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Constellation Energy Nuclear Group
Fukushima Update

NEI Used Fuel Management Conference
Renaissance Vinoy, St. Petersburg, FL

David Dellario

May 7, 2013

Background

- Constellation Energy Nuclear Group
  - Joint Venture between Exelon and Électricité de France (EdF)
  - Headquarters in Baltimore, Maryland
  - Nuclear fleet includes
    - Calvert Cliffs (Combustion Engineering PWR - 2 Units)
    - R.E. Ginna (Westinghouse PWR - 1 Unit)
    - Nine Mile Point (General Electric BWR - 2 Units)
  - Fleet-level project established to respond to Lessons Learned from the Fukushima events



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Session Outline

- CENG Actions on NRC's Post-Fukushima Spent Fuel Pool (SFP) Requirements
  - Response to and implementation of NRC Order EA-12-051
    - Tier 2 and Tier 3 NRC Near-Term Task Force (NTTF) Recommendations
  - Aspects of NRC Order EA-12-049 that apply to Spent Fuel Pools
    - Provide SFP makeup and cooling
  - Reactions to potential Tier 3 requirements and early transfer of fuel from SFPs to Dry Cask Storage



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New Perspectives on Spent Fuel Pools



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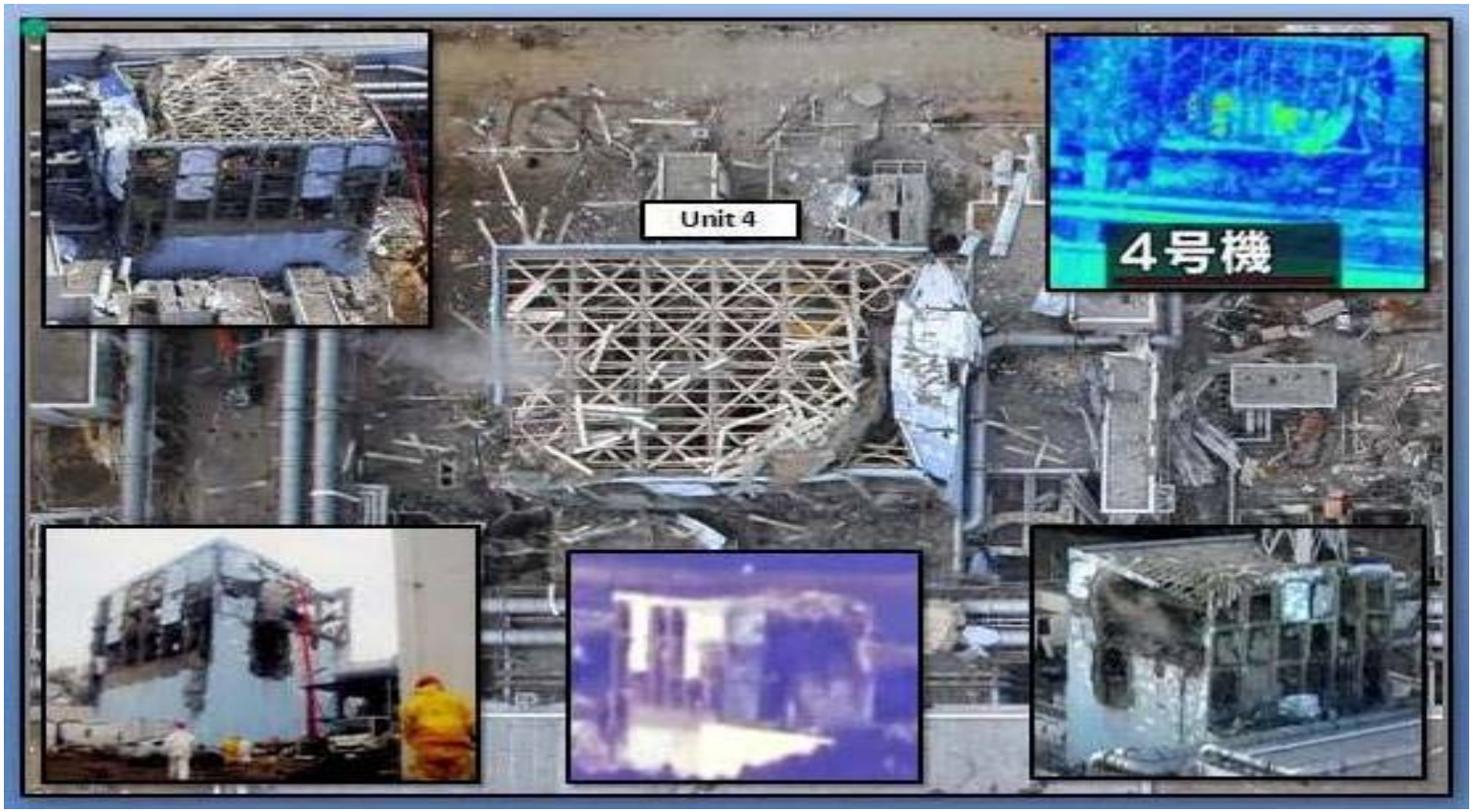
New Perspectives on Spent Fuel Pools (cont'd)



