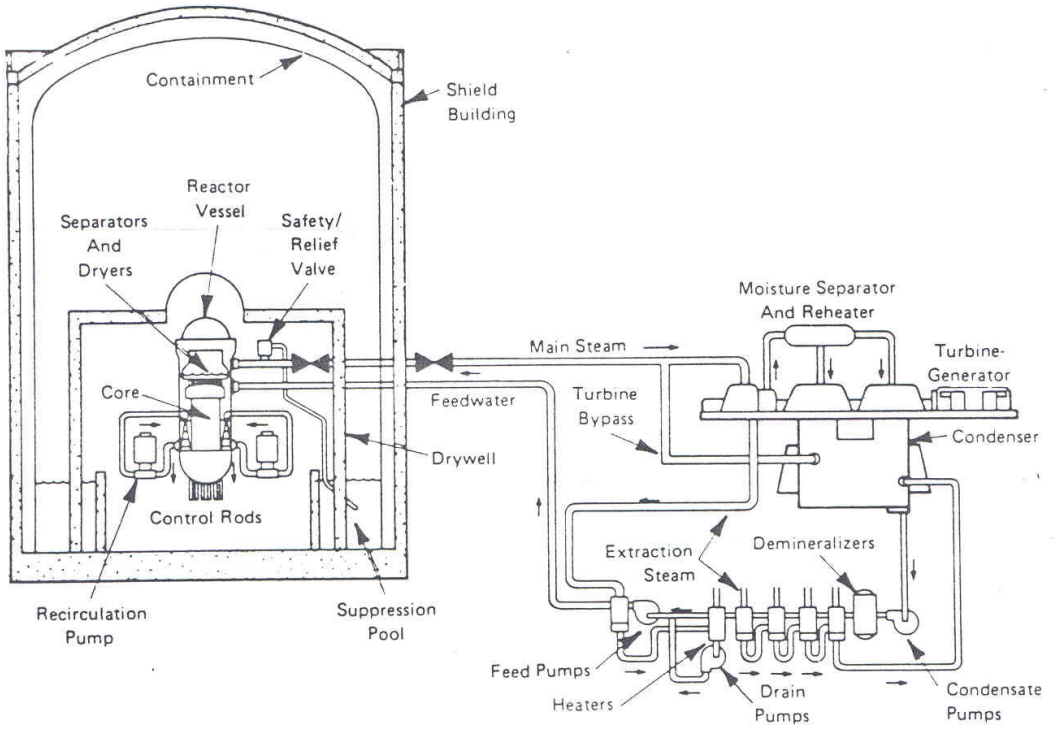
Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

fact sheet

Steam Leak at Hope Creek

Nuclear Regulatory Commission Daily Event Report (DER) No. 41109 dated October 10, 2004, described a manual shut down of the reactor at the Hope Creek Generating Station in New Jersey. According to the DER, operators manually scrammed the reactor from about 69 percent power in response to a steam leak inside the turbine building. Following the reactor scram, the vacuum in the main condenser decreased to the point where the feedwater pumps automatically tripped. Operators manually started both the high pressure coolant injection (HPCI) and the reactor core isolation cooling (RCIC) systems to assure adequate flow of cooling water to the reactor. Operators manually closed the main steam isolation valves to stop the steam leak.



Hope Creek has a boiling water reactor (BWR) similar to that shown in the graphic. The problem started in the turbine building housing the components on the right side of the graphic. In a BWR, feedwater enters the reactor vessel. Heat generated by the nuclear fuel in the core boils the water, making steam. The steam flows to the high pressure turbine. Steam leaving the high pressure turbine enters the moisture separator and reheater to remove water droplets before the "dry" steam goes to the low pressure turbine sections. Although not shown on this graphic, a pipe allows water collecting in the moisture separator to drain to the condenser. This pipe, 8 inches in diameter at Hope Creek, broke.

The broken pipe allowed steam from the moisture separator to escape into the turbine building. Air from the turbine building flowed in through the broken pipe to the condenser. The condenser is kept at a vacuum to "pull" steam through the turbine. The feedwater pumps are turbine driven, as suggested by the steam line from the high pressure turbine shown in the graphic. The loss of vacuum in the condenser disabled the feedwater pumps, forcing the operators to start the HPCI and RCIC systems (not shown on the graphic) to provide makeup water to the reactor vessel for core cooling.

