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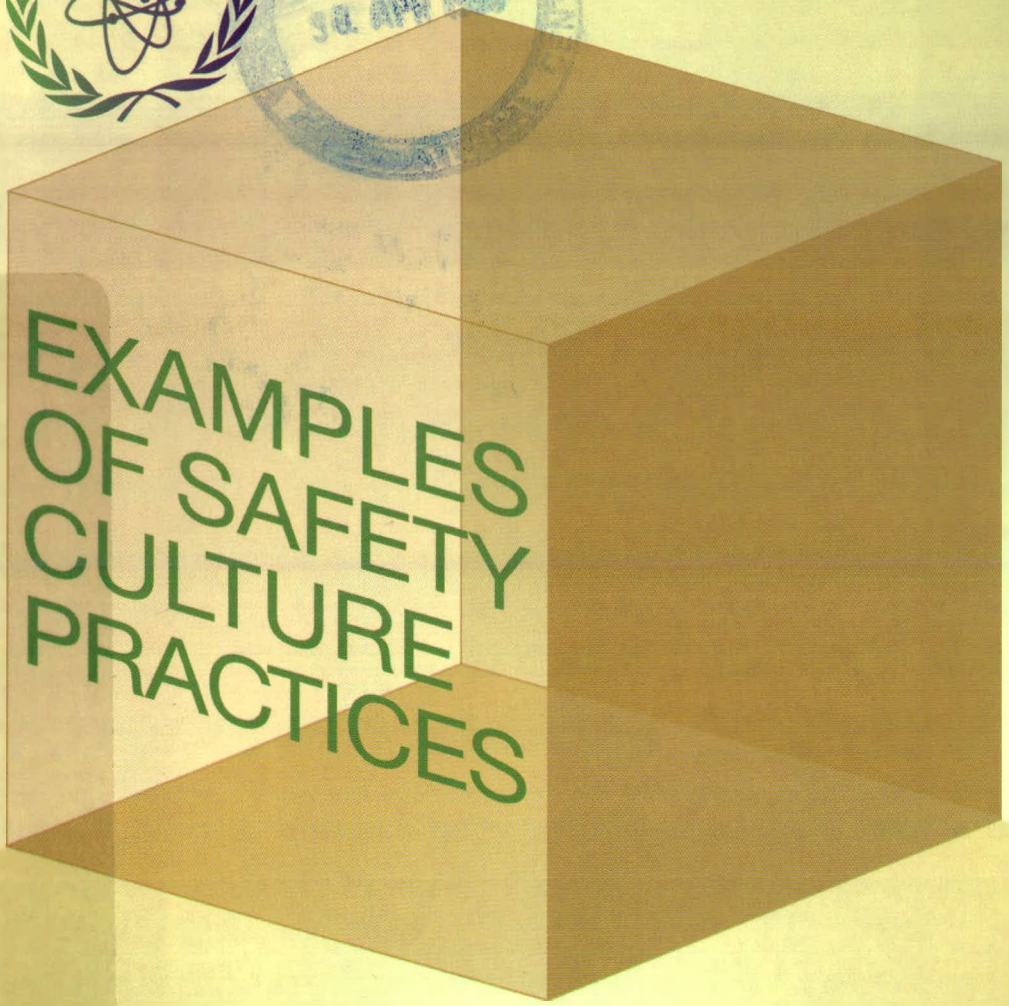

EXAMPLES OF SAFETY CULTURE PRACTICES

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

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FOREWORD

This report has been prepared to illustrate the concepts and principles of safety culture produced in 1991 by the International Safety Advisory Group as 75-INSAG-4. It provides a small selection of examples taken from a worldwide collection of safety performance evaluations (e.g. IAEA safety services, national regulatory inspections, utility audits and plant assessments). These documented evaluations collectively provide a database of safety performance strengths and weaknesses, and related safety culture observations.

The examples which have been selected for inclusion in this report are those which are considered worthy of special mention and which illustrate a specific attribute of safety culture given in 75-INSAG-4.

It is important to keep in mind that the applicability and value of a good practice are dependent on the specific underlying culture of the organization and country concerned. Therefore, a specific example of good practice may not always be directly transferable, unlike the underlying features and attributes which are universally applicable. However, it may be possible to adapt the good practice examples to be applicable to the underlying culture within an organization.

