The Agency's role in emergency planning and preparedness for nuclear accidents

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Over the past 25 years, the increasing growth in the use of nuclear energy and radioactive materials has been accompanied by a corresponding awareness of the need for strict requirements and regulations governing those aspects of design, construction, operation, and maintenance pertinent to ensuring the continued safety and health both of the operating staff and the general public. Although the range and depth of engineering safeguards and regulatory controls that currently apply to nuclear energy and radioactive materials programmes ensures that the probability of any malfunction capable of presenting a significant risk to the operator or the public is extremely small, it is recognized nevertheless that no human enterprise can be entirely risk free, and in the development of any nuclear energy or radioactive materials programme, it would be most imprudent not to recognize that the remote possibility of a failure leading to an accident condition can never be entirely eliminated. Implicit in this recognition is the need to determine in advance the appropriate emergency actions necessary to prevent or mitigate any adverse affects should such an accident occur and to develop formal emergency plans for ensuring that the relevant remedial procedures can be implemented within the requisite time scale should the need ever arise.

What is emergency planning and preparedness?

Emergency planning and preparedness is concerned with that sequence of events where the well-established standards, rules, regulations, and procedures governing the use of radioactive materials and the normal operation and maintenance of a facility are no longer being satisfied. It spans a somewhat uncharted area between the point of departure from controlled use and operation and the subsequent return to controlled conditions, a period during which compliance with normal rules may no longer be achievable and when it may be necessary to make emergency decisions in which the risks taken to avoid a particular adverse consequence must be balanced against those that might prevail if avoiding action were not taken.

For convenience we can summarize the two main aspects of emergency planning and preparedness under the following headings:

Radiological emergency planning, which is concerned with the development and preparation of emergency plans to mitigate the consequences to public health and safety, or to the environment, in the event of a radiological accident.

Radiological emergency preparedness, which encompasses the training of all persons who will be involved in implementing the emergency plans, the acquisition of resources and facilities, and the testing of emergency plans and procedures by means of drills and exercises to ensure effective response in the event of a radiological emergency.

Who is responsible?

It is essential that effective emergency preparedness procedures, together with plans for their implementation, are drawn up by those organizations that will need to apply them and that they are prepared well in advance of the facility commencing operation, particularly those related to the facility operator's organization. Similarly, and in consultation with the operating organization, those sections of the public authorities at local, regional, and national level who may need to respond in the event of an accident must ensure that they produce emergency preparedness arrangements appropriate to their own response commitments. The input from each of these participating organizations should then be integrated into an overall national emergency plan and response infrastructure. This is an essential prerequisite for ensuring that co-ordinated remedial actions can be taken in the unlikely event of an accident having potential off-site radiological consequences.

What is the Agency doing?

A comprehensive service for advice, assistance, and training in the planning, reviewing, and testing of the various facets of this infrastructure is provided for Member States within the aegis of the Agency's Programme on Planning and Preparedness for Radiation Emergencies. The major objectives of this programme are:

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(i) the promotion of a common basis of understanding among Member States for the provision of emergency planning and preparedness procedures, including the establishment of internationally acceptable intervention levels based upon the requirement of the dose-limitation system for installations which have the potential to cause exposure of the general public;

(ii) to advise Member States on the adequacy of emergency planning and preparedness, including the off-site response capability of the operator's organization and the public authorities;

(iii) the development and publication of technical guidance;

(iv) to assist Member States in the preparation and implementation of emergency response procedures and guidance;

(v) to provide assistance to Member States for the assessment of their emergency preparedness arrangements, including the assessment of exercises to test their emergency response plans;

(vi) to be prepared to act, upon request, as an intermediary between Member States for transmitting requests for, and offers of, assistance and to send staff members or consultants to the site of a radiological emergency to help in emergency operations or to act on behalf of the Agency as observers; and

(vii) the provision of training courses geared to the needs of Member States in the various aspects of emergency planning and preparedness.

Over the past four years, and on the basis of consultants' advice, the Agency has identified several areas which require special attention. These include: the need to obtain a more universal agreement on the levels of exposure (sometimes referred to as "Intervention Levels" or "Emergency Reference Levels") at which predetermined remedial actions such as sheltering, evacuation or the use of a radioprotective prophylactic drug (such as stable potassium iodide to saturate the thyroid gland and reduce its uptake of radioiodine) would be implemented to protect members of the public, in the event of a release of radioactive material to the environment; improved methods for accident assessment (including monitoring the material being released during the course of an accident, both at the point of release and in the environment); improved Emergency Control Centre facilities (including the use of more sophisticated data handling procedures, such as that provided by the new generation of micro-computers to enable more efficient analysis of data generated during an emergency for the basis of decision-making); and the need to ensure that those areas of a nuclear facilitiy, where the need for continued occupation is essential for maintaining and restoring control in the event of an emergency, will remain habitable throughout the course of the accident.

