

**MANAGEMENT OF SAFETY,
SAFETY CULTURE AND SELF ASSESSMENT**

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ABSTRACT

The paper reviews the concept of safety culture and characterizes organization with respect to its degree of implementation. Management of safety at operating organizations and at safety authorities is discussed, including the symptoms which need to be monitored. Finally, self-assessment is proposed as the key to continued safety management progress.

The principles of safety are now quite well known and are implemented worldwide. It leads to a situation where harmonization is being achieved as indicated by the entry into force of the Convention on Nuclear Safety. To go beyond the present nuclear safety levels, management of safety and safety culture will be the means for achieving progress.

Management of safety at the installations as well as its control and monitoring by the safety authorities become a key to the future of nuclear energy.

The first requirement for safety management is a commitment from the top management at both corporate and nuclear power plant (NPP) level. The second requirement is to develop the necessary work environment for developing a good safety culture through openness, communication, listening to staff problems and noticing on time the warnings indicating possible degradation of safety. The third requirement is a commitment to develop and maintain a good safety culture. The last requirement on operating organizations is to stay "humble": do not take for granted that the good level of safety will stay for ever, especially in the field of safety culture, keep a questioning attitude. Peer reviews are useful for this purpose.

Regulatory inspection and enforcement is an essential tool for monitoring the safety level at installations. Since more and more non-prescriptive regulatory approaches are now taken in the world, inspections also tend to depart from pure compliance to performance and/or process checking. Such an orientation certainly reinforces the prime responsibility of the operating organization in safety.

Peer reviews from external organizations or international ones represent also a good way for regulatory authorities to exchange experience and to further enhance the monitoring of safety in operating organizations.

The purpose of self-assessment is to promote improved safety performance through the direct involvement of personnel in the critical examination and improvement of their own work activities and work results.

The nuclear industry in general is getting to a more and more mature stage and the future for continuing the safety enhancement will be with safety culture and especially self assessment which correspond to a mature safety culture.

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Safety management is the term used for the measures required to ensure that an acceptable level of safety is maintained throughout the life of an installation, including decommissioning. The safety culture concept and its implementation are described in part one of the paper.

The principles of safety are now quite well known and are implemented worldwide. It leads to a situation where harmonization is being achieved as indicated by the entry into force of the Convention on Nuclear Safety. To go beyond the present nuclear safety levels, management of safety and safety culture will be the means for achieving progress.

Recent events which took place in major nuclear power countries have shown the importance of the management and the consequences on safety. At the same time, electricity deregulation is coming and will impact on safety through reductions in staffing and in operation and maintenance cost at nuclear installations. Management of safety as well as its control and monitoring by the safety authorities become a key to the future of nuclear energy.

1. SAFETY CULTURE CONCEPT

The concept of safety culture is defined in INSAG-4 as:

"safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

Safety culture is also an amalgamation of values, standards, morals and norms of acceptable behaviour. These are aimed at maintaining a self-disciplined approach to the enhancement of safety beyond legislative and regulatory requirements. Therefore, safety culture has to be inherent in the thoughts and actions of all the individuals at every level in an organization. The leadership provided by top management is crucial.

The significance of nuclear safety issues will vary among organizations and reflect their particular needs. There will always be a necessity to choose which issues are to be addressed as a priority using resources available. The efforts made to enhance safety culture can have beneficial consequences for plant engineering, construction and performance through better organization, analyses, anticipation and ways of doing work such as better planning of outages.

Development of a strong safety culture can result in more effective conduct of work and a sense of accountability among managers and employees.

In promoting an improved safety culture there have been different emphasis, with some countries favouring an approach giving a high profile to the use of behavioural sciences while others have emphasized the quality management system approach to enhancing safety performance. There is consensus that account should be taken of both national and organizational culture in promoting an improved safety culture and an appropriate balance of behavioural sciences and quality management systems approaches should be pursued.

The characteristics and attitudes referred to in the definition of safety culture should be commonly held and relatively stable. "Commonly held" implies that there is a core of key attitudes and values that are acknowledged by the

majority. "Relatively Stable" implies that any change tends to be evolutionary rather than revolutionary. Safety culture is important in that it is an influence on behaviours, attitudes and values which are important factors in achieving good safety performance. Organizations with mature safety cultures focus more on the overall goals and key points rather than only on compliance with procedures.