Views of Fukushima Dai-ichi Unit 4 After the Event



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New Perspectives on Spent Fuel Pools (cont'd)

Close-up of Spent Fuel Pool at Fukushima Dai-ichi Unit 4 After the Event



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Reliable Spent Fuel Pool Level Indication

- Acceptance Criteria – No Fuel Damage
- Recommendations and Requirements
  - INPO IER L1-11-2, Spent Fuel Pool Loss of Cooling and Makeup
  - NRC Order EA-12-051, Reliable Spent Fuel Pool Level Indication
- Key SFP Water Levels
  - Support operation of normal SFP cooling system
  - Provide substantial radiation shielding
  - Fuel remains covered



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Reliable Spent Fuel Pool Level Indication (cont'd)

- Key considerations
  - Fixed primary and backup instrument channels
  - Components permanently mounted
  - Sensors shielded from event-generated missiles/debris
  - No interference with SFP operations
  - Continuous level monitoring from top of racks to high alarm
  - Substantial history of operating reliability
  - Potential interaction with other plant systems
  - Environment compatibility
  - Wireless and wired technologies meet same requirements



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Technologies Considered

- Through Air Radar
- Guided Wave Radar
- Ultrasonic/Laser
- Float/Displacer
- Pressure Transducer
- Bubbler (Differential Pressure)
- Thermal Resistance
- Resistance – Tape
- Capacitance
- Camera



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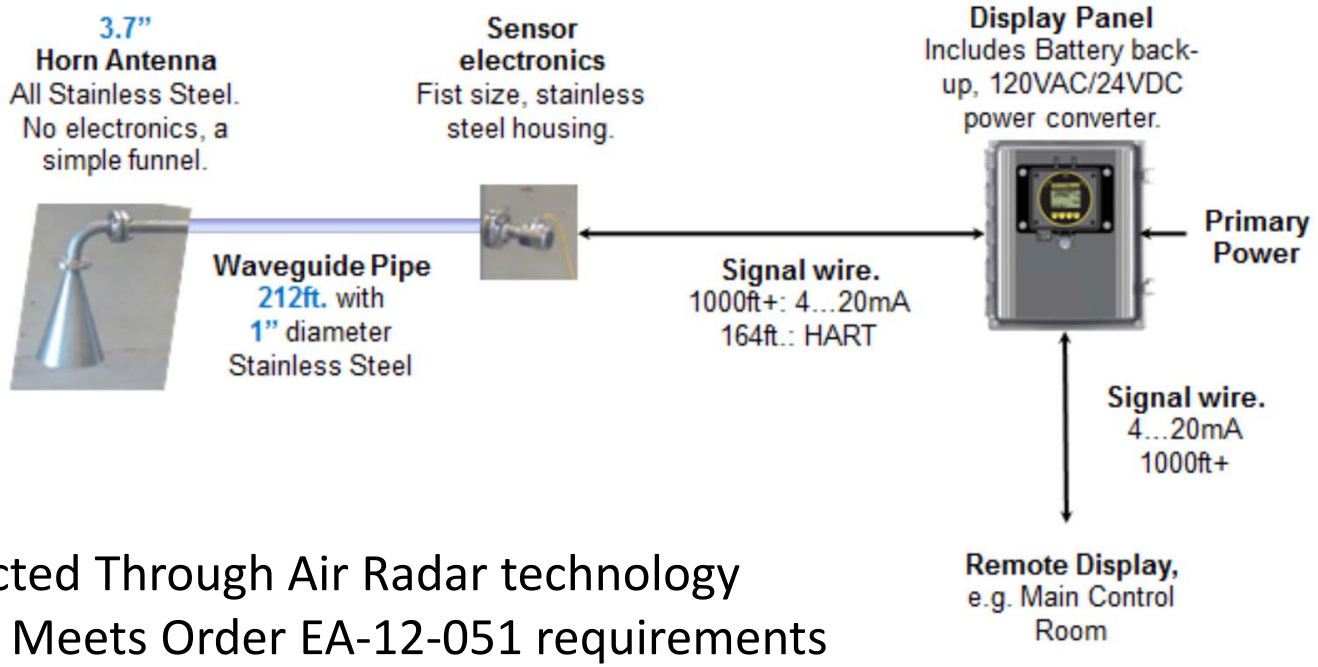
Reliable Spent Fuel Pool Level Indication