Additionally, the degree to which an organization has already instilled a strong positive safety culture, as described by the attributes in 75-INSAG-4, is likely to influence organizational and individual perspectives on whether a specific example is viewed as a good practice goal for the future, an already existing good practice 'norm' of the organization or even an undesirable safety culture practice.

The report was prepared at a consultants meeting held in Vienna from 4 to 8 December 1995 and at an Advisory Group meeting held in Vienna from 7 to 11 October 1996. The IAEA wishes to express its appreciation to the participants of those meetings, all of whom played a role in discussion, review and finalization of the draft report.

The IAEA officer responsible for the report was M. Dusic of the Division of Nuclear Installation Safety. The IAEA would like to acknowledge those nuclear power organizations worldwide which have provided the examples used in this report.

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1. INTRODUCTION

1.1. BACKGROUND

The IAEA initiated the preparation of this report, which is designed to provide Member States with many observed and documented examples of good (and ineffective) safety culture practices as an underlying cause of good (and poor) safety performance.

The principal purpose of the IAEA Safety Series publication 75-INSAG-4 (hereinafter INSAG-4) is to document the universal features and attributes of a good safety culture for organizations and individuals at all levels that are involved in the production of nuclear power, including: national governments, regulatory bodies, utilities and plant operating organizations. Feedback from safety culture reviews and nuclear safety performance worldwide can provide guidance based on comparisons of INSAG-4 attributes with the actual situations observed.

1.2. OBJECTIVE

It is the purpose of this report to illustrate concepts and principles of a good safety culture given in INSAG-4 by providing a small selection of examples taken from the overall collection of safety performance evaluations. A few examples of ineffective safety culture which have had a negative impact on safety performance are also provided to illustrate the significance of the positive safety culture attribute.

1.3. SCOPE

This report is intended to provide only a selected compilation of safety culture practices. The examples which have been selected for inclusion in this publication are those which are considered worthy of special mention and which illustrate a specific attribute of safety culture given in INSAG-4. However, they are not necessarily 'best' practices which need to be replicated. The examples selected from utility or operating plant organizations are either those commonly observed at operating nuclear facilities or are those considered to be representative of practices which are fundamentally important but have not as yet been consistently observed at all operating plants.

Additional examples of good safety culture practices can be found in various plant performance evaluation reports. The compilation may be used as a reference for organizations and individuals, including those involved in the development of a good safety culture. It may also be of value to organizations responsible for nuclear power

plant safety by providing a basis for comparison against their own safety culture practices, thereby identifying further opportunities for improvement.

1.4. STRUCTURE

The report is organized and structured to be generally consistent with the terminology and sequence of the safety culture attributes presented in INSAG-4. Section 2 provides examples of good (and ineffective) safety culture practices at government and regulator levels, the policy level in the utility, the plant management level and the individual level. The relevant safety culture attributes for each level are quoted from INSAG-4 and appear in italics. After the narrative description of each safety culture good practice, a short explanation is given to highlight its relationship to the INSAG-4 attribute.

Section 3 summarizes some experiences and approaches used by organizations to change their safety culture.

Finally, the Appendix contains summary examples of safety culture characteristics observed by the IAEA Assessment of Safety Culture in Organizations Team (ASCOT). The ASCOT services were established in 1993 with the prime objective of promoting safety culture concepts. This has been achieved through more than 30 seminars in over 25 countries and the experiences are summarized in the Appendix.

2. EXAMPLES OF SAFETY CULTURE PRACTICES

2.1. APPROACH OF GOVERNMENT AND ITS REGULATORY ORGANIZATIONS

2.1.1. Government

> *In any important activity, the manner in which people act is conditioned by requirements set at a high level. The highest level affecting nuclear plant safety is the legislative level, at which the national basis for safety culture is set.*

Good practice 1

A national government legislature directed a group of legislators to periodically assess how effectively the regulatory body regulates nuclear safety. Accordingly,

every year a group of members of the legislature audits some important aspects of the regulatory body in terms of its organization, resources and relationship with the licensees, and makes recommendations to the government for improvement. The report is made public and presented to the media. Most of the recommendations have been accepted by the full legislature and implemented by the regulatory body.

This example shows the important consideration given by the legislative level to the review of nuclear safety regulation and the need for an independent review of safety practices at the government level.

