# Recent nuclear safety activities at the IAEA

by M. Rosen*

The accident at Three Mile Island propelled the question of nuclear safety into worldwide prominence. Could nuclear power plants be operated safely? Did safety requirements or the basic technology of nuclear plants need major revision? The serious implications of these questions spurred the nuclear community to a thorough reappraisal of its approach to safety – an approach developed during a quarter of a century of safe operation of commercial nuclear power plants.

Within days of the accident on 29 March 1979, extensive re-examinations of national programmes, and those of international organizations, began. Today, three years later, the effects of the accident on nuclear safety are now clear. They have already been highlighted in the conclusions of the international conference** which was held in Stockholm, Sweden, in October 1980 as part of the IAEA's expanded nuclear safety programme. Although there is no need for a step change in safety requirements or in the technology of nuclear power plants, the conference concluded that some shifts in emphasis are required.

Particularly singled out in the studies of the past several years is the area of *operational safety*. Here, the human factor plays a basic role in preventing and dealing with accidents. This means, above all, that operators should be better qualified and more rigorously trained and retrained, particularly about what to do in case of abnormal occurrences. This shift in emphasis is not directed solely at the operating staff. Management must also take primary responsibility for safety and make it a basic objective of the utility. A critical factor here is the need to ensure that the rapidly accumulating experience of operating nuclear plants is promptly collected and evaluated. Today, evaluation of operating experience is widely regarded as an important tool in recognizing situations which may lead to accidents, and in analysing how to prevent them.

To the more important lessons learned at TMI can be added the need for emergency preparedness and advance planning. National planning is essential, but bilateral and multilateral agreements for mutual assistance between states are also important. The OECD has found that in its region every fourth reactor is within 40 km of an international border. The implicit necessity for international co-operation is only one example where substantial benefits can be derived from closer contacts between nations. A strong incentive also exists for sharing through other co-operative safety efforts the limited resources available in both money and technical expertise. It applies particularly to nuclear safety research where specialized organizations such as the Nuclear Energy Agency (NEA), the Council for Mutual Economic Assistance (CMEA), and the Commission of the European Communities (CEC) already foster close collaboration among their Member States.

This article discusses the current nuclear safety activities at the IAEA, and perhaps of more interest, the new initiatives which arose from the lessons learned at TMI. To start with, it will be useful to dwell briefly on the character of the IAEA as an international organization and to say some general words about its nuclear safety programme. As one becomes aware of the services that the Agency provides, and of the use that is made of them, it becomes apparent that the international community is taking the necessary steps to ensure the safe use of nuclear power throughout the world.

### The Agency's programme

The IAEA is now almost 25 years old, and from the beginning it has served as a focus for international exchange of information on all subjects related to nuclear energy. Its Statute gives it a mandate in two other areas: to foster training; and to develop the international standards needed to establish the safety of nuclear energy. The Agency is also directed to allocate its resources globally, bearing in mind the special needs of the developing areas. With its broad membership it is ideally suited to act as a centre for contact and exchange between East and West, North and South.

The IAEA's activities in the field of nuclear safety still pursue these original objectives. The principal

* Mr Rosen is Director of the Agency's Division of Nuclear Safety.

** International conference on current nuclear power plant safety issues, organized by the IAEA and held in Stockholm, Sweden, from 20–24 October 1980.

programmes disseminate information through meetings and publications; provide advice and training on safety through advisory services and through the Technical Co-operation Programme for developing countries; and develop internationally agreed safety standards. In addition to activities aimed at the safe operation of nuclear facilities, there are important radiological safety programmes. Also underway is a limited risk-assessment project to assess and compare the risks associated with various energy systems and to develop methods to quantify risk more precisely.

Through the years the Agency has maintained a technically competent Secretariat. The Division of Nuclear Safety has a professional staff of 28 people from 15 Member States. In addition, 7 full-time experts have been seconded cost-free to the Agency, and about 5 man-years of services are provided annually by cost-free technical experts who participate in the many working-groups and committee meetings held in Vienna. Thirty technical committee meetings, four conferences or seminars, and ten advisory missions of technical experts are held in a typical year, and ten to fifteen publications are produced.

