at hand, reactor safety research may be extended to areas concerning severe core damage, fission product retention in the containment, and accident management.

The most important problems with respect to severe core damage are the formation and distribution of hydrogen, its burning behaviour, and the resulting loads on the containment. Questions related to fission product retention in the containment and to the source term are other aspects to be examined.

Planning efforts concerning accident management may become even more important. Investigations and studies have to be focused on measures involving use of operational equipment or additional, easy-to-install systems to cope with consequences of potentially severe accidents. Better planning for accident management may result in a considerable further reduction of risk and the consequences of accidents.

Following the nuclear accident in Chernobyl, the Federal Republic of Germany launched a number of initiatives to strengthen international co-operation in reactor safety. Consequently, it is highly appreciated that the IAEA has called for a Special Session of its General Conference which will give Member States a possibility to discuss measures to strengthen international co-operation in the field of nuclear safety and radiological protection. The Conference will deal with the full range of nuclear safety issues, including nuclear safety policy. In particular, the Conference will consider two international agreements committing parties to provide early notification and information on nuclear accidents with possible transboundary effects and to co-ordinate emergency response and assistance in the event of a nuclear accident.

The Conference should also address the question of international agreement on safety standards to obtain a more uniform and high level of reactor safety. Existing IAEA guidelines, like the NUSS standards, will provide a useful basis for these discussions. In addition, information exchange on engineered safety features and operational experience should be improved to harmonize reactor safety measures worldwide. It is expected that the IAEA Conference will give guidance for expert working groups on nuclear safety, to improve co-operation in this field (including ways and means to further refine nuclear safety standards). In addition, general access to nuclear power plants should be given to international safety assessement teams.

Although nuclear safety and radiation protection basically will always remain the responsibility of national authorities, the response to the Chernobyl accident will lead to a further strengthening of international co-operation in these areas.

The IAEA can be proud that — based on its excellent record on operation and services to Member States — its central role in any international initiative has been recognized again by the world community whose interest in the peaceful use of nuclear energy, even after the impact of the Chernobyl accident, has clearly proved the need for a well-functioning international organization.

UNITED KINGDOM

Chernobyl – the aftermath

What can the industry learn from the accident?

by The Lord Marshall of Goring

There is no question that the nuclear industry has been dealt a serious blow by the Chernobyl accident. Its precise impact, in terms of the future use and development of nuclear power worldwide, will take time to assess. There will be many months, if not years, of continuing debate in the political and public arenas. Certainly there will be a lengthy and searching technical analysis of the events that led to the accident and the consequences that followed. And bearing in mind the transboundary effects, the institutional arrangements for safety control will undoubtedly be reviewed in the national and international context. None of this can be accomplished quickly.

The nuclear community has viewed the events at Chernobyl with deep concern and we express our sympathy to those people in the Ukraine who were injured as a result of the accident. We also applaud the superhuman efforts of those engaged in the recovery operation.

Implications of Chernobyl

In the immediate aftermath of such a setback, it is not possible for me to speak with any authority on the implications of the accident for individual countries. It is inescapable, however, that while the effect on national power programmes will vary from country to country, the overall impact will be far more profound than that which resulted from the accident at Three Mile Island from which the industry was, in my view, on the point of recovering. One can only stand back and look where nuclear power is today and ask the questions, will it recover and how and when will it recover?

It is my opinion that nuclear power will recover essentially because it *must* recover. Different countries will of course cope with the situation on different timescales. Individually, they will be influenced by their access to supplies of fossil fuels, by public acceptance, and the extent to which nuclear dependency is already established in their countries. As IAEA Director General Hans Blix recently expressed it in Geneva, for some countries nuclear power has already reached the point of no return.* For other countries, where nuclear power has

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* The reference is to the address of Dr Blix this June to the European Nuclear Conference '86. For the text of his remarks, see the article by Dr Blix in this issue of the *IAEA Bulletin*.

not gone beyond the early formative stage, Chernobyl is likely to produce a delaying situation which will take many years to overcome.

Technical lessons

The Chernobyl reactor was of a type not adopted in the West and from what is known of the system, I believe it unlikely that it would easily have been licensed here. In view of the technical differences of the RMBK reactor from its Western counterparts, the accident may not in the end prove to be of great relevance from the purely technical and engineering standpoint. To this extent it may not even influence nuclear power production in Western countries. Three Mile Island, on the other hand, was of significant technical relevance and resulted in valuable lessons being learned in matters of design and safety assessment.

