Radiation: how safe is "safe"?

David Dickson reports on the growing US debate over the hazards of occupational exposure to low level radiation

SERIOUS doubts are being raised in the US about the adequacy of existing safety standards for those whose work exposes them to sources of low level radiation. If substantiated, a revision of existing standards could have considerable impact on many aspects of the nuclear power industry.

The debate has been given wide public exposure by a series of Congressional hearings, held in Washington last month, which brought together three topics guaranteed to attract the attention of the average US newspaper reader: nuclear radiation, cancer, and charges of government malpractice.

Similar concerns have been raised twice before. In the 1950s medical evidence from survivors of the atomic bombs dropped on Hiroshima and Nagasaki, and from those who had worked closely with radiation for medical purposes, drew attention to the hazards of exposure to high levels of radiation. And at the end of the 1960s, fierce public controversy raged over the charge that fall-out from nuclear weapons tests had caused widespread genetic damage to unborn children.

After a period of relative dormancy the debate has now flared up again, this time over the long-term effects experienced by those known to have been exposed to what had previously been considered as acceptably-safe low levels of radiation.

In particular attention has focused on the fate of members of three particular groups: those who participated in the testing of nuclear weapons during the 1950s, those who have worked at the Government's nuclear fuel production facilities at Hanford in Richland, Washington State, and those who have worked on the production of nuclear-powered vessels, such as submarines, in the US Navy's shipyards at Portsmouth, New Hampshire.

Concern about possible long-term health effects suffered by those involved in nuclear weapons testing—as many as 300,000 military and civilian personnel were involved in tests in the Nevada Desert and the Pacific Ocean between 1945 and 1962—has been raised by reports of an abnormally high incidence of leukaemia among soldiers in one particular blast, called Smoky, which took place at Yucca Flat in 1957.

This test, which involved military manoeuvres in the test area shortly after the explosion had taken place, was specifically designed to test the

physical and psychological impact of nuclear weapons on test.

According to the Defense Department, the average exposure of men at Smoky was 1.25, considerably below the generally accepted occupational level of 5 rems a year. Yet at least eight of the 2,245 soldiers involved have since developed leukaemia, a level that has been called "out of the normal range" by the director of the Centre for Disease Control, Dr William H. Foege.

If the Smoky test has raised question about the effects of a single exposure to a relatively low amount of radiation, the other two cases—Hanford and the Portsmouth Shipyards—raise a slightly different question: the hazards associated with long-term exposure to low-level radiation sources.

Concern at the possible hazards facing workers at the Hanford plant was first raised in 1974 by Dr S. Milham, epidemiologist for the State of Washington. Indications of abnormally high incidence of deaths from certain types of cancer were confirmed by Dr Thomas Mancuso, of the Department of Epidemiology at the University of Pittsburgh, whose 13-year study of medical records revealed high incidences of multiple myeloma (cancer of the bone marrow), cancer of the pancreas, and lung cancer (*Health Physics*, Vol 33, No 5, pp 369-384).

Furthermore statistical analysis of Dr Mancuso's data by epidemiologist Dr Alice Stewart and statistician Dr George Kneale of the University of Birmingham, England, have led them

to suggest that the doubling dose for these cancers—the amount of radiation needed to double their incidence in a particular population—could be as low as 3.6 rads, 19 rads and 13 rads respectively, with a doubling dose for all cancers as low as 33 rads for men and 9 for women. These are considerably below generally accepted figures.

At Portsmouth, Dr Thomas Najarian, a blood specialist with the Boston Veterans Administration, carried out a survey of past dockyard workers after becoming suspicious at the death from leukaemia of one of his patients.

As a result of his study Dr Najarian claimed that the incidence of leukaemia among shipyard workers was four times higher than should have been expected. And according to a report in the *Boston Globe*, which assisted Dr Najarian in his study, the overall cancer death rate among Portsmouth nuclear workers was more than twice the national average, and substantially higher than the yards non-nuclear employees.

In each of the above cases the significance of the results—in particular whether the observed cancers can be blamed on the known exposure—is hotly debated. The effects of low level radiation is an issue on which scientific emotions run high, not least on the validity of the no-threshold, linear-response model which, though remaining a hypothesis, is now widely assumed in calculations of acceptable levels of risk.

Based as they are on uncertain scientific premises, Government policies can quickly become a morass. The latest victim, the exposure of whose floundering at the Congressional hearings carried frequent echoes of the Watergate scandal, was the Department of Energy, responsible both for the operation of Hanford plant and for financing Dr Mancuso's study.

The hearings were held by the health and environment subcommittee of the House Committee on Interstate and Foreign Commerce. And its suspicions had been raised by the circumstances surrounding the department's decision to terminate Dr Mancuso's contract, and to transfer the research project to the Oak Ridge Associated Universities.

The department countered charges that the contract had been terminated because of the nature of the findings by pointing out that the decision had been taken before the findings were known. And in earlier correspondence, Dr James L. Liverman, acting assistant secretary for environment, claimed the reason for the transfer was 62-year-old Dr Mancuso's "imminent retirement."

The Smoky test, 31 August 1957

On learning that Dr Mancuso was not required by the University of Pittsburgh to retire before the age of 70, Dr Liverman admitted in testimony to the subcommittee that his use of the phrase had been "unfortunate, inappropriate and perhaps even in error." Rather he claimed that the reason was a critical peer review indicating "a judgement by his scientific peers that the work should be limited, terminated, or another investigator selected to be the principal investigator."