**Safety standards and regulations**

The Agency plays an important role in setting safety standards. A recent feature has been the efforts to encourage and assist Member States to implement the guidance contained in the three main areas of this activity:

- The nuclear safety standards programme
- The basic safety standards for radiation protection
- The regulations for the safe transport of radioactive materials.

In 1974 an ambitious programme, NUSS (the letters being an acronym for Nuclear Safety Standards), was started to establish internationally agreed safety standards for nuclear power plants. Preparation of the basic NUSS documents is now nearing completion: all five Codes of Practice have been published in the Agency's four working languages (English, French, Russian and Spanish) and by the end of 1981, 37 of 57 planned safety guides had been completed (26 of them already published in English and many in the other working languages). When the developmental phase comes to an end during the next two years, about 250 one-week technical committee meetings, each attended by an average of ten experts, will have been required to produce the 2200-page set of documents that is the goal of the programme.

What is being accomplished is not only a setting down of specific requirements but also a technical consensus among the developers, experts and users of nuclear power – a common understanding for safety. Agreement has been reached on the necessity of, and the requirements for, a regulatory organization to conduct a nuclear power programme properly; and also on such items as the specific information and investigations required for safe plant siting; and the specific guidance that will permit a systematic approach to safe design of all principal plant components and structures. These standards are not a substitute for industrial codes such as those of the American Society of Mechanical Engineers (ASME) or the Deutsches Institut für Normung (DIN) in which minutely detailed procedures are given on how to carry out design requirements, but are complementary to them. They can be of particular value in developing countries where equipment and services are obtained from several countries which may not share the same standards.

Although at present there are no plans for formalizing the acceptance of the NUSS standards in an international convention, a considerable effort is now being devoted to encourage their use. Training courses and seminars are being organized to promote them as the basis for preparing national regulations, for the domestic development of nuclear industries, and for use in international commerce. The Agency is arranging visits to its Member States by special missions of experts directly involved in the preparation of these documents, during which discussions can be held with regulatory, utility and other personnel. Such missions should be particularly useful to countries in the early stages of nuclear power programmes. Fourteen countries have already requested missions and five visits were completed by the end of 1981.

The extensive international effort which produced the NUSS documents has provided a sound basis for guidance on nuclear power plant safety. Their world-wide acceptance and utilization can be an important step in ensuring that countries, whether with advanced or with developing nuclear power programmes, have an adequate degree of safety.

A highlight of 1981 was the approval by the IAEA Board of Governors of the Agency's revised Basic Safety Standards for Radiation Protection (Safety Series No.9). These standards, first issued in 1962 and revised in 1967, are based on recommendations of the International Commission on Radiological Protection (ICRP); they were developed by the Agency jointly with WHO, ILO and NEA. They are intended to serve as guidelines for Member States and are written in a form that can serve as a regulatory basis for the radiation protection of both workers and members of the general public. It is hoped that the latest revision, directed towards further reducing the risks from the use of ionizing radiation, will increase the protection of workers substantially and that of the general public even more. The Agency believes that the basic safety philosophy of these standards could well serve as an example for industrial activities involving other hazards to man.

An important aspect of the revised Basic Safety Standards is the requirement that all radiation exposures be "as low as reasonably achievable" – the first example of a system of protection which, although it