Good practice 2

A national government legislative body enacted a law which created an independent regulatory agency to regulate the safety of all nuclear power installations within the country. The agency was charged with ensuring adequate protection of public health and safety and protection of the environment. It was given broad discretion in determining what licensing terms and regulatory standards were necessary for ensuring an adequate level of plant safety. Regulatory and decision making processes of the agency were set up to be independent of any outside influence detrimental to safety. Within the legislation, a safe operating envelope must be specified by the regulatory body as part of the licence. It also requires that the agency conduct safety research as needed to carry out its responsibilities effectively. The legislation makes clear, however, that the operating organization has the primary responsibility for safety. Adequate funding ensures that the regulatory agency has the resources necessary to maintain its role.

The manner in which the legislature established the regulatory agency made it clear that nuclear safety was to be sustained at a high level.

2.1.2. Regulatory organizations

INSAG-4 Safety Culture Attribute

> *Regulators have considerable discretionary authority in matters of nuclear safety. This is conferred by legislation and the more detailed instruments under which they operate.*

Good practice 1

A regulator recognized that a positive safety culture could not be regulated or mandated. Neither did the regulatory body consider safety culture directly in evaluating nuclear power plant performance. However, to the extent that safety performance deficiencies were identified by regulatory body inspections, the regulator's inspection programme required its inspectors to assess the underlying

safety culture (i.e. managerial and organizational) causes. In such cases inspectors were expected to document, in their inspection report, the safety culture causes contributing to the identified performance problems or weaknesses. Required training for inspectors included both root cause analysis techniques and principles and practices of management and organization in order to effectively carry out such inspections. Inspectors were also occasionally assigned to participate in the regulator's special plant safety performance evaluation teams in order to obtain first hand practical experience in the safety culture evaluation techniques and to learn about contributing safety culture causes for safety performance problems.

These regulatory initiatives have increased the focus of utility and plant management on the safety culture issues which underlie safety performance deficiencies. They have also improved the regulator's ability to identify and report to plant management any safety culture weaknesses.

INSAG-4 Safety Culture Attribute

> *A regulatory body has a weighty influence on the safety of nuclear plants within its purview and an effective Safety Culture pervades its own organization and its staff. The basis is again set down in a safety policy statement. This makes a commitment to implement legislation and to act to promote plant safety and the protection of individuals and the public, and to protect the environment.*

Good practice 1

A regulator's senior management established, published and distributed to its staff an internal guidance document entitled Principles of Good Regulation. The principles incorporated all activities and decisions associated with the organization's regulatory role. The principles formally laid out the ethics with which regulatory actions and activities should be conducted. The principles stated that all regulatory actions and decisions shall be of the highest ethical standards; be open to the public; use agency resources efficiently; be timely, coherent and logical; and be based on the best available knowledge. The principles were established with the input and support of the regulatory staff. They were prominently posted within the regulatory agency's work areas and used periodically to conduct agency self-assessments.

The formal documented statements of the principles of good regulation and organizational values defined the cultural values existing within the agency and supported its continuation into the future. The statements provide utilities with an understanding of the regulator's values; they are important in developing and strengthening constructive dialogue on safety culture and other matters. The state-

ments also provided a reference 'yardstick' with which to assess whether staff regulatory actions and internal organizational activities measured up to the principles and values.

INSAG-4 Safety Culture Attribute

> *Controversial topics are dealt with in an open fashion. An open approach is adopted to setting safety objectives so that those whom they regulate have an opportunity to comment on the intent.*

Good practice 1

A regulatory body intended to establish a policy statement on the safety goals for its domestic nuclear power plants. The regulatory agency recognized that the establishment of a numerical safety goal would be controversial and would have the potential for requiring changes to be made in the design and operation of plants already operating. The proposed safety goals were published for public comment and disseminated to the affected organizations and special interest groups. The finally agreed safety goals were established with the participation and input of the nuclear power plant industry, the public and special interest groups. In this case the established numerical safety goals were quantified on a probabilistic risk basis.

The open manner in which the safety goals were established served the public interest for protecting public health and safety as well as the interests of the power industry for ensuring that no unnecessary financial burdens would be imposed. The procedure strengthened the support of all parties for meeting the final safety goals.

Good practice 2

The senior managers of a regulatory agency held an annual public regulatory conference with senior representatives from operating power reactor organizations in order to present information and exchange views on safety topics of current interest to the regulator and the nuclear power industry. The information conferences were widely attended and included industry–regulator panel discussions on each safety topic. The regulatory agency and industry senior management used the forum to present their views and propose resolution strategies on the major safety issues confronting the nuclear power industry.

