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Need for a Safety Culture in the Nuclear Facilities of Saudi Arabia

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Abstract: With the inception of the King Abdullah City of Atomic and Renewable Energy (KA-CARE) in the Kingdom of Saudi Arabia (KSA), the future of Nuclear Power looks promising. Although the addition of nuclear power will help solve the energy related issues of the country, however, it will also be a challenge to build a Safety Culture in nuclear facilities in a short span of time. Safety culture is essentially anassembly of characteristics and attitudes in any organizations and individuals, which establishes that, as an overriding priority, nuclear plant safety issues will receive the attention warranted by their significance. Since the history of nuclear power in the Kingdom is still in infancy, attention to safety will involve the participation of many elements of organizations and for individuals at all levels and in all types of activities. Key features wouldinclude individual awareness of the importance of safety; knowledge and competence, conferred by training and instruction of personnel and by self-education; commitment, requiring demonstration at senior management level of the high priority of safety and adoption by individuals of the common goal of safety; motivation, through leadership, the setting of objectives, systems of rewards and sanctions and through individuals' self-generated attitudes; supervision, including audit and review practices, with readiness to respond to individuals' questioning attitudes and responsibility, through formal assignment and description of duties and their understanding by individuals. The essential components of the safety culture have been discussed in depth in this paper.

Key words: Plant safety · Organizations · Safety culture · Motivation · Framework

INTRODUCTION

In any organization, the manner in which people react to an emergency situationis conditioned,to a large extent, on the requirements that has been set at the planning stage atthe highest level. For nuclear plant safety issues the highest level is at the legislative level, where the national basis for safety culture is provided. Within an organization, similar considerations apply. Policies promoted at a high level create the working environment that condition individual behavior. An organization pursuing activities with a bearing on nuclear plant safety makes its responsibilities well known and is underscored in its safety policy statement. This statement is provided as guidance to staff and to declare the organization's objectives and the public commitment of corporate management to nuclear plant safety. Implementation of these safety policies requires that accountability in safety matters is clear. Adequate resources are devoted to safety, as outlined in Figure 1.

Large organizations with significant impact on nuclear plant safety provide independent internal management units with responsibility for the surveillance of nuclear safety activities. As a matter of policy, all organizations arrange for regular review of those of their practices that contribute to nuclear plant safety.When corporate level commitment for safety is publicly asserted and well known, it shows the stance of corporate management in relation to its social responsibilities and demonstrates also an organization's willingness to be open in safety matters [1].

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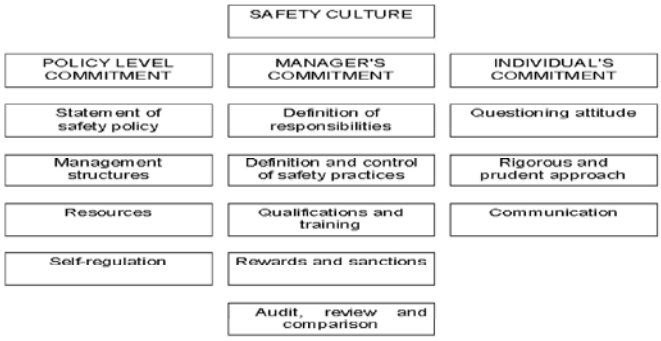

Fig. 1: Basic elements of safety culture

The attitudes of individuals are greatly influenced by their working environment. The key to an effective safety culture in individuals is found in the practices molding the environment and fostering attitudes conducive to safety. It is the responsibility of managers to institute such practices in accordance with their organization's safety policy and objectives.Unique and clear lines of authority facilitate discharge of individual responsibilities. Managers ensure that work on matters related to nuclear safety is carried out in a rigorous manner.