Developing and implementing the safety culture concept needs both a "top-down" and a "bottom-up" approaches. This change in culture must stem from all directions, however, consistent and visible leadership from the top is essential. For management led changes to be successful, it is essential that there is effective cooperation and two-way communication at all levels of the organization. Honest and open communications depend on the development of trust throughout the organization. Technical specialists, human factors specialists, operating personnel and management must work together to develop a common understanding across their various functions. This is in itself a learning process, and as such, a characteristic of a good safety culture. Continuous learning and improvement processes play a central role in the development and maintaining of a good safety culture.

An organization with a good safety culture relies on the close interdependence between technical safety and organizational processes. In practice, a high level of safety culture means the systematic organization and implementation of activities aimed at creating high quality technical, human, and organizational systems.

Irrespective of the level of technical sophistication a mature safety culture can defend in depth against the risk of accidents. An investment in improving safety culture can be beneficial in cases where nuclear facilities are designed to earlier standards.

When considering safety culture as practiced around the world, it is apparent that nearly all organizations involved in nuclear activities have in common a concern for safety and how to improve and maintain it. Yet there is substantial diversity among organizations in their understanding of "Safety Culture" and how to act to influence it in a positive way.

This variation is represented in different developmental stages. Three stages seem to emerge, each of which displays a different awareness and receptiveness to the effect of human behavioural and attitudinal matters on safety. The characteristics of each stage, identified below, provide a measure for organizations to use as a basis for self diagnosis. The characteristics may also be used by an organization to give direction to the development of safety culture, by identifying the current position and the position aspired to. It is possible for an organization at any time to exhibit any combination of the characteristics listed under each of one of these stages.

Stage I: Safety solely based on rules and regulations

At this stage, the organization sees safety as an external requirement and not as an aspect of conduct that will help the organization to succeed. The external requirements are those of national governments, regional authorities, or regulatory bodies. There is little awareness of behavioural and attitudinal aspects of safety performance, and no willingness to consider such issues. Safety is seen very much as a technical issue. Mere compliance with rules and regulations is considered adequate. For an organization which relies predominantly on rules, the following characteristics may be observed.

- Problems are not anticipated; the organization reacts to them as they occur.
- Communication between departments and functions is poor.
- Departments and functions behave as semi-autonomous units and there is little collaboration and shared decision-taking among them.
- The decisions taken by departments and functions concentrate upon little more than the need to comply with rules.
- People who make mistakes are simply blamed for their failure to comply with the rules.

- Conflicts are not resolved; departments and functions compete with one another.
- The role of management is seen as endorsing the rules, pushing employees and expecting results.
- There is not much listening or learning inside or outside the organization which adopts a defensive posture when criticized.
- Safety is viewed as a required nuisance.
- Regulators, customers, suppliers and contractors are treated cautiously or in an adversarial manner.
- Short term profits are seen as all important.
- People are viewed as 'system components'- they are defined and valued solely in terms of what they do.
- There is an adversarial relationship between management and employees.
- There is little or no awareness of work, or business, processes.
- People are rewarded for obedience and results, regardless of long term consequences.

Stage II: Good safety performance becomes an organizational goal

An organization at this stage has a management which perceives safety performance as important even in the absence of regulatory pressure. Although there is growing awareness of behavioural issues, this aspect is largely missing from safety management methods which comprise technical and procedural solutions. Safety performance is dealt with, along with other aspects of the business, in terms of targets or goals. The organization begins to look at the reasons why safety performance reaches a plateau and is willing to seek the advice of other organizations.

- The organization concentrates primarily on day to day matters; there is little in the way of strategy.
- Management encourages cross-departmental and cross-functional teams and communication.
- Senior managers function as a team and begin to co-ordinate departmental and functional decisions.
- Decisions are often centered around cost and function.
- Management's response to mistakes is to put more controls, via procedures and retraining, in place. There is a little less blaming.
- Conflict is disturbing and discouraged in the name of teamwork.
- The role of management is seen as applying management techniques, such as management by objectives.
- The organization is somewhat open about learning from other companies, especially techniques and best practices.
- Safety, cost and productivity are seen as detracting from one another. People think that safety means higher cost and reduced production.
- The organization's relationship with regulators, customers, suppliers and contractors is distant rather than close; this is a cautious approach where trust has to be earned.
- It is important to meet or exceed short-term profit goals. People are rewarded for exceeding goals regardless of the long-term results or consequences.
- The relationship between employees and management is adversarial, with little trust or respect demonstrated.
- There is growing awareness of the impact of cultural issues in the workplace. People do not understand why added controls do not yield the expected results in safety performance.

