

Safety Culture Program for Nuclear Facilities

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Context

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3- FEATURES OF SAFETY CULTURE:

3-1 Safety Culture Definition

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

As it is said in the INSAG-4 [2] the safety culture has two general components. The first is the necessary framework within an organization and the responsibility of the management hierarchy, the second is the attitude of the staff at all levels in responding and benefiting from the framework. Thus the management of safety and the involvement of staff are key factors achieving a good safety culture. On the other hand it is recognized that safety and quality are synonymous attributes in the good plant performers [2], [3].

The main culture principles can be summarized in:

- Looking toward excellence in nuclear safety matters.
- Achieving optimum reliability.
- Placing adequate human and economic resources.
- Establishing quality in organization structure and plant operation.
- Incorporating technology innovation.

The global objectives is to achieve:

- Safety improvement.
- Optimum efficiency.
- Quality measures.
- Innovation processes.

A number of landmark IAEA reports [1],[2],[3],[4] and [5] form the basis for definition of Safety Culture.

"The Safety Culture of an organization is the product of the individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of an Organization's health and safety management. Organizations with a positive Safety Culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventative measures.

It is needed to combine a safety culture plan and a continuous quality improvement program so as to obtain the best possible safety and culture results, therefore a safety culture plan has to be formulated which establishes the vision, mission, principles, global objectives and specific objectives and tasks and of a continuous quality improvement plan with three phases: phase I-learn to work as a team, fix the methodology and look for the results, phase II-focused toward objectives, simplification and improvement of work processes, phase III look toward supporting recommendations and achieving the policy goals. Fig.1 illustrates a Viable Nuclear Energy Option [1]

VIALE "NUCLEAR ENERGY OPTION"