Managers ensure that their staffs are fully competent for their duties. Instruction instills more than technical skills or familiarity with detailed procedures to be followed rigorously. These essential requirements are supplemented by broader training, sufficient to ensure that individuals understand the significance of their duties and the consequences of mistakes arising from misconceptions or lack of diligence.Ultimately, satisfactory practice depends on the behavior of individuals, as influenced by motivation and attitudes, both personal and group. Managers encourage and praise and seek to provide tangible reward for particularly commendable attitudes in safety matters. Managerial responsibilities include the implementation of a range of monitoring practices which go beyond the implementation of quality assurance measures and include, for example, regular reviews of training programs, staff appointment procedures, working practices, document control and quality assurance systems. It is the task of managers to ensure that their staff respond to and benefit from this established framework of practices and, by attitude and example, to ensure that their staff are continuously motivated towards high levels of personal performance in their duties [2].

It is the task of staff at all levels is to respond to and benefit from the framework for an effective safety culture. The response of all those who strive for excellence in matters affecting nuclear safety is characterized by:

- A questioning attitude,
- A rigorous and prudent approach
- And communication.

The result will be a major contribution to safety.Before an individual begins any safety related task, his or her questioning attitude raises issues such as those listed in the following:

- Do I understand the task?
- What are my responsibilities?
- How do they relate to safety?
- Do I have the necessary knowledge to proceed?
- What are the responsibilities of others?
- Are there any unusual circumstances?
- Do I need any assistance?
- What can go wrong?
- What could be the consequences of failure or error?
- What should be done to prevent failures?
- What do I do if a fault occurs?

In the case of relatively routine tasks, for which the individual has been fully trained, question and answer will be automatic to a large extent. For tasks with a novel content, the thought process becomes more deliberate. New and unusual tasks that have important safety content will be the subject of written procedures clarifying these matters.

Individuals Adopt a Rigorous and Prudent Approach. This Involves:

- Understanding the work procedures.
- Complying with the procedures.
- Being alert for the unexpected.
- Stopping and thinking if a problem arises.
- Seeking help if necessary.

- Devoting attention to orderliness, timeliness and housekeeping.
- Proceeding with deliberate care.
- Forgoing shortcuts.

Individuals Recognize That a Communicative Approach Is Essential to Safety. This Involves:

- Obtaining useful information from others.
- Transmitting information to others.
- Reporting on and documenting results of work, both routine and unusual.
- Suggesting new safety initiatives.

A questioning attitude, a rigorous and prudent approach and necessary communication are all aspects of an effective Safety Culture in individuals. The product contributes to a high level of safety and generates a personal pride in dealing with important tasks in a professional manner.

Developing Safety Culture in Nuclear Activities: The Safety Report "Developing Safety Culture in Nuclear Activities" provides further advice on how to classify organizations according to the status of safety culture (three stages of development) and on the basis of this classification advice is given how to develop safety culture further. The report could be a starting point for nuclear facilities, specifically in the Kingdom, to implement a safety culture environment in the facility. The Safety Report also highlights useful practices in this development. The three stages of development highlighted could be:

Stage I: Safety solely based on rules and regulations,

Stage II: Good safety performance becomes an organizational goal and

Stage III: Safety performance can always be improved.

Stage I:
Safety Solely Based on Rules and Regulations: At this stage, the licensee 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. For an organization such as the Safety Commissions in the Kingdom, which would rely 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-making 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.
- Production is 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: A safety organization in the Kingdom, at this stage has a management, which perceives safety performance as important even in the absence of regulatory pressure. 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 based on 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 production 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: The Safety 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 behaviors are seen within the organization, which enable improvements to take place and, on the other hand, there are behaviors, which act as a barrier to further improvement [3].

Consequently, people also understand the impact of behavioral issues on safety.

- The level of awareness of behavioral and attitudinal issues is high and measures are being taken to improve behavior. Progress is made one step at a time and never stops.
- 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. In addition, 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. Irrespective of the size of the organization a pre-requisite for the development of a good safety culture is the visible commitment of the person or persons responsible for leading the organization or group.There is a wide range of practices that are of potential value in the practical development of a progressive safety culture. Most of these practices are already identified in INSAG-4 but some practices not specifically mentioned in INSAG-4 are already commonly accepted as being of value in the development of an effective organization. A subset of practices, which are judged to be of particular relevance to the development of safety culture, is described later in more detail [4].