Stage III: Safety performance can always be improved

An organization at stage III has adopted the idea of continuous improvement and applied the concept to safety performance. There is a strong emphasis on communications, training, management style, and improving efficiency and effectiveness. Everyone in the organization can contribute. Some behaviours are seen within the organization which enable improvements to take place and, on the other hand, there are behaviours which act as a barrier to further improvement. Consequently, people also understand the impact of behavioural issues on safety. The level of awareness of behavioural and attitudinal issues is high, and measures are being taken to improve behaviour. Progress is made one step at a time and never stops. The organization asks how it might help other companies.

- The organization begins to act strategically with a focus on the longer term as well as an awareness of the present. It anticipates problems and deals with their causes before they happen.
- People recognize and state the need for collaboration among departments and functions. They receive management support, recognition and the resources they need for collaborative work.
- People are aware of work, or business, processes in the company and help managers to manage them.
- Decisions are made in the full knowledge of their safety impact on work, or business, processes as well as on departments and functions.
- There is no goal conflict between safety and production performance, so safety is not jeopardized in pursuit of production targets.
- Almost all mistakes are viewed in terms of work process variability. The important thing is to understand what has happened rather than find someone to blame. This understanding is used to modify the process.
- The existence of conflict is recognized and dealt with by trying to find mutually beneficial solutions.
- Management's role is seen as coaching people to improve business performance.
- Learning from others both inside and outside the organization is valued. Time is made available and devoted to adapting such knowledge to improve business performance.
- Safety and production are seen as inter-dependent.
- Collaborative relationships are developed between the organization and regulators, suppliers, customers and contractors.
- Short term performance is measured and analyzed so that changes can be made which improve long-term performance.
- People are respected and valued for their contribution.
- The relationship between management and employees is respectful and supportive.
- Aware of the impact of cultural issues, and these are factors considered in key decisions.
- The organization rewards not just those who 'produce' but also those who support the work of others. Also, people are rewarded for improving processes as well as results.

The above characteristics describing each of the three stages of evolution could serve as the basis for a survey to establish which stage an organization has reached. Different parts of the installation organizational structure can in fact be found at different stages of safety culture development.

The process for the development of safety culture can be assisted by the use of a learning process within an organization. There is a wide range of practices that are of potential value in the practical development of a progressive safety culture. The timescale required to progress through the various stages of development cannot be predicted. Much will depend upon the circumstance of an individual organization and the commitment and effort that it is prepared to devote to effect change. However, sufficient time must be taken in each stage to allow the benefits from changed practices to be realized and to mature. People must be prepared for such change. Too many new initiatives in a relatively short period of time can be organizationally destabilizing. The important point to note is that any organization interested in improving safety culture should start and not be deterred by the fact that the process will be

gradual.

There is a possibility that certain practices may be more suitable to one of the three particular stages of development of safety culture, although the complexity of the cultural change process precludes any universal guidance. In developing an improved safety culture attention needs to be paid to the national culture. In some countries there may even be significant differences among regional cultures. The characteristics of a national culture can amplify or attenuate the factors associated with a good safety culture.

2. MANAGEMENT OF SAFETY AT OPERATING ORGANIZATIONS

The first requirement for safety management is a commitment to safety from the top management at both corporate and NPP level. It is demonstrated in different ways such as a yearly general declaration, fixing short term and long term safety objectives and including safety managers in the NPP structure who are accountable for the safety in operation. Safety advisory panels or groups are also important to monitor and assess the overall plant safety and to support the safety measures to be taken.

The second requirement is to develop the necessary work environment for developing a good safety culture through employee welfare, openness, communication, listening to staff problems and noticing on time the warnings indicating possible degradation of safety. Safety culture concept needs both a "top-down" and a "bottom-up" approach. Continuing learning and improvement processes play a central role. Although safety performance indicators have not yet been agreed upon on an international basis, each NPP management should set up its own in order to be able to detect progress or deterioration of performances.

