How Has Fukushima Changed the Future of the Nuclear Industry?

Roundtable / Dinner

Nuclear Energy Insider:
U.S. Plant Safety Enhancements
Charlotte, NC
--October 25, 2012

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How Has Fukushima Changed the Future of the Nuclear Industry?

BLACK & VEATCH
Building a world of difference.

Shaw®

Exelon.
Nuclear

WANO

U.S.NRC
United States Nuclear Regulatory Commission

ESI®

eDF

NEI
NUCLEAR ENERGY INSTITUTE

URS

IAEA
International Atomic Energy Agency

AREVA

Westinghouse

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Why Are We Here?

- Knowledge exchange
  - Assess state of Nuclear Industry, post Fukushima
  - Big Picture View
- Share insights / perspectives
  - Governments
  - Operators / Licensees
  - Vendors & Contractors
  - Associations, consultants
- Timely issues with a lot of associated questions
  - Regulator directives / orders
  - Impact on operating plants
  - Impact on future designs

Situation Analysis

- On March 11, the “unthinkable” happened
  - Earthquake and Tsunami in Japan
  - Fukushima Daiichi NPP site blackout & subsequent accident
- Ensuing weeks…
  - Serious for country of Japan and local population
  - Earthquake & tsunami was big disaster
  - But nuclear accident severe: radioactive releases
- Considered one of three worst
  1. Chernobyl
  2. Fukushima
  3. Three Mile Island

“ …public confidence in the safety of nuclear power was badly damaged by the Fukushima accident “ - IAEA

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Situation Analysis

- Before Fukushima there was concern that an accident of even lesser magnitude would kill the nuclear renaissance
- Has not proven to be true
  - Energy/electricity is too big an issue
  - Without coal, no other base load sources
  - High growth countries need nuclear power
  - Some 40 countries have confirmed support for Nuclear
  - Only a few in Europe will exit
- Yet there has been a pause for re-evaluation
- Lessons-learned are now being applied
- New build proceeding in China, U.S., Russia, elsewhere…

"An accident anywhere is an accident everywhere"

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Situation Analysis

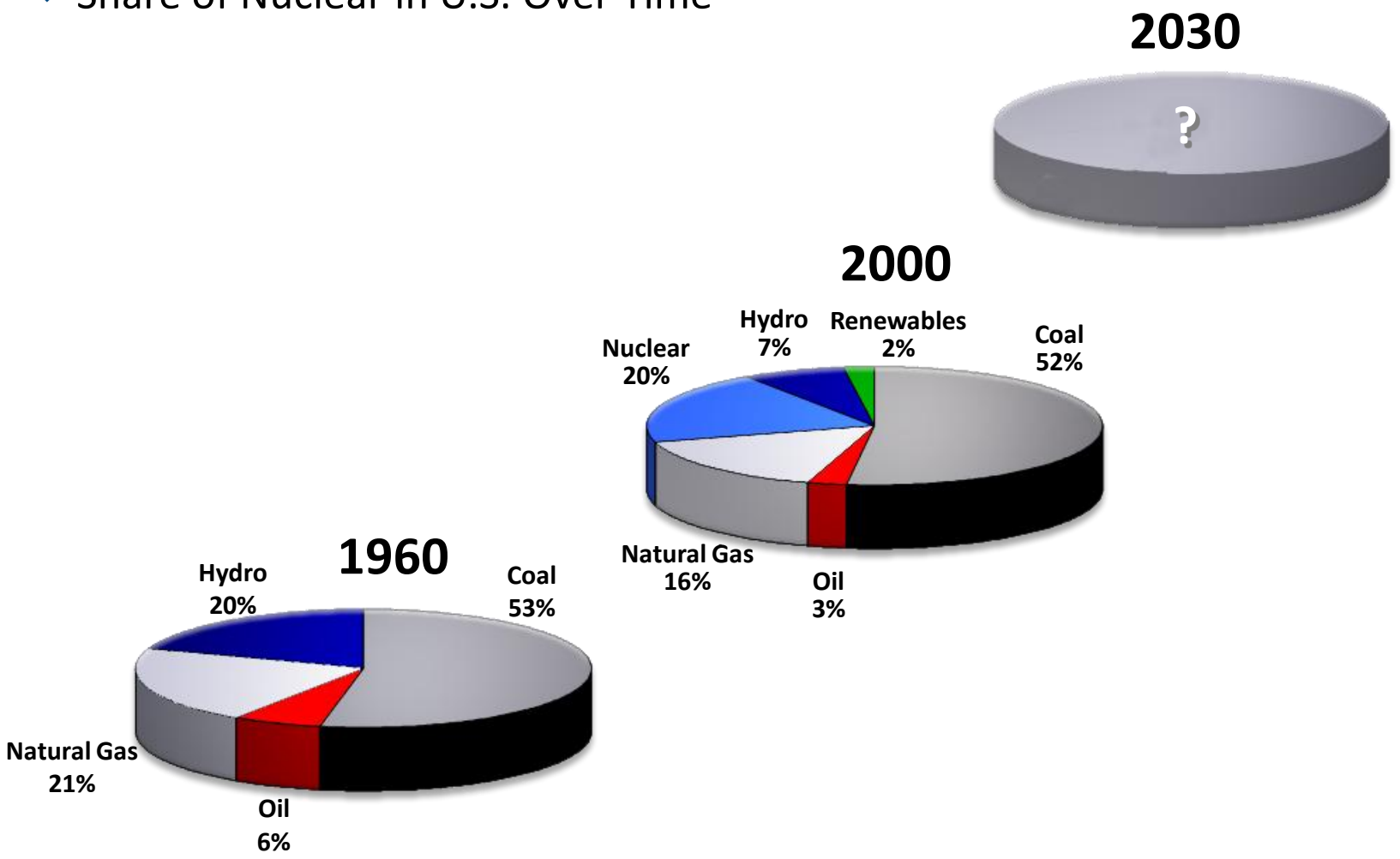
- Because of potential impact, government, industry and private entities began assessments of the lessons learned
- These included:
  - IAEA
  - US-NRC and most other country regulators
  - WANO
  - INPO
  - EPRI
  - NEI
- Most utilities also designated personnel to follow the event, its lessons and develop safety recommendations
- INPO, EPRI and NEI assembled a leadership team and published “The Way Forward”

