TV at TMI: Hard-Core Rubble

Forty months after a crippling accident shut down the Three Mile Island-2 nuclear-power plant, engineers got their first viewing of actual reactor damage. Although videotapes of the two-hour television-camera inspection made on July 21 offer only summary impressions of the gross condition of the core, there was sufficient detail to establish that much of the reactor's core had been reduced to a bed of rubble. There were also visual indications that the temperatures inside the reactor never approached those necessary for a meltdown.

To make their photographic excursion into the heart of TMI-2's highly radioactive core, engineers cut and removed a "lead screw" — a 24-foot mechanism that runs down a control-rod drive-mechanism tube. With the screw out of the way, the tube offered a clear channel down to what should have been the top of the reactor's fuel assemblies. But the self-illuminated underwater camera, only 1.25 inches in diameter and 1 foot long, descended 36 feet down the tube—or 5 feet into what should have been the solid reactor-fuel assemblies — before encountering the rubble of broken, shattered and crushed metal.

Officials of General Public Utilities, the firm that owns TMI, noted at a July 22 press conference that what the camera revealed was not especially surprising. In fact, "this configuration of the core [with no fuel assemblies in the center down to five feet] fits within the predictions of a number of studies which have been made since the accident," GPU's Doug Bedell told SCIENCE NEWS.

What happened? There are two leading theories. One holds that violent temperatures subjected the metal fuel rods to embrittling stresses. Upon subsequent exposure to quick temperature-related expansion or contraction, the metal simply shattered. The other theory holds that hydrogen present in the reactor at the time of the accident reacted with a zirconium alloy in rods cladding the fuel to embrittle the metal. Again, the embrittled metal would be especially vulnerable to cracking from the thermal stresses undoubtedly present.

Although there had been considerable concern during and immediately after the accident about a possible meltdown—the melting of fuel and potential destruction of any part of the reactor coming in contact with the 5,000°F to 6,000°F metal—the videotape pictures suggest the core probably never got that hot. (Meltdowns are the most feared reactor-accident scenarios because they present the greatest opportunity for a massive venting of radioactive materials into the environment.) What the videotape did show was that the upper half of the reactor — known as the plenum (it holds the reactor's internals, such as the control-rod drive tubes) — was "intact with no visible signs of damage," according to Bedell.

The melting point of metal in the plenum is about 2,600°F. Since the plenum components did not melt, or even seem bowed as might occur at temperatures as low as 1,800°F, Bedell says, "you certainly wouldn't expect to find melted fuel pellets," which liquefy only under conditions approaching 5,000°F. "We're not saying there is no melted fuel in the reactor," Bedell says, "because we won't know that until we're able to get into the reactor and remove the fuel. All we're saying is that the television-camera tests showed no evidence of melted fuel."

Fuel pellets exposed to thermal shock can splinter, break or crack just as the cladding on the fuel rods apparently did. And GPU officials expect they will ultimately find a certain amount of damaged fuel. "But broken, shattered pellets are not the same as melted pellets," explains Bedell, "and when we're talking about a meltdown, we're talking about melted fuel."

GPU officials emphasized that the purpose of making the TV videotape was not to reconstruct the accident nor to certify what happened. Instead, they hoped it would serve as the first step in planning for removal of the damaged core and its scattered fuel. Even knowing something as rudimentary as whether the metal has been reduced to rubble will help cleanup engineers choose core-removal equipment. For example, it now appears underwater vacuums, not scoops and large hoists, will be needed.

GPU will continue efforts to "map" TMI-2's core. But the next big step planned is a lifting of the reactor's "head," scheduled for mid-1983. The head, above the plenum, is sort of a cap that's been bolted onto the top of the reactor. Only with its removal can the important core dismantling efforts finally get underway. But an April 7, 1982 General Accounting Office report notes that "the TMI-2 cleanup cost and completion schedule has slipped steadily since the initial estimate was developed in mid-1979," and "this trend is continuing."

Cost is a major factor for the cleanup-schedule revisions. In its quarterly financial statements, GPU has been chronicling a litany of financial problems that stem from individual and class-action litigation over the accident, the increasing cost of buying power from other utilities to replace that which TMI-1 and 2 were supposed to produce, and civil fines imposed against the utility for safety, maintenance, procedural and training violations at TMI.

In recent weeks, however, the governments of West Germany, Switzerland, Sweden, Spain and Japan have exhibited interest in aiding GPU with the TMI-cleanup effort. According to the June 24, 1982 NUCLEONICS WEEK, the Germans hope to market defueling equipment for use in the cleanup, and are even willing to provide engineers for site cleanup projects. Japan, anxious for data on reactor decommissioning—something it expects to have to deal with at home between 1986 and 1990—is being sought out as a possible financial partner. And according to the NUCLEONICS WEEK report, Sweden hopes that "hands-on experience will convince voters confronting an upcoming referendum on nuclear power that [it] has experience and know-how to prevent or control a major accident." *—J. Raloff*

Chemical weapons vote

The House of Representatives last week voted to delete funds for the production of binary chemical weapons (agents that consist of two harmless compounds when stored separately but that combine into a poisonous nerve gas when fired in a shell) from the Reagan administration's $177 billion Defense Authorization Bill. The $54 million involved would have paid for the initial production of the weapons at a new plant in Arkansas.

This action sets up a confrontation between the House and Senate because the Senate approved the administration's request in May. At that time, Sen. Gary W. Hart (D-Colo.), who argued that existing quantities of nerve gas were sufficient, failed to amend the Senate's version of the bill (SN: 4/3/82, p. 230). The administration contends that production is necessary to deter a large Soviet chemical warfare capacity. If the money is reinstated during House-Senate discussions on the bill, this would authorize the first U.S. production of chemical weapons in 13 years.

Defense Secretary Caspar W. Weinberger and White House security adviser William P. Clark tried to head off House action by sending letters in support of a compromise amendment that allowed production of the new binary weapons while requiring elimination of old chemical weapons at the same rate as new ones were added. The House, however, defeated that amendment.

About $650 million in chemical warfare funds left in the budget is designated for protective suits, decontamination equipment and the disposal of existing chemical weapons. □