The regulatory information conference provided the nuclear industry with an open and effective means to inform the regulatory body of its views on the possible resolutions to controversial issues currently under review within the regulatory agency.

INSAG-4 Safety Culture Attribute

> *Regulators recognize that the primary responsibility for safety rests with the operating organization and not the regulator. To this purpose, they ensure that regulatory requirements are clear but not so prescriptive as to set undue constraints.*

Good practice 1

After several years of having relatively prescriptive requirements, a regulatory body initiated industry and public discussion on the risk from nuclear plants and the introduction of a less prescriptive licensing approach. This led to the publication of a document on the subject of risk which clarified and explained the regulatory position. The resulting clear, but less prescriptive, licensing requirements have allowed utilities to propose a utility specific safety approach, which conforms to the less prescriptive requirements and must be approved by the regulator. This has led to greater flexibility in meeting safety requirements and greater ownership of approved safety approaches by the utilities.

The degree of regulatory prescription can vary as a result of local culture, the stage in a nuclear safety programme and the need to maintain adequate regulatory control and public confidence.

2.2. REQUIREMENTS AT POLICY LEVEL IN THE UTILITY

2.2.1. Statements of safety policy

INSAG-4 Safety Culture Attribute

> *An organization pursuing activities with a bearing on nuclear plant safety makes its responsibilities well known and understood in a 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.*

Good practice 1

A utility prepared, documented and distributed to all managers, staff and contractors a clear and concise statement on its health and safety policy. The policy document was written to include statements which clearly defined individual roles and responsibilities for ensuring safety within the organization. The utility avoided

issuing too many additional policies, which could have weakened the clarity and importance of its health and safety policy.

Clearly assigning individual and organizational safety responsibilities within the policy document itself resulted in a high degree of awareness and understanding among the responsible individuals.

Good practice 2

A corporate safety department prepared and distributed a nuclear operating safety handbook to inform staff members about how the company's safety policy was expected to be implemented. The foreword of the handbook, which was signed by the utility's chief executive officer stresses, among other things, the paramount importance of safety to the company. The handbook outlines the important safety concepts and principles, the respective roles and safety responsibilities of organizations/departments in the country and within the company. It presents, in a simple and clear way, how the basic safety principles are to be implemented at the various stages of plant life, from design to operation through decommissioning, as well as how 'defence in depth' is assured at each stage. It also explains the safety culture concept and the effect of attitudes of utility employees on safety. The handbook is also used as a support for local plant safety training and provides an example of how staff can be effectively informed about a utility's commitment to safety policy and its effective implementation.

2.2.2. Management structures

INSAG-4 Safety Culture Attribute

> *Implementation of the utility's safety policies requires that accountability in safety matters is clear. In addition, large organizations with significant impact on nuclear plant safety provide independent internal management units with responsibility for the surveillance of nuclear safety activities.*

Good practice 1

The utility improved management effectiveness at its operating power plant by reducing the number of organizational layers to clarify safety accountabilities. The key levels comprised the following:

(a) Working level (e.g. plant operators) involved with specific operational tasks.
(b) Team leaders and supporting specialists involved with providing a service to the working level. The team leaders are responsible for work planning and

co-ordinating training for their staff, whilst supporting specialists (e.g. physician) provide specific technical advice.

(c) Section or function heads involved with managing a process or system. They are responsible for developing operational standards and ensuring that their part of the overall business plan for the unit is achieved.

(d) Unit management involved with developing the longer term strategic plan for the unit and liaising with the utility and regulatory body. The change in management structure improved vertical communication on-site because of the smaller number of organizational layers acting as filters to communication. It also improved team-work among functions because of the broader organizational grouping at each level.

The example shows the benefits of having a management structure with clear lines of communication.

Good practice 2

A utility has an organizational unit which acts as an internal health and safety regulator for the utility's chief executive officer. The internal unit has no direct safety responsibility, as this rests with site management. The unit has permanent inspectors assigned to each operating unit. The inspectors serve as the 'eyes and ears' of the chief executive officer, particularly in observing the safety practices at each unit. Inspectors also assist the site manager in understanding their legal responsibilities related to safety. Inspectors are chosen on the basis of their broad operational safety experience. The on-site inspectors are able to identify safety culture issues better than inspectors based off the site. Off-site inspectors were responsible for assessing plant safety experience, proposed significant plant modifications and performance trending (e.g. reactor trips).