The Concept of Vision, Mission, Goals and Values: Within an organization, safety culture is a subset of the wider organizational culture. Many practices, which are used internationally to improve organizational effectiveness, can contribute to developing improved safety. This section contains information on some of these general practices.

Many organizations recognize the importance of ensuring that there is a unity of purpose among their employees and that they are motivated to achieving the organizational goals. These organizations also recognize that guidance should be given to employees on how they should behave towards each other and towards others external to the organization.

Openness, trust and two-way communication are keystones to establishing effective organizations. The concepts of vision, mission, goals and values are often used to achieve the above desired requirements. Although normally used in a business-planning context, these concepts can also be usefully applied to promote safety improvement.

The individual concepts are briefly described below in the context of safety.

Vision: The vision describes in a few keywords the future aspirations of the organization and paints a picture of where the organization would like to be in future. The time scale for achieving the vision will vary with each organization, but generally the time scale is several to many years. A vision can be used to align the efforts and energies of employees. An example of a safety related vision for an organization would be “to be regarded as the best safety performer in its sector of industry. The creation of the fundamental vision is the responsibility of top management but it is essential that employees have an opportunity to learn and understand the driving force for the vision so that they are committed to achieving it. There is a great responsibility on all managers to communicate the vision to their workforce.

Mission: The mission briefly summarizes in a few paragraphs what has to be done in order to achieve the vision. It may refer to the organization’s intended relationship with employees and external groups. It may also contain quantitative targets and can undergo change during the time frame of the vision. An example of a safety related mission would be “to improve safety performance such that the organization is in the top 25% of performers in radiological, environmental and conventional safety”. When this mission is achieved the journey towards the achievement of the vision may require the “top 25%” to change to the “top 10%” and so on.

Goals: There will be a range of actions that have to be taken to achieve the mission. Each action will have a specific goal. Each goal can be regarded as a focal point for an action plan within the organization and serve as motivation for employees. An example of a safety related goal is “to reduce the average radiation exposure of employees by 10% during the next year.

Values: Values are those standards and principles, which people in a group or locality might share. Values govern attitudes, which show themselves in the behavior of people towards each other. In organizations values will be present implicitly. The aspirations of an organization for how people should be treated and how the people themselves want to be treated, may be explicitly stated in values set by top management. These values have to be shared and must be made known to all levels of the organization. They are considered inviolate. A value that addresses safety is that “safety is never compromised”.

Process for Developing and Implementing a Vision, Mission, Goals and Values: It should be emphasized by the Safety Organization in the Kingdom that the real power of these concepts is less in the words created than in the process used to create it. Employee involvement is essential, but there is a particular emphasis on top managers and their subordinate managers to lead, communicate and seek input from their workforce. These concepts have no benefit unless the workforce genuinely shares them.

Developing a safety related vision; mission, goals and values may be a good starting point and a focal activity for initiating improvements in safety culture. Once the vision, mission, goals and values have been developed, a strategic plan should be developed to facilitate its implementation. This strategic plan should include policy, organizing, planning and implementation, a means of measuring performance and review mechanisms, supplemented by appropriate audits[5].

Coaching of employees by managers to improve safety performance is important. There should be a process of continuous evolution of improved safety rather than satisfaction with achieving safety targets. In some organizations, use is made of individuals who have special skills in encouraging change in human attitude and behavior. These individuals are referred to as facilitators. Some general characteristics of a facilitator are shown later in this presentation. In some organizations the manager would assume the role of facilitator.

The facilitator has to help others cope with change and act as a teacher of skills to teams and leaders. This should incorporate any feedback and constructive dialogue on safety culture. Whoever undertakes the role of facilitator must model and exemplify the behaviors and attitudes of any new culture developed for the organization.An on-going activity for this individual is the constant coaching and encouragement of all staff, including managers in learning new attitudes and behaviors with the emphasis on promotion of feedback of progress [6].

Experience has shown that organizations characterized as being very open to the public, professional associations and the regulator as well as internally have gained in both public confidence and in the successful management of safety. Confidence and trust can easily be lost when secrecy and a tendency to cover up on failures is discovered. It will generally take a long time before confidence and trust can be recovered. Openness is also a basic requirement for the sharing of experiences, which in turn, provide a basis for an organization's ability to learn and improve over time.

