NPRE 457: HW 40

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1 Three-Mile Island

For the Three-Mile Island accident, the major design flaw was the layout of the main control console causing the valve to be left open for eight minutes into the accident.

Additionally, there was human error starting with the plant personnel performing maintenance on the feed water system and turning off a pump connecting the condenser to the demineralizer. This caused the main feed water pumps to automatically stop. Coupled with this oversight, the block values were also left open, which caused a larger accident. After the pressure relief valve failed to close, the operators did not notice until 2 1/4 hours after the incident. The humans also shut down the HPIS pumps, which caused the fuel to overheat.

Finally, the equipment failure started with the valve not closing and causing continuous loss of coolant. In addition to the valve not closing, there was a a solenoid that failed to diagnose the valve as open. At the end, the fuel melted down.

2 Chernobyl

For the Chernobyl accident, the major design flaw was the lack of a containment structure. The lack of containment building allowed the radiation to disperse into the environment. Also, the tips of the control rods were made of graphite. The graphite tips caused a positive reactivity insertion during scram.

Additionally, human error began with the test procedure not being adequately review from a safety standpoint. The day operators changed could not complete the tests during the day causing the night crew to take over. The night crew was not properly trained for this safety test, which initiated the entire event. The operators began to remove control rods because the power began to drop, but the power was dropping due to Xenon poisoning. The power increase from removing the control rods caused the Xenon to burn up, which massively increased the reactor power causing an explosion.

Finally, the equipment failure started with the reactor operators ignoring all warning signs the computer displayed. Ignoring the warning signs was allowed because the equipment let them turn off the warnings. Also, the control rods for the reactor were pulled out during operation causing the fuel assemblies to overheat, build hydrogen, and explode.

3 Windscale vs. Chernobyl

Both reactors at Windscale and Chernobyl were graphite moderated systems. However, Windscale used molten sodium as the coolant while Chernobyl used light water. Both resulted in radiation leakage into the environment, but Chernobyl released orders of magnitude more radiation than Windscale. Finally, both accidents were initiated by a physics event that the reactors did not foresee. In Chernobyl, Xenon poisoning and burn-up caused the accident while, in Windscale, Wigner energy in the graphite lattice caused the accident.