A more vigorous approach to IAEA safety services

To better assist national authorities, an expanded range of nuclear safety services is being offered by the IAEA

by E. Yaremy and K. Hide

Repeatedly over the past several years, countries have emphasized the importance of developing stronger mechanisms and processes for reinforcing international programmes and services in the field of nuclear safety.

Most recently, in September 1991, discussions at the IAEA's International Conference on the Safety of Nuclear Power underscored the need to develop more vigorous overview processes to achieve high levels of safety performance, to strengthen existing IAEA services, and to promote the achievement of sufficient regulatory oversight. Later that month, the IAEA General Conference adopted a resolution recommending that Member States avail themselves fully of the IAEA's services for advancing operational safety, welcomed the Agency's endeavours in the safety assessments of reactors built to earlier standards, and requested the IAEA to come forward with specific proposals based on the findings of the safety conference.

To a large extent, the renewed emphasis is a response to nuclear developments over the last decade, and the concomitant evolution of IAEA programmes. Starting with the initiation of the Operational Safety Review Team (OSART) programme in the early 1980s, the IAEA's nuclear safety services have become more and more directed to providing peer reviews from an international perspective of activities carried out by national authorities. Over the past 5-6 years, largely as a result of the Chernobyl accident in 1986, the range of services has expanded to include the review of regulatory activities; engineering matters (siting, design concepts, safety analysis, probabilistic safety assessment); and operational safety (operating processes, event assessment, feedback of experience).

In all cases, the goal is to strengthen national capabilities to carry out nuclear safety activities, using international experience as the basis. The objective is not to supplant national responsibilities.

This article reviews the IAEA's major services in the area of nuclear safety, and looks at the direction they are taking in response to the needs and interests of IAEA Member States.

Nuclear regulatory oversight

A fundamental requirement for the safe utilization of nuclear energy is an appropriate national infrastructure for its application. Such an infrastructure requires the incorporation of a sufficiently competent and independent nuclear regulatory body. Such regulatory oversight in no way detracts from the responsibility of operators to run their plants safely. Rather, it provides the public with an extra measure of protection that is completely independent of production pressures. In that context, regulation is, in fact, an application of the defense-in-depth principle which has been followed throughout nuclear energy's development.

As a consequence of the Chernobyl accident, and the part played in it by the regulatory regime, the IAEA is strengthening its activities in this area. Among steps that have been taken are the establishment of peer discussion groups on particular regulatory subjects, such as inspection, monitoring, and assessment of ageing nuclear power plants. These discussions, with two to three senior regulatory representatives from three or four different participating countries, enable across-the-table exchange of regulatory experience in an informal manner. Practices discussed can then be considered for application in the participant's national environment.

Additionally, expert missions are being scheduled at a country's request. Increasingly,

Mr Yaremy is Head of the Safety Standards Co-ordination Section, and Mr Hide is Head of the Nuclear Operational Safety Services Section, in the IAEA's Division of Nuclear Safety. Major contributors to this article were Mr V. Tolstykh, Mr B. Moore, Mr F. Niehaus, and Mr B. Thomas.

the value of a systematic peer review of a country's national regulatory approach by a team of international regulatory experts is being seen as a positive step. The IAEA has conducted two such missions under its International Regulatory Review Team (IRRT) programme, to Brazil and to Romania (six experts for 2 weeks). As part of their work, experts compare the country's regulatory practices with existing international guidelines as embodied in documents of the IAEA's nuclear safety standards programme (NUSS) and equivalent practices applied elsewhere.

The need for such reviews has been particularly illustrated by the political changes in Eastern Europe. In the past, the centralized political systems of countries there did not recognize the need for strong independent regulatory oversight. With the emergence of new States in Eastern Europe, this need is particularly pressing as the first step for them to set up the necessary national capability. As regulatory responsibilities are purely the prerogatives of governments, the IAEA's assistance, co-ordinated through close co-operation with other intergovernmental and governmental bodies, generally is regarded as not only appropriate but essential.

