

NUCL 402 HMWK 11

1) Table of Initiation, Key Reasons, Human Errors, and Instrument/Computer Failures, Risks

| Part | Three Mile Island | Chernobyl | Fukushima |
|-----------------------------|---|--|---|
| (i) Initiation | Condensate and boiler pumps trip, leading to reactor trip from clogged plates. | Xenon buildup neglected and reactor run at low power levels. | Tsunami removes diesel generators, disabling active safety systems. Tsunami was generated by offshore earthquake |
| (ii) Key Reasons | After opening for depressurization, PORV does not close as intended. This causes heat increase, operators wrongly stops safety systems, leading to partial core melt. | Recirculation pumps turned on while safety rods out past their limit, this caused almost flat temperature profile. When reactivity increased, the liquid (which was close to flashing point) flashed, blowing off entire (although not well designed) biological shield. | Diesel generators could not power safety systems, backup batteries worked for shorter time period than expected, valve control was lost, access was difficult due to destroyed roads. |
| (iii) Human Errors | Operator wrongly stopped AFW, because they did not understand meaning of dropping fluid levels in core. | In order to run experiment, operators pulled control rods past design limits and then also disabled ECCS, which lead to the reactivity spike and resulting vapor explosion due to heat. | Operators errors were not to blame for this incident, but communication and emergency management in "worst-case" scenarios must be evaluated. |
| (iv) Risks of Radioactivity | Tiny risk, barely any reactivity breach, containment stayed intact through event. | Radioactive contents were detected as far away as Sweden, entire city of Pripyat is now abandoned. | Primary containment kept integrity through accident. Some contamination was released because of violent H ₂ explosions in hydrogen tanks above core. |

2) Table of How to Avoid these three accidents

| Accident | TMI-2 | Chernobyl | Fukushima |
|------------|---|---|---|
| Prevention | Better training for accident scenarios | Better training of all involved to stop the performing of the experiment intended | Diesel generators should be protected to same factor of safety as the core |
| | Better human factors design for controls on core | Safety systems should need a harder override so that experiments require high clearance | Passive cooling should be included to at least control core when active systems fail |
| | Having advisors on hand with better understanding could stop operator error | Negative reactivity coefficient designed core would help to avoid situation ever for reactivity spike | Hydrogen should be vented in a better way to avoid the explosion that compromised integrity of plant. |