The example shows an effective approach taken by one utility for independent assessment and surveillance of the safety attitudes and safety practices of the line organization.

2.2.3. Resources

INSAG-4 Safety Culture Attribute

Adequate resources are devoted to safety.

Good practice 1

A task group was set up to provide resources for safety culture improvement initiatives. Members are volunteers drawn from other organizational units at the site and are typically assigned to the group for six months. The group is charged with

identifying areas for improvement based on its own experience, station audits and safety review findings. Those areas not adequately addressed by the site's work planning process are selected for follow-up. Initiatives have included development of safety awareness training and improved safety related labelling.

The task group gives staff the opportunity to initiate and participate directly in safety improvement initiatives and to exchange ideas and knowledge with other site personnel. The experience also supports enhanced organizational teamwork after members return to their line responsibilities.

Good practice 2

Following a careful review of the operations department training requirement, a significant increase in the training needed was identified. In particular, additional staff resources were identified as being necessary for the operations department to conduct its normal task assignments while allowing sufficient time for the required training to be accomplished. On the basis of additional resource reviews, it was determined that other departments in the plant could reallocate selected members of their staff to the operations department without loss of effectiveness.

This is an example of where the adequacy of resources devoted to safety was carefully reviewed and the identified shortfalls corrected. Safety culture is not intended simply to increase the staff of the unit, but to devote adequate resources to safety.

2.2.4. Self-regulation

INSAG-4 Safety Culture Attribute

> *As a matter of policy, all organizations arrange for regular review of those of their practices that contribute to nuclear plant safety.*

Good practice 1

Operating event reviews included a rating for safety culture significance. A three element taxonomy was used for the rating based upon INSAG-4. The elements consisted of:

(a) People (i.e. the competence and awareness of staff regarding hazards and their control);
(b) Process (i.e. the capability of the management system to provide for risk assessment, procedures, systems for training, audit and monitoring arrangements);

(c) Culture (i.e. the commitment to safety, the adoption of a rigorous and prudent approach and the organizational priority to safety including the provision of adequate resources).

This example shows the benefit of the organizational monitoring of safety culture as part of the self-assessment process.

Good practice 2

The senior executives of a utility developed a range of quantitative performance indicators relating to safety culture, which are routinely evaluated at the company's safety review meeting. The indicators reflect various attributes of a good safety culture and include features such as the number of plant management tours conducted, the amount of safety training carried out and the number of outstanding maintenance defects. Overall, these indicators provide senior executives with an assessment of the degree to which actual safety practices are consistent with the desired safety culture at each site.

This example shows a successful approach used by a utility to periodically review the overall safety culture of the organization.

2.2.5. Commitment

INSAG-4 Safety Culture Attribute

> *On a personal basis, managers at the most senior level demonstrate their commitment by their attention to regular review of the processes that bear on nuclear safety, by taking direct interest in the more significant questions of nuclear safety or product quality as they arise, and by frequent citation of the importance of safety and quality in communications to staff.*

Good practice 1

The numerical targets for plant safety and performance measures were incrementally raised on an annual basis to promote continuing safety and performance improvement. Managers whose responsibilities were significantly tied to the various measures were assigned the responsibility for tracking, trending, documenting and reporting safety and performance against the targets at monthly status meetings. The meetings were widely attended by site and utility managers. The senior nuclear executive and chief executive officer also attended and actively participated in each of the meetings. The executives used the meetings to emphasize to the managers the

importance of attaining the established goals and in particular the achievement of the safety objectives as the highest priority.

The presence of the most senior executive level managers at the monthly status meetings visibly demonstrated the importance placed on achieving the established safety goals. Their presence and input had the effect of further reinforcing the plant organizational attitude of 'safety first' while vigorously addressing the need for improvement in overall plant performance.

Good practice 2

The corporate manager responsible for the site frequently attended the plant manager's daily planning meeting with his department heads and their principal supervisors. In addition to being kept informed of significant plant operational issues and activities, the site director used his presence at the meetings to periodically communicate the importance of ensuring high quality in the resolution of a safety related problem being discussed. He also reminded those present that although problems affecting safety should be resolved efficiently, plant operating schedules would be modified if needed to ensure that quality and safety performance standards were not compromised.