The scope and overall purpose of such reviews are now being developed further with international consensus. The scope needs to be flexible to cater to each country's particular situation — for example, whether it has a regulatory structure in its early formative stages, or one that is rather developed but would benefit from additional assistance to build up capabilities.

In these areas and others, the IAEA will be working more closely with nuclear authorities in its Member States to strengthen regulatory capabilities.

Engineering safety services

One inescapable feature of industrial evolution is that designs and practices are refined, improved, and changed, based on experience and technological capabilities. Consequently, in the nuclear industry, as in others, there are facilities built to older standards that do not incorporate the safety capabilities of more modern designs.

At the national level, the safety level of such a facility may have been the result of either an inadequate consideration (by today's standards) of natural and engineered factors associated with its construction, the design concept itself, or the adequacy and completeness of the facility's safety evaluation. In many cases, the particular country may not now have the necessary knowledge and resources to carry out reviews to ensure a safety level consistent with modern standards, particularly in instances where the plants have been imported from external suppliers.

In recent years, the IAEA has seen increasing demands for engineering safety review (ESRS) missions of various types. In the siting area, countries particularly have been concerned with seismic considerations; specifically they are interested in making sure that the appropriate seismic parameters have been established for the site and that the appropriate aseismic design methodology has been applied to the plant design.

In another area, related to a facility's design concept, several countries in Central and Eastern Europe have benefitted from IAEA reviews of Soviet-designed WWER 440/230 nuclear plants. The reviews serve as an example of what can be done through a joint undertaking at the international level. There are other types of older reactors in operation in the world that also require reviews, and as all plants age and safety technology evolves, periodic reassessments will be necessary. Along this line, the IAEA will be developing consensus on a review approach to ensure a minimum level of safety. It will also be promoting its engineering review services in those instances where related IAEA activities have identified a need for them.

Regarding new design concepts, an international review service may prove especially valuable, since it is able to reinforce safety evaluations carried out by national authorities. This can be particularly useful in the instance of novel designs or departures from standard designs which have not been previously assessed. The IAEA has conducted such types of reviews, for example, at the Gorky Nuclear District Heating Plant in the Russian Federation, and at two nuclear plants (a pressurized-water reactor and a pressurized heavy-water reactor) in the Republic of Korea.

Other areas for specific types of reviews that could be useful from an international standpoint include fire protection, physical plant ageing, and accident management techniques. The IAEA now is making such services available.

Also drawing interest are probabilistic safety assessments (PSAs). There have been great advances in the application of PSA techniques in the last 10 years. The application of PSA is being promoted by the IAEA for all nuclear facilities to ensure a comprehensive safety assessment of the facility design and operation.

To individually assist Member States in their PSA programmes, the Agency has set up the International Peer Review Service (IPERS). It has proved very useful in providing an independent review of the PSA methodology applied,

the completeness of the PSA, appropriateness of input data used, and the validity of the results in comparison with similar assessments carried out elsewhere.

The OSART programme

Over the past 10 years, the IAEA has been conducting Operational Safety Review Team (OSART) missions at nuclear power plants around the world. The programme today is extensively used and well known in the nuclear power community. As of 15 May 1992, a total of 63 OSART missions to 51 nuclear power plants in 25 countries have taken place. Forty-eight of these missions were to operating plants and 14 were to plants under construction. Another five missions have been requested through December 1992.

OSARTs usually review eight areas important to operational safety at operating plants and up to eleven areas at plants under construction. To date, the OSART programme has concentrated on operational safety and industrial practices at the nuclear power plants. Many recommendations and suggestions have been made about the various nuclear power plants to improve or modify their operating and industrial practices in order to raise their operational safety performance to the higher levels of international practices. It is the evaluation by peers and consensus of the international OSART team members that provide the basis and motivation for improvement.