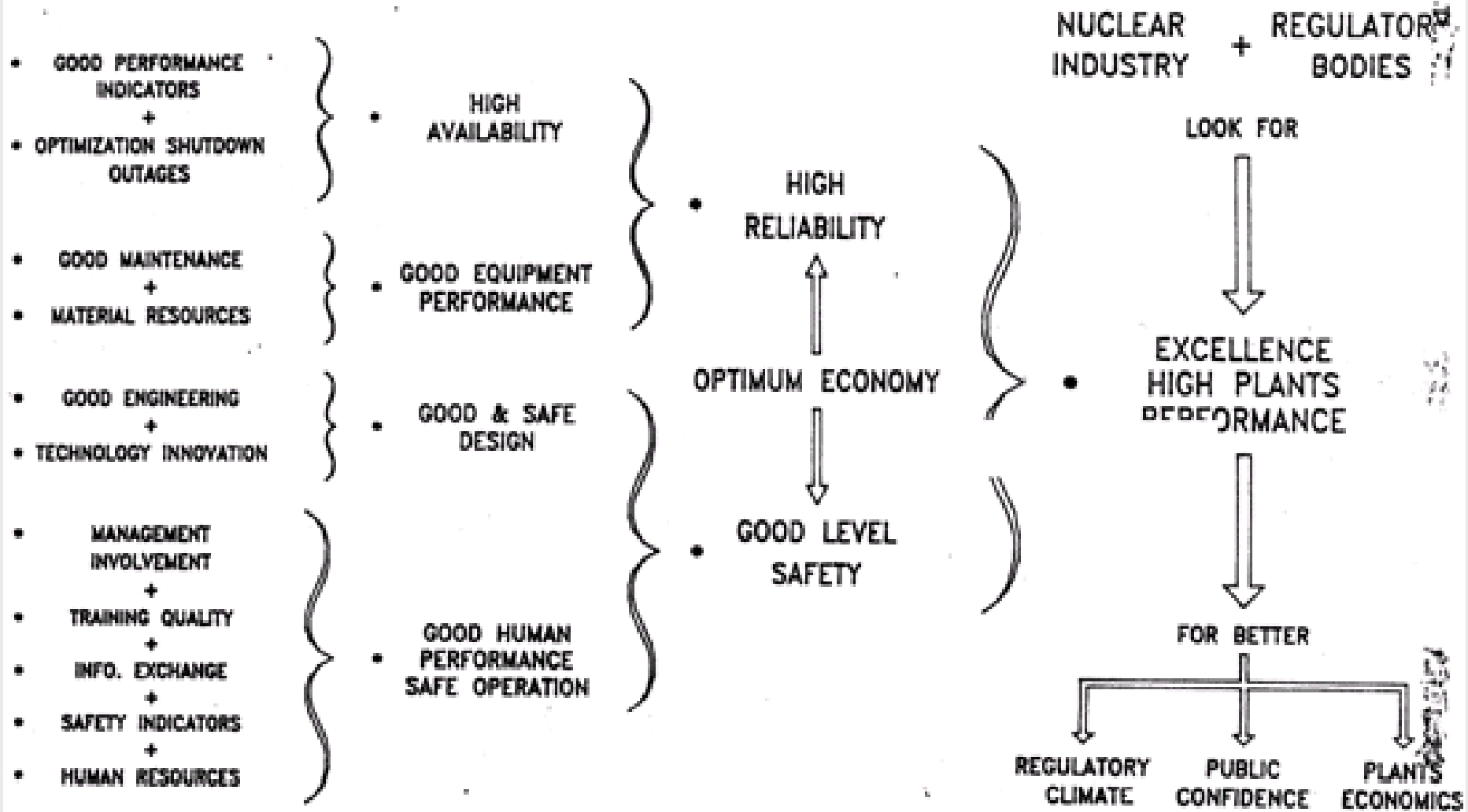


Fig 1

2- SAFETY AND SAFETY MEASURES:

2-1 General Approach to Safety

There is a worldwide consensus on the general nuclear safety objective [1], [2], [3], [4] to protect individuals, society and the environment from harm by establishing and maintaining in nuclear installations effective defenses against radiological hazards. This general safety objective is equally valid for innovative reactors and fuel cycle facilities as it is for existing systems. It leads to two complementary safety objectives, an objective for radiation protection and a technical objective. The two are interdependent.

2-3 Safety improvement

The following actions are guidelines for safety improvement [1]. [6].

- 1- Plan to improve technical specifications and operating procedures.**
- 2- Detailed severe accident program.**
- 3- Safety system functional inspection program**
- 4- Improvement in the evaluation of design modifications.**
- 5- Improvement in the operating experience analysis.**
- 6- Analysis of new international regulations and guidelines.**
- 7- Framework for regulatory body interface.**
- 8- Plan for continuous improvement in radiological protection.**
- 9- Collective radiation doses reduction program.**
- 10- New access to radiological controlled area.**
- 11- New measures for emergency response.**
- 12- Development of decommissioning standards.**
- 13- Development of safety culture assessment techniques better root-cause analysis.**
- 14- Performance indicators trends analysis.**
- 15- Marginal to safety issues and cost-beneficent licensing act.**

2-4 Optimum reliability and resources

The following measures have to be used to achieve optimum reliability [1], [3].

- 1- Maintenance program optimization.**
- 2- Scram and significant event reduction.**
- 3- Outages optimization.**
- 4- Unavailability factors minimization.**
- 5- Materials engineering.**
- 6- Improve quality of primary coolant.**
- 7- Reduction of activates at low power.**
- 8- Improve efficiency.**
- 9- Radioactive wastes reduction program.**
- 10- Plant life extension program.**
- 11- Spent fuel storage.**
- 12- Medium and low radioactive wastes storage.**
- 13- Plan for development of medium and long term human resources in the nuclear safety and quality unit.**

In all types of activities, for organizations and individuals at all levels, attention to safety involves many elements: Individual awareness, knowledge and competence, commitment, motivation through leadership, supervision and responsibility. Fig.2 illustrates the major components of safety culture including requirements at policy level, managers commitment and individual commitment [1], [2], [3]. Fig.3 gives selection of some important 16 cultural principles [1], [2], [3], [6].