These particular aspects of emergency planning and preparedness are being addressed by the Agency by consultancy and advisory groups and are expected to result in the publication of relevant Agency Safety Guides or Recommendations. Several of the more salient aspects are discussed in the following sections.

Accident assessment

Accident assessment is the collective process of determining the nature and severity of an accident, the prediction and determination of consequences, and making decisions concerning what corrective and protective measures should be implemented to mitigate the consequences of the accident. It is one of the most important aspects of an emergency preparedness programme supportive of a nuclear facility.

As the operators of a nuclear facility are in the best position to make an initial assessment of the operational conditions (and prognosis) at the time of an accident, including any engineered safety features which may have been activated or may have failed to function, it follows that *the unequivocal responsibility for the initial assessment of the accident situation at the facility rests with the operator* [1]. The initial prediction of any off-site consequences of an accident is also the responsibility of the facility operator since it must be based upon the initial assessment at the facility if timely protective measures are to be implemented off-site. The initial assessment must be supplemented and updated by subsequent field assessments which will enable the facility operator to provide continuously revised predictions of the potential off-site consequences. These can then be considered or confirmed by the public authorities (off-site) who must maintain communication with the nuclear facility and should have the necessary confirmatory capabilities together with the responsibility for implementing any required protective measures such as evacuation, sheltering, radioprotective prophylaxis, traffic movement control, and diversion of agricultural products and water supplies which may have been contaminated.

Although establishing an effective accident assessment capability had long been recognized (even before the Three Mile Island accident) as an important "key" to mounting an effective and proper emergency response, this aspect of emergency preparedness, until recently, suffered from a rather archaic, unimaginative "paper and pencil" approach. This old approach did not, in most instances, take full advantage of existing and potentially helpful state-of-the-art technology. Further, the old manual methods of conducting accident assessment did not always recognize the necessity for operators to make quick and correct decisions while operating in a high stress situation. New technology is now emerging in the form of computerized accident assessment systems and these systems are now being installed in some countries. However, there is a lack of "standardization" of these new systems and of the companion methodologies

which form the "software" of these systems. Some degree of "standardization", not necessarily in the actual equipment itself, but in what the overall systems should be able to do, is required.

The useful task of the Agency is to develop and publish suitable technical guidance in the area of accident assessment. By seeking out the best in the various methodologies and systems being established, the Agency can hope to influence the development of "performance standards" for accident assessment. The Agency commenced work in this area in May 1982 with a goal of completing the technical guidance in the form of a handbook, early in 1984.

The emergency control centre

Any nuclear facility which has a potential for causing harm to persons off-site in the event of an accident, must make provision for establishing an Emergency Control Centre from which the overall site and local off-site emergency procedures can be directed and co-ordinated. It is essential that the directing of emergency activities be transferred from the plant control room to the Emergency Control Centre as soon as possible after the onset of a plant emergency, in order that those concerned with plant system operations and attempting to restore the plant to normal operation can work without distractions.

The Emergency Control Centre should, therefore, be separate from the plant control room and can be either a purpose-built, dedicated facility or a pre-designated room (such as a conference room) which can be rapidly transformed into a control centre in the event of an emergency. Where it cannot be shown that the Emergency Control Centre will remain tenable under all potential emergency conditions, an alternative, duplicate facility should be provided. Initially, emergency activities will be directed by senior personnel in the plant control room until the Emergency Control Centre is available and manned, at which time the emergency activities will be transferred to the Emergency Control Centre with advisory staff under the direction of a Site Emergency Director. The Site Emergency Director is responsible for the overall co-ordination and control of all actions within the site boundary, for the direction of the on-site response to the emergency situation, and for the necessary liaison between the site and the headquarters of the operating organization, the regulatory body, and the public authorities. He will also be responsible for ensuring that those actions outside the site boundary, for which the plant management has been allocated responsibility in the overall emergency plan, are properly implemented. A typical Emergency Control Centre should be equipped with such things as telephones (including dedicated lines to key points within the emergency organization), radio facilities for communicating with on-site and off-site radiological hazard assessment teams, maps and site layouts of increasing scale on which to plot the results of radiological surveys and indicate the current hazard status and necessary remedial actions, an accident assessment system, and emergency status boards upon which the essential aspects of the accident (including any release of radioactive material, meteorological conditions, and remedial actions taken) may be summarized.

