

7.5.1 Three Mile Island

In March 1979 the operational PWR at Three Mile Island experienced a loss of coolant accident (LOCA) (see sections 7.6.2 and 7.6.3) when a pressure relief valve in the pressurizer (figure 1) stuck open without the operators realizing what had happened (Cameron 1982).

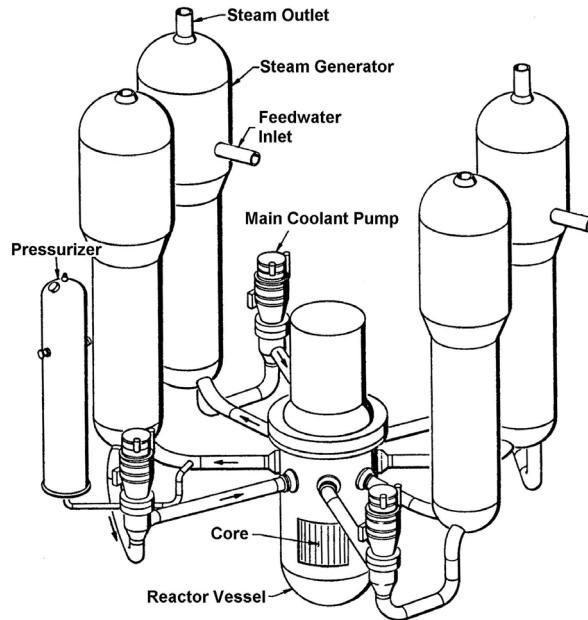


Figure 1: PWR coolant system. Adapted from USAEC (1973).

The primary coolant drained out of the core that then overheated. The operators injected emergency cooling water with little effect partly because, unknown to them, water continued to drain out of the jammed pressure relief valve. Meanwhile, unexpectedly, a large bubble of steam and gas formed at the top of the core and prevented water from rising into it and cooling it. Half of the reactor melted and, in the process, the operators were forced to release a little radioactive steam to the atmosphere in order to prevent excessive pressure build-up in the containment building. Parenthetically there was some build-up of hydrogen due to the high temperature interaction of steam with the zircaloy cladding and this may have exploded in the upper core. Eventually, sufficient water was forced into the core to cool it and bring the situation under control. The reactor's other protection systems functioned as they should and the concrete containment building prevented any further release of radioactive material.

For some months after the accident it was assumed that there had been no core meltdown because there was no indication of serious radioactive release

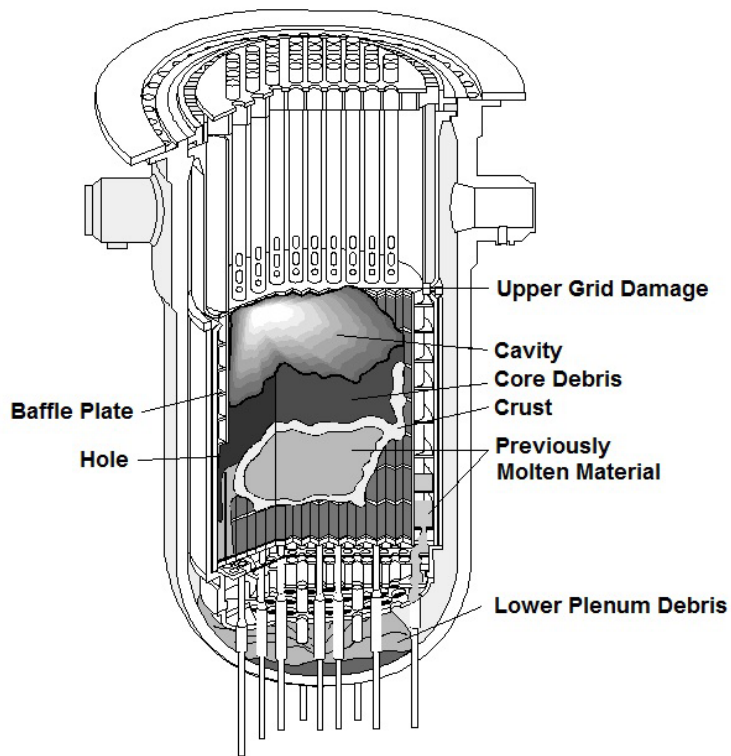


Figure 2: State of the Three Mile Island reactor after the accident (IAEA website 2015).

within the secondary containment structure. However, as depicted in figure 2 (IAEA website 2015, see also Osif *et al.* 2004), it transpired that almost half the core had melted. Despite this, the reactor vessel remained almost completely intact and there was no major escape of radioactive material into the secondary containment structure. This helped allay the worst fears of the consequences of core meltdown in other LWR plants.

The principal conclusion in the aftermath was that improved instrumentation was needed to ensure the operators had reliable information on the state of the reactor systems. If they had known the relief valve was open the damage to the reactor would have been much less. In addition, it was concluded that operator error also contributed to the accident and therefore improved training was also needed.