

The Accident at TMI-2

- Operators stopped RCS pumps on cavitation
- Operators tried to depressurize RCS to 400 psi after 7 hours in order to start RHRS
- Containment isolation was delayed because of low containment pressure and absence of containment isolation signal on SIS
- Operators failed to recognize importance of high in-core and loop temperatures

The Accident at TMI-2

- Operators failed to notice stuck-open PORV for 2 hours; PORV position was monitored by power to solenoid (not by position)
- Operators turned off ECCS-HPI on noticing high pressurizer level (“solid” pressurizer)
- Operators failed to notice coolant saturation conditions in RCS at core outlet
- Operators failed to notice high pressure in drain tank and the bursting of its rupture disc

The Accident at TMI-2

- Loss of condensate pump caused loss of main feedwater which caused turbine trip
- Auxiliary feedwater valves remained closed after maintenance
- Operators failed to notice for 8 minutes lack of aux. fdw flow; cause location of recorders
- Delayed reactor trip resulted in additional heat in RCS; no reactor trip on turbine trip
- PORV stuck open (PORV leaked before)

Safety Culture and TMI; Conclusions

- The Kemeny study established that the root causes of TMI are primarily human-related
- Greater credit should be given to the groundbreaking work performed by Kemeny, et al. in the area of Safety Culture

Safety Culture and TMI; Conclusions

- The importance of Human Reliability for nuclear safety had already been established in 1975 by the WASH-1400 study
- However, this insight did not penetrate into the nuclear community until 1979, after TMI

Safety Culture and TMI; Kemeny Recommendations

- “There must be a system for gathering, review and analysis of operating experience”
- Establish an industry-wide international communication network for sharing safety-related information

Safety Culture and TMI; Kemeny Recommendations

- “The licensee must prepare clear operating procedures for use in emergencies”
- “The licensee must define clear responsibilities in the event of an emergency”

Safety Culture and TMI; Kemeny Recommendations

- “Clearly defined roles and responsibilities must be established for operation”
- “We recommend that each NPP have a separate safety group that reports to high-level management”

Safety Culture and TMI; Kemeny Recommendations

- The nuclear industry must dramatically change its attitude towards safety
- The nuclear industry should establish appropriate standards for management, QA and operational procedures

Safety Culture and TMI; Kemeny Findings/Quotations

- The WASH-1400 Reactor Safety Study analyzed events, equipment failures as well as human errors
- However, NRC made no use of WASH-1400 insights in its review analyses until after TMI

Safety Culture and TMI; Kemeny Findings/Quotations

- “The control room design was lacking in many ways”:
- Inadequate attention to man-machine interface
- Large number of alarms without adequate prioritization

Safety Culture and TMI; Kemeny Findings/Quotations

- “The approach to safety had a major flaw”:
- Too high emphasis on low-probability major failures, resulting in a mind-set not to worry about less important failures of higher probability

Safety Culture and TMI; Kemeny Findings/Quotations

- “Regulations alone cannot assure safety; it is an absorbing concern with safety that will bring about safety”
- “Once regulations become voluminous and complex,... they can serve as a negative factor in nuclear safety”

Safety Culture and TMI; Kemeny Findings/Quotations

- “The fundamental problems are people-related; not equipment problems”
- “There are problems with the ‘system’ that manufactures, operates and regulates NPPs”

Safety Culture and TMI

- The term “Safety Culture” came in use after the Chernobyl Accident
- The Kemeny Report had already identified all important aspects of Safety Culture

Safety Culture and TMI

- Prior to TMI little attention had been paid to Human Factors
- The Investigation into TMI showed the important Role of Human Factors

Safety Culture and the Accident at Three Mile Island

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