The third requirement is a commitment to develop and maintain a good safety culture. It recognizes the close interdependence between technical safety and organizational processes. In practice, a high level of safety culture means the systematic organization and implementation of activities aimed at creating a high quality defense-in-depth against both technical, human and organizational failures that may cause accidents.

Irrespective of which stage of safety culture as defined in chapter 1 an organization is at, there is one fundamental requirement that is essential, namely the genuine and visible commitment of the top management of the organization to the improvement of safety. Top management should have knowledge about safety cultural issues so that they are in a position to undertake the leadership role to create and communicate the future safety vision for their organization. Managers should not only know how to motivate their team but also how to avoid demotivating them. The involvement and commitment of senior management in pursuing high standards of safety is essential. Without a visible and genuine demonstration of this commitment by personal behaviour and leadership example by senior managers, other workers in the organization will not be convinced of the importance of safety compared to other organizational issues. Words without deeds will create an illusion of safety that will result in the development of a superficial safety culture.

To support the development of a good safety culture and an appropriate safety management, senior managers can contribute by:

- Gaining understanding of safety culture concepts and practices by undergoing appropriate training;
- Demonstrating a leadership style that has an appropriate balance between caring and controlling;
- Being visibly interested in safety;
- Having safety as a priority item on the agenda at meetings;
- Encouraging employees to have a questioning attitude on safety issues;
- Ensuring that safety is addressed in the strategic plans of their organization;
- Having personal objectives for directly improving aspects of safety in their areas of

- responsibility;
- Regularly reviewing the safety policy of the organization to ensure its adequacy for current and anticipated circumstances;
- Monitoring safety trends to ensure that safety objectives are being achieved;
- Taking a genuine interest in safety improvements and giving recognition to those who achieve them, and not restricting their interest to situations where there is a safety problem.

Senior management should ensure that their organization has a safety management system that provides a structured systematic means of achieving and maintaining high standards of safety performance.

The last requirement on operating organizations is to stay "humble": don't take for granted that the good level of safety will stay for ever, especially in the field of safety culture, keep a questioning attitude. External peer reviews are useful for that purpose and are getting more and more popular through the IAEA OSART and ASSET services and through the WANO Peer reviews. The Convention on Nuclear Safety also relies on peer reviews. More and more efforts are dedicated to learning from experience and to the sharing of good practices worldwide through various mechanisms. It helps keeping the operating organizations "humble" and vigilant on the safety performance of their plants.

Examples of practices that help to maintain the operating organization humble and vigilant are given as an illustration:

- Use of "predictive risk analysis" or "risk assessment methodology" during the preparatory phase of an activity. This analysis of risk of errors and of their consequences is basic to quality. Performed by a multi-disciplinary team, it should focus on quality requirements for the main safety-related issues, and thereby contribute to better understanding and communication between servicing and operating teams. It also improves the awareness of each member of the team on the key points and overall aim of the activity and its connection with other activities. If well applied, this predictive risk analysis is a learning process and is a good tool to spread safety culture by contributing to better understanding and adherence to safety requirements.
- Errors considered as a learning opportunity. Any event related to safety, and especially human or organizational errors, must be first considered as a valuable opportunity to improve operations through experience feedback and lessons learned. It is of the utmost importance to encourage the development of employee attitudes that give them confidence, without fear of blame, to report fully errors, particularly human errors, so that the opportunity can be taken to learn how to further improve the process. One consequence of this, as is shown by some experience, is that the number of events reported can actually increase. It indicates a higher safety awareness which will induce better detection and reporting.
- Systematic in-depth analysis of events. The first step is the detection of events by reporting against clear criteria including the analysis of human factors. The causes may be one or several of the following: technical, human behaviour, organizational culture, process, procedure, equipment, man-machine interface, environment or latent weaknesses in defence. The need for honesty, objectivity and comprehensive reporting of incidents and the use of this information must be stressed. One essential condition, especially in case of human error, is the participation of the personnel or the team involved in the event. They should be encouraged to propose corrective and preventive measures. It must be clearly stated by management that safety culture is not necessarily a "zero error" culture, but rather a learning process which relies on openness and experience feedback to get improvement.

