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Construction Operating Experience: Benefits and Challenges

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Vogtle 3

- Westinghouse AP1000 PWR
- Free-standing steel vessel with shield building
- 1,117 MWe
- Located in the State of Georgia
- Scheduled to commence operation in July 2023

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Use of Operating Experience in Construction and Commissioning

- Cable Separation (challenges)
- Inspector Exchange (benefits)

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AP1000 Background

- Main AC power is NOT Class 1E
- Non-Safety related standby diesel generators
- Safety-Related (Class 1E) power comprised of 4 Divisions of DC power
  - 24-hour battery bank all four divisions
  - Additional 72-hour battery bank for 2 divisions
- Class 1E power provides 250 Vdc and 120 Vac interruptible power from Class 1E batteries to safety-related loads required for safe shutdown in the event of a loss of all AC power for 72 hours post-accident
  - Also supplies normal and emergency lighting and ventilation

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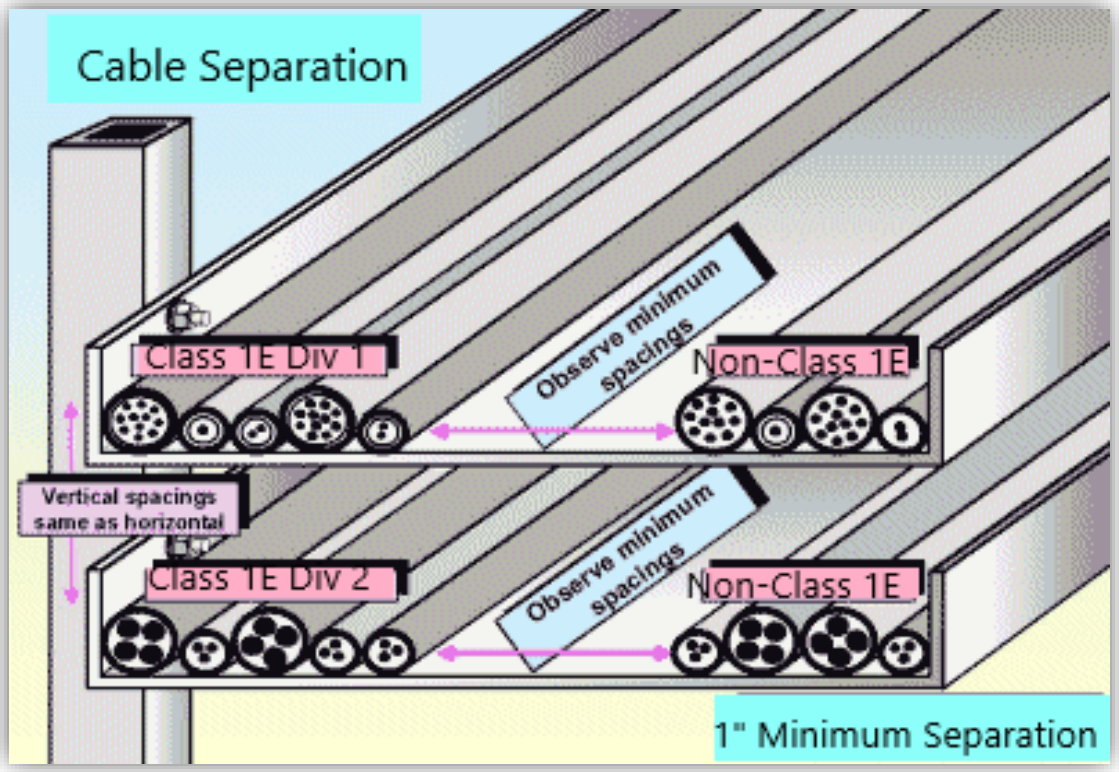
Background – Cable Separation



Design function of Class 1E cable raceway is to ensure physical separation

- Between Class 1E divisions
- Between Class 1E and non-Class 1E cables

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Issue Discovery – Cable Separation

- November-December 2020
  - Class 1E cable raceway walkdowns resulted in 57 condition reports for cable separation not met
- Extent of condition identified 600 discrepancies on work dating back to 2019
  - Cable separation inspected and approved by quality control review that was not in conformance
  - Known non-conformances without condition reports

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Initial Cause

- Root Cause from Unrelated Electrical Issues:
  - Work instructions AND quality control inspection documentation weaknesses
    - Several installation issues corrected without creating a condition report
    - Missed opportunity to recognize wider problem
- Initial Cable Separation Root Cause:
  - Culture across the construction organization

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Event Response: NRC

- June 2021, NRC chartered a reactive inspection
- Focus of the inspection was on the programmatic breakdowns that allowed the conditions to develop

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Inspection Results

- Escalated significance (White) finding for failure to maintain appropriate vertical and horizontal separation between Class 1E divisions and between Class 1E and non-Class 1E equipment inside switchgear cabinets
  - Initially identified by NRC inspector as licensee extent of condition for root cause had not looked inside switchgear cabinets
  - Licensee follow-up identified similar discrepancies in all 16 switchgear cabinets associated with reactor coolant pump and reactor trip system switchgears

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Inspection Results

- Escalated significance (White) finding for failure to identify and correct Class 1E cable separation and seismic/structural non-conformances of cable raceways
  - Quality Control inspections failed to promptly identify cable separation and seismic/structural issues
  - Deficiencies that were identified were not appropriately written into the corrective action program
  - Without appropriate condition reports, the wider issues were not promptly corrected

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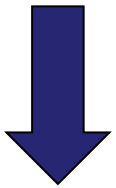
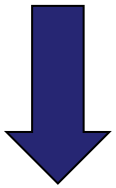
Progression of Cause Evaluation

Insufficient work planning/procedures



Organizational culture for electrical contractors not focused on identification and resolution of quality issues



Licensee leadership failed to implement regulatory requirements for Class 1E equipment

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Safety Impact

- Cable separation issues within switchgears could have allowed:
  - Reactor Trip
  - Reactor coolant pump trip for accident response
  - Potential common mode failure
- Cable separation impacted multiple safety systems:
  - Passive core and containment cooling systems
  - Protection & monitoring system
  - Uninterruptible power supply system

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Event Response: Licensee

Corrective Action to Prevent Recurrence:

- Identified non-conformances corrected
- Changes to leadership behavior
  - Formalizing observation program, including trending of observations
  - Benchmarking other sites
  - Training on corrective action program
- Enhanced quality control measures for coordination and metric analysis

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Lessons Learned

- Initial licensee OE review only looked at the past 5 years of domestic events
  - US construction experience is largely 30+ years ago
  - Recent international OE was not captured
- Challenge
  - Communicating international OE to licensees
  - OE training for inspectors at the right time
  - Maintaining the relevance of past events (10+ years)

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Lessons Learned

1. Collect Operating Experience ✓
2. Store Operating Experience ✓
3. Retrieve Operating Experience ?
4. Apply Operating Experience

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HRTD
Human Resources
Training & Development

US / China Cooperation for AP1000 Construction

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Impact

- Extensive observation of testing
- Credit for several “first-of-a-kind” tests
- Operating experience used to identify focus areas for licensed operator training

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Conclusions

- NRC observations in China allowed operating experience to inform U.S. AP1000 inspection activities
- Experience shared - US NRC arrangement with Poland's Atomic Energy Agency

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- ML2136A057 Vogtle 3 & 4, Cable Separation SIT Report (August 29, 2021)
- ML22108A153 Vogtle 3, SIT Assessment Follow-up Letter (April 19, 2022)

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Questions?