- Selected Through Air Radar technology
- Fully Meets Order EA-12-051 requirements
- Relatively short lead time – approximately 24 weeks
- No parts contact SFP water
- Installation feasibility confirmed for CENG Fleet
- Lowest overall cost for equipment



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Reliable Spent Fuel Pool Level Indication (cont'd)

SFP Level Indication Milestones	CCNPP	NMP1	NMP2	Ginna
Commence Engineering and Design	2Q13	2Q13	2Q13	1Q14
Complete Engineering and Design	3Q13	4Q13	1Q14	2Q14
Receipt of SFP Instruments	1Q14	3Q14	3Q14	1Q15
Commence SFP Instrument Installation	2Q14	3Q14	4Q14	1Q15
Close-out Project / Plant Turnover	3Q14	2Q15	2Q15	2Q15



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Tier 2 and 3 NTTF Recommendations

Recommendation Number	NTTF Recommendation
2.2	Ten year confirmation of seismic and flooding hazards
3	Capability to prevent or mitigate seismically induced fires and floods
5.2	Reliable hardened vents for PWR/BWR 3 containments
6	Hydrogen control and mitigation inside containment and other buildings
7.2	**Provide safety related AC electrical power for SFP makeup system**
7.3	**Technical Specification changes to have one train of onsite emergency electrical power operable for SFP makeup and instrumentation**
7.4	**Installed seismically qualified means to spray water into the Spent Fuel Pools**
9.1 and 9.2	Emergency Preparedness enhancements for prolonged SBO and multi-unit events
9.3	Enhance ERDS capability
10	Additional Emergency Preparedness topics for prolonged SBO and multi-unit events
11	Emergency Preparedness topics for decision making, radiation monitoring and public education
12.1	Reactor oversight process



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Tier 2 and 3 NTTF Recommendations (cont'd)

- Tier 2 actions considered beyond near-term due to
  - Need for further technical assessment and alignment
  - Dependence on Tier 1 issues
  - Availability of critical skill sets
- Tier 3 actions are long-term and
  - Require further staff study to support a regulatory action
  - Results of shorter-term actions are needed to inform longer-term actions
  - Dependent on the availability of critical skill sets
  - Dependent on the resolution of NTTF Recommendation 1



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Tier 2 and 3 NTTF Recommendations (cont'd)

- Tier 2 SFP Recommendations
  - Recommendation 7.2 - Provide safety-related A/C power for the SFP makeup system
  - Recommendation 7.3 - Revise Technical Specifications to require one train of on-site emergency electrical power to be operable for SFP makeup and instrumentation in all modes
  - Recommendation 7.4 - Install a seismically qualified means to spray water into the SFPs to include an easily accessible connection for water supply at grade level outside the building
- Additional SFP Recommendation
  - Evaluate the transfer of Spent Fuel from SFPs to dry cask storage



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Tier 2 and 3 NTTF Recommendations (cont'd)

- Tier 2 SFP Recommendations initially addressed by aspects of FLEX that focus on SFPs
- Recommendations 7.2, 7.3 and 7.4 are being considered for inclusion in the Extended Loss of AC Power (ELAP) Rulemaking for long-term resolution
- Additional recommendation to transfer spent fuel to dry cask storage strategy for CENG has not been evaluated or developed at this time



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FLEX Strategy – Spent Fuel Pool Cooling

