Ghent Version 2 Probe License Amendment Request Pre-submittal Phone Call

May 26, 2020

energy harbor

Ghent Version 2 Probe License Amendment Request

- Introductions:
  - Mark Manoleras, Engineering Director, Energy Harbor Nuclear (EHN)
  - Andrew Crotty, Manager, Strategic Engineering, EHN
  - Brian Prinkey, Supervisor, Engineering Programs, EHN
  - Gary Alberti, Senior Consulting Engineer, Engineering Programs, EHN
  - Tim Saibena, Nuclear Engineer V, Engineering Programs, EHN
  - Phil Lashley, Supervisor, Fleet Licensing, EHN
  - Ken McMullen, Nuclear Engineer V, Fleet Licensing, EHN
  - Damian Testa, Customer Solutions Manager, Westinghouse
  - Jay Smith, Fellow Engineer, Westinghouse
  - Jeff Raschiatore, Consulting Engineer, Westinghouse

energy harbor

Ghent Version 2 Probe License Amendment Request

- Agenda
  - Energy Harbor Presentation
    - Problem Statement
    - Beaver Valley Unit 2 - General Overview
    - Unit 2 Steam Generator Program
    - Alloy 800 Nickel Banded Tubesheet Sleeve Description
    - Installation of Alloy 800 Nickel Banded Tubesheet Sleeves
    - Ghent Version 2 Probe
    - Conclusions
  - Questions

Ghent Version 2 Probe License Amendment Request

- Problem Statement
  - There is no qualified nor licensed NDE technique to inspect the parent tube behind the nickel band of an Alloy 800 tubesheet sleeve
    - Resulted in a service life restriction of 8 operating cycles
- Response
  - Advances in inspection technology have provided options to address this issue
  - Modified off-the-shelf eddy current equipment has demonstrated the capability to adequately examine the parent tube behind the nickel band of an Alloy 800 tubesheet sleeve
  - Process has followed industry approved methods for qualification of inspection techniques and development of POD curves
  - A full cycle of operation is achievable with sufficient margin against the SG performance criteria

Ghent Version 2 Probe License Amendment Request

- Beaver Valley Unit 2 - General Overview
  - 1987: Unit 2 commenced commercial operation
    - Westinghouse Nuclear Steam Supply System (NSSS)
      - Three loop design
    - Westinghouse Model 51M steam generators
      - Alloy 600 low temperature mill annealed tubing
      - Remedial measures implemented prior to commercial operation to mitigate Primary Water Stress Corrosion Cracking (PWSCC) susceptibility
        - Row 1 & 2 U-bend in situ stress relief
        - Tubesheet shot peening (full thickness of tubesheet)
    - Remedial measures implemented to offset degradation
      - Generic Letter 95-05 for tube support plate degradation (08/18/1999)
      - F* (F Star) for tubesheet degradation (09/27/2006)
      - Alloy 800 leak limiting sleeves for tubesheet degradation (09/30/2009)
        - To date, only tubesheet sleeves have been installed
        - No tube support plate sleeves have been installed

