Seeking True and Durable Public Trust and Confidence in Nuclear Power Plants

After Fukushima: Disaster Management Themes in Nuclear Power Plant Emergencies

STEPHENSON DISASTER MANAGEMENT INSTITUTE

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Mission

Our mission is to save the lives of people and animals by continuously improving disaster response management through leadership in applied research and executive education.

Goals

- Bring business principles and research to bear on disasters
- Produce applied research and disseminate best practices to the business and practitioner community
- Build partnerships between academic scholars, emergency management practitioners and the private sector

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After Fukushima: Disaster Management Themes in Nuclear Power Plant Emergencies

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Project Foreground

- Nuclear Renaissance?
- Public Trust: New Nuclear Power Plants (NPP) sites will require
  - Getting to Durable Risk Acceptance of Nuclear Facilities.
  - Public acceptance of high-hazard, low-probability industrial accidents.

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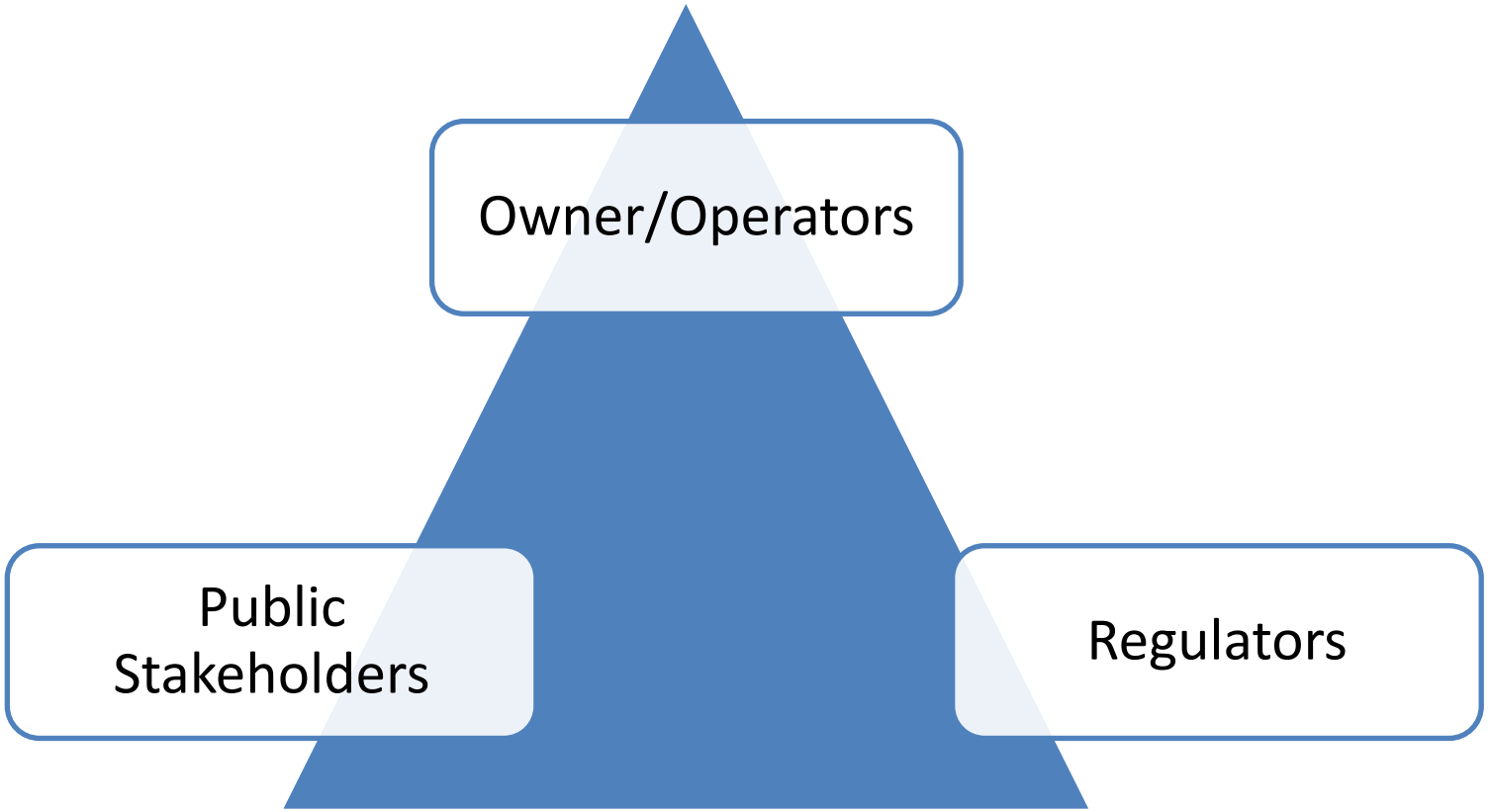
Triad of Relationships in the Public Process