Key Questions

- How have the 3 major nuclear accidents (and many others less severe) in history impacted the industry?
  - Three Mile Island
  - Chernobyl
  - Fukushima
- An accident anywhere is an accident everywhere…has this proven to be true?
- What has/will be the impact on industry structure, owners/ licensees, regulators and coordination bodies?
  - Utilities (private, public, quasi)
  - Japanese regulators, NRC, etc.
  - IAEA
  - WANO, INPO, NEI, WNA, etc.

Will Fukushima Reduce Nuclear?

- Share of Nuclear in U.S. Over Time



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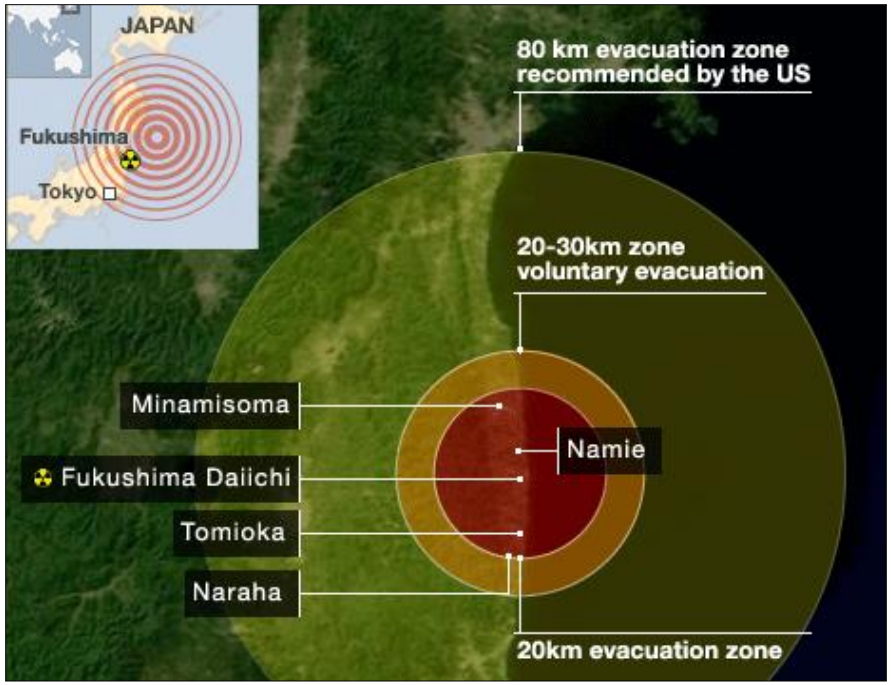
Key Questions

- What *strategic* changes will we see from Fukushima?
  - Implications for country energy policies
  - Generation mix
  - Plant siting (location, elevation, etc)
  - Plant configurations (number of units)
  - Size of units (SMRs, etc.)
  - Reactor designs and technologies (LWR/BWR, fuel cladding, etc.)
  - Alternate fuel cycles (thorium, etc.)
- What are the implications for spent fuel?
  - Cooling, storage technologies
  - For waste repositories
- For any other aspects of the supply chain?