Although improved operational safety is the primary goal of the OSART programme, the IAEA's Nuclear Operational Safety Services Section has been asked to re-evaluate the role and structure of the OSART programme. One focus of the review will be to determine if more emphasis should be placed on the regulatory and nuclear safety aspects and less on the industrial practices involved in the operation of nuclear power plants.

This re-evaluation may result in some modifications to the normal 3-week OSART timetable. The changes would place increased emphasis on subjects such as the implementation of safety culture; establishment and communication of safety policy and objectives; performance and testing of safety systems; fire protection; feedback of operating experience; internal quality assurance audits and follow-up processes; interfaces and relationships with regulatory authorities; refresher training of the operating staff especially in emergency operating procedures; accident management provisions; work practices on matters related to nuclear safety; and other areas.

The goal of this re-evaluation is to ensure that the IAEA continues to meet the needs of its Member States and the nuclear community to address the ever-increasing concerns relating to the safety of nuclear power plants.

Countries requesting selected IAEA safety services, 1983-92

	OSART	ASSET	IPERS	IRRT	ESRS		OSART	ASSET	IPERS	IRRT	ESRS
Belgium		1				Morocco					2
Brazil	3	3		1	1	Netherlands	2	1	5		
Bulgaria	4	4			2	Pakistan	2	4			1
Canada	2					Philippines	2				1
China	3	1	1			Poland	1				1
Czechoslovakia	5	2			2	Portugal					1
Egypt					1	Romania	1	1		1	1
Finland	2	1				Russian Federation	4	5	1		2
France	4	2				Slovenia			1		
Germany	4	3				South Africa	3	1			
Hungary	1	3			1	Spain	2	2	1		
Indonesia					1	Sweden	4	1	1		
Iran					1	Switzerland			1		
Iraq					2	Syria					1
Italy	2					Tunisia					1
Japan	2					Turkey					1
Korea, Rep. of	4	1	1			Ukraine		2			
Lithuania		1				United Kingdom	2	1			
Malaysia					1	United States	3				
Mexico	2	1				Yugoslavia	2	1			3

Note Missions completed or requested through December 1992

Scenes from IAEA safety missions (clockwise from above); Members of an ASSET team inside the control room of the Kozloduy nuclear plant in Bulgaria; Chinese specialists brief members of an OSART team during a mission to the Qinshan nuclear power plant, the country's first operating nuclear electricity plant; a scenic view of the Bohunice plant in southern Czechoslovakia; OSART experts visiting the Dukovany nuclear power plant in Czechoslovakia; members of an OSART team and their Japanese counterparts in the control room of the Takahama nuclear plant. (Credits: B. Thomas, F. Franzen, J.-P. Bemer, IAEA.)

Incident reporting system

The IAEA Incident Reporting System (IRS) is an international focal point for nuclear power plant operating experience derived from unusual events. It was established by the IAEA for the exchange of operating experience on an international level, so that one Member State can benefit from experience gained in other Member States. It currently serves as an important focal point of co-operation in this area with the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (NEA/OECD), with discussions now directed on the creation of a single IRS database.

The IRS was established with the intention for a participating country to exchange information whenever its analysis of an operational incident identified a lesson that others should learn to prevent the incident's repetition elsewhere. Today the system contains more than a thousand unusual events, representing a considerable body of lessons learned for use in the international feedback of operating experience.

In the twofold IAEA-IRS process, incident analyses include national investigation of unusual events in nuclear plants with subsequent in-depth discussion at the international level by international experts. Results of international analyses are distributed by means of topical safety studies, reviews on patterns and trends in nuclear power plant events, reviews of experience on root-cause analysis of incidents, and annual reports.

