Fermi I Breeder Reactor

The Fermi I reactor was a breeder located at Lagoona Beach, 30 miles from Detroit. On October 5, 1966, high temperatures were measured (700 compared to normal 580¡F) and radiation alarms sounded involving two fuel rod subassemblies. The reactor scrammed and there was indication of fuel melting. After a month of sweating, they tested out enough subassemblies to limit the damage to 6 subassemblies. By January 67 they had learned that 4 subassemblies were damaged with two stuck together, but it took until May to remove the assemblies.

When they had checked the sodium flow earlier, they had detected a clapping noise. In August 67 they were able to lower a periscope device into the meltdown pan and found that a piece of zirconium cladding had come loose and was blocking the sodium coolant nozzles. The zirconium cladding was part of the lining of the meltdown cone designed to direct the distribution of fuel material should a meltdown of the fuel occur. Such structures are necessary in a breeder reactor because of the possibliity of molten fuel reassembling itself in a critical configuration. This is not a possibility in an ordinary light water reactor because of the low level of enrichment of the uranium, but a fast breeder reactor is operated with a much higher level of enrichment. The phrase "China syndrome" was coined in regard to this accident as they were contemplating the possibilities should a meltdown of fuel with critical reassembly take place. The uncontrolled fission reaction could create enough heat to melt its way into the earth, and some engineer remarked "it could go all the way to China".

With ingenious tools designed and built for the purpose, the piece of zirconium was fished out in April of 1968. In May of 1970, the reactor was ready to resume operation, but a sodium explosion delayed it until July of 1970. In October it finally reached a level of 200 Mwatts. The total cost of the repair was about $132 million. In August of 1972 upon denial of the extension of its operating license, the shutdown process for the plant was initiated.

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NRX Reactor at Chalk River, Canada

The events of December 12, 1952 at this experimental heavy water-moderated nuclear reactor make a wild tale of the type of common-mode failures which make everyone nervous about nuclear reactors. First, four

valves which kept air pressure from raising the control rods were opened in error by an operator. The supervisor noted warning lights and rushed to the basement to close the valves. Once he had closed them, he assumed that the rods had dropped back, but they hadn't dropped fully - they had dropped only far enough to shut off the warning lights.

The supervisor, realizing that the reaction was still on, called the control room to order the operator to push buttons 4 and 3 to stop the reactor, but mistakenly said 4 and 1! The operator rushed off to do it before he could correct his mistake. Button 1 raised 4 banks of control rods, causing the reaction rate to double every 2 seconds. This buildup was noted after about 20 seconds and the reactor was scrammed. Because of the air pressure problem, the control rods didn't go all the way down. After about 44 seconds, the plant physicist dumped the heavy water to kill the moderation and stop the reaction. This dumped tons of radioactive water into the basement. About 3 minutes later, the 4 ton lid blew off the reactor, spurting radioactive water and setting off alarms warning of lethal radiation levels. The building was evacuated. This incident included a hydrogen-oxygen explosion and the melting of some uranium fuel, yet the release was contained. It's just that the days when everything goes wrong at the nuclear plant are pretty scary.

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Windscale Reactor in England

The Windscale nuclear reactor was a graphite-moderated, air-cooled reactor with huge filters on top of the stack. It was located near the Irish Sea west of the lake district of England. On Monday, October 7, 1957, the blowers were shut down to allow controlled heating ot the graphite blocks to achieve a "Wigner release", a release of stored up energy in the graphite moderator. The thermocouples were thoroughly tested before the process.

On Tuesday the operators noted a drop in the temperature of the graphite when it should have been rising, so they repeated the process. A sudden rapid rise in the temperature of the uranium cartridges was noted. Cadmium control rods were dropped in to cool the reactor, but the graphite temperature continued to rise. They got confusing and conflicting instrument readings.

On Wednesday, erratic conditions were noted. Cooling air was restarted in order to reduce the graphite temperature.

On Thursday the radiation meters at the top of the stack showed high readings, then dropped back. Then both temperature and radiation readings started to rise. Attempts to cool the reactor failed, and just increased the

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radiation readings. There were indications of a burst uranium fuel rod with a tenfold increase in ambient radiation. They tried to use an overhead scanning device but it jammed. Two men in protective suits on an elevator device opened an inspection hole to see cherry-red uranium rods and blue flames in the graphite. The problem involved 100-200 channels. They tried to punch the rods out, but they were bent and wedged. They disgorged the surrounding channels, applied CO2, but still the graphite burned.

On Friday the decision was made to water down the reactor, ruining it, to avoid a catastrophic release of radiation. The water was kept on until noon Saturday. The milk from 150 surrounding dairy farms was confiscated because of the Iodine-131 levels. In an affected area of some 200 square miles some cattle were destroyed. Apparently there was no strontium release, and the water supply showed no contamination.

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SL-1 Reactor, Idaho Falls

The SL-1 was a 200 kW nuclear reactor designed for electric power production for remote Artic stations. It was being operated by three men on the night of January 3, 1961. It had a two-month history of sticking control rods and the reactor had been shut down for maintenance. The crew was to assemble the control rod devices and prepare for startup.

Ratiation alarms sounded, monitors a mile away gave alarms and health physics people rushed to the reactor. The building was intact and the lights were on, but they measured a level of 25 rads/hr at the entrance and 200 rads/hr as they approached the control room.

On a rush to the reactor, they found it a shambles and found radiation levels over 500 rads/hr. With protective suits, they rushed to the reactor building and found two of the men, one still alive. They found the third man impaled by a control rod, pinned to the ceiling.

Once the bodies were removed, they measured over 400 rad/hr from the bodies, too hot for a normal burial.

This was a non-pressurized system. No meltdown occurred and less than 10% of the radiation was released, but it represented the worst nightmares about nuclear accidents.

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