Most successful organizations actively encourage teamwork among their employees. A team is a group of people who are committed to work together to achieve some common objectives. The combination of individuals in teams generally results in a more effective solution to a problem or achieving an objective. This is particularly true when the problem is of a complex nature and its solution requires the input of different disciplines. Many organizations, recognizing the benefits of teamwork, have invested in training their employees to work effectively in teams. By providing their employees with some basic understanding of group behavior and the stages of development that groups undergo, they have enhanced the quality of teamwork. Some organizations have also trained employees in techniques that allow a structured approach to problem solving and this training has been combined with team development. Excellent teamwork is beneficial to all aspects of the organization and is of particular benefit for safety, which often depends on the effective relationship between groups or between individuals. It is important when using teams to undertake work that there is no dilution of accountability and that accountability is clearly defined at the individual level [7].

The high quality standards attained by nuclear installations could not have been achieved without extensive teamwork both within the organization and with groups external to the organization e.g. contractors.It is important that strong team loyalties should not prevent openness in reporting safety related failures or near misses.

Continuous Evolution of Improved Safety Performance: The Nuclear Safety organization in the Kingdom will need to focus on "continuous evolution". In other words no matter how well the organization is currently performing, it always needs to be looking at how it might perform better still. This includes looking at ways current systems and processes might be improved and also looking at how advantage can be taken of changing technology. Continuous evolution is most effectively sustained by focusing on improvements generated by employees. It is recognized that the design of a nuclear facility has to be frozen at some stage, but this does not prevent evolution of future design standards.

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 behavior and leadership example by management, 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 [8].

To support the development of a good safety culture management and staff 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 Board of Management of an organization, which possesses the highest level of executive authority should routinely discuss and review safety performance. A practice adopted by some Boards of Management is to nominate one of their members to assume a special responsibility on behalf of the board in monitoring safety performance and the proactivity of line managers in implementing plans that include seeking improvements in safety.

Development of a strong safety culture can result in more effective conduct of work and a sense of accountability among managers and employees. They should be given the opportunity to expand skills by training. Thus, the resources expended result in tangible improvements in working practices and skills. This consideration should encourage further development to improve safety culture.Safety culture is important in that it is an influence on behaviours, attitudes and values, which are important factors in achieving good safety performance [9].

Management of Safety: "Safety" is the pivot in the public debate on nuclear energy. It is a prerequisite for its future, as it was the centre of our endeavours for development in the past, from the very beginning of nuclear electricity production. Looking back, we can distinguish three different approaches to enhance safety:

- From the start and in the phase of the commercial breakthrough of nuclear power plants, the focus has been on technical solutions. Pursuing this strategy, we developed very reliable, but complex machines. With increasing success, reliability and safety tended to approach a limit, all further improvements were more and more counterbalanced by added complexity.
- Then, human performance problems became the focus of attention. This brought about significant improvements of the man-machine-interface, leading to a substantial lower probability of a human being to err when performing his job in a NPP. But again, we gradually seem to approach a limit that cannot be exceeded when following this strategy: Increasingly more of the fixes of problems we establish, either simply do not hold for a long time, or they just create another problem somewhere else.
- For further real improvements, we have to go beyond technical design and beyond the performance of individuals and their interactions with components and technical systems. We have to include into our reflections and endeavors also interactions between individuals, collective social and organizational processes and managerial policies and practices. Psychologists speak e.g. of "super individual and self-regulating structures" and "behavior settings", in the nuclear industry, we have introduced the term "safety culture" [10].

The organized process to improve the safety culture is the "management of safety". The "management of safety" shapes the environment in which people work and thus influences their behavior and attitudes to safety.The "management of safety" is an integral part of the quality assurance program of an organization. It comprises all the organization's arrangements for safety. Like the safety itself, the "management of safety" is the responsibility of the operating organization ("self-regulation", no dilution of responsibilities).