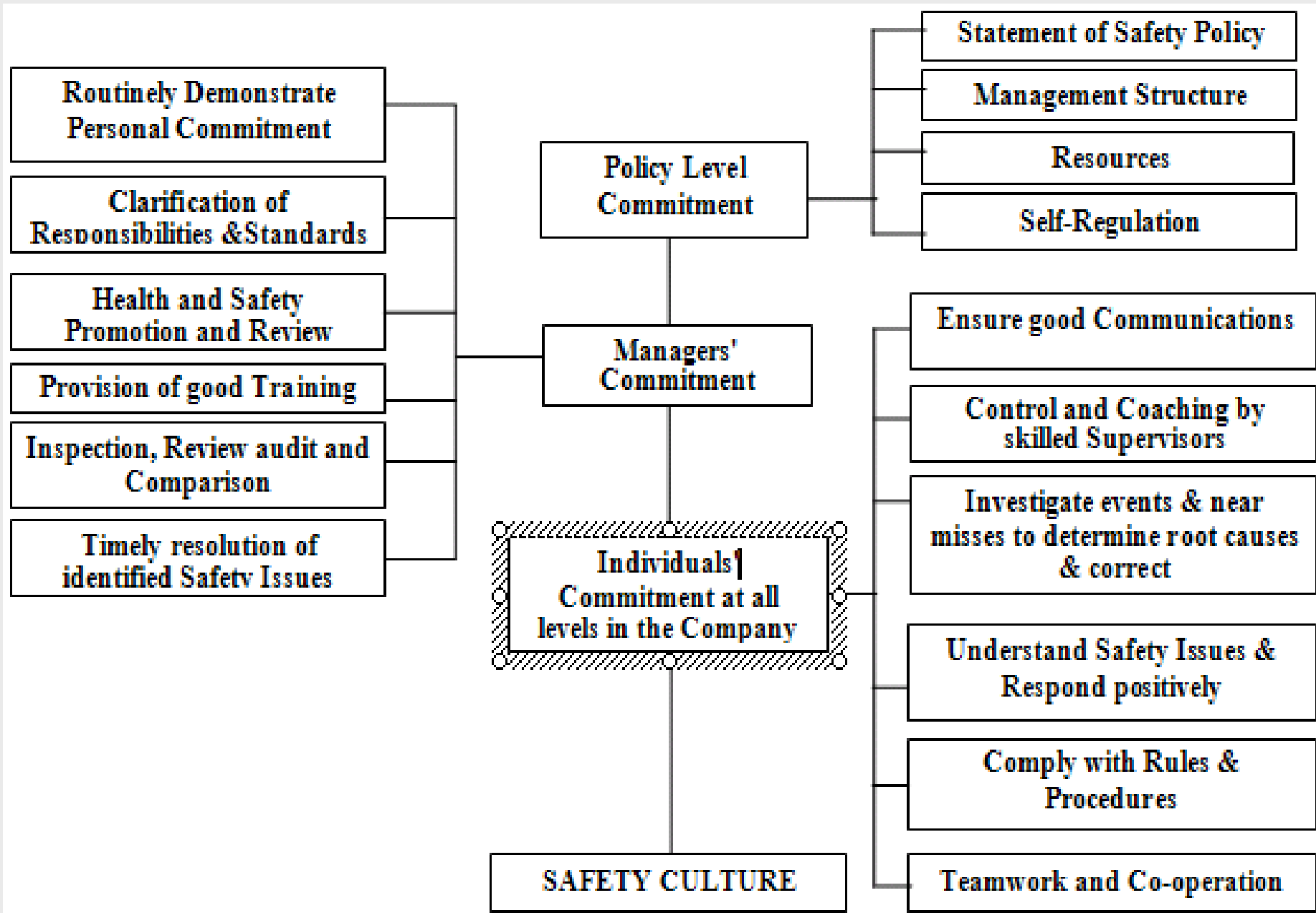


Fig 2: A Safety Culture Model

16 Cultural Principles

**Understanding and
commitment to common goals**

**Decision are made by the most
appropriate person**

**Self and system imposed
barriers are eliminated**

**Support and encouragement is
given to all**

**Individuals strive to work
together**

Everyone's views are valued

**Those most affected are
consulted in decision making**

**People are enabled to reach
their potential**

**Safety is never
compromised**

Information is shared

**Achieving high standards
through continuous
improvement**

**Strive to exceed customers
expectations**

**Individuals share
responsibility for their own
development**

**Individuals are aware and
contribute to business aims**

**Individuals skills are
identified and utilised**

**Visible recognition of effort
and achievement**

Fig 3

Developing safety related vision, mission, goals and values may be a good starting point and a focus of 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 their implementation. This plan should include policy, organization, planning and implementation, and a means of measuring performance and review mechanisms, supplemented by appropriate audits [1].