To maintain and improve nuclear safety through the IRS activity, some actions have been put forward for consideration. Among them is creation of a binding international network for collecting, handling, assessing, and disseminating information on unusual events (i.e. deviations, incidents, and accidents) occurring at nuclear power plants during operations, surveillance, and maintenance activities. Integrated responsibility among the processes for reporting unusual events and for feedback about them should be an intrinsic feature of this network. Currently steps are being taken within the IRS framework to reinforce existing elements and develop new ones which could be applied to such a binding network.

In particular, the IAEA would like to work towards:

- improving the speed and efficiency for communicating evaluations of unusual events at nuclear power plants;
- increasing the value of IRS information in the feedback process related to operating experience;
- enhancing national capabilities for systematically analysing nuclear power plant operating experience;
- identifying national weak points related to the feedback of operational experience; and
- making the IRS activity more transparent and more visible for the public.

These goals require international harmonization and peer reviews of the feedback process for operational experience. Activities might include fact-finding missions and guidelines to conduct periodic reviews of internationally significant safety issues with national regulatory organizations; periodic reviews of regulatory organization activities in the feedback area; workshops, training courses, and advisory/assistance visits at the regulatory body level.

Such efforts would help ensure that all Member States are able to adopt, and benefit from, an integrated approach to all aspects of nuclear safety.

Nuclear plant incident reporting system (IAEA-IRS)

Participants:	*Since:*
Argentina	May 1983
Brazil	November 1983
Bulgaria	February 1985
Canada	May 1987
China	May 1992
Czechoslovakia	January 1985
Finland	May 1983
Hungary	October 1984
India	June 1984
Korea, Rep. of	February 1983
Mexico	May 1991
Netherlands	June 1983
Pakistan	August 1984
South Africa	April 1990
Spain	January 1983
Russian Federation	September 1984
United Kingdom	March 1986
Yugoslavia	May 1986
Participants through the NEA/OECD:	
Belgium	February 1983
France	June 1983
Germany	July 1983
Italy	March 1985
Japan	February 1991
Sweden	October 1983
Switzerland	February 1987
United States	August 1985

Participating countries in the IAEA's incident reporting system for nuclear power plants

The ASSET services

Since 1986, the IAEA has been conducting ASSET missions in various countries that operate nuclear power plants; ASSET stands for Assessment of Safety Significant Events Team.

The control room of the Ignalina nuclear power plant in Lithuania.

The programme has drawn widespread interest and support within the nuclear community, particularly over the past several years. To date, 50 ASSET missions to 21 countries have been completed or requested through October 1993. The number of missions has grown from three in 1989, to eight in 1990, 11 in 1991, and 19 in 1992 covering various types of power reactors: pressurized-water reactors; pressurized heavy-water reactors; gas-cooled reactors; Soviet-designed pressurized-water reactors (WWER-440s of the 230 and 213 type, and WWER-1000s); and graphite-moderated reactors (RBMKs) operating in States of the former Soviet Union.

All told, more than 500 experts around the world have now been trained in the ASSET assessment techniques. The techniques include an investigation methodology that provides management with the practical guidance to eliminate in advance the root causes of future incidents and accidents. This methodology identifies the safety issues, assesses their significance, and identifies their root causes.

As established, the ASSET service reviews operational safety experience from the standpoint of events that have occurred. This includes investigating and identifying the direct, as well as the root, causes of incidents or accidents; generic safety lessons learned; and the appropriateness of corrective actions. An underlying premise is that sound plant design, although widely recognized as a prerequisite for safe operation, is not sufficient. An active management is also a key factor for safe operation.

The various options offered by the ASSET services to the IAEA Member States have now been expanded to include five types:

Type S. Seminar training of operators and regulators on use of the ASSET methodology to identify the safety issues; to assess their consequences to safety; and to eliminate the root causes of likely future accidents and incidents.

Type R. Review of the plant operational safety performance to assess appropriateness of corrective actions, and to exchange views on further enhancement of the plant safety culture

Members of an ASSET mission to Germany's previously operating Greifswald nuclear power plant, one of more than 40 such missions requested by countries over the past 3 years. German authorities shut down the plant in 1990.

for effective management of prevention of incidents.

