told that they need take no special measures other than not drinking rainwater, they were not reassured. When experts said that the radiation would cause some tens of extra cancer deaths over the next 40 years, they were very disturbed. When I commented that the risk was equivalent to smoking one or two cigarettes in a lifetime, it sounded so reassuring that the public concluded that it was incorrect. All statements were in fact correct but the perception of them was quite different.

The public seems to be unaware that we live in a radioactive world in which everything, even ourselves, is radioactive. I like to point out that an average Englishman's garden occupies one-tenth of an acre and by digging down one metre, one can extract six kilograms of thorium, two kilograms of uranium, 7000 kilograms of potassium, all of which are radioactive. In a sense, all that is radioactive waste, not our radioactive waste, but the residue left over when God created this planet. Unless the public understand that they are always surrounded by radioactive material, they will not see the risks of nuclear power in perspective.

The biggest challenge

I believe, therefore, that the biggest single task facing the industry is that which concerns public perception. Effective communication will be almost more important than technical improvement. Chernobyl presents the world's nuclear industry with a setback, a challenge, and an opportunity. For the first time, the public have a real interest to understand risk and radiation. If we can succeed in putting this accident into a proper perspective, then I believe in the long run that there will be an acceptance of nuclear power despite the trauma of Chernobyl.

UNITED STATES

Lessons of Chernobyl

by Carl Walske

The tragic accident at the Chernobyl 4 nuclear station in the Soviet Union has had a sobering effect in the West. Prior to this event, the world's civil nuclear industries had accumulated almost 4000 reactor-years of safe commercial operation. This includes nearly 1000 reactor-years of commercial operation in the United States without a single loss of life to a member of the public due to radiation exposure.

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The initial difficulty in obtaining accurate information about the accident heightened the level of public concern in the USA, as it did in the rest of the world. There was widespread speculation about what was occurring in the Ukraine and a few wildly inflated accounts about the number of casualties. Although most of our news commentators showed more restraint, the exaggerations unfortunately were repeated frequently before they were retracted or otherwise shown to be in error. The US Government has joined with other Western nations to call for improved international reporting of nuclear incidents, especially those with transboundary implications.

Safety reviews, evaluations

Domestically, safety reviews have been undertaken by the US Department of Energy of government-owned reactors, including the N-reactor which provides steam the Washington Public Power Supply System uses to generate electricity for the Pacific Northwest. The reviews reflect, in part, the initial attention given by industry and Government to reactors that have certain design features in common with the Soviet RBMK-1000. Like the RBMK-1000, the N-reactor uses graphite as a neutron moderator and is cooled by water in pressure tubes, although it is substantially different (better) in a number of features which affect safety.

As for reactors that are licensed for commercial operation, which now number 101, we know the light-water reactor design that predominates in the USA (and the rest of the world) is sufficiently different from the RBMK-1000 to disqualify summary calls for changes in regulatory requirements. The Nuclear Regulatory Commission (NRC) staff has found no reason so far to change any regulations as a result of what is known about Chernobyl. Further, the NRC commissioners indicated no intention to hold up nuclear plant licensing when they voted, 4-0, in late spring to issue a full-power operation license to the Catawba 2 nuclear plant, owned by Duke Power Company.

Yet, we cannot ignore the fact that Chernobyl has raised serious questions about nuclear technology in the public's mind and among their elected leaders. Key committees of the US Congress have held hearings on the subject. Chernobyl also has complicated efforts by some US utilities with regard to off-site emergency planning.

Over the long term, we are likely to find that most of Chernobyl's safety lessons already have been learned in the USA as a result of the 1979 Three Mile Island accident. That event spawned a host of varied changes in reactor hardware, operating procedures, and plant management.

Still, we would be remiss if we did not examine Chernobyl for opportunities to learn more about nuclear reactor safety and to reassure ourselves that no significant lessons have been overlooked. Toward that end, the US nuclear industry has established a technical review committee to study the Chernobyl accident. This committee is headed by Byron Lee, Executive Vice-President of the Commonwealth Edison Company, and is comprised of representatives from industry and academia. The panel recently held its first meeting.

Approaches to safety

Any study of the Chernobyl accident will be a useful endeavour only if we draw the correct lessons, however. We know there is a lot more to reactor safety than whether a plant uses graphite instead of water as a fission moderator, or whether it uses pressure tubes instead of a pressure vessel. The initial focus on such individual design features of the RBMK-1000 was not inaccurate *per se*. The trouble is that such an approach can lead to inappropriate conclusions. The truth is not so simple.

A sophisticated evaluation of a nuclear safety system must take the broad view. Philosophical questions need to be asked, such as: How safe is safe enough? What emphasis should be placed on accident prevention versus accident mitigation? What reliance should be placed on personnel versus hardware?

Statements by Soviet officials lead us to conclude that their philosophy has been to concentrate resources on accident prevention, rather than on mitigating the consequences if one should occur.

By contrast, our safety philosophy has been to emphasize both prevention *and* mitigation. We begin with the assumption that no matter how carefully the technology has been planned, something unanticipated can happen, either through a chain of mechanical breakdowns or operator errors. This is why we put a premium on redundant safety hardware, supplemented by programmes to ensure high quality training for operators and proper plant procedures.

A sophisticated evaluation of nuclear plant safety also must examine the system's three major elements — hardware, plant procedures, and personnel — in totality. Safety features used for one type of reactor design may not be essential for a reactor of a different type.

Chernobyl has not altered our concept in the USA about what is safe enough and what isn't. The goal of the US safety system remains the same: to reduce the risks of nuclear plants to such a low level compared to other risks encountered in daily living that they are unimportant either to the general public or to the people who live near them.

We are confident that US reactors easily meet this goal and represent the safest way to generate electricity. Our confidence is not derived from actual experience with nuclear plant accidents, which (fortunately) are few and far between. Rather, it is based on systematic analysis of all possible ways in which a reactor's safety system could fail. Such evaluations have been ongoing since the mid-1970s, as data have accumulated about the reliability of such key hardware as valves and pumps. Data also exist regarding personnel response. Further, we use the probabilistic risk assessments to determine if any individual reactors have special safety vulnerabilities that need to be addressed.

We would like to be able to do the same kind of sophisiticated analysis for Soviet reactors and then see if there are any lessons we can learn from it. As yet, however, our knowledge of the Soviet civil nuclear programme is incomplete and we will be evaluating the sequence of events which led to the Chernobyl accident.

In the meantime, our experience with the TMI accident could benefit the Soviets as they continue their recovery effort. One of the lessons we learned from TMI was the need for utilities to share information about reactor performance and operations. This resulted in the creation of the Institute of Nuclear Power Operations (INPO), to which all US nuclear utilities and a number of foreign utilities now belong. Subject to the approval of the US Government, we have invited the Soviets to join as well.

Data on the Chernobyl accident was presented to IAEA by USSR authorities and discussed by international safety experts at a post-accident review meeting from 25 to 29 August. About 600 experts participated and 230 members of the news media attended at IAEA headquarters in Vienna. Shown here is the meeting's opening plenary session. On the dais (from left) L. Konstantinov, Deputy Director General heading the Department of Nuclear Energy and Safety; Dr H. Blix, IAEA Director General; Dr R. Rometsch, the meeting's Chairman; Prof. V. Legasov, head of the Soviet delegation to the meeting; and M. Rosen, Director of the IAEA Division of Nuclear Safety. See *News in brief* for further information.