4- OVERALL ASSESSMENT OF SAFETY CULTURE:

4-1 Evaluation Model

Fig.4 illustrates a general model that provides a framework for a high level screening evaluation of safety culture. [1], [2], [3] the model identifies factors that can significantly influence safety culture. The potential benefit of the model is that it prompts consideration of the various influences on safety culture and can highlight areas that warrant more detailed consideration. Although the model is primarily qualitative, it can serve as a basis for a simple screening matrix that provides a quantitative dimension.



Fig 4: General evaluation model

4-2 Strong Safety Culture

A strong safety culture consists of three major factors, a viable management system; a widely shared awareness of nuclear hazards and widely shared behavioral norms and values.

A strong safety culture can be only expected in cases where the management system is implemented into actual behavior not because negative personal or group consequences are feared, but as a result of profound awareness about nuclear hazardous and positive social norms, attitudes and values of management and staff.

Poor safety culture comes up in cases where the existing management system is in itself undeveloped, insufficient or inadequate. Negative attitudes or disruptive informal social norms become predominant.

4-3 Safety Performance Indicators:

Most organizations record 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.

These can include [6], [7], [8]

- Average exposure mSv/year.**
- Collective exposure man-Sv.**
- People exceeding 15 mSv/year**
- Lost time due to accidents.**
- No. of forced shutdowns.**
- Extended periods of outage due to repair work.**

Some organizations use indicators of a more positive nature to complement the traditional passive indicators. 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 the previous month/quarter;
- Percentage improvement teams involved in determining solutions to safety related problems;
- Percentage of communication briefs that include safety information;
- Number of safety inspections conducted by senior managers/ managers / supervisors during the previous week / month (a safety inspection may be combined with a housekeeping inspection);

- Percentage of employees' suggestions relating to safety improvement;
- Percentage of routine organizational meetings with safety on the agenda.

This list is not comprehensive and is illustrative only. The value of positive safety indicators is that they serve as a mechanism for awarding recognition to employees who are endeavoring to improve safety by thought, action or commitment recognition for achievement. It is a powerful motivating force to encourage continued improvement [3] Fig.5 introduces the key elements of a safety management system.

5- STAGES OF DEVELOPMENT OF SAFETY CULTURE

Three stages of development seem to emerge each displaying a different awareness to emerge the effect on safety of human behavior and attitudes.

5-1 Stage 1–Safety Based Solely 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 behavioral 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 each one as it occurs.
- 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.
- 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.

5-2 Stage 11–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 growing awareness of behavioral 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 and 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 organizations 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 coordinate departmental and functional decisions.
- Decisions are often centered on cost and function.
- Managements` response to mistakes is to put more controls in place via procedures and retraining. There is a little less blaming.
- Conflict is disturbing and is 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. Safety is thought to imply higher cost and reduced production.
- The organization's relationship with regulators, customers, suppliers and contractors is distant rather than close; there 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 workplace. It is not understood why added controls do not yield the expected results in safety performance.

5-3 Stage-III Safety Performance Can Always Be Improved

An organization at stage III has adopted the idea of continuous improvement and applied the concept of safety performance. There is a strong emphasis on communications, training, management style, and improving efficiency and effectiveness. Everyone in the organization can contribute. Some behavior is seen within the organization which enables improvements to be made but there is also behavior which acts as a barrier to further improvement consequently. People understand the impact of behavior issues on safety.

The level of awareness of behavior 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 asks how it might help other companies.

- The organization begins to act strategically with a focus on the longer term as well as awareness of the present. It anticipates problems and deals with their causes before they happen.
- People recognize and state the need for collaboration between 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 organization 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 that safety is not jeopardized in pursuit of production targets.
- Almost all mistakes are viewed in terms of work process variability. It is more important to understand what has happened than to find someone to blame. This understanding is used to modify the work 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.

