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Digital I&C in Nuclear

Briefing for the NRC

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Digital I&C

- Digital systems have been in use in all Sectors of industry including Nuclear since the 1970's

- Global agencies in all Sectors of industry have issued substantial guidance, information, papers, publications, studies, regulations, etc…to support understanding, implementing and operating digital control systems

- A large percentage of nuclear power plants both new and existing are using digital technologies both in safety related and non-safety related systems

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Fuqing Unit 1 and Taishan Control Room

- Tricon and Teleperm XS installed and many units globally meeting multiple regulatory requirements and providing safe, reliable operation

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Technology

- New Build or Modernization – technology is technology
- I&C Regulation applies to both
- What are we missing? – **Trust in Technology**
  - Some technology platforms have over 1 Billion hours of operation without failure upon demand in Safety Related systems across multiple sectors including nuclear
  - The technologies today individually and even more so once placed within a multiple channel architecture have PRA's that are 10^{-6} to 10^{-23} – more emphasis on overall PRA needs to be leveraged
  - Overall NRC movement towards risk-informed regulation, but I&C not fully aligned

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Technology

- Reliance Petroleum – Worlds Largest Control room in Sector globally
- 180,000 digital I/O
- Trust in Technology in critical process systems – emergency shutdown systems
- Foxboro DCS and Tricon platforms used – SIL4 for safety critical are designed to consider failures that can impact digital, yet have demonstrated high levels of fault tolerance and high reliability – same technology supplied to nuclear power plants

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Technology

- Outside US – Regulation is based on IAEA, IEC, IEEE and NRC guidance – why not in the US recognize global standards as well – critical to supply chain

- Common Cause Failure – is not common, most or all digital events evolve around misinterpretation of functional requirements or building of application code, not failure of the code itself or even the hardware supporting the application as in most safety or safety critical applications redundancy and in some cases triplications are in place

- Diverse Technologies in place globally

Regulation

- Need to expedite Regulatory change to allow for modernization

- New guidance should be structured to benefit from the technological advantages of digital platforms to make plants safer and more reliable
  - Less risk of trip
  - Less risk of entering LCO

- Industry core knowledge, design processes well advanced, being implemented in digital design process. NRC regulatory focus should be on the final outcome of plant designs and their impact on safety, not on trying to specify, or detail design processes used by utilities

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Regulation

- NRC not leveraging industry (EPRI) and international data, standards, and practices and incorporating these into the NRC regulatory framework

- NRC I&C staff should consider incorporating risk insights into I&C regulations
  - Too much emphasis is being placed on the software life cycle
  - Nuclear and other industry data show I&C systems are not the dominant contributors to failure, and the I&C failure rates are negligible when compared to the plant process systems they interface with

Future

Digital upgrades are a necessity to sustain long term, efficient and safe operation of the plants both new and old. Regulatory positions for all upgrades need to be useable and positioned so that there is minimal uncertainty allowing utilities to support their fleet safely into the future

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