On-Site emergency response planning and severe accident management

Presentation to IAEA International Experts' Meeting on
Severe Accident Management in the Light of the Accident
at the Fukushima Daiichi Nuclear Power Plant

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Emergency Planning – Continuous Improvement

Learning from the Experience of others

- Learning from each other and sharing ideas for improvements
- Drills and Exercises to identify and remove obstacles to success
- The most severe events experienced have always been the scenarios we did not imagine and prepare for.
- Review IAEA *EPR-Lessons Learned 2012*
  - *Lessons learned from the Response to Radiation Emergencies (1945-2010)*

Adapt lessons learned to our own situations

- We have different facilities, different reactor types, different cooling systems and containments
- Different site organizations and different technical support organizations
- Different local geography and population demographics
- Different interfaces with off-site emergency response authorities.
- We should expect to see some differences in how we have developed our response plans

Background for Point Lepreau Generating Station Emergency Response Planning

- Single unit Candu-6 station, providing about 35% of the power required by the utility, NB Power.
- Operating since 1982 on the east coast of Canada, 35km from the nearest city, Saint John, in the Province of New Brunswick.
- Off site nuclear emergency response managed by Provincial Government Emergency Measures Organization in Fredericton, 100km north.
- NB Power affiliated with Candu Owners Group. Other Canadian Nuclear Stations are in Ontario, 1000km to the west.

Adapting Emergency Response Planning to Changes in Management and Operations culture

- Management:
  - From promotion based on technical merit and length of service
  - To appointment based on proven management skills
- Operations:
  - From operations based on self confidence based on extensive training and operating experience
  - To focus on procedural adherence
  - Guidance not procedure for severe accident response

On-Site Emergency Response Organization

Overall concept of operations and response management

- Previous system:
  - Managers and department heads assemble and provide guidance and assistance requested by Shift Supervisor
  - Emergency Procedures = list of responsibilities
  - Technical support experts gather only when requested by management: report to Technical Manager
- Appeared to work well for short term response to Design Basis Events
- Challenged when managers appointed from outside the organization, different reactor types: business background.
- Challenged by more extreme events significantly beyond the design basis.
- Challenged when interfacing with outside agencies

On-Site Emergency Response Organization
Overall concept of operations and response management

- Present system:
  - Adaption of the Incident Command System *(organization and terminology familiar to off site response agencies)*
  - Specified Emergency Response Roles and Responsibilities not rigidly linked to normal organizational positions
  - Extensive Emergency Response training and qualification in conjunction with off site authorities (Provincial Emergency Measures Organization)
  - More detailed Emergency Procedures for each role listing Immediate Actions then Recurring Actions in priority order
  - Operations focussed Technical Support section (Planning Section) assemble for all Emergencies: communicate directly with Operations Section
- Most of the Incident Command staff are located together at the Command Post. Two sections operate outside the Command Post:
  - Operations Section
  - Planning Section

Operations Section response

- If an upset evolves into a Radiation Alert or an Emergency of any kind
  - Shift Supervisor as Operations Section Chief becomes Incident Commander and activates the Emergency Response Organization
  - Remains both Operations Section Chief and overall Incident Commander until
    - Emergency Response Organization is assembled and fully briefed, AND
    - There is a need to transfer Incident Command
    - We would expect a transfer of command if severe accident conditions were met

Operations Section response

- Event Specific response procedures *(for example, Loss of Coolant, Loss of Boiler Feedwater, Loss of Electrical Power),* if not working, interface with generic Emergency Operating Procedures (EOPs) *(symptoms based)*
- If generic EOPs are not working *(cooling cannot be restored by safety systems)*, then criteria are reached which transfer Operations to Severe Accident Management Guidance for the Control Room.
- Operations Section stay with this SAMG Control Room guidance until the Planning Section are assembled, fully briefed and have developed and communicated a written Action Plan based on Severe Accident Management Guidance.