Ghent Version 2 Probe License Amendment Request

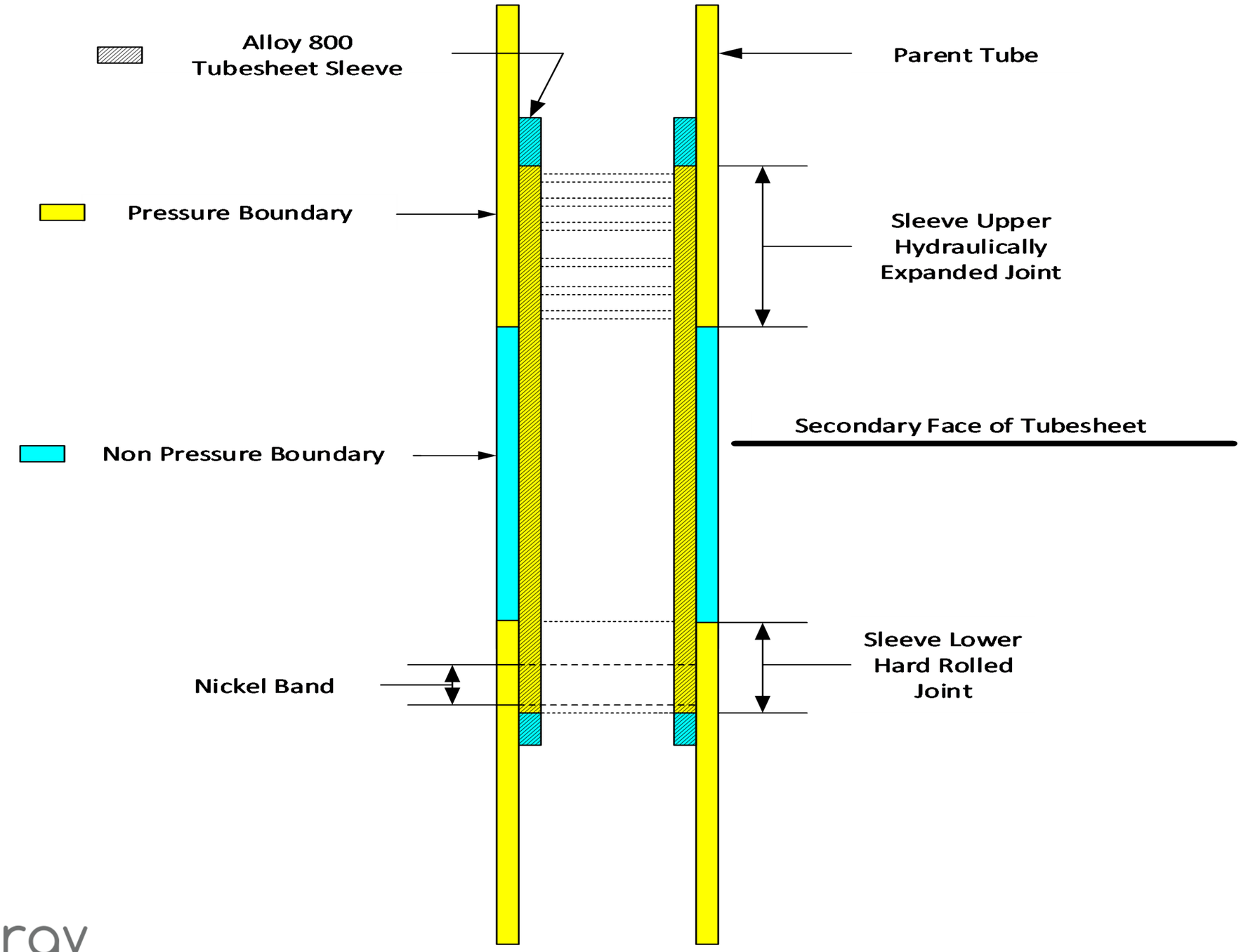
- Beaver Valley Unit 2 - Steam Generator (SG) Program
  - Technical Specification (TS) 5.5.5, requires that a SG program be established and implemented to ensure SG tube integrity is maintained
    - SG tube integrity is maintained by meeting the performance criteria for structural integrity, accident induced leakage, and operational leakage
    - The SG program establishes additional provisions for SG tube inspections and SG tube repair methods
  - TS 5.5.5.2.d - Provisions for SG Tube Inspections
    - NOTE - The requirement for methods of inspection with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube does not apply to the portion of the original tube wall adjacent to the nickel band (the lower half) of the lower joint for the repair process that is discussed in Specification 5.5.5.2.f.3. However, the method of inspection in this area shall be a rotating plus point (or equivalent) coil. The SG tube plugging criterion of Specification 5.5.5.2.c.3 is applicable to flaws in this area.

Ghent Version 2 Probe License Amendment Request

- Beaver Valley Unit 2 - Steam Generator (SG) Program (Cont.)
  - TS 5.5.5.2.f.3 - Provisions for SG Tube Repair Methods
    - Westinghouse leak-limiting Alloy 800 sleeves, WCAP-15919-P, Revision 2. An Alloy 800 sleeve installed in the hot leg or cold leg tubesheet region shall remain in service for no more than eight fuel cycles of operation starting from the outage when the sleeve was installed.