Objectives of Management of Safety: A shorter definition comes from the Confederation of British Industry:

"Safety culture is the way we look at things and the way we do things around here".

An important factor of safety culture is that it is more than the sum of its parts, it is a collective commitment to safety. Therefore, the "management of safety" must not focus only on individuals, but rather on the organisation as a whole. The general objective of safety management, to enhance safety culture, is too abstract to be operable. It can be subdivided in four sub-objectives, which are more tangible.

High Safety Standard: To develop the safety standards of nuclear power plants in the Kingdom of Saudi Arabia as high as possible one needs no justification. It is important to make clear that high standards of safety have to be achieved by both, the organizationand individuals.

No Conflict Between Safety, Production and Cost: In running the Nuclear Power plants in the Kingdom, it must be recognized that safety should not be jeopardised in the pursuit of production targets. On a long-term basis, only a safely operated plant can meet competitive goals. "Safety management" has to sharpen the awareness of managers and staff for this strategic view, to make it the basis of day-to-day decisions and to ensure that the pressure of short-term optimisation does not override this long-term recognition.On the other hand, to be fair, an absolute priority of safety over costs can never be reached and on an ethical basis, it even would not be acceptable. As everything else, safety is subject to the law of declining marginal utility. The higher the safety, the more money has to be spent to gain only a small increase in safety. Above a certain limit, it is not justified to use this money for that small advantage, when it could bring much higher benefits if used to reduce other risks or even real harm [11].

But this triviality must not be abused to refuse a very high ranking of safety and to reject any reasonable improvement in safety matters. Fortunately, this problem is reduced by the simple fact that most measures to increase safety simultaneously also increase reliability and very often reduce operating costs, for example improved planning and work control, clearer accountabilities, reduced organisational interfaces, better communication and team work and so on. The "management of safety", properly done, is largely identical with a more effective "management of works". Reasonably looked at, conflicting goals between safety enhancement and cost reductions are rather rare events and they can be decided upon in a rational manner, giving safety the attention needed [12].

Communication Between and Co-operation of All Units and Levels: For complex tasks, which require teamwork, communication is one of the key factors for effective and successful performance. Good communication brings about three essential advantages: It is a good defense against misunderstandings, it helps to override hierarchical and departmental barriers and it contributes to satisfactory working conditions, which on their side improve the motivation of workers on all levels.

More Effective Conduct of Work: Effective conduct of work is a prerequisite for competitiveness and for safety and simultaneously, it creates satisfaction with one's work, which again is the basis for motivation.

Features of the "Management of Safety": The safety management program has to ensure good safety performance through the planning, control and supervision of all safety related activities. To fulfill this, the "management of safety" should comprise the following 5 features:

Definition of Safety Requirements: The Kingdom Safetyorganisation in the Kingdom should express its commitment to high safety performance in a clear and unmistakable way, for example in a vision or mission statement defining safety requirements. In addition, it should specify the responsibilities and activities required to ensure safety and to satisfy legal, regulatory and company requirements and it should provide the resources (sufficient and competent staff, tools and equipment) necessary to achieve all that. In a consistent framework, safety management should define what needs to be done, to what standard and by whom.

Senior managers should develop ownership and active support of the organisation's safety policy and they should eagerly disseminate it throughout the whole organisation. All managers should understand their roles and responsibilities and should ensure that all individuals concerned are aware of and accept their safety responsibilities and have the capability and the appropriate resources to discharge these responsibilities effectively [13].

Ensuring High Safety Standards in Planning and Control: Safety management has to ensure that all safety related activities are properly planned and controlled, including identification of risks to health and safety, selection of procedures and precautions and - if

appropriate - arrangements to cater for emergencies. It also has to determine work authorisation requirements systematically.

Ensuring High Safety Standards in Work Performance: To attain high safety standards in work performance, safety management has - amongst others - to ensure that all staff have the competence required and it has to provide for effective communication and team support. The latter should help to understand and accept safety arrangements, reduce error probability, improve feedback mechanisms and enhance satisfaction at work and thereby motivation for good performance.