With the more recent introduction of the microcomputer, a number of the newly developed Emergency Control Centres are now equipped with computer-aided accident assessment and consequence prediction systems which have greatly reduced the time taken for determining the radiological consequences and appropriate remedial actions, following receipt of data. Additionally, data processing related to decision-making is being incorporated into many of these systems. This application of purpose-designed computer aids for use in emergency preparedness, and particularly as an integral part of the Emergency Control Centre assessment and decision-making process, is expanding very rapidly, both in utilization and sophistication, and is expected to have a major impact on the design and operation of Emergency Control Centres over the next several years.

A useful task of the Agency in this area is to develop and publish useful technical guidance on the desired features of Emergency Control Centres. By seeking out the best features in the design and operations of these Centres, the Agency can help its Member States in upgrading their own capabilities to respond to radiological emergencies.

On-site habitability

A number of nuclear plants currently in operation have now been in service for over two decades. Although designed and constructed to very high standards, the application of more recent developments in design criteria, relating to accident assessment and control, have indicated that some of these earlier plants may not offer the same degree of protection as that provided in more recent plant designs for those plant personnel who may need to remain in key areas during the course of an accident.

The areas of concern include the plant control room, key plant control areas and, in some instances, the Emergency Control Centre. Plant personnel in these areas may be potentially at risk, not only from conventional hazards (such as flying glass, high-temperature steam, fumes or gases), but also because of unacceptably high radiation dose-rates. Under severe accident conditions it is possible that the prevailing radiological conditions could make certain of these key areas untenable.

The problems encountered with ensuring habitability of key on-site areas during an emergency have received little attention to date. The Agency has therefore been requested to examine the subject with a view to producing guidance to designers and operators to assist them in designing new plant and in assessing the requirements for plant modifications, or "backfitting", for operating

plants where the ability to maintain habitability may be in doubt. A consultancy group is being set up by the Agency to examine this problem.

Emergency preparedness exercises

An actual emergency situation involving any particular nuclear facility will be a very rare event. The only realistic opportunity to test, maintain, and improve the effectiveness of the emergency response capability is therefore by means of skill-developing drills and comprehensive emergency exercises. These are essentially learning processes aimed at: identifying any weakness in training of personnel, procedures, equipment, communication, and facilities; providing experience in collaboration among groups who may not normally work together; and working under conditions similar to those that might prevail in the event of an accident. The most demanding and exhaustive test of emergency response capability is an integrated exercise involving full participation by all on-site and off-site organizations, requiring the complete functioning of all major organizational interfaces.

The ability to stage a realistic exercise depends very much on the care with which the exercise scenario is prepared. To the extent possible, the scenario should exercise the judgement, knowledge, and training of the emergency response staff under conditions as near as possible to those that would apply during an emergency. This is achieved by ensuring that the simulated accident situation provides the same type, form, and sequence of information and events as would be available during an actual emergency. A successful scenario reflects and supports the various objectives of the emergency exercise, and hence, of the particular aspects of the emergency plan it is intended to assess.

In 1981 the IAEA Director General wrote to all Member States offering to send special assistance missions to help in the development and improvement of emergency plans, by means of emergency plan reviews and the evaluation of emergency exercises. In June 1981 the Agency received its first request, from the Government of Yugoslavia, to review emergency planning arrangements for the Krško Nuclear Power Plant. A number of recommendations were made by the Agency and, in February 1982, the Yugoslavian Government sent five persons to the Agency's first emergency planning and preparedness training course. This group was then the trained nucleus of people that, with assistance from other Yugoslavian National, Republic and local governmental organizations, further developed emergency plans and preparedness in support of the Krško Nuclear Power Plant. In November 1982, at the end of a sixteen-month period of concentrated effort, the Yugoslavian Government requested that the Agency send a small team of experts to observed and evaluate a two-day comprehensive emergency preparedness exercise for the Krško Nuclear Power Plant. These were the first requests for both an evaluation of emergency plans and an emergency exercise to be received and carried out by the Agency. Since 1981 the Agency has responded to requests for review of emergency plans from a few Member States and several other Member States have now indicated that they will be submitting similar requests.