Ghent Version 2 Probe License Amendment Request

- Alloy 800 Nickel Banded Tubesheet Sleeve Description



Ghent Version 2 Probe License Amendment Request

- Installation of Alloy 800 Nickel Banded Sleeves
  - License Amendment 170 (09/30/2009)
    - Approved the use of Alloy 800 leak limited sleeves
  - License Amendment 184 (12/16/2015)
    - Approved a five-cycle limitation on service life
  - License Amendment 193 (02/25/2019)
    - Approved an eight-cycle limitation on service life
  - Technical basis for the sleeve service life limit
    - Prior to installation, the parent tube is inspected at the location of the sleeve joints to ensure the region is free of detectable flaws
    - Severe degradation in the sleeve joints can be detected during subsequent in-service inspections
    - The axial load capability of the sleeve joint is not compromised in the event that severe degradation is present behind the sleeve nickel band region
    - A limit on the amount of time that the sleeves were to be in service

Ghent Version 2 Probe License Amendment Request

- Installation of Alloy 800 Nickel Banded Sleeves (Cont.)

DATE	# OF TUBESHEET SLEEVES INSTALLED
2009 - 2011	None
2012 (2R16)	97
2013 - 2016	None
2017 (2R19)	171
2019 (2R20)	216
2020 (2R21)	88

  - Currently, 567 Alloy 800 tubesheet sleeves in-service
- Sleeves installed in 2R16, 2R19, 2R20 & 2R21 will have to be removed from service in 2R24, 2R27, 2R28 & 2R29 respectively
  - 8 cycle service life due to perceived inspection shortfalls related to nickel band
- Energy Harbor has developed and site qualified an eddy current probe that has demonstrated adequate detection capabilities in the parent tube adjacent to the nickel band
  - Ghent Version 2 probe

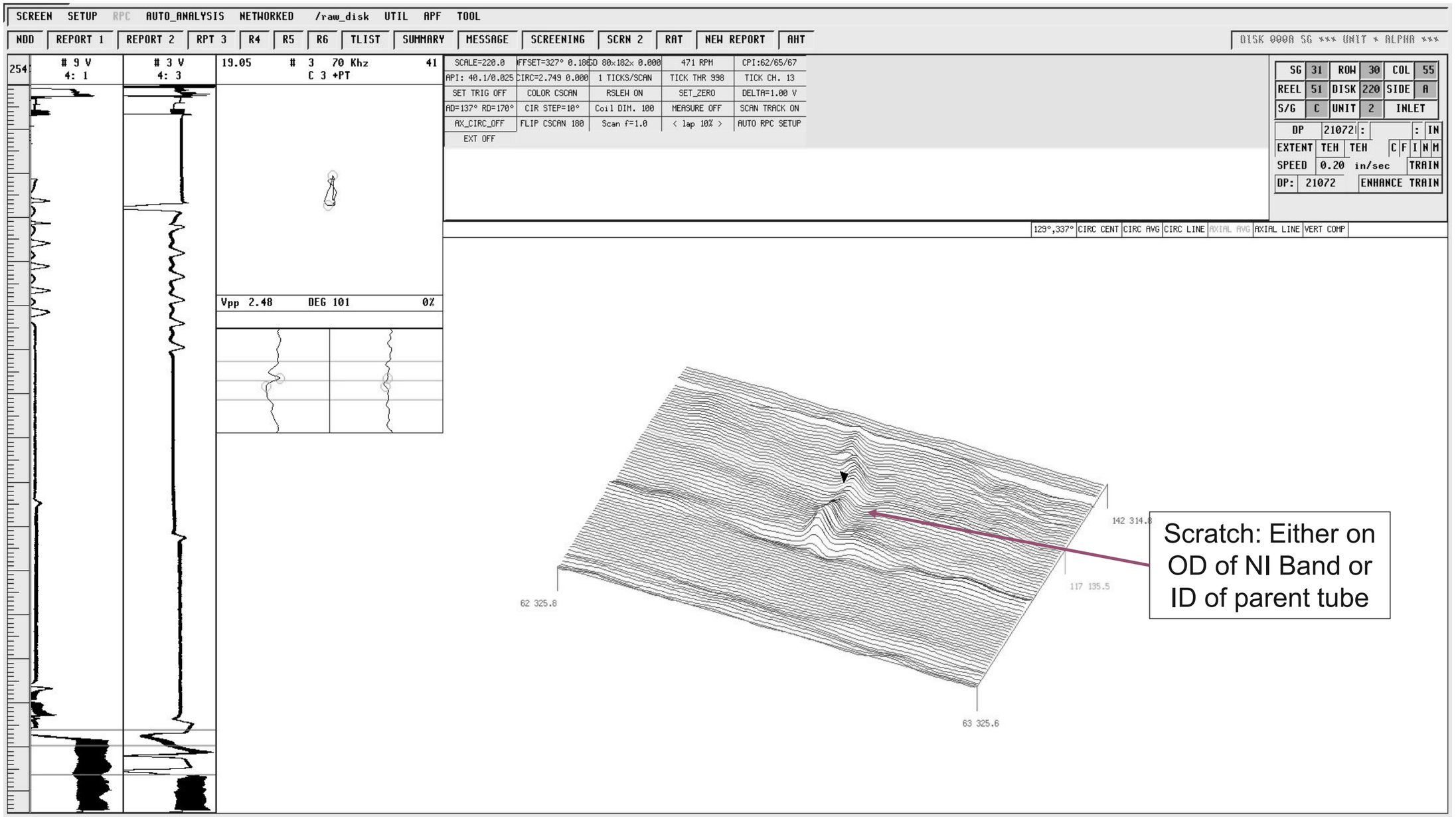
Ghent Version 2 Probe License Amendment Request

