

## Three Mile Island (TMI-2)

### TMI-2 Characteristics

- TMI-2 on March 28, 1979 near Harrisburg, Pennsylvania
- TMI-1 was shutdown for refueling
- TMI-2 had been operating for only 3 months
- TMI-2 was operating at 97% power just before the accident
- TMI-2 is a 900 MWe PWR by Babcock & Wilcox (B&W): dual loop with each loop having 2 pumps and a once-through steam generator (which has very little feedwater reserve)

### TMI-2 Sequence of Events starts at 4:00 am

- during maintenance on an ion-exchange (demineralizer) system for feedwater polishing, feedwater flow lost (an anticipated transient) to steam generator due to feedwater pumps tripping as a result of trying to clear a blocked transfer line
- the 3 auxiliary feedwater systems (2 electrically operated pumps and 1 steam-driven pump) pumps start as intended
- loss of heat removal by steam generator leads to temperature/pressure increase in RCS
- reactor scrammed on high pressure, so control rods inserted
- pressurizer has 2 safety valves, a motor-operated relief valve (MOV), and a block valve
- pressurizer MOV relief valve opens sending water to pressure relief tank located in the containment building; after about 15 min the tank fills up and the radioactive water flows into the containment sump (and radioactive gases released to containment atmosphere); sump water is initially pumped to the auxiliary building; LOCA was too small (pressure limits low) for the containment isolation system to be activated (design flaw in that only one parameter, namely, high containment pressure would cause isolation system actuation)
- meanwhile, two block valves had inadvertently been left closed due to some prior maintenance work, therefore auxiliary feedwater flow unavailable; eventually, in  $\approx 2$  minutes the water in the steam generators boils off; after about 8 minutes the closed block valves were discovered and then opened
- pressure relief valve fails to close (thus a small leak created in RCS) but control room light indicates that it has closed
- now the primary system (RCS) pressure begins to drop
- the high-pressure ECCS is activated after about 2 minutes
- operator thinks the RCS is full, so the ECCS is turned off after a couple of minutes; however, the pressurizer water level indicator was incorrect (it read high)
- water level then drops below the top of the fuel (melting now); top of the core remained uncovered for almost an hour
- after 1 hour RCS pumps begin to vibrate from lack of water so 2 pumps were turned off, after another 40 min the other 2 pumps were stopped; to have left pumps on could have caused pump/piping and seal failure; after about 3 hours a pump was restarted; without solid water natural circulation not set up
- took 2½ hours before open relief valve was detected, water loss was stopped using the block valve
- a hydrogen bubble was formed in the upper part of the rx vessel

### TMI-2 Releases

- during accident the letdown system was used to reduce water volume in RCS when it was supposedly full; however, the volume control tank of the CVCS overfilled; this was the main release point (Kr and Xe gases)
- because plant was relatively young some fission products (e.g., Cs-137) had not yet had time to fully buildup