But it was a case of out of the frying pan into the fire. Representative Paul Rogers, chairman of the subcommittee, produced a summary of the reviewers' recommendations which showed that although two referees had indeed made critical comments, the other four had been positive, and the general consensus had been that the work should be continued.

Department officials were left in confusion, and no clear reason has yet emerged for the decision to terminate the contract (on which an Inspector General's report is expected shortly). One possible explanation is a conflict between the painstaking lengths Dr Mancuso felt it necessary to go to obtain sufficiently accurate data to produce meaningful results, and pressure on the department to produce arguments that could be used in public debate. "He did not come up with a system amenable to our needs in the time-frame that we had to work with," Dr Liverman told *Nature* last week.

Whatever the reason, the department's mishandling of the issue has proved embarrassing, and reinforced suspicion that it has sought to discourage research leading to distasteful findings. And similar impressions have been raised by the reactions of the Defense Department to Dr Najarian's study of the Portsmouth shipyard workers.

In reply to the articles in the *Boston Globe*, the Pentagon claimed that the study was "simplistic" in its approach, and that its conclusions were "not credible" and "do not accurately reflect the actual health conditions for employees engaged in radiation work." Admiral H. G. Rickover, architect of the "nuclear navy", claimed that "from the best scientific evidence, we don't see a problem."

Last December, after publication of Dr Mancuso's report, the Navy asked the Department of Energy to initiate a study of the effects of radiation on shipyard workers. However, it was only after Congressional pressure and accusation of "stonewalling" that it agreed to let the Centre for Disease Control—an arm of the Department of Health, Education and Welfare—to

take a look at the medical records of Portsmouth workers, a study which the Navy had claimed was "redundant".

Part of the Navy's concern—indeed that of Government agencies in general—is the large amounts of compensation for which they could be liable if it is established that cancer victims were the result of exposure to nuclear materials, however low the radiation. And this could set an expensive precedent for private industry.

Admiral Rickover told the subcommittee that a medical follow-up of Portsmouth workers should be done without the "spectre" of its becoming the basis for future claims against the government. "If such a study is done for the purpose of establishing a massive claims programme, then we might as well say beforehand that the Government will distribute so many billions of dollars to all US citizens, and be done with it," he said.

Three main results have emerged from the recent public debate. The first of these is a stronger commitment—considered by many to be long overdue—by various government agencies to follow-up studies designed to establish more precisely the precise nature of the hazards of long-term exposure to low level radiation.

The Department of Energy, for example, has put into effect plans for a major survey of the medical histories of its past employees, a study which could cost up to \$30 million over the next ten years. And the Pentagon, which earlier admitted it merely had one individual spending a quarter of his time trying to contact survivors of the Smoky test, is instituting a similar study; widely-broadcast requests for information brought 10,000 calls in 2 weeks, and necessitated the installation of a 20-line switchboard.

The second result has been to raise serious questions about the propriety of government agencies bearing responsibility both for developments in the field of nuclear power, and for the health of those engaged in such developments. Notwithstanding the relatively "clean record" that such agencies are able to produce, the whole handling of the Mancuso affair (including attempts to use Dr Mancuso's earlier negative findings to refute the claims of Dr Milham on cancer levels among Hanford workers, despite Dr Mancuso's protests that such conclusions were premature) has provided many with a graphic illustration of the dangers.

Representative Rogers, for example, described the situation he had discovered in the department as being "the most disordered, unstructured mess that I've looked into in some

time", adding that "I'm not sure that I don't question the whole issue of the Energy Department conducting health work."

Finally the debate has revealed evidence that suggests a need to revise accepted guidelines for long-term, low-level radiation exposure. At present, the guidelines generally accepted are those laid down by the Federal Radiation Council in 1960, suggesting a maximum exposure of the general population—in addition to normal background radiation—of 500 millirem a year, and a maximum occupational exposure of 5 rem.

The Environmental Protection Agency is known to be looking closely at both of these figures, and is expected to suggest that at least the first should be revised downwards.

Scientific evidence on occupational risks is pointing in the same direction. Dr Edward P. Radford, professor of environmental epidemiology at the University of Pittsburgh told the subcommittee that there was now evidence that the risk of cancer induction from radiation might be twice as high as had been estimated as recently as six years ago.

"I believe the whole-body occupational exposure limit should be reduced at least to 500 millirem per year, with careful review of the limits of exposure to individual organs such as the thyroid or bronchial system. This is a matter that is long overdue for change," Dr Radford said.

Although speaking in a personal capacity, Dr Radford's remarks were particularly significant in that he is chairman of the National Academy of Sciences advisory committee on the Biological Effects of Ionising Radiation (BEIR).

The BEIR committee, a respected—if sometimes controversial—source of scientific advice on the dangers of radiation, was initially established in 1970, partly in response to the public debate on the effects of nuclear fallout occurring at that time. Its first report, published in 1972, made little specific reference to occupational exposure limits; and partly in order to remedy this, the committee was asked last year by the Environmental Protection Agency to produce a follow-up report, publication of which is due in September.

The scientific measurements so far are still widely contested, the heat of the debate often appearing in direct proportion to the scientific uncertainties involved. But as Dr Seymour Jablon of the National Academy of Sciences, a fierce critic of some of Dr Mancuso's and Dr Stewart's conclusions said of the Hanford study at the recent AAAS meeting: "Certainly there's something peculiar going on." □