

# Anatomy of an accident

## Tokyo

HUMAN error, defectively made technology, inadequate inspection procedures and lack of instructions for dealing with emergencies lay behind Japan's worst nuclear power accident, which occurred at the Mihama nuclear power plant last February, according to a final report on the accident released on Monday (24 November) by the Ministry of International Trade and Industry (MITI).

The Mihama accident, which marked the first time that an emergency cooling system of a Japanese reactor was triggered to prevent a meltdown of the reactor core, has shattered public confidence in nuclear power in Japan. And, by aggravating public resistance to nuclear power, the accident has helped to bring siting of new nuclear power plants to a halt at a time when the government is ambitiously trying to expand Japan's nuclear power base. The MITI report will do little to restore public confidence.

The accident occurred on 9 February when one of thousands of tubes in the primary cooling system of the No. 2 pressurized water reactor at Mihama burst open and more than 50 tons of radioactive primary cooling water flooded into the secondary cooling system. The emergency cooling system then automatically released a similar amount of water into the primary cooling system to prevent exposure and overheating of the reactor core.

A fundamental error in the manufacture of the cooling system more than 20 years ago and subsequent inadequacies in safety inspection procedures led to the burst in the primary cooling system, the MITI report concludes. The contractors

## ENVIRONMENTAL POLICY

### GATT attack

#### Washington

Two US congressmen introduced legislation last week to prevent the Administration from weakening US environmental laws to protect international trade. The bill, by Henry Waxman (Democrat, California) and majority leader Richard Gephardt (Democrat, Missouri), warns the Administration that Congress will not stand for the 'harmonizing' of US environmental rules simply to conform with international standards, a threat that first arose in August, when negotiators for General Agreement on Tariffs and Trade (GATT) talks decreed that countries could not allow their internal environmental polices to get in the way of international trade. At the time, GATT ruled that the United States had violated the trade agreement when it banned Mexican tuna imports on the grounds that Mexican fishing fleets kill too many dolphins. C.A.

who assembled the boiler incorrectly installed anti-vibration bars that are supposed to suppress vibration of the thin U-shaped primary cooling tubes as high-temperature radioactive water rushes through them under pressure. In some parts of the cooling system at Mihama, the vibration bars were 40 to 50 cm shorter than required in the design, and, as a result, the cooling tubes in that area were left free to vibrate; one of them eventually sheared owing to high frequency fatigue at the point where the tube is held by a support.

The error in construction was not detected during inspections of the plant before commissioning nor in subsequent regular inspections of the plant over the past 20 years (nuclear power plants in Japan are shut down for several months every few years for safety checks). Damage to the tubes by excessive vibration was evident in eddy current tests of the tubes that were made during the regular inspections to detect holes in the tubes, but the evidence of fatigue was found only upon reexamination of the eddy current records after the accident. A MITI spokesman says the damage was not detected earlier because "no one ever imagined the anti-vibration bars were incorrectly installed" and so no one was specifically looking for fatigue near the tube supports.

A re-inspection of eddy current records from all 18 pressurized water reactors in Japan shortly after the Mihama accident revealed similar defects in the anti-vibration system of the nearby Takahama No. 2 reactor, and this reactor has also been shut down. Both the Mihama and Takahama reactors will be out of operation for several years while their steam generators are replaced at a cost of hundreds of millions of dollars.

But the problems at Mihama were not confined to the primary cooling tubes. After the leak occurred, the main steam isolation valve of the damaged steam generator failed to close properly in an automatic operation because over a period of time grease had leaked onto the sliding surface of the valve stem and turned into a "very sticky degenerated substance" that prevented full closure, the report says. Instead, the jammed valve was closed manually.

On Monday, MITI instructed electric utility companies to tighten up their regular inspections of the primary cooling systems of nuclear power plants, in particular the valves and anti-vibration bars. The ministry has also called on the companies to revise their operation manuals because the manuals at present "do not contain instructions for operating procedures in the event of a malfunction of the equipment".

**David Swinbanks**

### New sheriff in town?

#### Washington

It may not be a fearsome investigative operation like that of Representative John Dingell (Democrat, Michigan), but the investigations and oversight subcommittee of the House of Representatives Science, Space and Technology (SS&T) committee is starting to show some of the same teeth. Taking a page out of Dingell's book, the subcommittee last week threatened a subpoena and a confrontational hearing if the Department of Energy (DOE) did not reveal its internal cost estimate for the Superconducting Super Collider (SSC).

On 20 November, the day before the subpoena was to be served, DOE backed down and agreed to let members of the subcommittee examine the documents. Although the issue of the SSC's cost — which has doubled since the project was first proposed — will be the subject of scrutiny, subcommittee staff say that they are not looking for a smoking gun. "We haven't had a tip that there's something nasty going on," says staff member Robert Roach. "The issue is the ability of Congress to exercise its oversight authority."

This is a notable shift for a committee that has traditionally been one of science's strongest supporters. Because the committee, which oversees the National Science Foundation and the National Aeronautics and Space Administration, controls no money, it has had little real clout in the past. But Dingell's investigations committee, which oversees the National Institutes of Health, also has no funding authority, but has managed to become a formidable force in shaping science policy, using nothing but the power of subpoenas and Dingell's intimidating cross-examinations. Although the SS&T investigations committee does not intend to take on scientific misconduct soon, it has shown that it is willing to investigate many of the research projects it once held sacred.

In the case of the SSC, the investigations committee has been requesting internal memoranda between SSC programme director Joseph Cipriano and DOE secretary James Watkins giving periodic updates on the project. Although DOE provided the subcommittee with some 40 boxes of other SSC documents, the department first refused to acknowledge that the Cipriano documents had ever existed, then said that they might have been destroyed. After the subcommittee pressed the issue, DOE admitted the documents did exist, but said it would not reveal them, citing as a precedent President Richard Nixon's refusal to turn over documents relating to the Watergate scandal. Now the DOE has given in on that point too, and the subcommittee intends to investigate the possibility that DOE has systematically underestimated the cost of the SSC to avoid congressional opposition. Christopher Anderson