Type A. Review of the root-cause analysis of an event very significant to safety in order to disseminate generic recommendations on effective prevention of incidents with similar root causes at other power plants.

Type I. Assistance to plant management in implementing the ASSET recommendations regarding the incident prevention programme (quality control, preventive maintenance, surveillance) and the experience feedback programme (root-cause analysis, repairs, and remedies).

Type F. Follow-up activities related to the plant safety culture regarding management of the prevention of incidents as a result of the implementation of the recommendations of an ASSET *Type R* mission.

Results of ASSET missions. Many recommendations resulting from the in-depth assessment of plant operational safety performance and from the detailed analysis of plant safety issues have been made to operating and regulatory organizations.

Based on the results of 30 ASSET missions carried out through April 1992, the specific corrective actions offered with respect to nuclear power plants have addressed a number of major findings:

- The root causes of the Three Mile Island and the Chernobyl accidents are still not completely eliminated at many nuclear power plants.
- The three operating elements pertinent to prevention of any accident — proficiency of personnel, operability of equipment, and adequacy of procedures — are not permanently meeting acceptance criteria.
- Identification and elimination of the root causes of deviations are not systematically carried out to prevent the occurrence of incidents and accidents.

The needs of Member States. As a result of missions, the ASSET methodology has been adopted by all plants visited, and it was made part of the regulatory requirements in the host countries.

Currently, further refinements of the ASSET methodology are being studied at the request of operating and regulatory organizations. One refinement would provide computerized tools of ASSET techniques to identify the plant safety issues, to assess their significance to safety, and to conduct root-cause analysis.

In the near future, at the request of Member States, the ASSET services will be made available for other types of nuclear facilties besides power plants. This would better serve to harmonize managerial practices for the prevention of any accident in the nuclear community.

A drive for excellence

Through a range of services, not all of them cited here, the IAEA is assisting national nuclear authorities in their efforts to strengthen activities in the field of nuclear safety.

From the global perspective, the growing awareness of, and requests for, safety services testify to the renewed commitment that countries are making to the safe and reliable operation of nuclear electricity plants everywhere.❐

Techniques developed under the IAEA's ASSET service are used to analyze safety issues with the aim of preventing incidents at nuclear plants.

International Nuclear Event Scale: Clearer communication

Supplementary to its technical support programmes, the IAEA is providing a useful communications service designed to help people place nuclear-related events into proper perspective: the International Nuclear Event Scale (INES). The scale categorizes events from level-zero for one having no safety significance to level-7 for a major accident having widespread health and environmental consequences. On the INES scale, for example, the Three Mile Island accident in 1979 would have been rated at level-5; the on-site damage was severe but the off-site release of radioactivity was very limited. The Chernobyl accident in 1986, which had far-reaching transboundary effects, would have been rated at the top of the scale, level-7.

The scale was developed jointly by experts from the IAEA and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development. It is fundamentally a tool to promptly and consistently inform the public about the general safety implications of reported events at nuclear installations. The aim is to ease common understanding among the nuclear community, the media, and the public.

