Lessons Learned from Past Accidents

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Lessons Learned from Past Accidents

- Three Mile Island NPP, United States
- Chernobyl NPP, Ukraine (former USSR)
- Tokyo Electric Power, Japan - In-Service Inspections
- Davis Besse NPP, USA - Vessel Head Corrosion
- Brunsbuttel and Philippsburg NPP, Germany - Technical problems
- Dampierre NPP, France - Organizational problems
- Paks NPP, Hungary - Fuel Damage
- Mihama NPP, Japan - Quality Control
- Fukushima TEPCO Nuclear Power Plants
Three Mile Island
NPP, Unit 2
March 28, 1979
TMI-2
Causes

• Reactor core overheated and melted

• Pressurizer pressure relief valve opened but failed to close

• Operators lacked understanding of event

• Operator actions made conditions worse

• As a result, Loss of cooling accident “LOCA”
TMI-2
Lessons Learned

• Strengthen design safety
• Strengthen human performance
• Improve Emergency Operation Procedures, to be symptom based
• Enhance regulatory oversight
Chernobyl NPP, Unit 4

• Severe core melt due to fire and overheating

• Severe off-site radiation release

• Population evacuation
Chernobyl NPP, Unit 4 Accident

Figure 31. Radiation Hotspots Resulting From the Chernobyl Nuclear Power Plant Accident

- **Confiscated/Closed Zone**: Greater than 40 curies per square kilometer (Ci/km²) of Cesium-137.
- **Permanent Control Zone**: 15 to 40 Ci/km² of Cesium-137.
- **Periodic Control Zone**: 5 to 15 Ci/km² of Cesium-137.
- **Unnamed zone**: 1 to 15 Ci/km² of Cesium-137.
Chernobyl Lessons Learned

- Eliminate positive void coefficient
- Improve RBMK design
- Improve operating procedures
- Improve human performance
Tokyo Electric Power-In Service Inspections
Japan

Deficiencies in organisational management processes led to the shutdown of all 17 nuclear plants:

• complacency towards knowledge-based decision making;

• decision-making done in isolated vertical silos

• weak questioning attitude

• “safety first” in the vision, but not practiced

• ambiguous regulations for reporting deficiencies
Severe Vessel Head Corrosion

• Production took priority over safety

• Managers had lost first hand oversight of operating conditions

• Operating experience not effectively used

• Poor implementation of plant corrective action programme
Davis Besse NPP
Brunsbuttel and Philippsburg NPP
Germany

• Brunsbuttle- Boron Dilution out of limits
• Philippsburg- Hydrogen explosion

• poor Quality Assurance Program (QA)
• operating manual problems
• start-up operating procedures problems
• isolation from industry
• lack of questioning attitude
• over-dependence on the “technical capability” of vendors
• lack of independent assessment and oversight
Dampierre NPP
France

Regulatory Order: “Fix Problems or Close Plant”

- isolation between plant services
- union and management conflicts
- insufficient safety culture
- complacency by plant staff
- lack of adequate planning processes in maintenance
Paks Npp
Hungary

30 Fuel Assemblies Severely Damaged

- Poor design of fuel cleaning tank
- Inadequate safety analysis
- Over reliance on contractor
- Poor operations oversight
- Lack of fundamental nuclear safety principles
Appendix 2: Arrangement of Chemical Cleaning Tank

Surge Tank  El. +3.5 m
Podium Floor  El. +0 m
RPV Pool

AMDA Cleaning Equipment

Cleaning Pool Shaft No. 1
FA Storage Pool
Process Lines
El. -14.8 m Cleaning Tank
Appendix 5: Fuel Assembly Positioning Test in Erlangen, Top View of Cleaning Tank

Outlet

Fuel Assembly Dummy

Upper Guide plate

30 FA positions

Volume_{empty}: 6.3 m^3
Weight_{empty}: 4.2 t
Layout of the B operating mode
Defense in Depth
Break down

Poor Design
FANP

Weak Safety Analysis
FANP
Paks NPP

Weak Regulatory Review
HAEA

Over Reliance on Contractor
Paks NPP
HAEA

Poor Operational Oversight
Paks NPP

Lack of Nuclear Safety Concerns
FANP
Paks NPP
HAEA

Fuel Cleaning Incident
Pipe Rupture

- Inappropriate maintenance management and quality assurance activities (utility, manufacturer and contractor)
- “Safety culture” had weakened in each company
- Inappropriate outsourcing management by utility
- Utility did not understand and timely correct the actual conditions in the field
Mihama NPP
Fukushima TEPCO NPPs
Japan

• Sever Accident
• Extreme external events: Tsunami + earthquake
• Multi-units site, sharing emergency systems, accident management provisions
• Challenge of design basis and beyond design basis
• Fact finding Mission
• Ministerial Conference
• Action Plan
Thank You for Your Attention