NPRE 457: HW 38

Joseph F. Specht IV

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1 EBR I Criticality Accident

For the EBR I, one of the main design flaws was the use of NaK, which burns in contact with air if any leakage were to occur – the pipes containing the NaK would need to be reliable throughout their entire lifetime. Another design flaw was the use of an impeller during the beginning of plant operation. The impeller was switched to an MHD pump after the impeller had sufficiently corroded. Finally, there was also a positive Doppler reactivity feedback in certain scenarios, which are very undesirable.

Additionally, the human errors were disconnecting the automatic scram system for the high temperature test. The disconnecting of this system caused the power to peak in the pins and cause fuel melt. Additionally, the operators inserted a slow moving control rod during the high temperature test. However, the operator should have used the fast moving control rod and not the slow control rod.

Finally, the equipment that failed was the core as half of the core melted. Additionally, no instruments detected anything was wrong. There was no sound, steam, smoke, or explosion for this accident.

2 Fermi I Fuel Meltdown Incident

For the Fermi I reactor, a main design flaw were the lack of inlet flow diversity that allowed the fuel to overheat after a single obstruction blocked the flow. Also, there were too few thermocouples in the design. The lack of thermocouples left to reactors to rotate the already melted fuel rods into the spots with thermocouples to diagnose the fuel.

Additionally, the biggest source of human error was cooling accident experiment the AEC ordered. From this experiment, a plate broke loose and obstructed the flow causing "relatively trivial" damage to the fuel. After this accident, the ARC did not pay for the repairs after an accident that caused fuel damage. After this accident, the reactor ran for years while not being repaired. In the next accident, the operators turned off the automatic control system and had the control rods moved farther out than they should have been.

Finally, there was one major equipment malfunction. The flow was blocked as a crumpled piece of Zircaloy play completely covered the inlet nozzle. The nozzle being obfuscated caused the fuel to melt.

3 Steam Generator Leakage at the BN-350 Desalination Plant

For the BN-350 desalination plant, the biggest design failure were in the suppliers for the steam generators and evaporators. This equipment was poorly constructed and had numerous leaks resulting in steam almost leaving the reactor containment.

Additionally, the human error was the continued usage of the reactor after the leakages were detected during startup. The terrible welds were done manually, which is also another source of human error. The leakages affected all but one loop, but the remaining loop was not replaced after the leakage accidents.

Finally, the biggest equipment failure were the poor welds in the steam generators and evaporators. There were two major leaks and three minor leaks in 1974 because of low quality welds. There were also mechanical defects from end cap manufacturing. These cap defects lead to leakages later in the reactor lifetime. However, after being replaced, the evaporator still leaked.