Technical Support for the Operations response

- Planning Section
  - Support and guidance during response to any emergency *(plus Radiation Alerts)*
  - *Continuous direct communications between Planning Section Chief and Operations Section Chief*
  - For Severe Accidents,
    - Planning Section follow Severe Accident Management Guidance to develop an Action Plan
    - Tactical response command is transferred from Operations to Planning Section once an Action Plan is ready for Implementation

Technical Support for the Operations response

- Planning Section
  - Planning Section Chief
    (current or former Operations Shift Supervisor)
  - Fuel Cooling Member
    - *follows Severe Accident Guides to devise best available strategy for fuel cooling*
  - Containment Member
    - *follows Severe Challenge Guides to avoid serious containment challenges*
  - Senior Technical Advisor
    - *considers all other nuclear safety issues*
    - *coordinates input and advice from system specialists and other subject matter experts and technical advisors*
  - Assistants: *Administrative support, Computational Aids, Security*

Scope of Incidents considered in Planning Basis

- **Loss of emergency response equipment and systems**
  - Fukushima demonstrated that extreme events can cause the loss of all our installed options for providing cooling water and electrical power
  - Connection points added (and have more yet to add) for mobile generators and mobile pumps to provide key safety functions if all installed pumps and generators are made unavailable by an incident.
  - Procured our own mobile generators and pumps for near site storage and identified additional suppliers from whom replacements could be obtained.

- **Flexibility in deployment of Emergency Mitigating Equipment**
  - Three teams at the facility on each shift
    - Operations Emergency Response (Fire Fighters) Security
  - An incident may fully engage any team in direct response
  - Each team cross-trained to deploy and connect mobile generators and pumps

Scope of Incidents considered in Planning Basis

- **Access to vital equipment during a severe accident**
- **Re-assessed radiation and environmental conditions for more extreme events**
- **Changed response strategies, radiation shielding, added ventilation filters**

- **Key challenges:**
  - **Potential leakage pathways from pressurized containment** ***(into confined spaces containing vital equipment)***
  - **Noble gases passing through Emergency Filtered Ventilation** ***(potential for short term elevated fields under adverse weather conditions)***

Scope of Incidents considered in Planning Basis

- **Loss of key personnel**
- **Severe natural events cause widespread disruption** *(hurricanes, earthquakes, tsunamis)*
- **May make assembly of Emergency Response Organization difficult** *(notification, transportation)*
- **Five or more individuals trained for each Emergency Response Role**
  - **Drills where respondents did not arrive**
- **Key response actions confirmed by more than one role**

Scope of Incidents considered in Planning Basis

- **Loss of key personnel**
- Expect Operating crew to declare Emergency and activate Emergency Response Organization
  - Can we activate response if key Operations staff are lost ?
  - What additional actions do other Emergency respondents have to undertake? *(those normally expected of Operations)*

Scenarios for Drills and Exercises

- Use of more extreme events
  - Before Fukushima, often challenged that scenarios were "incredible" and would not happen
  - Chernobyl and Fukushima were beyond our imagination
  - Can only design drills based on what we can imagine
  - Need to exchange ideas on additional drill scenarios
- We have practiced:
  - Planning for an approaching hurricane
  - Extended loss of electrical power due to internal fires or external events such as ice storms
  - Major explosion and fire in which Operating crew lost during the initial event

Scenarios for Drills and Exercises

- Redefining what it means to win
  (protecting the public versus saving the facility)
- Severe Accident response practice required a significant shift in operations training philosophy.
- Traditionally, simulator training for Operations Staff has always provided a success path which, if found, could save the facility from serious damage.
- To get significantly beyond the design basis and test severe accident response in enough depth, have to gain acceptance for a new "win".
- By our definition of a severe accident, the facility cannot be saved in a restorable condition.
- Significance of this change in philosophy for operations training should not be under rated.

Operations Safety Culture and Severe Accident Management Guidance

- Many challenges in re-assessing Emergency Response planning following Fukushima

- Challenge of changes in Operations Safety Culture
  - Emphasis on procedural adherence
  - *Do not touch the plant without a procedure*
  - *If procedure does not work, stop and wait for an approved change*
  - Initial acceptance of Severe Accident Management Guidance (SAMG) *(**NOT** procedure)* becoming more difficult
  - In high stress situation of Severe Accident, where SAMG are not written to cover every situation, what have you found to be an optimal approach for operators to accept SAMG as guidance not procedure?