- Ghent Version 2 Probe
  - Modified standard Ghent probe design
  - Employs strong rare earth magnet to saturate nickel band
  - Contains Plus Point & Ghent probe coils
    - Allows for full length sleeve inspection including the parent tube behind the NI band with 1 pull of probe
  - Ghent coils re-positioned to enhance circumferential crack detection
  - Contains centering devices and beads to center the probe
  - Site qualified for detection IAW Appendix H of EPRI SG Exam Guidelines
    - Demonstrated adequate detection capability behind the nickel band

Ghent Version 2 Probe License Amendment Request

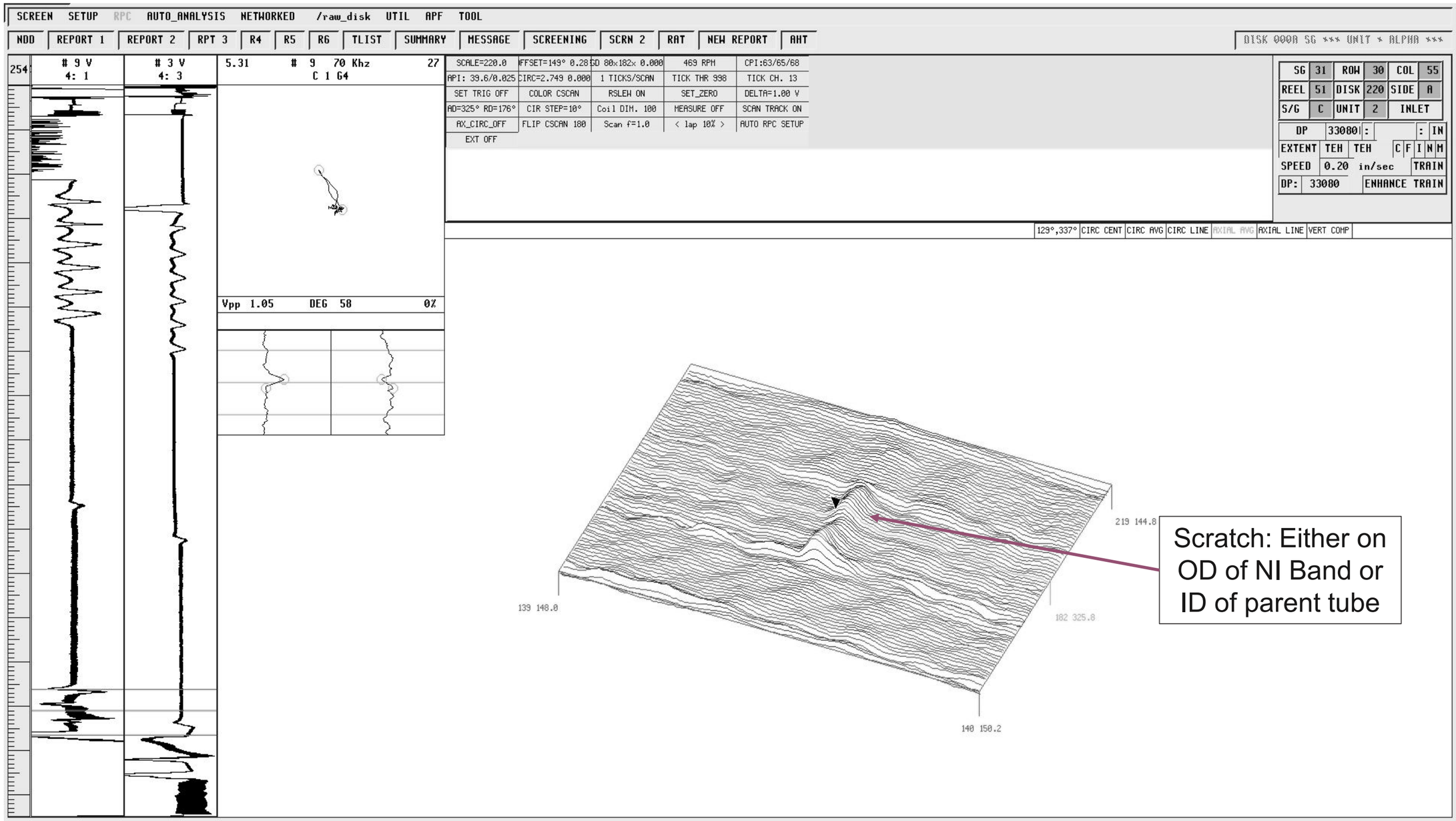
- Ghent Version 2 Probe (Cont.)
  - Version 1 design was field deployed in October 2018 (2R20)
    - 25 sleeve sample
    - Field data was for "Information only"
    - Field data was considered "less noisy" than what was seen in the lab
  - Version 2 design was field deployed in April 2020 (2R21)
    - Examined all 567 sleeves that remain in-service
    - +Point coil still used as the call of record
- V2 probe detected scratches in the NI band of two sleeves
  - Sleeves were installed in 2R20
  - History review showed scratches were present in 2R20 (post installation)
  - Could not determine if scratches were on ID of tube or OD of NI band
  - Sleeves were plugged as scratches were in pressure boundary
