Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

Decision-Making in an Uncertain World: *Regulatory Challenges*

IAEA International Experts' Meeting
May 21st to 24th 2013
Vienna, Austria

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Outline

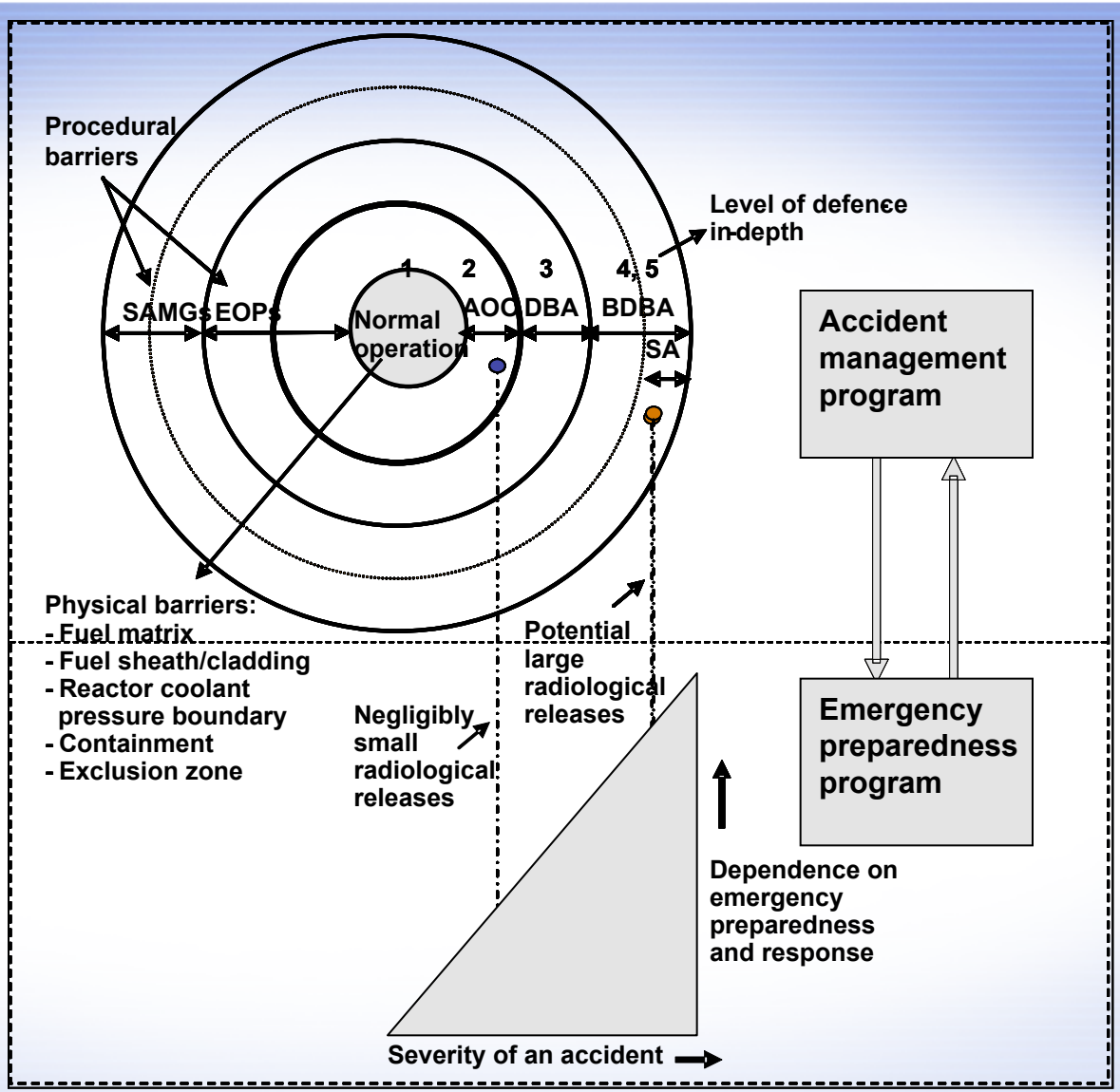
- Objectives
- Plant States, Accidents and Decision-Making
- Challenges and Promising Developments
- Conclusions
- Questions

Objectives

- Identify challenges for decision-making when dealing with nuclear accidents ranging from design basis accidents to severe accidents, from the perspective of a regulator
- Contribute to safety improvement initiatives
- Identify areas for research

Plant States, Accidents and Decision-Making

- Some terminology first…



Plant States, Accidents and Decision-Making

- Decision-making
  - Several available classifications, but simple (and sensible) often works best – Rasmussen's S-R-K
    - Skill, rule and knowledge-based behaviour (SBB)
    - On any given day, a mixture of these behaviours is used
      - incorrect to assume that normal operations are purely SBB and RBB, and that abnormal, unexpected situations are solely KBB
  - SBB and (mostly) RBB are normally supported by operating manuals or emergency operating procedures (EOPs), training and proper supervision

Plant States, Accidents and Decision-Making

- Individual decision-making is important but is not the whole story
  - Individual and crew
    - Event-handling strategies are specified and practiced to ensure robust handling of abnormal operating occurrences (AOOs) and design basis accidents (DBAs)
      - Judicious combination and coordination of event-based and symptom-based EOPs, proper allocation of roles to the operating crew)
  - Locus of control for decision-making
    - Up to and including DBAs: essentially the crew, with alerting of emergency response team as warranted
  - Staffing
    - Licensees for power plants are normally required to maintain a predetermined number of qualified personnel, known as the minimum shift complement (MSC)

Plant States, Accidents and Decision-Making

- Putting it together … and looking forward

Plant States			Within design basis accidents		Beyond design basis accidents	
	Normal	AOO	DBAs	**Not DBA but emcompassed by them**	**BDBA without significant core degradation**	Severe accidents
Probability of rad. release						
Response to be performed		Accident Management Program			Emerg. Preparadness	
Locus of control	Local (or mostly)				Possibly more global	
Type of response	Operating manuals	EOPs (event based)	EOPs (event based)	EOPs (event or symptom based)	EOPs (event or symptom based)	SAMGs
Type of decision-making	Mostly S, a fair bit of R, at times a bit of K				Some S, some R, at times some K	
Staffing	Minimum Shift Complement (MSC)				Sufficient number of qualified staff (includes MSC and some)	

Challenges and Promising Developments

- Change in the locus of control, on-site
  - From MSC to another group (at the facility)
- Change in the locus of control, on and off-site
  - From the “local” level to a more “global” level
- Understanding what KBB is and how to best support it
  - How to enable individuals, and the team, to deal as well as possible with the unexpected
  - Integration with accident response (i.e., accident handling)
  - Some scientific knowledge is available, but far more is needed
- How to specify requirements for sufficient number of qualified staff
  - Roles, qualifications vs knowledge, mission time, availability, etc.

Conclusion

- Reviewed existing knowledge on decision-making and accident management
- Identified issues and challenges in the decision-making behaviours for the management of nuclear accidents and associated emergencies
  - changes in the locus of control, on-site and off-site,
  - lack of knowledge about how to best support decision-making at the KBB level, and
  - definition of what is meant by “sufficient number of qualified staff”.
- Opportunity for the regulator and industry to deepen knowledge and improve accident response planning

- Questions?

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