Additionally, safety management has to support good safety practices and to correct poor practices. Presence of managers in the work place, appropriate awards and sanctions and encouraging the reporting of "near misses" can help to obtain that goal.

Encouraging Safety Related Attitudes and Behaviour: Questioning attitude, rigorous and prudent approach and good communication are the characteristic features of a good safety culture. It is the task of safety management, to improve all three of them, in order to obtain an ever-higher safety culture. The shaping of attitudes and behavior is a much more demanding task than the – equally necessary – task of improving competence and skills of individuals. It is the real core of the "management of safety" and, in spite of all doubts, it can be met successfully. We do perform this task in NPPs all over the world and we do have some success in our endeavors. But it is my personal impression that, in a large number of cases, the success could be increased by applying a more systematic approach, or with some outside assistance. We at WANO are preparing for such assistance to our members [14].

Improving Feedback on Safety Performance: To facilitate an effective feedback system, safety performance must be measured routinely. The measures should have the capability to highlight whether the safety performance of the organisation is being maintained or improved and they should also allow the underlying causes of any performance deficiency to be identified. This is essential, if appropriate counter-measures are to be identified. Measuring the safety performance is both easy and delicate, simultaneously.

After measures have been defined, audits and reviews should be performed on a regular basis. They should cover all safety-related areas and should be carried out either internally or through independent institutions on a peer basis. IAEA, WANO and INPO offer corresponding services.

In response to findings in audits and reviews, appropriate corrective actions have to be identified and implemented. The safety management has to ensure that this is done systematically and includes an assessment of the effectiveness of the corrective actions after their implementation. Specific Safety Management Issues

Flexibility: The description of the "management of safety" given above is neither complete nor generally applicable. In any case, due allowance should be given for adjustments to different cultures in different countries and in different companies. It is the overall effectiveness that counts, not the specific composition.

Effectiveness: The "management of safety" sets the framework for all endeavours to enhance safety culture. But it should be clearly pointed out that even the most perfect framework can never substitute the commitment of the individuals concerned. A more perfect framework is a help to reach the goal with a higher degree of probability, but it can never be a warranty. To enhance safety culture, the "right" individual attitude of the senior managers is indispensable. If the senior managers do not feel it 1necessary to improve the safety culture, no framework and no system, however perfect, can be successful.

Another problem with perfect systems holds even for "willing" people: Whenever a system is very perfect, people tend to perceive this system as a means that automatically achieves the goal, without the need for strenuous individual effort; the "system" solves the problem, not individual strain and engagement. This subjectively felt sense of relief from individual challenge and responsibility is a common phenomenon in case of perfect systems and also holds for the "management of safety". A good system is essential; a perfect system can create new problems.

Finally, to reach a high effectiveness level, all employees, managers and staff, have to accept the goal of high safety performance and to understand the processes and procedures the organization has chosen to pursue that goal. They have to do what is right, because they know what is right, not because it is required.

Sustainability: Humans tend to choose the easiest way, to forget things, to stop thinking and to transfer carefully considered procedures into automatically followed routines. Therefore, safety culture is an inherently

declining feature. If we do not continually strive to enhance it, it gradually degrades. We constantly have to move forwards, ever standing still means stepping backwards. The management of safety has to establish an ongoing learning process as part of the safety culture, otherwise an established standard cannot be maintained [15].

Performance Indicators: Monitoring the safety performance is a management responsibility. The use of quantitative performance indicators has a lot of advantages (e.g. enabling trending, goal setting and benchmarking with other plants), but care should be taken not to give them too high a value in order to avoid misleading effects. For example, if reaching a low number of "unplanned automatic scrams" is valued very highly, pressure could rise to adjust the set points for triggering the scram "appropriately". Or, with regard to the "collective dose", people could find themselves seduced to reduce equipment tests, or they could welcome a reason for not performing inspections of the workplace and work practices (this problem is independent of the more general dispute on the appropriateness of this indicator due to substantial doubts regarding the validity of the linear-no-threshold hypothesis, which is the base of the "collective dose"). As a last example, the number of "significant events" as a performance indicator could increase tendencies to cover up or to play down the importance of the event. Very probably, every indicator can exert negative influences, if it is valued too highly. So, performance indicators are useful and probably even necessary, but they should be used with care and the management should clearly explain their limited importance.