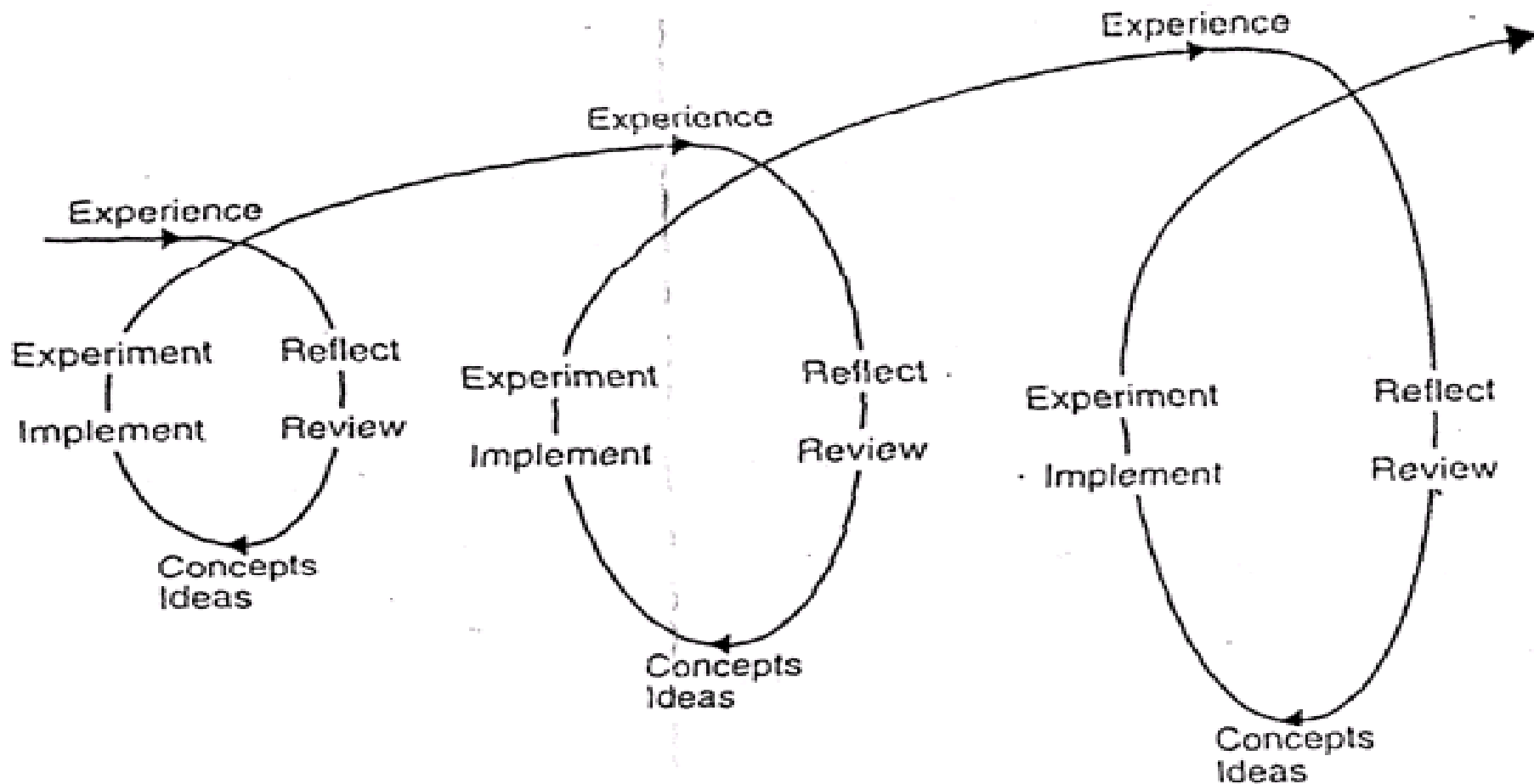
- Safety and production are seen as interdependent.
- Collaborative relationships are developed between the organization and regulators, suppliers, customers and contractors.
- Short term performance is measured and analyzed so that changes can be made which improve long term performance.
- People are respected and valued for their contribution.
- The relationship between management and employees is respectful and supportive.
- People are aware of the impact of cultural issues, and these are factors considered in key decisions.
- The organization rewards not only those who produce but also those who support the work of others. People are also rewarded for improving processes.

Irrespective of the size of the organization, a prerequisite for the development of a good safety culture is the visible commitment of the person or persons responsible for leading the organization or group.

5-4 Learning Process

The process for the development of safety culture can be assisted by the use of a learning process within an organization.