**IAEA interregional safety-related training courses (1981–1982)**

| Title* | Location | Starting date | Duration (weeks) |
|---|---|---|---|
| Safety analysis review | Argonne (USA) | March 1981 | 8 |
| Risk prevention in the use of radiation and nuclear installations | Saclay (France)*** | May 1981 | 4 |
| Radiological protection and nuclear safety | Buenos Aires** (Argentina) | June 1981 | 7 |
| Course for radiation protection officers in regulatory bodies | Berlin (GDR) | Sept. 1981 | 4 |
| Nuclear power plant operational safety | Karlsruhe (Germany, Fed. Rep.) | Sept. 1981 | 6 |
| Siting of nuclear power plants | Argonne (USA) | Sept. 1981 | 8 |
| Safety analysis review | Cairo (Egypt) | Nov. 1981 | 5 |
| Planning, preparedness and response to radiological emergencies | Argonne (USA) | Feb. 1982 | 3 |
| Seismic aspects of siting nuclear power plants | Argonne (USA) | Feb. 1982 | 5 |
| Safe transport of radioactive materials | Harwell (UK) | May 1982 | 2 |
| Risk prevention in the use of radiation and nuclear installations | Saclay (France)*** | May 1982 | 4 |
| Quality assurance | Seoul (Rep. of Korea) | July 1982 | 4 |
| Siting of nuclear power plants | Saclay (France)*** | Oct. 1982 | 4 1/2 |
| Radiological protection and nuclear safety | Buenos Aires** (Argentina) | April 1982 | 33 |

* About 30 participants per course.
** Conducted in Spanish.
*** Conducted in French.

already provides adequate safety to all individuals, still requires consideration of a further decrease in the remaining potential hazard. This aspect was prominently featured at a symposium held in Madrid on the application of the ICRP dose limitation system at nuclear fuel cycle facilities, organized in co-sponsorship with WHO, NEA and ICRP and attended by almost 300 participants.*

Through the adoption of the Agency's Regulations for the Safe Transport of Radioactive Materials and their worldwide application, a very high standard of safety has been achieved. These regulations have been incorporated into the rules of nearly all international transport agencies, including the Intergovernmental Maritime Consultative Organization, the International Air Transport Association, and the Inland Transport Committee of the Economic Commission for Europe.

Like the radiation protection standards, the transport regulations need to be revised at suitable intervals. An updated version is now planned for 1984, marking roughly a decade since the current one was issued. Meanwhile, Member States are being assisted in implementing the existing regulations and in ensuring compliance with them. Advisory missions are available, and a training course for personnel from developing countries is to be held in the United Kingdom in 1982. A new guide on quality assurance and other explanatory documents have also been prepared. These give comprehensive information on the "why" aspects of the regulations to aid officials in understanding their technical bases.

### Emergency response

In looking at the development needs in nuclear safety, effective and practical emergency planning and preparedness are high on the agenda. In response to the increased concern for better handling of nuclear emergencies, the Agency has strengthened its programme.

* A report on this symposium can be read on page 45 of this issue of the IAEA Bulletin.

Several recent publications that indicate the thrust of the new activities in this area are:

- Safety Series 55 – Planning for off-site response to radiation accidents in nuclear facilities
- NUSS Safety Guide 50-SG-06 – Preparedness of the operating organization for emergencies at nuclear power plants
- NUSS Safety Guide 50-SG-G6 – Preparedness of public authorities for emergencies at nuclear power plants.

Until recent years, detailed advanced planning and training of personnel for emergencies were only discussed on a theoretical level. There was no strong emphasis on practical planning, and little importance was assigned to tests and exercises. Now it is recognized that, to assess their effectiveness, plans must be tested before they have to be put into practice. To complement existing Agency documents on the development of emergency plans, this year will see the publication of a new handbook giving examples of exercises and scenarios for various types of accidents that could occur at nuclear facilities. Designed to test all the main components of the emergency plan and to require action on the part of on-site and off-site organizations, these exercises are relatively simple, and they are detailed in easily readable language with guidance not only on the conduct but also on the evaluation of the tests.

In addition to the published technical guidance, the enhanced activities include training programmes and special assistance missions to Member States to develop, evaluate and improve emergency plans. An annual training course, held this year in the United States of America, has been established to assist those developing countries that have nuclear facilities in operation or under construction.

### Exchange of information

During the past several years, many governments have called on the IAEA to promote more vigorously international co-operation through the exchange of information. In response, several important new actions have been taken. A November 1981 meeting in Vienna was the start of the Agency's efforts to act as a focal point for the global collection, analysis and dissemination of information concerning abnormal operating occurrences. It is intended that this information can be rapidly fed back to regulators, designers, and operators. High on the future agenda is the development of a guidebook to advise all Member States on suitable systems for collecting and reviewing information about safety-related events. This is an important step towards the harmonization of national systems and a useful step towards the successful development of an international system. Arrangements will be made for regular meetings to select and review those events which are of interest to the international nuclear community.