- Ability to learn. The enhancement of nuclear safety relies on both actions taken in response to failures (reactive prevention) and the ability of organizations to identify the nature and causes of developing problems and to apply effective interventions to meet them (proactive prevention). A more proactive approach to safety management can be achieved through processes that will promote improved performance over time. Organizations of this kind have been characterized as "learning organizations".
- Employee contribution. Every employee has a primary responsibility for contributing to their personal safety and to that of their fellow employees. Many organizations have found, by experience, that this contribution is best facilitated by encouraging employee involvement in safety. Individuals tend to take a personal interest in those matters related to their personal safety. Examples of employee involvement in safety include safety improvement teams, safety committee and safety meetings.

3. MANAGEMENT OF SAFETY FROM THE REGULATORY AUTHORITIES VIEW POINT

In addition to its regulatory functions in developing regulations, licensing and operating experience feedback analysis, a regulatory authority ensures that the operating organization is fulfilling its responsibility in terms of nuclear safety.

Regulatory inspection and enforcement is an essential tool for monitoring the safety level at installations. Since more and more non-prescriptive regulatory approaches are now taken in the world, inspections tend also to depart from pure compliance to performance and/or process checking. Such an orientation certainly reinforces the prime responsibility of the operating organization in safety.

Since safety culture cannot be "regulated", appraisal of the safety culture in operating organizations becomes a major challenge for regulatory authorities. Indicators of safety culture development and of deviations of usual performances become essential.

Traditionally most organizations have measured the number of accidents and safety-related events. Whilst providing important trend information, these indicators are of a passive nature and their exclusive use can be demotivating to the workforce. Some organizations have used indicators of a more positive nature to complement the traditional passive indicators. Examples of positive safety indicators include:

- Percentage of employees who have received safety refresher training during the previous month/quarter
- Percentage of safety improvement proposals implemented during previous month/quarter
- Percentage of improvement teams involved in determining solutions to safety related problems
- Percentage of employee communication briefs that include safety information
- Number of safety inspections conducted by senior managers/managers/supervisors during previous week/month (the inspection may be combined with a house keeping inspection)
- Percentage of employee suggestions that relate to safety improvement
- Percentage of organizational routine meeting with safety as an agenda item.

The value of positive safety indicators is that they serve as a mechanism for giving recognition to employees who are endeavouring to improve safety by thought, action or commitment. Recognition for achievement is a powerful motivating force to encourage continued improvement.

There is considerable international diversity in the regulatory approach to safety in terms of where emphasis should be placed. The regulator has options in dealing with the regulation of human and organizational factors. Options include compliance-based approaches, where there are very explicit standards and requirements that are applied uniformly to all nuclear facilities or activities and that result in a standard approach being taken. However, this approach may be less effective or even inappropriate for the area of organization and safety culture.

Another option is to focus on outcomes - to establish safety performance indicators and to devote regulatory energies to tracking indicators and launching investigations when the indicators show a level of performance that is deteriorating or not acceptable. The problem that has been discovered with this approach is that it is very difficult to develop predictive indicators, and that the indicators that can be developed are often either too easy to manipulate or are not sensitive enough to developing problems to allow early intervention.

An additional option, referred to as a process-based approach to regulation, takes specific account of the fact that the safe operation of nuclear facilities depends on the effectiveness of the organizational processes established to operate, maintain, modify and improve a facility. Briefly put, the process approach focuses on the organizational systems that the facility has developed to assure the ongoing safe operation from the perspective of the facility's internal logic. Process-based regulation recognizes that the design of organizational processes must remain flexible in order to allow the facility to create processes that are internally consistent, adapted to their history, culture and business strategy and that allocate resources in the most rational way. A process-based approach attempts to allow this flexibility while forcing the facility to think very carefully about the logic of their processes, to demonstrate to the regulator that they have taken a very rigorous approach to the design, implementation and ongoing evaluation of their key processes and that they are alert to opportunities to improve their systems. A combination of the above three approaches can be used as they are not mutually exclusive.

Effective processes can take many different forms, but they must stand the test of being explicit, predictable, logical, implementable and include a basis for self assessment. The advantage of process-based regulation for the areas of organization and safety culture is that assessments that focus on the logic of key organizational processes and the care that the utility or plant takes in implementing and self-assessing these processes allows a degree of flexibility but is just as rigorous as prescriptive approaches that concentrate on compliance.

