Nuclear power plant safety: Steps toward better performance

At many nuclear plants, self-assessment processes are helping management to review and improve levels of safety

by Keith Hide

As part of the nuclear industry's response to the accidents at Three Mile Island (TMI) in 1979 and at Chernobyl in 1986, programmes to evaluate and encourage improvements in the operational safety performance of nuclear power plants were initiated. In the United States, the Institute of Nuclear Power Operations (INPO) was founded by nuclear utilities. It performs periodic operational safety evaluations of all nuclear power plants in the USA. INPO also provides a number of other services to help US and volunteer international utilities improve their safety performance.

On a broader international scale, the IAEA initiated the Operational Safety Review Team (OSART) programme for voluntary reviews of operational safety performance at power plants worldwide. The IAEA also initiated other voluntary programmes — such as those on the Assessment of Safety Significant Events (ASSET), Assessment of Safety Culture in Organizations (ASCOT), and the Incident Reporting System (IRS) — to assist nuclear plant operators in evaluating and strengthening their safety performance.

In September 1994, IAEA Member States began the process of ratifying a new Convention on Nuclear Safety. This convention will establish, for the first time, internationally agreed obligations for ensuring the safety of nuclear power plants and the commitment of the signatory States to meeting them. Under the Convention, Member States with nuclear power plants will report periodically to their peers on the measures taken to meet their obligations.

Although the exact nature of the reports to be made under the Convention has yet to be determined, Member States will need to determine, in some way, the degree to which the performance of their own nuclear power plant programme is in accordance with the obligations of the Convention. Operational safety performance reviews performed by independent organizations such as the IAEA could provide information for this purpose, but the substantial outside resources they require limit their availability.

Many utilities have chosen to use self-assessment processes to help their management obtain current information about safety performance. Regulatory authorities are increasingly recognizing and using self-assessments to judge nuclear power plant safety performance. Experience has shown that when organizations objectively assess their own performance, understanding of the need for improvements and the motivation to achieve them is significantly enhanced. Such self-assessments might also contribute substantially to the periodic reports required by the Convention.

For purposes of discussion, self-assessment practices can be grouped into three general areas as follows:

- frequent or continuous monitoring of performance against established management performance expectations;
- periodic, in-depth reviews of the effectiveness of selected activities or programmes by in-house teams of experienced reviewers and technical experts; and
- one-time, in-depth reviews to probe the full extent and basic causes of known weak performance areas.

This article outlines these self-assessment practices and the benefits they are providing.

Performance monitoring

Many utilities now use a variety of performance indicators to set and communicate their goals or expectations for performance of plant equipment, programmes, and personnel in areas

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that affect safety, production and efficiency. Performance indicators are best expressed in clear, numerical terms that relate to performance in a variety of areas. They normally include the ten major performance indicators that are reported to the World Association of Nuclear Operators (WANO) by nuclear utilities worldwide and a substantial number of others that are based on the particular needs of individual plants and groups, such as chemistry, radiological protection, and maintenance, within plant organizations. Many plants use the results achieved by top-performing plants or established industry standards as benchmarks to set their own goals for performance and improvement.

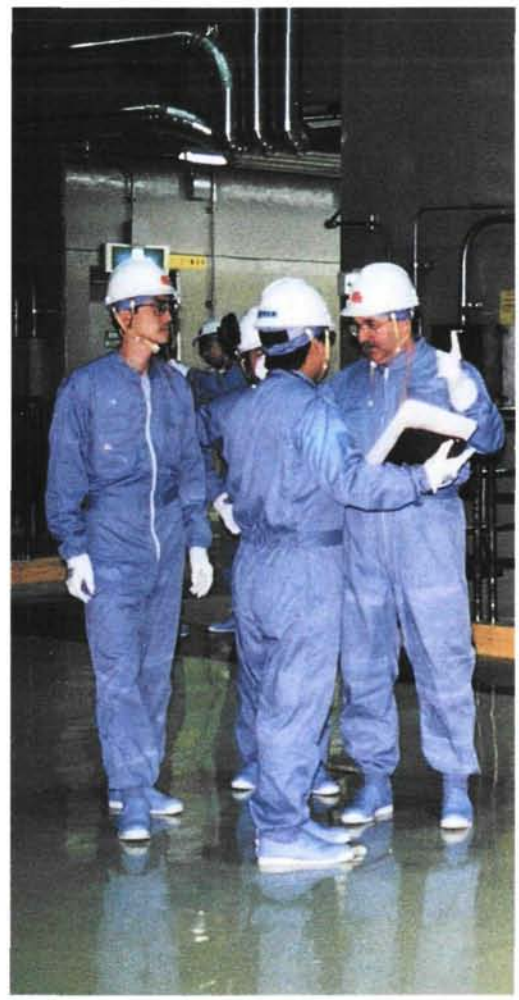
Structured monitoring of actual performance results against the agreed performance indicator goals helps provide management and other plant personnel with useful information on the current performance and areas in need of additional attention. Some utilities establish, for each performance indicator or related groups of indicators, a series of numerical values that reflect significant weakness, the need for some improvement, satisfactory performance, or significant strength. Periodic reports to management on performance can then be tailored to reflect not only the current level of performance, but the trend in performance. Colour-coding is sometimes used to help highlight results and trends in these reports.

