



President Carter is briefed in the control room at Three Mile Island by Harold Denton of the NRC (left).

Harrisburg: counting the cost

AT Harrisburg, the accident still poses enormous clean-up problems. The radiation level inside the reactor containment dome reached 30,000 rems per hour, and officials face the task of cleaning up 250,000 gallons of radioactive water from inside the reactor vessel itself. "We are looking at plans to bring the reactor to a cold shutdown without an increased leakage from the plant" said Harold Denton, Director of Reactor Regulation of the Nuclear Regulatory Commission (NRC). But Senator Morris Udall said it would be months before any clean-up could begin. "if, indeed, a clean-up is possible".

In the meantime, there have been press reports blaming the Metropolitan Edison Company for violating Federal regulations for reactor operation. The *International Herald Tribune* cites detailed NRC reports that valves controlling the emergency water supply to the reactor's cooling system had been closed for two weeks for routine maintenance. Mr Darrell Eisenhut, an engineer for the NRC, told a press conference that in addition the analyses showed that the main cooling system had been turned off at the wrong time and that four auxiliary pumps were disengaged in violation of Commission regulations. These faults combined to cause 60,000 gallons of radioactive water to flood the reactor chamber to a depth of eight feet. The zirconium in the reactor fuel cladding then combined with the water to release hydrogen gas which created a large 1,000 cubic feet bubble at the top of the vessel, causing the fuel rods to overheat and rupture releasing fission products into the water.

In a letter to *The Guardian* in London, Sir Martin Ryle of the Cavendish Laboratory in Cambridge said that the deficiencies of the emergency core cooling system of

the Harrisburg family of pressurised water reactors (PWRs) had "been known publicly for five years and by the US Atomic Energy Commission for considerably longer". According to Ryle, the system consists of four separate methods of cooling and relies on correct working of monitored temperature, pressure and waterlevel and the correct sequencing of the various pumps and valves. "It is an excessively complicated system that has never been tested except for 'tests' by computer simulation", said Ryle. He added that the highly dangerous hydrogen bubble should have been predicted as a matter of "A-level textbook knowledge" or failing that as the result of an "afternoon's experiment".

In the financial world, the accident touched off heavy sales of nuclear power related stocks. The US stock market as a whole suffered a broad decline which was attributed to investors worrying over the implications of the accident for the US energy situation. However, stock in Columbia Pictures, owners of *The China Syndrome*, a film about a nuclear meltdown "somewhere in Pennsylvania", rose as its box office takings reached a new high. An anti-nuclear group in South Carolina reported that their phones had been busy 16 hours a day. "People call up and say I can't believe it. I saw the movie and then came home and saw the same thing on the 11 o'clock news."

Daniel Ford, executive director of the Union of Concerned Scientists, called on President Carter "to seek immediate removal" of Dr Joseph Hendrie as chairman of the NRC. Ford was reported as saying that Hendrie had participated in a "far reaching cover-up of critical nuclear safety difficulties".

Joe Schwartz

Joe Schwarz monitors world wide reactions

'We all live in Pennsylvania..'

IN THE UK, the Secretary of State for Energy, Tony Benn, said that before the accident he had faced continuous pressure to "go American" and replace Britain's gas cooled reactors with American PWRs similar to the Harrisburg design. Pressure came from advisers, civil servants, and the nuclear industry itself, but he rejected the plan. Benn said the Harrisburg accident proved that "energy decisions must be kept under democratic control of Parliament". Prime Minister James Callaghan told Parliament: "We have been very wise in concentrating on a safer type of reactor." One of the three firms competing for the order of Britain's first PWR is Babcock and Wilcox; the others are the West German company Kraft Werke Union and a consortium which includes Rolls Royce and Northern Engineering.

France and West Germany, the two most committed nuclear nations in Europe, sent scientific teams to Harrisburg to inspect the accident. Two West German experts reported that the reactor was closer to a core meltdown than was publicly admitted.

The French Government announced its intention to proceed as usual with nuclear development, but the Opposition and the trade unions have called for a re-examination. Francois Mitterand, leader of the Socialist Party, accused the government of secrecy and high handedness in pushing through its power programme. The Socialist minority in parliament called for a halt to France's plan to build nine additional PWRs similar to the Harrisburg reactor in the next five years.

Prime Minister Raymond Barre told the European Press Club: "We must multiply our security measures but France cannot renounce nuclear energy". Minister of Industry Andre Giraud said: "An accident of this type has been taken into account in the design of French nuclear plants."

Le Monde reported numerous criticisms of the Government's stance. The Committee of Interregional Ecological Movements (CIME) demanded an immediate halt to the French nuclear programme because of the danger to urban centres. A Harrisburg-type accident, CIME said, would contaminate 300,000 people around the Fessenheim reactor (Mulhouse), 100,000 around Flamanville (Cherbourg) and 500,000 around Pellerin (Nantes).

The most dramatic action in France

was at the Mediterranean naval base near Toulon with the bombing of several million dollars worth of reactor equipment intended for export to Iraq, West Germany and Belgium. Responsibility was claimed by a group of militant ecologists in a call to *Le Monde*. The caller said: "We have succeeded in neutralising machines dangerous to human life." However, French officials are reported as believing that the bombing may have been an Israeli action directed primarily against the Iraqi reactor programme.