Irrespective of which regulatory approach is adopted, organizations committed to continuous safety improvements will benefit from an open and frank dialogue with the regulatory body, especially when the dialogue focuses more on achieving fundamental safety objectives than on merely formal compliance with detailed rules and regulations. Experience has shown that this type of dialogue will promote an enquiring and learning attitude, a key element in enhancing safety culture. In other words, the regulatory approach adopted may significantly influence the possibilities to foster a continuous improvement approach on the part of the utility or plant. In practice, an optimal combination of all these suggested regulatory approaches may be the most effective. The optimum regulatory approach will depend upon the influence of the national culture.

In the interests of promoting safety culture in organizations under its jurisdiction, the regulatory body could consider :

- Within the constraints of national legislation, allowing some flexibility for organizations to manage for safety and develop aims and goals that exceed legal requirements;
- targeting inspection effort to areas of risk and recognizing that some plants may have effective safety management systems. At these plants, sufficient inspections of control processes and selective inspections of outcomes on the plant may be adequate as a regulatory tool;
- not seeking to have blame allocated in the investigation of incidents, and avoiding inappropriate punitive action on the reporting of incidents;
- making the reasoning behind regulatory controls visible, e.g. publish them;

- establishing predictability and stability in the regulatory process;
- trying to agree on appropriate technical ground rules for safety cases and for assessment methodologies;
- having regular dialogue with organizations and encouraging openness in dealings;
- training inspectors to deal with the public on nuclear safety issues in a way that is understood;
- training of inspectors in safety management (including safety culture) and human factors matters.

Peer reviews from external organizations or international ones represent also a good means for regulatory authorities to exchange experience on installations safety performance evaluation and to further enhance the monitoring of safety in operating organizations.

It is important that regulators be alert to incipient weaknesses in safety culture and this section provides some guidance on symptoms to look for when carrying out their regulatory duties. The operating organization should also pay attention to these symptoms. The symptoms have been categorized into organizational, regulatory, employee and technological issues.

Organizational issues

External environment pressure. Many organizations are subjected to increasing economic and business market pressures that are forcing them to reduce significantly their costbase, often through down-sizing of their workforce. In some regions of the world there has been major political and social change that has impacted organizations both directly and indirectly. These changes create uncertainty in organizations that inevitably affect the behaviour and attitude of people. Organizational goals and priorities can change significantly and there is the potential for safety standards and performance to be adversely affected. Attention should be paid by all involved, either in the management or regulation of safety, to how significant corporate change processes are being managed to ensure that the principles of good safety are not being jeopardized.

Inadequate problem resolution. Symptoms of inadequate problem resolution are repeated crises, significant accumulations of corrective actions, lack of effective managerial prioritization of remedial actions and failure to address the root causes of problems. Inadequate problem resolution can result in an increasingly overloaded and under-resourced situation that causes a highly ritualized response to problems

Organizational insularity. Organizational insularity can cause safety culture to deteriorate simply because managers come to believe that safety performance is satisfactory and so become complacent. Managers have no benchmarks or learning opportunities. Insularity can be internal to an organization. It often occurs that plants and facilities belonging to the same utility create and display very different organizational and operational styles and identities. The regulators should determine on a regular basis that an 'open' and interactive organizational style prevails between the plants under their jurisdiction.

Openness. Open and honest communication between regulator and representatives of an organization is essential if the former is to be able to assess and evaluate the safety culture. Difficulties in obtaining information may be a sign that there is a weakness in the safety culture. An organization striving to improve and develop its safety culture should be willing to share its experience with others as well as using the experience to improve its own safety. This may also extend to the 'openness' of the organization to participate in and contribute to international exchanges and initiatives.

Regulatory issues

Corrective actions. When safety culture first starts to weaken one of the most obvious signs is evidence of a

significant accumulation of corrective actions that have not been addressed. The existence of an effective self-assessment, root cause analysis and corrective action programme is a positive indication of a good safety culture.

Patterns of problems. Part of the ongoing monitoring of compliance and plant status checks normally carried out by the regulator is the collection of information from varied sources. By arranging this information in pre-determined categories it is possible to create a profile or pattern of similar situations from which preliminary conclusions can be drawn. Repetition of problems usually indicates that the root cause was not identified correctly and that whatever corrective action may have been implemented was not adequate. Whilst they are not true indicators of performance, trends are guides which can alert the regulator to areas of concern based on actual plant sourced information.