Performance monitoring against goals provides management with frequent, objective information on the quality of plant operations in the areas addressed by the performance indicators. It further allows managers to address their attention to the areas where assistance or additional support may be needed to meet station performance goals. Another major advantage of this type of monitoring is that reports of performance can be easily shared, by means of graphs and visual presentations, with all plant personnel. This helps keep all personnel aware of current performance in their own areas and in areas that they support. Some utilities format these reports in the form of annunciator panels colour-coded to reflect the results according to specified performance categories, and display them throughout the plant. Many have found that the use of such systems significantly enhances understanding and support within the plant staff of management's goals for performance and how they relate to their own activities.

Periodic effectiveness reviews

Though performance indicators and goals provide information on a frequent basis, their value is limited to the specific areas selected for monitoring, and they do not give much insight into the causes of performance weaknesses. Effectiveness reviews that look into qualitative as well as quantitative information have also proven to be valuable self-assessment tools. These reviews do examine adherence to regulatory or external requirements, but the most effective reviews go well beyond that to examine the effectiveness and efficiency of programmes and activities in achieving their intended purpose. Effectiveness reviews of major plant evolutions, such as outages and plant startups, often provide valuable insights into plant and staff performance. They may also be useful in assessing the effectiveness of corporate support or support from other organizations that can impact plant operation and safety performance.

Effectiveness reviews may be accomplished by teams of individuals who are independent of the activity being reviewed, by those who are closely involved in the activity on a day-to-day basis or, ideally, by teams including both. Such reviews may be done well by quality assurance personnel, if they have current expertise and expe-



Members of an OSART team at the Hamoaka nuclear plant in Japan.
(Credit: Taylor/IAEA)

rience in the area to be reviewed. However, many utilities have discovered the advantages of using personnel who are directly involved in or responsible for the activity under review as members of these teams. Such individuals bring valuable insights into the review process and improve the quality of review results. But perhaps more importantly, they often gain fresh perspectives and understanding from their participation that increases their awareness of problems, the importance of correcting them and possible ways of correcting them. In addition, the training they receive in review techniques by virtue of their participation often significantly improves their ability to assess performance in their own areas of responsibility on a day-to-day basis.

Strong support from management has been shown to be an essential factor in achieving good effectiveness reviews. This can be shown by selection of capable review team members including appropriate management and supervisory personnel, support of each team's efforts to identify all contributing problems and their causes, and responding to the results of reviews in a positive way that supports improvement without punitive action or embarrassment. These factors are important to obtaining the open sharing of information and opinion between reviewers and those being reviewed that is needed to produce good results.

Quality assurance programmes have traditionally provided a framework for review or audit of station programmes and activities, using review schedules that provide periodic examination of important performance areas and focusing on adherence with quality programme requirements and regulations. However, many current self-assessment efforts expand considerably on this framework by performing reviews at the request of managers or staff personnel and focusing more on overall effectiveness of programmes and activities in achieving their intended purpose. In some plants, more than 50% of the assessments performed are a consequence of plant staff requests, and managers and other personnel at all levels participate in assessment teams.

One-time reviews of problem areas

Most utilities recognize that focusing self-assessments or effectiveness reviews on known or suspected problem areas is one of the most effective ways of improving performance. At least one utility senior manager has stated that his manager's primary responsibility is finding problems and opportunities for improvement and making the appropriate improvements. Opportunities for improvement may be identified through performance indicator monitoring, plant and industry operating experience, comparison with other nuclear power plants, and a variety of other means. The principles for achieving good reviews are the same as those stated above for periodic reviews.