A simple model based on the Kolb learning cycle [8], [9] is shown in Fig.6. A person or organization learn by reflecting on what they have experienced, formulating concepts and ideas for change while continuing existing best practice. The implementation of such concepts and ideas is intended to improve performance and there by modify future experience. At an appropriate time this modified experience can itself be reviewed and lessons learned.



Scope

Stage I	Stage II	Stage III
Technical Solutions	Procedural Solutions	Behavioural Solutions
	Retraining	Culture

Fig 6: Simple model of organizational learning (after KOLB)

7- DETECTION OF INCIPIENT WEAKNESSES IN SAFETY CULTURE:

Symptoms of a Weakened Safety Culture:

Regulators have an obvious and legitimate interest in maintaining safety culture, and whilst it may not be practicable or appropriate for them to prescribe a safety culture, they have an important role to play in encouraging organizations to identify, understand and apply positive steps to improving safety culture [6], [8], [10], [11].

7-1 Organizations issues.

7-1-1 Pressure from external environment.

Many organizations are subjected to increasing economic and market pressures that are forcing them to significantly reduce their cost base. Organizational goals and priorities can change significantly and there is a potential for safety standards and performance to be adversely affected.

7-1-2 Inadequate resolution of problems.

Symptoms of inadequate resolution of problems 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.

7-2 Regulatory Issues

7-2-1 Corrective actions

One of the most obvious signs that safety culture is starting to weaken is evidence of a significant accumulation of corrective actions that have not been addressed. The existence of an effective program for self assessment, root cause analysis and corrective action is a positive indication of a good safety culture.

7-2-2 Inadequate resolution 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. 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. Information can be collected from formal or informal sources and where possible should be cross checked to validate its accuracy.

7-2-3 Procedural inadequacies:

An important element of safety culture is that employees should have confidence in procedures and use them correctly. However, it is essential that the regulator understands the system of regular documentation review and that any deterioration is detected at an early stage. Failure to detect and rectify "out of normal" situations regarding procedures, will lead to plant employees ignoring instructions, losing confidence in documented requirements and probably taking unilateral and unsafe actions.

7-2-4 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 performed and the correct solutions defined. The establishment of a review and analysis group at utility with the correct level of experience and qualifications will inspire confidence in the analysis process.

7-2-5 Lack or failure of independent nuclear safety reviews

For all safety related proposal and modifications, independent safety assessments should be undertaken by persons other than those who carried out the original work. In a healthy safety culture, these assessments will always have been fully documented and checked for methodological, calculation, and technical accuracy and validity using approved procedures.

7-2-6 Reality mismatch

The state, configuration and condition of the plant must at all times be fully consistent with the claims that are required in support of the safety case must never make demands on plant or personnel which are unrealistic or unreasonable.

7-3 Employee issues

7-3-1 Excessive hours of work

Working hours must be formulated and regulated to allow people to perform their duties within reasonable time-scales without imposing undue pressures which can induce unsafe and undesirable consequences.

7-3-2 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 is being paid to the quality and applicability of training programs.

7-3-3 Failure to use suitably qualified and experienced persons

All nuclear plant operations should be carried out by suitably qualified and experienced persons. Whilst this is a basic requirement and even a license conditions for many operating regimes, it obviously can not always be achieved in practice. Such failure tends to show itself in incident and accident event reports that conclude that further training / retraining of personnel is required.

7-3-4 Understanding of job descriptions

Typically in poor safety cultures, some individuals are not fully aware of the total requirements, responsibilities and accountabilities of their job. This can arise either because job descriptions have not been properly prepared in the first instance or because individuals have not been properly done their employer's expectations.

7-4 Technology Issues: Plant Conditions

Working Plant conditions provide a useful and valuable insight into the general health of an organization's safety culture. Poor housekeeping standards are an indicator of behavior and attitudes which are not likely to be conducive to the development of a sound safety culture.

Other indications are lack of attention to alarms or nor repair of malfunctioning equipment, overdue maintenance work or poor information recording and archiving systems.

CONCLUDING REMARKS

There is no consistent and visible prescriptive formula for developing a strong safety culture, the choice of practices for developing an improved safety culture should take account of the existing national and organizational culture in order to ensure effective implementation.

The maintenance and improvement of a safety culture is a process of continuous evolution. Indicators are available to assess positive progress in this evolution and to detect a weakening safety culture.