The potential advantage of international co-operation through sharing resources, expertise, and cost is obvious. A meeting in Moscow in December 1981 strongly supported closer worldwide co-operation and stressed the value of routine discussions concerning the main objectives of national research programmes and their more important results. Topics of particular interest included containment integrity, early failure diagnosis, and fuel behaviour under accident conditions. The Agency will organize two additional safety research meetings this year.

Seminars are another useful means of information exchange. Two were held in 1981, each a week long, and they attracted leading management personnel and technical staff from regulatory organizations and utilities, particularly from developing countries.

The seminar on Safety Review and Inspection of Nuclear Power Plants dealt with organizational, technical and manpower requirements for inspection and licensing. The seminar pointed out the diversity in national practices among Member States, but there was agreement that a prerequisite in all countries is the establishment of a well-defined system of regulations so that decisions of regulatory authorities can be understood and enforced. Participants expressed interest in a follow-up meeting on the subject of how regulatory requirements have evolved in different nations, particularly as to how the safety philosophies which have developed in countries that export nuclear technology compare to those in countries which import nuclear power plants.

At the seminar on the Safety of Two-Loop Pressurized Water Reactors a wide spectrum of issues was covered, including new safety requirements stemming from the TMI accident; the use of probabilistic risk assessment; the application of statistical theory to accident analysis; and emergency planning. How developing countries could obtain safety information from the IAEA, as well as through bilateral arrangements, was also discussed. As the seminar ended it was agreed that there were other topics of specific interest to operators of two-loop PWRs which should provide the subject matter for future meetings. These could include implementation of lessons learned from TMI, development of technical specifications for operation, commissioning procedures and backfitting.

Frequently, when a topic is of widespread current interest, the Agency can provide a forum for airing and perhaps reconciling differing opinions and points of view on safety-related topics. In 1981 a committee meeting on Fission Product Release Following Severe Accidents brought together 26 experts from 15 countries and international organizations. The subject, which has attracted considerable interest in countries with advanced nuclear programmes, has many controversial aspects

and is highly complex*. However, the committee was in agreement that there should be some reduction in the "source term", the postulated amount of radioactive fission products released in a reactor accident. Since the reduction for many postulated accidents might be of several orders of magnitude, this could affect siting and emergency planning, even though estimates of total risk would not be significantly altered. Several uncertainties that remain on this question were also highlighted, such as the ability to predict containment failure, and the behaviour of aerosols in the primary circuit of a nuclear reactor. The subject is of such interest and is evolving so quickly that a second meeting has been planned for this year.

Another timely topic of interest to both developed and developing countries is that of quantifying safety goals so that a nation's resources can be allocated most effectively. To do so requires a synthesis of nuclear technology, probability theory, economics, and sociology in order to arrive at a balanced system to avoid or mitigate the consequences of nuclear accidents. The Agency is planning a meeting in 1982 to discuss this subject. Since it will be the first international meeting on this topic, widespread interest is expected.

* One aspect of this topic was discussed in the article *Realistic risk estimates* in the December 1981 issue of the IAEA Bulletin (Vol.23, No.4, pp.37–39).

### The future

During the past several years the nuclear safety role of the IAEA has grown. The efforts to broaden co-operative exchange of information and to pool resources among nations can make a strong contribution to the enhancement of nuclear safety throughout the world. They can also help convince the public that nuclear plants can be safe, reliable, and a viable means of meeting the world's energy needs. But, of vital importance is the need to encourage the use of the results of Agency activities. The NUSS programme, the information exchange activities, the emergency planning services have all been developed with the active participation of the Agency's Member States, and they must be fed back to industry, government and utilities in these countries. A continuing theme for the future will be to assist Member States in implementing the guidance which has been developed.