An example of the use of one-time problem reviews concerns the system used at one nuclear power plant to tag equipment that was out-of-service for maintenance work. After a few minor cases of errors in tagging, plant managers decided to conduct an in-depth review of its tagging procedures and related activities. They formed a team that included members of the maintenance staff, operations staff, technical support staff, and others, and required them to examine all aspects of the tagging system. The team attempted to flow-chart the tagging process and found that they were unable to do so. At the conclusion of their work, the team had identified many deficiencies in the effectiveness of the system, foremost of which were its complexity and the lack of understanding of it by those who used it on a day-to-day basis. The plant then developed a completely new, simpler process that could be more easily understood and used more reliably.

In another example, a utility that had experienced several indications of deteriorating performance in broad areas elected to perform a comprehensive review of the management and effectiveness of all station activities. In this case, the problems were considered to be so pervasive that the utility decided the team should be comprised of experienced plant operations experts from outside the company. A team of senior experts with excellent knowledge and current experience in plant operations and management was assembled by the utility and given strong support in identifying the fundamental causes of the plant's malaise. The results initiated many fundamental improvements in the management of plant activities and the responsibilities given to plant personnel. It was recognized by the national regulatory authority as an effective identification of fundamental problems at the plant. As a result, an extensive regulatory review was avoided. Both the regulatory authority and the plant considered the self-assessment more useful than a regulatory inspection, because of the expertise of the reviewers and because of the plant's positive recognition and ownership of the results.

Peer review programmes

Utilities in at least four countries have implemented their own peer review programmes and are using their own expertise to assess perform-

ance in each of their nuclear power plants. They have organized programmes for peers from other stations to assess each of their nuclear stations at regular intervals. These programmes provide valuable training in proven review techniques to numerous plant personnel who participate as peer reviewers. The knowledge and experience they gain pay dividends when they return to their own plants. They can view performance in their own areas more objectively and with a fresh perspective. Often, they get ideas from the plant being reviewed that they use to strengthen their own performance.

Regulatory overview

Some regulatory agencies believe that encouraging self-assessment and checking on the thoroughness and results of such efforts provides valuable insight for the regulator and promotes a sense of ownership for problem identification and correction within the utility, where it is most important. As a result, they are increasing their efforts to ensure that all utilities implement effective self-assessment programmes to detect operational weaknesses and identify the fundamental causes early. It is believed that review of self-assessment results can be an improved alternative to regulatory inspections as a means of ensuring that plants maintain high standards of performance.

International initiatives

Those involved in the use of self-assessment programmes agree that self-assessments represent one of the most powerful tools for improvement because of the following benefits:

- They are performed by individuals who are most knowledgeable of the people and practices at the nuclear power plant.
- They can be easily tailored to the needs of individual plants.
- They minimize the potential for embarrassing exposure of plant weaknesses to outside persons, and maximize the opportunity for candid, frank discussion of problem areas between reviewers and staff members.
- They strengthen insight into performance problems, their causes, and their effects at all levels, and thus strengthen support for improvement.
- They can be performed on a frequent or continuous basis, giving management current information on the effectiveness of a wide variety of programmes and activities.

The IAEA is considering how it might best support the development and use of self-assessments as a means of strengthening nuclear power plant operational safety. Activities in progress or under consideration include the following:

- providing guidance on self-assessment activities for utilities and regulators. An IAEA Safety Guide is being developed;
- supplementing the OSART process and OSART guidelines (IAEA TECDOC-744, May 1994) to provide for reviewing the effectiveness of plant self-assessment activities;
- using the OSART process to identify and collect best practices in self-assessment and sharing them with the industry through the OSART Mission Results data base (OSMIR) and other methods;
- sponsoring international conferences and workshops on self-assessment;
- assisting Member States in implementing self-assessment programmes, upon request;
- reviewing self-assessment processes and the results of self-assessments upon request.

Expectations for operational safety performance are reaching higher and higher levels, and international interest in the performance of individual nuclear utilities and power plants is increasing. In this climate, the use of effective self-assessment processes is expected to become more important in both well-developed and developing nuclear programmes. Frequent, critical self-examinations of safety performance will be required to ensure that acceptable levels of performance are achieved and maintained. As part of its safety services to Member States, the IAEA will do its best to support and encourage the use of self-assessments in nuclear utilities and power plants. ❐

Leibstadt nuclear plant, Switzerland.