Participants: Private Sector

- Private Sector: NPP Owner/Operators
  - Investor-Owned Utilities
    - Safety and Security Contractors
    - Consultants
- Quasi-Public Utilities
- Critical Infrastructure/Key Resources

Participants: Regulators

- Federal
  - Main: Nuclear Regulatory Commission
  - Ancillary: EPA, DOT, DHS, DHS/FEMA, DOE
- State (CA as Example):
  - Public Utilities Commission
  - State Government – Governor, Congress
  - Ancillary: CA EPA, Cal Emergency Management, CalTrans
- Local
  - County Government
  - County Emergency Management
  - County Police, Fire, Health and Emergency Medicine

Participants: Stakeholders

- Citizens Groups
- Public Interest Lawyers
  - Nonprofit Organizations
  - Local Interested Parties
- Individual Citizens

Public Process

- Federal and State Law:
  - All licensing decisions must be made jointly by the NRC and CPUC after full notice and comment process.
  - Public Meetings
    - Meetings held every several months over a period of 18 – 24 months.
    - Owner/Operator presents data and findings to Regulator and the Public
    - Typically highly technical
    - Public invited to comment and question

Research Questions

- Under what conditions do participatory processes facilitate true and durable risk acceptance?
- Under what conditions are experts and expert knowledge considered by all participants in the process?
  - In what ways are experts accepted as authorities?
  - Under what conditions do each of the participants in the process come to trust expertise? Lose trust?

Additional Research Questions

- Does the participatory process allow for meaningful exchange of information between the three parts of the triad?
  - "Meaningful" includes information that is digestible and usable by all parties such that they can "understand" the risks/hazards being communicated.
  - "Meaningful" also includes the exchange of information in a way that all parties know that they have been "heard"
- Are appropriate assurances provided to each participant in the triad?
  - "Appropriate assurances" are appropriate to each participant:
  - To Stakeholders: Those who are made vulnerable to the technology are being kept safe from it, now and into the foreseeable future over multiple management generations.
  - To Regulators: Adequate levels of technical expertise and safety and security personnel over multiple management generations.
  - To Owner/Operators: Durable trust agreements that will remain in effect over the lifetime of the facility so long as obligations to public and regulators are kept.

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Study Site: Diablo Canyon Nuclear Power Plant, San Luis Obispo, CA

- Plant went online in 1985 after numerous legal and political challenges
  - Construction began in 1968
  - Current Operating Permit expires 2024
  - Relicensing effort to extend life an additional 20 years
  - Relicensing application put on hold by CPUC on March 18, 2011 after the Sendai Earthquake
  - One of the most hotly contested NPPs in the United States – 1,900 people were arrested protesting the groundbreaking; legal challenges went to the Federal District Court in D.C. resulting in a decision authored by a now sitting Supreme Court Justice that eventually review must end and groundbreaking must go forward.
- Parallel seismicity study
  - two relatively newly discovered fault lines that run within one mile of the facility
  - Hosgri Fault and Shoreline Fault
    - Mapping of these faults has been a contentious and parallel issue to the relicensing effort.

Methods of Inquiry

- Ongoing Observation of the Public Meeting Process for previous 12 months
  - Observations include:
    - Methods and language owners and regulators use to communicate technical data to one another and the public
    - Methods and language stakeholders use to communicate anxieties to owners and regulators
- Archival and Media Record including Participants' use of the Internet to communicate information
- Interviews with representatives of all participants

Theoretical Framing

- What would assure the public enough to accept risk?
  - What questions should the public ask, if it knew the questions it should ask?
- Assume that when the public is placed at risk of long-lived and highly hazardous activities, the risk propagator enters into a “stewardship” relationship with the public.
  - The Owner (and Regulators) place the public in a position of vulnerability to actions it cannot control.
  - This creates a relationship analogous to a legal “trust” relationship – wherein, there is an obligation on owners and regulators to take adequate steps not only to assure public safety and security but also to assuage public anxiety.
  - This is The Vulnerability Principle

