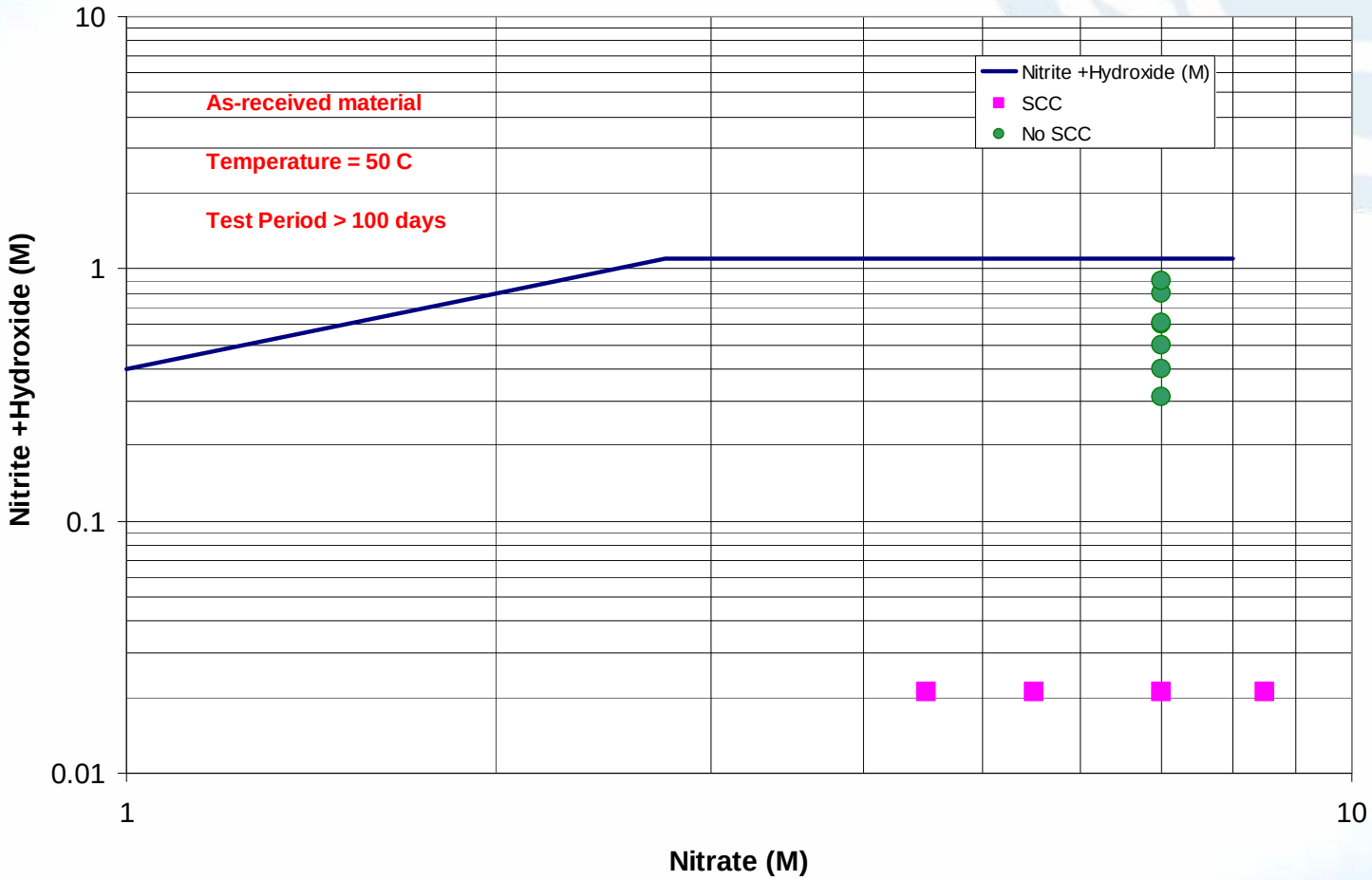
Corrosion Inhibitor Criteria for Type III/IIIA Tanks During Salt Dissolution

- **Objective:**
  - **Determine minimum hydroxide and/or nitrite concentrations necessary to inhibit nitrate stress corrosion cracking at the low temperatures anticipated during density gradient salt dissolution.**

- **Approach**
  - **Cyclic Potentiodynamic Polarization (CPP):** electrochemical tests to identify regions of susceptibility to localized corrosion mechanisms.
  - **Polarized U-bend Tests:** mechanical/electrochemical tests to establish minimum inhibitor requirements to prevent stress corrosion cracking.
  - **Slow Strain Rate Tests**: mechanical/electrochemical tests to establish minimum inhibitor requirements to prevent stress corrosion cracking.

- **Investigated effects of oxides due to heat treatment of the carbon steel (i.e., simulated weld stress relief).**

Corrosion Inhibitor Criteria for Type III/IIIA Tanks During Salt Dissolution



Future Improvements

- Corrosion control was a specific area of focus during EM-20 sponsored tank structural integrity workshop held at SRS during FY08.

- Goals of corrosion control program should include:
  - Continue to maintain safe storage for extended life.
  - Dynamic to handle waste removal and processing conditions.

- Corrosion control focus areas include:
  - Vapor space and liquid/air interface corrosion prevention.
  - Optimized chemistry control to support evolving waste processing and extended storage goals.

Summary

- Corrosion control programs at SRS have successfully mitigated localized corrosion mechanisms during waste storage operations.
- Current research at SRNL is focused on optimizing the chemistry control program for waste removal and waste processing activities.
- EM-20 structural integrity technology roadmap will continue to keep the focus on improvements to the corrosion control program.

Questions?

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