Power Plant Simulators – NRC Perspectives

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Agenda

• Simulator Regulations
• Regional Perspectives
• Simulator Modification and Testing
• Simulator Fidelity
• Exam Security Violations
• Positive Performance Example
Simulator Regulations

• 10 CFR Part 55.4 “Definitions”
  – Plant-referenced simulator – simulator modeling the systems of the reference plant with which the operator interfaces in the control room, including operating consoles, and which permits use of the reference plant’s procedures

• 10 CFR Part 55.31(a)(5) “How to Apply”
  – Control manipulations required for licensing may be performed on a plant-referenced simulator meeting 10 CFR 55.46(c).
Simulator Regulations

• 10 CFR Part 55.45(b) “Operating Tests”
  – Operating test performed in plant and on plant-referenced or commission-approved simulator

• 10 CFR Part 55.46 “Simulation Facilities”
  – Plant-referenced simulators must demonstrate expected response
  – Sufficient in scope and fidelity to conduct evolutions listed in 55.45(a)(1)-(13) AND 55.59(c)(3)(i)(A)-(AA)
Simulator Regulations

• 10 CFR Part 55.46 “Simulation Facilities”
  – Allow for completion of control manipulations
  – If used for the control manipulation requirement in 55.31(a)(5)
    • Most recent core load
    • Without procedure/simulator exceptions or training scenario deviation
  – Conduct testing, correct discrepancies, and have uncorrected performance test failures available for NRC review before initial or requalification test
Simulator Regulations

• 10 CFR Part 55.49 “Integrity of Examinations and Tests”
  – Ensure that simulator set-up does not compromise test integrity
Regional Perspectives

• Software modification testing and documentation
• Decreasing experience levels of simulator staff
• SBT evaluation
• Plant modifications
• Increase in simulator fidelity issues, findings, and violations
Simulator Modification and Testing

- Alarms observed in plant but not on simulator
- Relief valve failure to close
- Feedwater regulating valve leakage significantly different from reference plant
- Four green findings since 2014 on failure to conduct and evaluate simulator testing
- One green non-cited violation for failure to retain performance tests
Simulator Fidelity

• Seven green and one white violation since 2014
• Green violation of 10 CFR 55.46(c)
  – Manual control of reactor pressure using safety relief valves
  – Water level swings due to operation of safety relief valves much larger than simulator
• Green violation of 10 CFR 55.46(c)
  – Once through steam generator turbine bypass valve
  – **Negative training that challenged orderly shutdown (not reportable event)
Simulator Fidelity

• Green violation of 10 CFR 55.46(c)(1)
  – Did not model plant response when using main feed regulating valves in manual
  – Discrepancy existed since 1985

• Green violation of 10 CFR 55.46(c)
  – Instruments not modeled correctly
  – Control rod drift without the malfunction inserted
  – Enthalpy error in moisture separator reheater caused erratic main generator output readings
Simulator Fidelity

• Green violation of 10 CFR 55.46(c)(1)
  – Emergency diesel generator control switch
  – Caused equipment inoperability

• Green violation of 10 CFR 55.46(c)(1)
  – Condensate storage tank level would not lower below 5 feet
  – Reactor protection system fuses failure to de-energize
Simulator Fidelity

• Green violation of 10 CFR 55.46(c)
  – Control rod motor generator sets modeling resulted in control rods remaining withdrawn up to two minutes longer than plant design
  – Simulator modeled a safety injection with certain ATWS events
  – Since 1989
Simulator Fidelity

• White violation of 10 CFR 55.46(c)(1)
  – Simulator did not model feedwater leakage and resulting reactor level response after scram
  – Did not provide correct alarm response
  – Did not correctly model behavior of startup feedwater regulating valve controller
  – **Negatively impacted operations personnel performance in the actual plant during a reportable event**
Examination Security

• Three Green Violations related to simulators since 2014
• Green SL-IV violation of 10 CFR 55.49
  – Plant computer screens deleted data, but not parameter and axis labels
Examination Security

• Green violation of 10 CFR 55.49
  – Personnel in simulator booth not on security agreement
  – Exam material left in simulator

• SL-IV violation of 10 CFR Part 55.49
  – Exam related material not appropriately removed
  – Multiple occasions
Positive Performance Example

- Two unit site
- Modification installed on Unit 2, but not yet on Unit 1
- Unit 1 is reference unit
- Installed modification in simulator
- Training needs assessment performed
- Allowed by the applicable ANSI standard
Questions??

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