Framing Cont'd: Institutional Stewardship

- Highly Reliable Operations
  - Error-free or nearly error-free operations amidst high complexity
- Institutional Constancy
  - Over multiple management generations (even where accountability for mistakes made today will be lost when errors are discovered several management generations into the future)
- Public Trust and Confidence (PT&C)
  - In such a way as to inspire PT&C
    - Trust in ability to meet obligations
    - Confidence that obligations will be honored several generations into the future – particularly important in long-lived hazards wherein financial exigencies may make honoring commitments financially unpalatable
    - PT&C in regulators to ensure that owner/operators will honor their obligations
- After Fukushima Dai'ichi the public will likely not be assuaged that the radiation never reached levels injurious to human health
  - Radiation Protection assurances have to be at or very near zero emissions.

Context

- National domestic nuclear power conversation - 25 years after Chernobyl.
  - Demand for energy independence and reduction in carbon emissions
  - Degree of U.S. Public Trust and Confidence in nuclear power
  - Strong safety records over several management generations
  - BUT…Aging, infrastructure
    - Extend permits of plants built in the 1970s?
    - Building new plants will take sizeable investment from the public sector including upfront costs and limitations on liability
    - New plants will also face challenges from interested stakeholders

Context (2)

- Before Sendai Earthquake and Fukushima NPP Incident, biggest perceived threats (and stakeholder assurances sought) were:
  - Technical or operator accident – "Normal Accident" like 3 Mile Island (Perrow).
  - Aging Infrastructure accident (NPP operators note that they have largely replaced all aging equipment)
- After Earthquake: new set of stakeholder demands for assurances emerge:
  - Are current NPPs built to withstand natural events? Are they robust enough to survive cascading infrastructure failures? How much "slack" or "cushion" is built into current systems?
  - Can and will proposed NPPs be designed to withstand unforeseen events (i.e., overbuilt?) [Part of the larger project]
  - Crossover with conventional Emergency Management issues: are EM systems able to cope with a nuclear disaster caused by a natural or terror event?

Disaster and Emergency Management Themes

- This “chunk” of the project focuses on:
  - Conventional Disaster and Emergency Management Themes and Challenges as applied to the NPP accident context
  - Themes are relevant to nearly any disaster
  - NPP context creates an additional set of concerns regarding radiation protection and increases a demand for useful information

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Framing Disasters: What Happens After

- Disasters are what happens after the event.
  - The Natural Event is the hazard that becomes a disaster as it impacts people and communities
  - Disasters emerge in:
    - The breakdown of critical infrastructures upon which we rely as backbone support for our day-to-day systems (Roe and Schulman; de Brujine; van Eeton) and
    - The tearing of the "social fabric" of a society (Kreps; Quarantelli & Dynes).

Framing Disasters: Cascading Failures

- Disasters are characterized by “Cascading Failures” (Vicente) particularly in “tightly coupled” and “complex” systems (Perrow; Clarke):
  - As components of the system breakdown, they take other parts with them (e.g., power goes down, followed by phone service, increased medical needs, inability to deliver supplies, etc.).
  - These components are often interlinked in unanticipated manners and leading to unexpected failures – “you know that something will go wrong, but beyond the normal stuff, you aren’t sure what until it happens” – County Emergency Manager

Framing Disasters: All Hazards Management

- All Hazards Management and All Hazards Mitigation – this management approach attempts a synoptic view of the universe of potential outlier events
  - Planning for “unknown unknowns”
  - Disaster planning is partially, if not largely, a process of preparing for as many contingencies as possible and,
  - Planning for how to respond when conditions get chaotic and complex

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10 conventional Emergency Management Theme Areas

- The following slides apply 10 conventional EM themes amplified by the nuclear context
- Potentially increase public anxieties in such a way as to demand a new set of assurances.
- Create additional challenges for public sector emergency managers

1. Incident Command

- Emergency Management for Industrial Accidents: After Fukushima (and BP Deepwater Horizon)
  - Who or what agency will command emergency operations in an industrial or nuclear accident?
  - What role will the owner/operator have in operational command (e.g., BP and TEPCO)?
  - **"Multi-jurisdictionality"** Problem –
    - US emergency management – local jurisdictions control emergency response efforts until they are overwhelmed
    - Shared command may be required