Procedural inadequacies. Documentation is the life blood of an organization and regulatory requirements demand that it be acceptable in quality and content. It is also required that safety documentation be complied with and, therefore, it must be up to date and reflect the actual situation. Normal quality assurance audits and checks should cover these requirements, however, these are usually not performed often enough to monitor the day to day status of review and revision. An important element of safety culture is that employees will have confidence in procedures and use them correctly. However, it is essential that the regulator has an indication of the situation pertaining to regular documentation reviews and that any deteriorating situation is detected at an early stage.

Quality of analysis of problems and changes. Regulators have to be sure that any analysis carried out at the plant follows a systematic, auditable system which will ensure that the correct methods are used, validation is performed and the correct solutions defined. Too often the process is circumvented due to inadequate identification of the problem, lack of resources and knowledge or time constraints and these can lead to inappropriate actions being taken. High quality in analysis usually also requires an integrated approach i.e. to have a broader view on safety and recognizing the need for integrated analyses with the involvement of different specialists. In order to be more proactive the analyses performed also need to include a long-term perspective.

Lack and failure of independent nuclear safety reviews. For all nuclear safety-critical proposals and modifications, independent nuclear safety assessments should be undertaken by persons other than those who have undertaken the original work. In a healthy safety culture, these assessments will always have been fully documented, and checked for methodological, calculational and technical accuracy and validity, using approved procedures.

Reality mismatch. A well developed safety culture will always be consistent with the nature of the safety case and the state of the plant. The plant state, configuration and condition must, at all times, be fully consistent with the claims that are being made in the safety case and that likewise the claims that are required in support of the safety case must never make demands on plant or personnel which are unrealistic or unreasonable.

Violations. Non-compliance (violations) tend to be recorded by most licensees in varying degrees, in relation to breaches of operating rules and operating instructions. Such reports can be of variable quality and detail but all should be notifiable to the relevant regulatory bodies.

Repeated requests for dispensation to regulatory requirements. Requests for dispensations to existing regulatory requirements can occur, particularly prior to restart after a planned outage. When requests are frequent this should trigger a review of the adequacy of the regulatory requirement, or of whether production priorities are being over-emphasized at a possible disadvantage to safety.

Employee issues

Excessive hours of work. A significant factor in the degradation of personal performance is fatigue. Safety culture relies on optimum output in the areas of attention, questioning attitude, diligence and fitness for duty, however, all these are adversely affected when a person is tired and stressed. Working hours must be formulated and regulated to

allow individuals to perform their allotted duties within reasonable timescales without imposing undue pressures which can induce unsafe and undesirable consequences. Persistent abuse of overtime and the continued reuse of staff on call-outs or replacement work would indicate to the regulator that resource levels and planning of work require investigation.

Number of persons not completing adequate training. Training plays an integral role in the safety culture of an organization and the regulator would want to be assured that adequate attention was being paid to the quality and applicability of training programmes. These aspects are checked by submissions of the operating organization, examination and acceptance of the training required by the regulator, however, the attendance and performance of staff at training sessions needs ongoing attention.

Failure to use suitably qualified and experienced persons. A proactive approach includes identification of the principal duties and responsibilities of the job holder, the attributes required for the tasks to be performed and the preparation of a profile outlining the characteristics that would be required of the incumbent in order to carry out the duties effectively.

Understanding of job descriptions. Typically in poor safety cultures, some individuals are not fully aware of the full requirements, responsibilities and accountabilities of their job. The regulator should then require evidence that there is a one to one correspondence between the job holders' understanding of their respective job responsibilities, and the licensee should be able to produce evidence that the job holders actually understand the requirements of their jobs as defined by the licensee.

Contracting. An emerging trend in plant maintenance and support is the increased employment of contractors to replace traditionally plant based personnel. Whilst this has financial benefits for the utility it often comes at the expense of safety, either directly as a result of lower contractor standards or the indirect effects on permanent plant employees.

Technology issues

Plant conditions. Plant conditions provide a useful and valuable insight into the general health of an organization's safety culture. It has long been recognized that poor house keeping standards are an indicator of behaviour and attitudes that are not likely to be conducive to the development of a sound safety culture. Other indications are lack of attention to alarms or non-repair of mal-functioning equipment, overdue maintenance work or poor information recording and archiving systems.