By any standard, this was a large-scale exercise involving some 70 000 people to varying degrees, including some 180 separate on-site and off-site response groups trained in the various aspects of emergency response. The *on-site* actions included the manning of the plant Emergency Control Centre, demonstrations of remedial actions (such as fire control, rescue, and first-aid), damage assessment and repair, and radiological control. It also included a major *off-site* response covering various aspects of sheltering and evacuation of civilian population, provision of large-scale decontamination facilities, protective sheltering of live-stock and agricultural produce, and the sealing of water supplies – all of which were effectively demonstrated. The exercise was conducted in a very competent manner and a comprehensive report, assessing each aspect of the exercise, has been prepared by the Agency and forwarded to the Yugoslavian Government.

Because of the scale of the Krško exercise and the very competent manner in which it was carried out, the Agency hopes to be able to publish details of this exceptional exercise to serve as a guide to other Member States.

Training in emergency preparedness

The establishment of proper and adequate emergency planning and preparedness programmes in support of nuclear facilities depends heavily upon having people trained to do the job. It is one thing for the Agency to develop and publish useful technical guidance but quite another thing to have this guidance implemented "in the field" – that is, at the nuclear facilities themselves and within the governmental organizations involved. The Agency's special assistance missions, referred to in the previous section, assist partially in helping to achieve the implementation of the established technical guidance. But, in addition to these missions, specialized training is also required to enable the responsible persons to effectively *interpret* and *apply* the guidance to their own situations and needs. A training programme which is centred on "experience and example" is one of the best ways to achieve the desired end-result.

In keeping with the Agency's Department of Nuclear Energy and Safety's new thrust to assist Member States in implementing existing technical guidance in emergency planning and preparedness [1, 2, 3, 4] in their nuclear energy and radiation protection and safety programmes, the Agency established and conducted its "First Interregional Training Course on Planning, Preparedness and Response for Radiological Emergencies" in February 1982. This Training Course was well received by the

29 attendees from the nuclear industry and governmental organizations in 15 Member States. The Agency plans to offer the second course in this series early in 1984. The students attending such a course are exposed to a wide range of expertise gained by specialists from several Member States in various topical areas comprising emergency planning and preparedness.

Thus, through special assistance missions, coupled with its training programme, the Agency has made a significant step forward in helping Member States in this specialized area.

The need for mutual emergency assistance and the Agency's role

A nuclear accident having serious radiological consequences, albeit of low probability, would require a substantial response effort to mitigate them and to effect the recovery of both the plant and the off-site situation. This effort could tax the resources of a country experiencing such as accident, and might well be beyond its capabilities. Even highly developed countries, with many nuclear power facilities and a large technical supporting infrastructure, could find themselves hard-pressed to cope effectively with a nuclear accident, especially if it involved significant off-site radiological consequences. Some kind of external assistance enhancing the response capability would, therefore, appear to be desirable [5].

This need for external assistance was recognized in a report completed by a group of experts in July 1982 [5], and the group put forward a number of recommendations to the Agency to address it. The report was adopted by the Board of Governors in September of 1982. The two primary recommendations to the Agency are: (1) prompt development of an IAEA/INFCIRC document setting forth the terms and conditions that could be applied to emergency assistance; and (2) determination of the special planning considerations applicable to cases where a nuclear accident in one State might have a significant radiological impact on other States.

The development of a set of Guidelines for Mutual Emergency Assistance [6] was completed by an expert group in April of this year. These Guidelines are scheduled to be presented to the IAEA Board of Governors as a potential INFCIRC document addressing the first primary recommendation. The second primary recommendation will be addressed by an expert group in the Spring of 1984.

Other recommendations made by the group of experts in July 1982, which relate to other aspects of mutual emergency assistance and to upgrading the Agency's own internal emergency preparedness, are already being addressed or planned for completion within the next two years.

References

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[5] *Report by the Group of Experts on Nuclear Safety Co-operation and Mutual Emergency Assistance in Connection with Nuclear Accidents* GOV/2093 (Appendix) IAEA, Vienna, (16 August 1982).
[6] *Guidelines for Mutual Emergency Assistance Arrangements in Connection with a Nuclear Accident or Radiological Emergency* IAEA Expert Group, 25–29 April 1983, IAEA, Vienna (to be published).