2. Evacuation:

- Potential 50 mile nuclear evac zone creates massive challenge for first responders and transport planners in Los Angeles, New York, and Washington, D.C.
- As many as several million people live in a potential 50 mile evacuation zone

3. Emergency Shelter

- Shelter plans:
  - Sendai Quake – 450,000-600,000 displaced
  - Massive challenge to shelter that many people
- DHS National Level Exercise for New Madrid fault:
  - Attempts to shelter 1 million people.
  - One State EM said: “it’s an impossible problem”
- Shelter in place?

4. Public Health Information and Secrecy (versus radiation panic)

- Public Information
  - Is information accurate?
  - Does information conflict?
  - Are first responders at risk?
  - Is the public at risk? (and what does “at risk” mean?)
- Under what conditions are experts trusted sources of information? Under what conditions are they distrusted?

5. Public Health Facilities and Personnel

- Facilities
  - Do local and regional hospitals have adequate facilities for radiation protection, treatment and response?
  - Are there identified potential Medical Special Needs shelters that can be stood up quickly?
  - Do the local, regional and state have adequate supplies to prevent and treat radiation-caused illness or emergencies?
- Personnel
  - Are there adequate numbers of trained personnel to respond to the accident/incident at the local, regional and state levels?
  - Will mandated personnel report for work?
  - Is there adequate protective equipment for response and treatment personnel?
  - What is the universe of medical contingencies that could arise from a NPP incident/accident? What about a combined Natural-Industrial (NaTech) incident?
  - Are there adequate supplies and personnel to respond to all contingencies?

6. Industrial Reporting

- EOPs, Safety Plans, Response and Mitigation Plans, Risk Assessments
- Do industry reports adequately reflect and respond to external risk?
  - Are Emergency Operations Plans adequate?
  - Do siting documents and Environmental Impact Reports adequately reflect and mitigate risk from natural hazards?
  - What about scientific uncertainty, i.e., regarding seismic zones, flood hazard and Base Flood Elevations, wind events and wildfires?

7. Unconventional Crises and Complex Disasters

- **Unconventional crises**
  - Render planned responses unintelligible
  - Overwhelm response systems and force on-the-fly decision-making
  - All nuclear events are unconventional
- Complex Disasters (Two or More Events)
  - Cascading disasters
  - Do Emergency Operations Plans account for multiple events occurring at once?
  - Transboundary Crises – implicate multiple command and response jurisdictions
    - Are governance processes in place to sort out command confusion?
    - Responsibility v. Blame

8. Scenario Planning – Scale of "reference event"

- What is the "reference event"?
  - Is the facility overbuilt (i.e., built to withstand higher than expected natural events)?
  - To what extent does the design basis include events that seem improbable?
  - To what level of protection should the facility be built (the 1 in 1,000, the 1 in 10,000, the 1 in 100,000 event?).
    - Fukushima represents the 1 in 1,142 year event after 30 years of operation.

9. The Specter of the Black Swan (Taleb)

- Black swans are high-consequence events that were thought to occur in the long tails of the distribution curve
  - Black swan theory suggests that the tails are "fatter" than expected making costs/benefits higher than expected
- What is the probability of the reference event v. increasingly probable "black swan" events?
  - Can we account for "black swans"?
    - Probabilities for particular events seem to be changing – e.g., three 500 year floods in 8 years in Louisiana
- Changing Probabilities
  - What is the impact of the aging nuclear plant infrastructure on probability of failure of the facility?
  - Accuracy in seismic prediction is lacking
  - Climate change data suggests greater risks of floods, storms and wildfires

10. Development of the Natural Hazard Zone

- Increasing loading of risk on coastlines, fault zones and floodplains
- “Going to the hazard”
- This puts an increasing load on emergency response systems

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Conclusions and Further Research Efforts

- The triad of Owner/Operators, Regulators and the Public have a new set of risk acceptability questions given the natural hazards of the region and new precedent
- Assurances will have to include hazard mitigation that extends beyond the currently expected (given the “black swan” in Japan)
- Emergency and Disaster Management becomes an important part of the equation
- Public participation may be able to increase acceptability of risks