- FLEX strategy is a three phase approach
  - Initial Phase – installed equipment to maintain or restore SFP cooling capabilities (6 hours)
  - Transition Phase – portable on-site equipment to maintain or restore SFP cooling capabilities (6 – 24 hours)
  - Final Phase – off-site resources to sustain SFP cooling capabilities indefinitely (> 24 hours)



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FLEX Strategy – Spent Fuel Pool Cooling (cont'd)

- Objectives
  - Connections installed to SFP cooling system such that cooling is maintained without needing access to building or refueling floor
  - SFP makeup provided by portable pumps and hoses where capacity exceeds boil-off
  - Vent pathway for SFP steam/condensate is provided or analysis performed to confirm venting is not required
  - Spray capability is sufficient to cool fuel if SFP leakage is greater than makeup capacity



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FLEX Strategy – Spent Fuel Pool Cooling (cont'd)

- CENG Fleet
  - No water addition is required during Phase 1
  - Portable on-site equipment identified to maintain SFP cooling capabilities through Phase 2 (indefinitely for NMP)
  - On-site equipment will be adequately protected from applicable site external hazards
  - Analyses will be performed to demonstrate the impact of SFP steam/condensate – venting will be provided as required
  - Off-site (Regional Response Center) pumps and power supplies will be adequate to provide indefinite SFP cooling capabilities (Phase 3)
  - Numerous modifications needed to establish connections between FLEX equipment and plant systems



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FLEX Strategy – Spent Fuel Pool Cooling (cont'd)

Calvert Cliffs

FLEX Strategy for Spent Fuel Pool
(Guidance NEI 12-06)

Goal

Employ a 3 Phase Strategy to maintain Spent Fuel Pool level above the top of fuel assemblies seated in the fuel racks during an Extended Loss of AC Power (ELAP) and Loss of the Ultimate Heat Sink (LUHS)

- The goal of Phase 1 is to cope with installed plant equipment
- The goal of Phase 2 is to transition to on-site FLEX equipment
- The goal of Phase 3 is the additional capability and redundancy utilizing equipment provided by the RRC

Strategy

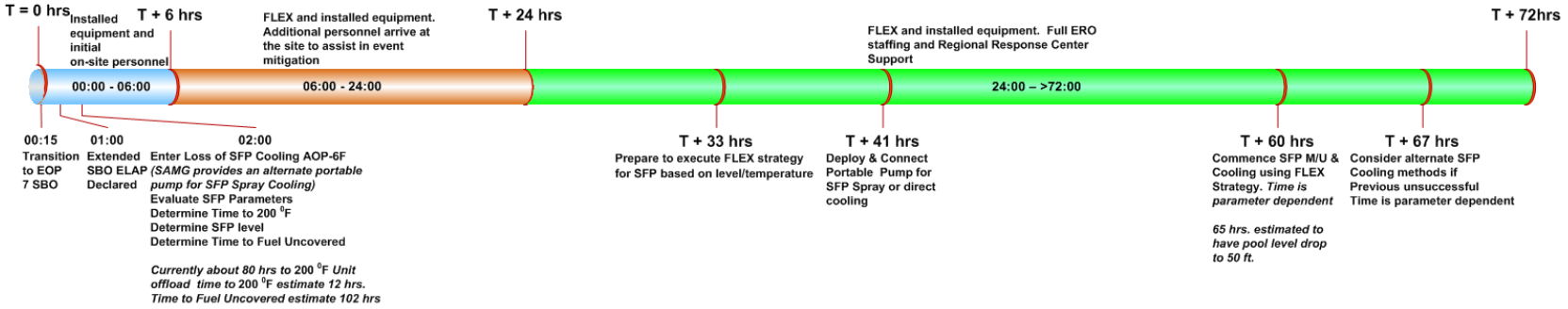
Achieve the goals of maintaining Spent Fuel Pool level above the top of fuel assemblies seated in the fuel racks using the following strategies:

- Protect the asset
- Minimize complexity of operator actions
- Use plug and play mechanical / electrical connections
- Minimize hose runs
- Minimize time to repower battery chargers
- Maximize Control Room indication and control
- Minimize operator entry into environmentally challenging areas

External Hazard Considerations

Beyond Design Basis External Events (BDBEE) hazard considerations include:

- Seismic (BDBSE)
- Flooding (PMF)
- Hurricanes (PMH)
- High Winds
- Tornado – Missile
- Extreme Ice, Snow, Heat & Cold





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Questions?



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