  - The Ghent probe field data quality was characterized as very good

Ghent Version 2 Probe License Amendment Request



2R21 +Point Graphic - In-service Examination

Ghent Version 2 Probe License Amendment Request



2R21 Ghent Probe Graphic - In-service Examination

Ghent Version 2 Probe License Amendment Request

- Ghent Version 2 Probe (Cont.)
  - Peer Review (Site Qualification)
    - Met Appendix H of the EPRI SG Examination Guidelines requirements
    - Used Independent Qualified Data Analysts (IQDA's)
    - Utilized EDM notch samples
  - Probability of Detection Study
    - ODSCC cracked samples obtained from EPRI
    - Ghent Version 2 probe used to inspect samples
    - Samples destructively analyzed in lab
  - POD distributions
    - Developed using data from cracked samples & lab results
  - Operational Assessment
    - Fully probabilistic evaluation
    - All SG performance criteria were met with considerable margin after one cycle of operation

Ghent Version 2 Probe License Amendment Request

- Conclusions
  - The Ghent Version 2 probe has demonstrated adequate flaw detection capability in the parent tube behind the nickel band
  - A fully probabilistic OA has demonstrated one cycle of operation is achievable with sufficient margin to the SG performance criteria
  - With the approval of the proposed amendment, the 8 operating cycle service life restriction can be eliminated

Thank You