Self Assessment: As already stated, safety culture tends to degrade with time. This problem is amplified by the very nature of humans, which impedes early recognition of declining performance. First signs and precursors are often denied or just regarded as isolated cases. This psychological defence mechanism is principally stronger when the information about negative signals comes from outside institutions. The other way around, it is generally easier to accept unpleasant news, if they are detected by one's self. Therefore, it is preferable for an organisation to have an internal or self evaluation program. This self assessment generally can identify signs of degradation earlier than an external audit or review. If detection is left to the latter (or even to actually occurring events), the required corrective actions are often far more extensive and expensive to implement. Of course, the critical self-assessment has to be complemented by clearly prioritised action plans, which address the root causes and which are pursued rigorously.

The self-assessment reinforces the responsibility of the operator. But to avoid complacency and professional blinkers, the self-evaluation program should be supported by periodic external peer reviews. The frequency of these external reviews can be much less than that of the internal assessments, but from time to time an external check seems to be a sound corrective.

Indivisibility: Safety is indivisible. Low standards in industrial safety or in housekeeping, a large backlog in maintenance work, a poor archiving system and all similar conditions give clear evidence of threats to nuclear safety.

Top is Top, but Only the Number Makes it Work: The strong commitment of senior management is a prerequisite to establish and maintain a high safety culture. But the strongest commitment from senior managers cannot compensate for lack of support from the whole staff. Only if all employees (or at least most of them) take ownership of a program to enhance safety performance continually, a really high standard can be reached. Senior managers can work as hard as they like, without support of their staff they will never reach a high level of performance. The quality of individuals is important, but the quantity of support decides the level which can be reached. The "management of safety" has to find the means to get real support from all employees.

Safety Is the Sum of 1001 Nothings: There is no single big strike by which one can reach a high level of safety performance. Rather, it is always a long and strenuous way with thousands of small steps, most of them seem to be only of secondary importance, but they all contribute to the great goal and none of them can be left out without endangering the goal. It is the task of the "management of safety" to make sure that all small steps are taken seriously and are implemented properly.

Group Behaviour: Groups bring about a diffusion of responsibilities and they tend to develop common opinions. This undermines questioning attitudes and, together with the encouraging feeling of shared judgement, it actually leads to higher risk taking. The "management of safety" should be aware of these psychological effects. Their principles and appropriate countermeasures should be integrated into training programmes and, very importantly, responsibilities should strictly be assigned to individuals, not to groups.

Error Management: How an organization deals with errors has a key influence on how well it can obtain a high safety culture. Two features are essential and the "management of safety" has to ensure that they are established firmly in the organization: First, errors should be regarded as a chance for learning, instead as a reason for punishing. Errors should be pulled out of the taboo corner and discussed openly. The better the communication on errors, the higher the safety performance (and the commercial performance!) of an organisation. Second, the goal of "preventing errors" should be complemented by the goal of "managing errors", that is handling the consequences of an error effectively. Since errors can never be avoided completely, we have to learn to cope with them. And finally, we should keep in mind that an individual error is always embedded in organisational processes, the subject of the "management of safety".

CONCLUSION

Finally, the safety organization in the Kingdom needs to consider the following:

Errors, weaknesses and areas for improvement are often known for substantial times, but countermeasures taken - if any - just alleviate the problem enough that operation can go on and do not really address the root causes, or simply are not followed rigorously until the problem is really solved. Recurring events, continued improvising and unacceptable high numbers of unresolved problems with overall reduced safety margins are the consequences. The "management of safety" has to establish and reinforce procedures that ensure timely, complete and sustainable solutions to all problems arising.Training has to be viewed as an investment, not a cost. The "management of safety" has to make sure that training needs are identified for each job profile and each individual and that training is performed at high quality. A good means is to use staff members as trainers, because mentoring/coaching is the best learning, but that must not compromise the quality of the training sessions. The training should include learning from failures and learning from successes and from good practices.

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