In West Germany, 35,000 demonstrators at the Gorleben hearing into nuclear reprocessing plans in Lower Saxony chanted, "we all live in Pennsylvania." Inside the hearings, a French scientist, Yves Lenoir of the mining academy of Fountainebleau, walked out of the meeting of 60 international experts saying that the hearings were a sham and had no influence over the decision. Lenoir said that any discussion of safety that did not take into

account the Harrisburg events was academic.

But the Ministry of the Interior in Bonn said that German safety standards were high compared with international standards but they would be "toughened up" drastically. "Utilities and the nuclear industry will have no chance to ease safety precautions," a spokesman said.

In Sweden the Opposition party demanded that the Ringhals Two plant near Goteberg—a PWR similar to Harrisburg should be closed for inspection; and Premier Ola Ullsten announced a national referendum on the country's nuclear programme. Danish politicians urged greater debate before their country took a decision to build nuclear reactors, and in Belgium the mayor of the town of Huy, 40 miles south-east of Brussels, ordered the closing of the 870 MW reactor, Tihange 1, saying that the Harrisburg accident had shown the town's emergency preparations to be inadequate.

In Japan, Premier Masayoshi Ohira said there would be no change in Japan's programme which currently has 19 reactors producing 11% of the country's energy. But 100 demonstrators staged a sit-in at the Ministry of International Trade and Industry calling for a thorough inspection of all Japan's nuclear power plants. The ministry itself was holding an emergency meeting with officials from 15 areas to discuss nuclear safety measures.

In Eastern Europe, comment on Harrisburg was limited. Soviet television devoted 15 minutes to the event on 2 April saying, "the accident has provoked a profound anxiety and continues to alarm the American people. A particular indignation has been aroused by the fact that the energy monopolies, in searching for profits, do not take the necessary measures in order to assure the safe functioning of nuclear power stations." □

Guidelines should go, DNA meeting concludes

Eleanor Lawrence reports on a meeting where biologists scoured themselves for going public on conjectural risks

LAST week in the village of Wye, deep in the Kent countryside, an audience predominantly composed of molecular biologists overwhelmingly reiterated the now widely-held view that recombinant DNA research poses no special risks.

The meeting was convened by the Royal Society and COGENE, the Committee on Genetic Experimentation of the International Council of Scientific Unions, to discuss the status of recombinant DNA work and the guidelines controlling it.

Essentially most scientists working in the field now believe that the original fears were based on bad scientific judgment, and that recombinant DNA experiments at the very worst can pose no more hazard than that of working with the most dangerous organism involved in the experiment. Therefore, they argue, regulations for recombinant DNA research are unwarranted and should be abolished. The inconsistency inevitable in guidelines designed to guard against conjectural hazards and the bureaucracy involved in their implementation pose a threat to the freedom of scientific enquiry.

The scientific basis for the change of heart appears to rest first on advice from experts in infectious diseases that it is virtually impossible to convert the laboratory strain of the common gut organism *E. coli* into an epidemic pathogen by the random insertion of a block of foreign genes.

The fear that the insertion of animal virus genes into *E. coli* would result

in a new route for the virus to bypass normal host defences is now also held to be groundless. The current conventional wisdom is that work with cloned viral DNA poses, if anything, even less risk than work with the virus itself, and that cloned viral DNA fragments offer the safest way to study the molecular biology of the most lethal viruses such as Lassa or smallpox.

Joe Sambrook of Cold Spring Harbor Laboratory observed that had Professor Bedson been working in Birmingham with cloned smallpox sequences rather than the complete virus, both he and Janet Parker would be alive today. (The World Health Organisation is indeed considering the possibility that cloned fragments of smallpox DNA might be the safest way of conserving the smallpox genome for posterity). Although little direct evidence addressing this question was available in 1977—when the Ascot Workshop's recommendation of such views to the NIH was influential in gaining considerable relaxation of guidelines for work with animal viruses—experimental support in the case of certain DNA viruses, at least, has recently been obtained from the NIH 'worst case' polyoma virus experiment (see box).

Participants in the debate also marshal evolutionary arguments, such as the growing appreciation that genetic exchange occurs across wide species barriers in microorganisms, as general ammunition. But it is not clear that

these arguments necessarily address the particular point that still worries those who see the need for guidelines. They ask to be assured that the specific product of any given recombinant DNA experiment is not going to be hazardous to those who may be exposed to it, either in the laboratory, or in the general environment.

Among those who call for the end of regulation a more subjective attitude is that expressed most forcibly by J. D. Watson of Cold Spring Harbor. Watson now attributes the call for the moratorium as mixture of fears over research with tumour viruses themselves and an attack of mild liberal guilt, and considers that he and this fellow signatories displayed a complete lack of scientific judgment. "We were jackasses" he told the conference. "It was a decision I regret: one that I am intellectually ashamed of". Watson adopted this position soon after the original 'Berg letter' was written.

Another signatory, Stanley Cohen of Stanford University, also felt the group's original action was irresponsible on scientific grounds, as well as politically naive. It was based simply on a "lack of certainty there was no risk" and was therefore an "irresponsible scientific argument".

The third signatory present, Norton Zinder, holds a somewhat different view. Although he now thinks their original fears to be groundless, in the circumstances as they saw them at the time there was no other action that could be taken.

Given that they now largely have the support of their scientific colleagues on