Key Questions

- What are the new expectations for emergency preparedness and response?
- What is the importance of command and control during a major catastrophe? How is it accomplished?



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What Are the Lessons-Learned?

- Risk Assessment
  - Prevent nuclear accidents at all costs
  - Threat re-assessment
  - Safety vulnerability assessments
  - Improved designs, operations, governance
- Regulation & Compliance
  - Surveillance and oversight
  - Testing of emergency equipment
  - Improve advance warning systems
- Emergency Preparedness
  - Should accident occur, mitigate risks and consequences
  - Contingency planning by each constituent
  - Option planning in advance

"Thou shall not construct NPPs on shaky grounds or in shaky countries"

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IAEA Conclusions

- Protection Against Extreme Events
  - Earthquakes, tsunamis, flooding, tornadoes
  - Terrorist activity
- Impacts / Consequences
  - Total station blackout
  - Loss of reactor cooling
  - Loss of spent fuel pool cooling
  - Loss of communications
- Recommendations
  - Enhancing emergency response capabilities
  - Hydrogen explosion control
  - More robust instrumentation for monitoring

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Industry “Flex Strategy”

- Developed by U.S. industry as another layer of security
- *Flexible* because each site can plan for greater probability extreme events in its locale
- Relies on portable equipment, some stationed offsite
- Types of equipment:

•Pumps
•Generators
•Battery banks
•Chargers
•Compressors
•Hoses

•Small Diesel Generators
•Diesel-driven pumps
•Fire trucks
•Portable ventilation
•Communication equipment
•Diesel fueling equipment

NRC Conclusions

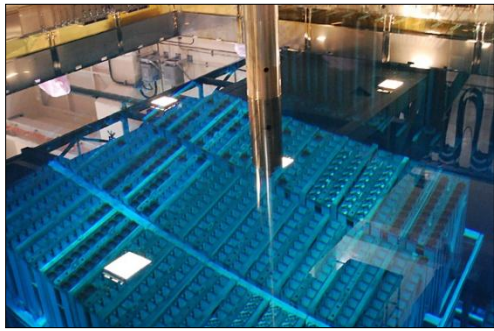
- Fukushima Task Force Recommendations
  - Develop additional strategies to cope with external events / station blackout
    - Better protect portable safety equipment
    - Obtain sufficient equipment to support all reactors at a site simultaneously
  - Install reliable, hardened vents for BWRs (Mark I & II)
  - Install enhanced instrumentation for monitoring fuel pools
- Interim Staff Guidance Documents
  - Open for public comment through July 7; finalize in August
  - Compliance deadline December 31, 2016
- 3-Tier implementation of recommendations including earthquake and flooding walk downs

NRC Tier 1: Immediate Action

- Seismic & flood hazard re-evaluations and walkdowns
- Station blackout regulatory actions
- Mitigating strategies for beyond design basis events
- Reliable hardened vents for Mark I & II containments (BWRs)
- Stronger & integrated emergency procedures, severe accident and damage mitigation guidelines
- Emergency preparedness regulatory actions

NRC Tier 2: Next Actions

- Spent fuel pool makeup capability
- Emergency preparedness regulatory actions
- Other external hazards re-evaluation
  - Tornadoes
  - Hurricanes
  - Drought
  - Etc.



NRC's reaction to Fukushima has been considered a conservative, measured response

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NRC Tier 3: Actions After More Study

- 10-year confirmation of seismic and flooding hazards
- Potential enhancements to prevent or mitigate fires & floods
- Reliable hardened vents
- Emergency preparedness enhancements for station blackout and multi-unit events
- Emergency response data system capability
- Reactor oversight process modifications
- Additional staff training
- Basis of EPZ
- Pre-staging of potassium iodide beyond 10 miles
- Transfer of spent fuel to dry cast storage

IAEA

" I believe that nuclear power plants have already become safer as a result of measures taken as outlined in the action plan on nuclear safety" -- Denis Flory IAEA

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One Utility's Status

- Assigned full-time corporate position
- Site positions also (may be part-time)
- Doing Evaluations
  - Totally busy time
  - Prioritization of sites, actions
- Budgeting and planning
- Scheduling actions
  - 1 year, 2 year, 3year

Emergency Preparedness

- Pre – Accident
  - Prevent at all costs
  - Improved designs, operations, governance
  - Surveillance and oversight
  - Testing of emergency equipment
  - Improve advance warning systems
  - Dependable communications
- Response Preparedness
  - Should accident occur, mitigate risks and consequences
  - Contingency planning by each constituent
  - Option planning in advance