In contrast, I think that we can learn a great deal from studying the handling of the Chernobyl emergency itself, particularly the evacuation of people and the marshalling of resources. We can also learn from the evidence relating to the dispersal of the radioactive cloud. Certainly we shall be able to review our emergency procedures in the light of the Chernobyl experience. But I believe that those lessons will be institutional and organizational rather than technical.

I would at this point like to make an appeal to the Russian authorities. It must be presumed that a number of Russian people have received a radiation dose large enough to produce statistically significant results in terms of long-term health. It is, in my opinion, vitally important that we turn the trauma of this event into whatever advantage can be found. We now have, inadvertently and sadly, the opportunity to add to our knowledge of the long-term health hazards of radiation and I believe that it is neither unethical or unprofessional for this to be done in the present circumstances.

In Geneva, Dr Blix indicated the positive steps which the IAEA is taking, with the agreement of the Russian authorities, to establish an international dialogue covering a whole range of topics both technical and institutional, relevant to the post-Chernobyl situation. I very much welcome this action by the IAEA and hope that the proposals as they emerge will include the particular studies to which I have referred.

The future energy scene

The fundamental need for nuclear power has not changed because of Chernobyl. The justification for the development of the nuclear option worldwide has not rested on some vague notion that nuclear power is a desirable commodity for its own sake, but rather on a realistic perception of the future energy scene. Supplies of oil and gas are not infinite. Discovery of new reserves is declining and both oil and gas will become scarce by early next century. Even with a vast increase in coal extraction, it is becoming increasingly apparent that if the available energy were to be shared among the world's increasing population, there would be insufficient resources to maintain a general level much above the present day energy consumption of the poorest worker. Therefore, on the timescale of half a century or so we must plan either on the basis that the developing countries remain short of energy and by implication confined to poverty in order that we in the developed countries retain a disproportionate share of the world's energy, or we must take steps to develop a new energy source. In rejecting the first option I believe that the only plausible new energy source is fission nuclear power and I am not persuaded that either fusion or any other presently postulated alternative holds out any great promise for the future on this kind of timescale.

National acceptance

If we do indeed need nuclear power, when will this need become universally accepted by the public at large? Not today and not worldwide because oil at present is cheap and people are shocked by Chernobyl. Of course, some countries such as France have innate special advantages which should enable them to maintain a policy of nuclear expansion. France has the natural advantages of no oil, no gas, no coal — and no choice except to have a successful nuclear programme. Japan is in a similar position, but the United Kingdom at present has plenty of oil and gas and a long-term supply of coal. These are important factors influencing public perception of the need for nuclear power in individual countries and their perception of this necessity influences their acceptance of the risks.

However, the price of oil is unlikely to remain low for long, since low prices will stimulate the world economy and the law of the market place will once again reverse the present trend. In the 1990s it seems probable that the expansion of nuclear power will be seen in a new light. Therefore, in my opinion, although Chernobyl is a serious setback for nuclear power, some countries will survive with their plans undisturbed and those that do change course now may well renew their interest in the early 1990s.

Regaining public confidence

What must be done in the meantime to win back public confidence? I believe that the public will only accept nuclear power when they understand it and when they understand that while it is not risk-free, it has the smallest risk of any energy resource. Why has the industry failed in its communication with the public?

First, the risks of nuclear power are those of radiation and we have a well-developed science of radiological protection. We describe radiation in terms of curies, becquerels, rads, rems, sieverts, grays, and by the milli, micro, and pico versions of these units. It is hardly surprising that the public does not understand these and is confused by their indiscriminate use. Second, even if we do rationalize our nomenclature, why do we not explain risk in a manner which is understandable and avoids the difficulties of numerical probability? Direct analogy can in fact be very simple. A once-off dose of one rem can be compared with the regular smoking of one-twentieth of a cigarette per week. Let me give you an example of how this choice of language influences public perception. When the radioactive cloud from Chernobyl drifted across Scandinavia and the United Kingdom and the public were told that the radiation was for a short time many times that of normal background, they thought this to be very serious. When they were