RICH Issues in December 2021

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Content

• Problem #1 – bad pressure transducer value
  – Description
  – Solution
  – Follow-up

• Problem #2 – Electronic Panel cRIO failure
  – Description
  – Solution
    ▪ Remote debugging
    ▪ Hardware swap
  – Follow-up

• General follow-up

• Conclusion
Problem #1 – Bad Pressure Transducer Value

• On December 11, 2021, reading from pressure transducer (PT) in air-cooling buffer tank jumped to -838 psi

• Initial impression was that PT had failed and should be replaced
  – Replacement scheduled for restricted access period on December 14

• RICH left operating with PT interlock disabled
  – If there was a problem with air-cooling system, the hardware interlock system would trip off on a low airflow interlock
Solution #1

- PT was replaced with a spare, but -838 psi reading prevailed
- Concluded that channel 0 of module 5 (NI-9219 analog voltage input module) in N₂ Volume cRIO responsible had failed reading PT
  - The three other channels in module were working fine
- Replaced module
- Issue resolved
  - PT reading returned to expected value
  - Pressure interlock re-enabled
- Logbook link
  - JLab login required
Follow-Up #1

- NI-9219 used was one reserved for RICH II, so a procurement request for a replacement module has been submitted.
- Awaiting radiation survey of failed module to be able to move it to EEL for tests.
- DSG’s cRIO test station program will be set up to help in diagnostics.
- NI will be contacted for repair/replacement.
Problem #2 – Electronic Panel cRIO Failure

• On December 12, 2021, all temperature and humidity data readings coming from channels of Electronic Panel (EP) cRIO froze

• RICH powered off until investigation completed and problem resolved
  – EP cRIO temperature sensors responsible for monitoring and interlocking on temperatures in the Electronic Panel
Solution #2 – Part 1: Remote Debugging

• Issue remotely debugged first
• NI Distributed System Manager reported timeout errors for modules
• cRIO rebooted in attempt to reset module communication
• After reboot, new error occurred indicating that cRIO could not recognize any of the four modules installed in cRIO
  – Error not resolved after multiple reboots
• Modules and/or cRIO had to be replaced
  – Scheduled for restricted access period on December 14
Solution #2 – Part 2: Hardware Swap

• Prior to access, spare cRIO with full set of spare modules prepared
  – Module 1: NI-9216 eight-channel RTD module
  – Module 2: NI-9216 eight-channel RTD module
  – Module 3: NI-9205 16-channel analog voltage input module
  – Module 4: NI-9485 eight-channel solid state relay module
  – Swap plan:
    ▪ First: Replace only modules since error specified issue in modules
    ▪ Second: Replace cRIO chassis

• Replacing all cRIO modules in chassis resolved issues
  – Interlock system back online
  – RICH turned back on

• Logbook link
  – JLab login required
Follow Up #2

- All four modules surveyed, released, and moved to EEL
- Simple LabVIEW program developed for initial debugging
  - All channels could be read with no issues, but no sensors or voltage source were applied to channels
- DSG’s cRIO test station program will be set up to help in diagnostics
- NI will be contacted for repair/replacement
General Follow-Up

- Two cRIO system hardware failures occurred within two days
- This is not the first time hardware in one of RICH’s hardware interlock cRIO systems randomly failed
- Previously, N₂ cRIO failed in March 2021
- Hall B systems with same series cRIO (cRIO-903X) have not had similar issues
  - FT, SVT, Torus, Solenoid
- Only difference in system is location in hall
  - RICH cRIOs are downstream relative to target
  - All others are upstream relative to target
- Could radiation effects from particles ejected by target in beam operations be damaging RICH cRIO components?
  - Discussing dosimeter options with RadCon
Conclusion

- Two issues of cRIO component failure occurred recently
- Both issues resolved by replacing modules in cRIOs
  - RICH hardware interlock system is online and operational
- Diagnostic testing of failed modules to be performed
  - DSG cRIO test station will be used
  - National Instruments will be contacted for repairs/replacement
- Further investigation into cause of failure underway
  - Looking into radiation monitoring in racks with cRIOs