"Thou shalt not construct NPPs on shaky grounds or in shaky countries"

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Emergency Preparedness

- During
  - Response teams mobilize
  - Implement pre-arranged action scenarios
  - Fit for purpose: demographic, external conditions
  - Importance of command & control
  - Importance of communications
  - Reporting, transparency
- Post – Accident
  - Stabilization
  - Removal & clean up of contamination
  - Others

Changing Roles, Missions

- WANO has announced mission change
  - Shift from prevention only, to include Emergency Preparedness
  - Improving integrated response of government and industry to nuclear emergencies
- INPO role during Fukushima, after
  - Organized an emergency supply chain network to assist in getting equipment to site
  - Consortium of utilities, vendors, etc.
  - Will INPO also announce an expanded mission?
- IAEA taking a stronger role
- Need for strong global governing body?

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Insights for Industry and Government

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Who Is Linton Consulting?

- A professional practice providing independent insights and advisory services to industry and government
- Focus: Energy, Power, Nuclear
- Business strategy, diversification, market development, trend analyses, scenarios and visioning
- Executive relationships and introductions
- Strategic View
  - Process develops high level insights on the future state
  - Ongoing analyses and executive interviews
- Services leading to sound business strategies, decisions, plans and implementation
- Partner with UxC, *Nuclear Energy Insider*, and InnovaNet

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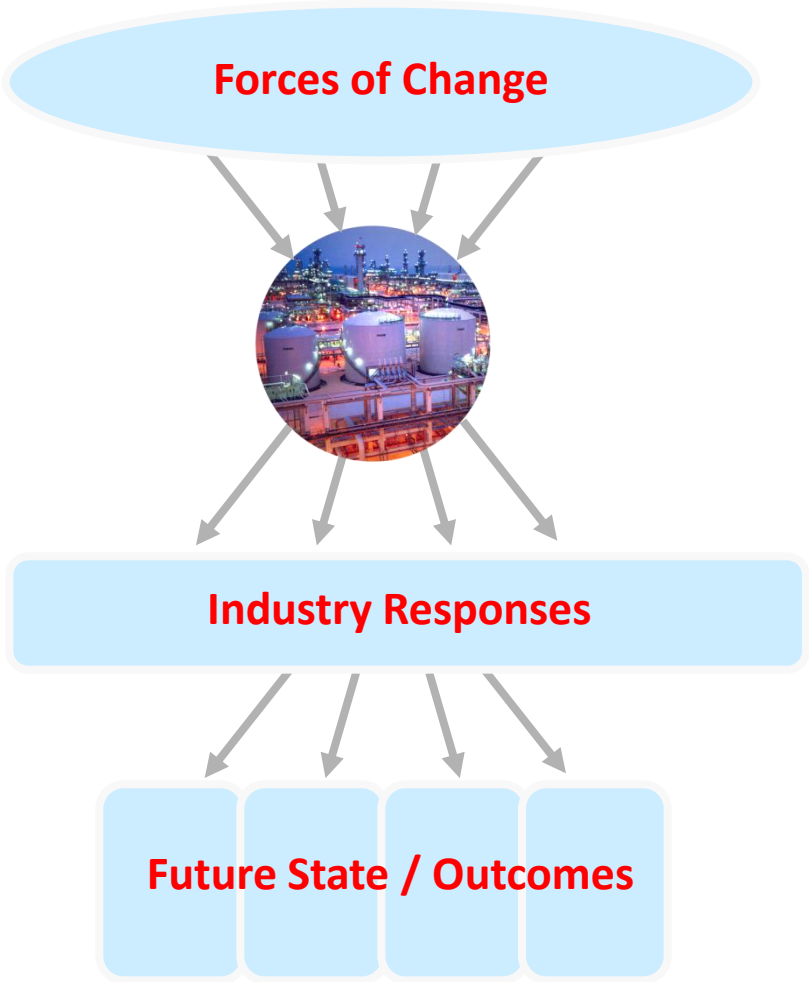
What is *Strategic View*?

- Research model
  - Used 15 years; 5 in energy
  - Forces affecting the future of the energy industry
  - Industry responses
  - Where it is leading – the future state/outcomes
- Process
  - Interviews with executives and thought leaders
  - Research & analysis
  - Executive Roundtable
  - Follow up & plan integration



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Executive Roundtables

- Common purpose
  - Convene executives and thought leaders for knowledge exchange
  - Expand understanding
  - Share perspectives
  - Confirm/challenge paradigms
  - Advise leadership
  - Uncover ideas and opportunities for your organization
  - Explore Future – trends and challenges
  - Establish practical, realistic path forward

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