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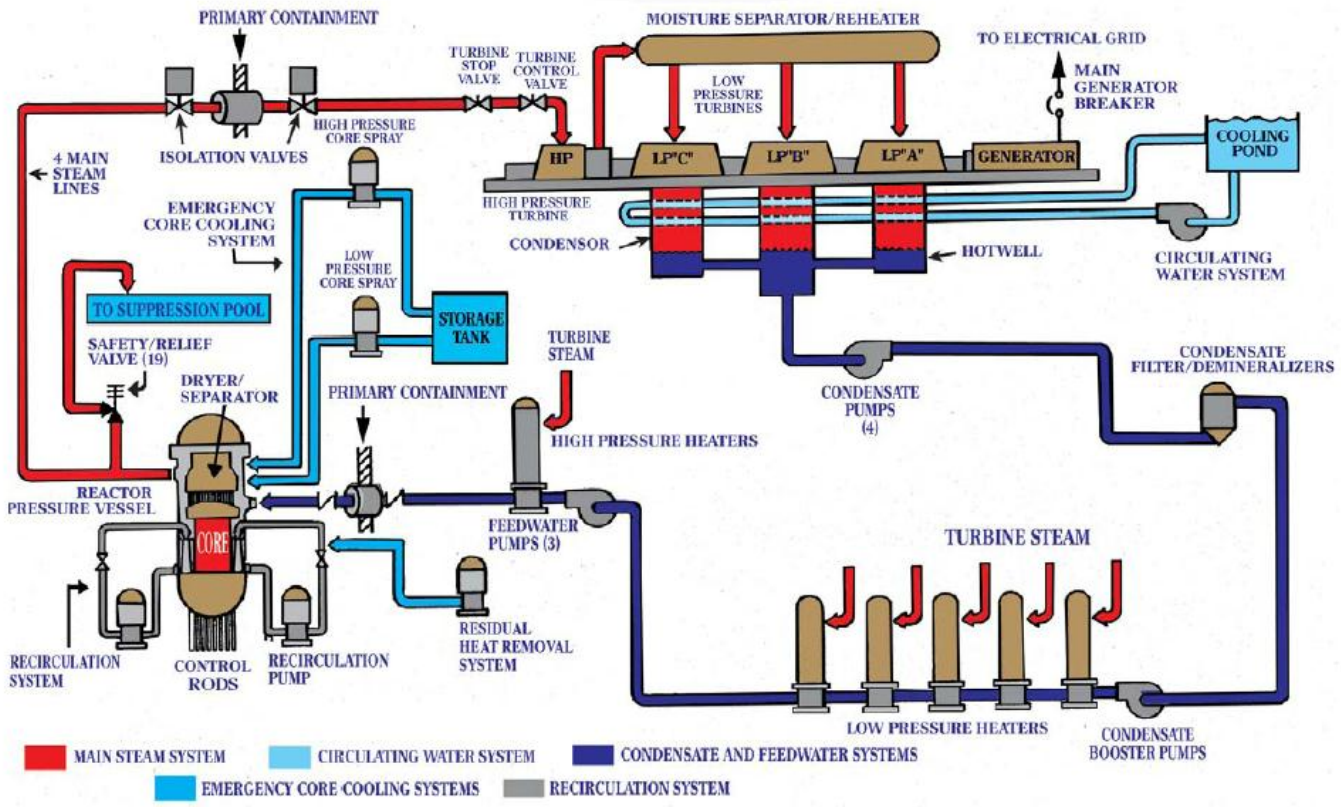
ISSUE BRIEF