4. SELF-ASSESSMENT

The nuclear industry in general is getting to a more and more mature stage and the future for continuing the safety enhancement will be with safety culture and especially self assessment which correspond to the stage 3 described above.

Ensuring operational safety is an obligation on the nuclear power plant operating organization. Characteristics of operational safety include: conservative decision making; operation of the plant within the safety analysis envelope; maintenance of defense-in-depth against unplanned events and their consequences through high levels of equipment reliability and human performance; and ensuring that all plant and procedure modifications are adequately considered for safety consequences. Self-assessment of operational safety has been identified as an important mechanism that organizations can use to improve safety. Independent external assessment, carried out by a body that is external to the utility, is not considered to be part of the self-assessment processes described here but should be used as confirmation of self assessments.

The purpose of self-assessment is to promote improved safety performance through the direct involvement of

personnel in the critical examination and improvement of their own work activities and work results. It is designed to ensure that line management is effective and monitoring operational safety performance and takes timely corrective actions to improve performance. At lower levels of the organization potential weaknesses can be detected and often resolved well before they reduce any margin of safe operation. Self-assessments are also designed to identify and overcome process weaknesses and obstacles to the achievement of safety performance objectives. As a result the allocation of resources can be prioritized.

Self-assessment is essentially a critical comparison of existing activities and results against a predetermined set of performance expectations. The full set of performance expectations can be the set of goals, targets and objectives, including those set by the organization management, that are to be followed and achieved by the staff as a whole and may include performance expectations other than safety. The performance expectations should be set by:

- taking into account regulatory requirements as a minimum level ;
- considering attributes of the top performing plants in relevant areas ;
- looking at best practices identified through information exchanges, international organizations and institutions.

Targets should be reviewed on a regular basis to ensure that performance continues to improve.

Experience of the application of self-assessment has shown that the following benefits can be gained from an effective programme. It maintains a continuous assessment of safety throughout the whole of the organization; this allows improvements to be made based on up-to-date factual knowledge and the objectives to be achieved.

Staff awareness of the self-assessment process can result in a better understanding of safety culture, of performance expectations and can broaden staff knowledge of the objectives to be achieved, and how they can be reached. Self-assessments can help to improve communication and working relationship across all levels of the organization.

A strong commitment to the self-assessment process can motivate staff to seek improvements in safety performance and in developing a greater sense of ownership and openness in which staff feel confident in bringing problems forward and in suggesting improvements.

The self-assessment process, in conjunction with other forms of internal and external assessments, is a major factor in reaching the desired overall performance expectations and maintaining and enhancing safety culture.

Although the primary beneficiary of strong self-assessments will be the plant and operating organization, the results of the self-assessments could be used, for example, to increase the confidence of the regulator in the safe operation of an installation

The commitment of the individuals and management at all levels is needed for the success of a self-assessment programme. This includes active involvement in developing and implementing the self-assessment plan.

Some organizations provide specific training for employees who have responsibilities for self-evaluation/assessment to ensure that the task is conducted to an acceptable standard. Some organizations are providing a wider range of their workforce with self-checking training to encourage employees to assume an individual responsibility for their personal safety and those of their colleagues. Such training can assist in identifying unsafe acts or unsafe conditions.

Independent evaluations and audits are conducted by competent people independent of the area or activities being audited. This can be achieved either by using external consultants or by using employees from different sections,

departments or sites to audit their colleagues. Those with auditing responsibilities will generally require specific training in this task to ensure competence.

Review and audit activities in the nuclear industry are commonly used. Those which focus merely on compliance can create a negative image of audits in the eyes of employees and can create difficulties for auditors in their work. Some organizations have changed the role of audits from the exclusive identification of non-compliance to include the identification of improvement opportunities. Auditors, by the nature of their work, have the opportunity to observe "best practices" in the organization, and audits can be used as a means of disseminating information about best practices to all parts of the organization. Judgement of what constitutes "best practice" is subjective to a degree and the inclusion of this supplementary requirement may present difficulties for the traditional quality assurance audit.

A feature of many successful audits is that there is a pre-audit meeting between the auditors and the auditees to discuss and agree the scope and programme for the audit. This involvement by the auditees does much to ensure that the auditors' work is perceived positively.

Self assessment will soon become the key to continued safety management progress.

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