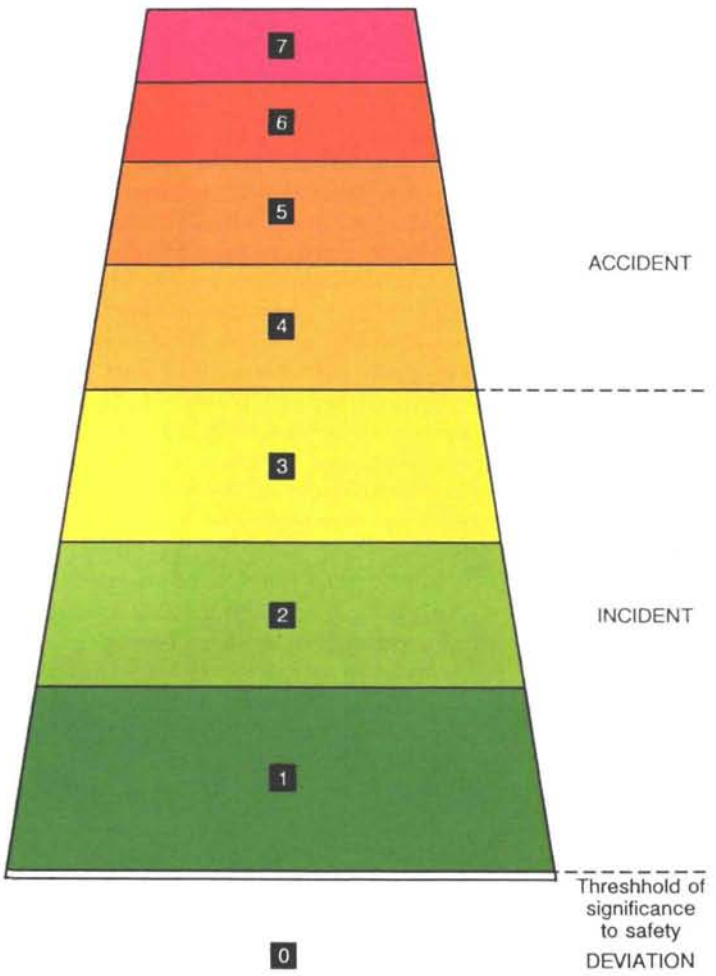
Today, 32 countries are participating in the INES system. During 1991, and through May 1992, none of the nuclear events reported through INES was rated higher than level-3. None had off-site impacts. Most of the reported events were rated at levels 1 or 2.

Despite such generally low ratings, nuclear events habitually draw intensive media coverage. Fortunately, the INES scale is proving to be very useful in filling what previously may have been a communications gap, particularly considering the technical nature of nuclear power and the industry's specialized terminology.

A case in point was the scale's international use during the nuclear incident in March 1992 at the Leningrad nuclear power plant in the Russian Federation. Partly because the event occurred at an RBMK reactor —the Chernobyl type — media interest was exceptionally high, in some cases alarmingly so, and the IAEA started receiving scores of inquiries as soon as news of the event broke in the early morning of 24 March. INES quickly became a commonly understood point of reference. Russian nuclear authorities used the scale in their prompt reporting of the event to the IAEA, preliminarily ranking it at level-3. The rating — and the limited consequences it signified — were widely reported in press accounts over the next two days, as the facts about the incident became clearer. By the time Russian authorities revised the event downward, to a level-2, on 25 March, INES had become a more familiar reference and communications tool for many news reporters, industry communicators, and citizens.

Organizationally, the scale itself is part of an information network involving the IAEA, national nuclear authorities, and INES liaison officers in participating countries around the world. The events themselves are analysed and ranked by national nuclear authorities, with reports transmitted to the IAEA through the INES officer. The IAEA then disseminates the report to INES contacts worldwide, and provides essential information for use by governmental information officers in responding to questions from the media and the public.

So far, INES predominantly has been used for reporting events at nuclear electricity plants. Recently, however, it was extended and adapted to enable it to be applied to all nuclear installations associated with the civil nuclear industry and to any events occurring during the transport of radioactive materials to and from those facilities.



INTERNATIONAL NUCLEAR EVENT SCALE (INES) LEVELS:

Level-0: **Below scale (deviation; no safety significance)**
Level-1: **Anomaly**
Level-2: **Incident**
Level-3: **Serious incident**
Level:4: **Accident without significant off-site risk**
Level-5: **Accident with off-site risk**
Level-6: **Serious accident (significant off-site impact)**
Level-7: **Major accident (widespread health & environmental effects)**

— More details about INES are contained in a leaflet recently prepared by the IAEA Division of Nuclear Safety.