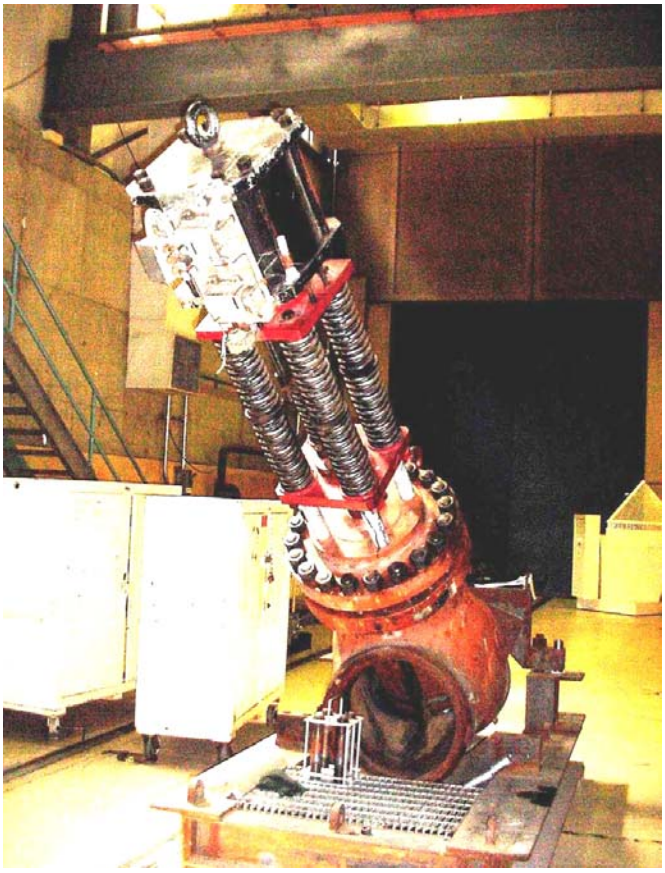
MSIV Scram at Pilgrim

The Pilgrim boiling water reactor in Plymouth, Massachusetts automatically shut down from full power at 4:28 p.m. on Saturday, August 22, 2015, when a main steam isolation valve (MSIV) unexpectedly closed. Pilgrim has four large diameter pipes that carry steam produced in the reactor vessel to the main turbine. Each steam pipe has an MSIV located just inside and just outside where the pipe passes through the primary containment wall.



The MSIVs have two primary safety roles. If the pipe between the containment wall and the main turbine were to break, the opening would rapidly depressurize the reactor vessel (normally at nearly 1,010 pounds per square inch pressure). The MSIVs rapidly close within a few seconds to limit the loss of cooling water from the reactor vessel and protect the reactor core from overheating damage. The second safety role of the MSIVs is similar. If fuel in the reactor core becomes damaged, radioactive material escapes into the water and steam within the reactor vessel. The MSIVs rapidly close to limit the release of radioactivity from the primary containment.

Because the MSIV's safety roles both involve rapid closure, the valves are designed to be "fail-safe." The picture shows a typical MSIV. Large spring coils can be seen that keep the MSIV closed. To open an MSIV, the operator flips a switch that applies pneumatic pressure to overcome the spring force. If power is lost, the pneumatic pressure drops and the springs close the MSIV. Likewise, if a leak or other failure causes the pneumatic pressure to drop, the springs close the MSIV.



The initial report for Pilgrim's shut down stated that it was caused by the closure of one MSIV. But the reason for the MSIV's unexpected closure was not provided. Workers will review computer logs and other data to determine why it closed.

The rapid closure of one MSIV at full power caused pressure inside the reactor vessel to rise. The reactor core was still producing 100 percent steam, but now that steam was being forced into three pipes instead of four. The pressure rise collapsed some of the steam bubbles forming in water flowing upward through the reactor core region. In a boiling water reactor like Pilgrim, water allows more atoms to fission than does steam. Consequently, the reactor's power level also increased.

The initial report for the shut down did not identify what parameter triggered the automatic scram. There are two leading candidates: (1) high pressure in the reactor vessel, and (2) high reactor power. When the reactor pressure increases to more than about 1,063 pounds per square inch, the reactor automatically scrams. And when the reactor power level increases by about 20 percent, the reactor automatically scrams. The rapid closure of one MSIV at full power starts a race between reactor pressure and reactor power towards their automatic scram setpoints. Both will likely finish that race; workers will review data to determine which parameter won.

The initial report stated that no equipment malfunctions or operators miscues complicated the plant's response to the MISV closure. NRC inspectors will review the unplanned trip and record their findings in an upcoming inspection report. The plant's owner will submit a licensee event report (LER) to the NRC within 60 days explaining what caused the MSIV to close.

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