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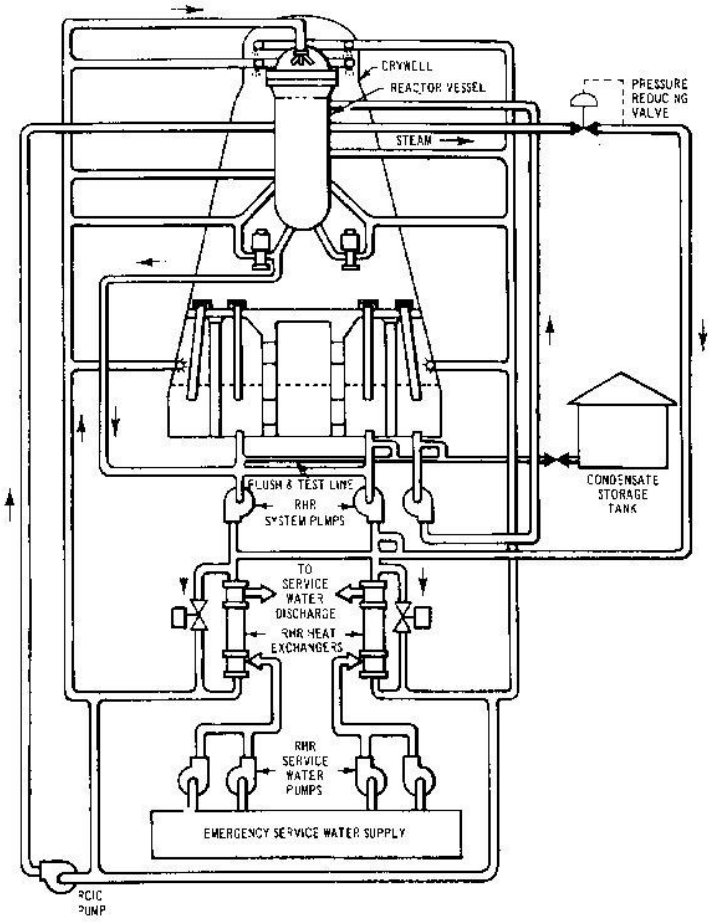
The operators stopped the steam leak by closing the main steam isolation valves (the black "bow-tie" on the main steam line just to the right of the reactor building wall). This "bottled up" the reactor vessel. The steam being produced by the nuclear fuel in the core could no longer travel down the steam lines to the condenser. Instead, safety/relief valves opened as designed to allow this steam to flow into the suppression pool. The suppression pool contains some 2 million gallons of water. It serves as an "energy sponge" during accidents and transients soaking up energy created by the reactor core.

Steam flowing through the open safety/relief valves into the suppression pool heated up that water. To control the heat-up and keep the "energy sponge" from getting saturated, operators manually started an emergency system called the residual heat removal (RHR) system. The RHR pumps were aligned to take water from the suppression pool, send it through large heat exchangers where water drawn from the Delaware River cooled it down, and return it to the suppression pool. In the graphic, this pathway would be the inner loops from the suppression pool to the RHR system pumps to the RHR heat exchangers and then back around to the suppression pool.



Operators made a mistake along the way. The operating license issued by the NRC to PSEG for Hope Creek limits how long the RHR pumps can be taken out of their emergency status for duties such as suppression pool cooling. Both RHR pumps stayed in suppression pool cooling mode longer than permitted by the operating license, which required the operators to issue a second report to the NRC about this mistake.

Before the reactor at Hope Creek is restarted, the company and the NRC should determine what caused the 8-inch pipe to break and whether other piping at Hope Creek is equally vulnerable to that type of failure. It might have been caused by erosion/corrosion, blamed for the recent fatal accident at the Mihama nuclear plant in Japan. Or it could have been caused by vibrations, blamed for a string of failures at the Quad Cities nuclear plant in Illinois. Both the broken pipe and equally vulnerable piping should be replaced/repaired before the reactor is restarted.

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