The corporate manager's attendance at the operations planning meeting to periodically remind the plant staff of the importance of quality in the completion of safety related work activities visibly demonstrated his commitment to performing safety significant activities in an efficient manner.

2.3. REQUIREMENTS ON MANAGERS IN OPERATING ORGANIZATIONS

2.3.1. Definition of responsibilities

INSAG-4 Safety Culture Attribute

> *Discharge of individual responsibilities is facilitated by unique and clear lines of authority.*

Good practice 1

Safety engineers were placed on shift to provide technical support in the detection and correction of abnormal situations. At some plants, the shift crews significantly increased their reliance on the safety engineer for decisions related to safety. This resulted in confusion regarding the responsibilities of the shift supervisor and the crew on the one hand and the safety engineer on the other. To address this issue the

respective roles and responsibilities were clearly redefined. Clear distinction was made between those who are directly in charge of safety and make decisions (i.e. line management) and those who only serve in an advisory role (i.e. the safety engineers). The shift supervisors were also given additional safety training equivalent to the safety engineers.

This example shows the importance of clearly defining the responsibilities of those who have direct control of safety and those who provide technical advice.

Good practice 2

A plant manager used a formal 'management of change' procedure to ensure that during staff reorganization, staff remained aware of their responsibilities during the transition. The procedure called on the plant manager to assess the safety significance of any personnel changes and to identify the need for additional staff training or changes to procedures. An implementation document was produced which set out how the changes were to be managed and which allocated responsibilities within the new staff organization. The proposed changes were discussed and agreed upon by the affected staff before they were implemented.

This example shows the importance of properly managing staff reorganizations and making staff aware of their responsibilities during and after the changes.

Good practice 3

To ensure responsibilities at a plant are clearly understood by all, the specific roles and responsibilities of each manager and technical advisor are clearly defined and agreed upon during discussion between the supervisor and subordinate. In addition, the resources assigned to each department are defined, together with the interrelationships between the various departments and individuals. Once their roles, responsibilities, interrelationships and resources are agreed upon, the information is circulated to all staff on the site. In this particular case the roles and responsibilities are formally documented and signed by all of the individuals involved.

This example shows the importance of clearly defining the roles and responsibilities of individuals and departments, as well as the interactions between departments or individuals.

Ineffective practice 1

An event investigation revealed that a radiological survey data collection sheet required four separate signatures: the radiation technician who collected the data, the radiation technician's supervisor, the health physics engineer and the health physics engineer's supervisor. It was also found that none of the signatories clearly understood

their review responsibilities connected with signing the data sheet. Once the radiation technician had entered an abnormally high radiation level, each signatory believed someone else was responsible for follow-up. Accordingly, no one followed up on the abnormal radiation condition.

This example shows the importance of clearly defining and assigning individual responsibilities to prevent oversight and omissions in the conduct of safety related activities.

2.3.2. Definitions and control of work practices

INSAG-4 Safety Culture Attribute

> *Managers ensure that work on matters related to nuclear safety is carried out in a rigorous manner.*

Good practice 1

Management ensured that all staff have an annual individual performance appraisal by their immediate supervisor. The appraisal discussion is structured and formalized in a document, which is signed by both individuals at the end. Every aspect of work performance is evaluated, including that which contributes to safety. The ways to improve work performance, including the knowledge and skills of the staff member, are discussed and decisions are taken on the need for, and nature of, any additional training.

This example illustrates an effective process by which a manager promotes good practices affecting safety related work activities.

Good practice 2

A booklet was prepared well before an outage and sent to the potential contractors, giving very precise information relating to the outage, industrial safety, fire safety, responsibilities of different sections, work order procedure, tagging regulations, the outage plan, the contact person's location and telephone numbers and logistical information.

This example shows the value of ensuring that staff and contractors are aware of all relevant safety related information.

Good practice 3

Management provided controlled copies of simple line diagrams and operating procedures for the safety related equipment in each equipment area. These were locally

available for personnel not directly responsible for performing the work or inspection of the equipment in the area (e.g. managers and supervisors), enabling them to perform local system configuration reviews.

This practice enhanced the effectiveness of managers' walk downs of the plant equipment areas and improved communication with personnel directly responsible for performing work activities on equipment.

Ineffective practice 1

An operations manager requested the reactor operator to raise power more rapidly than had been done in the past. In response to the request the reactor operator directed a plant equipment operator to ignore a number of pre-startup valve alignment checks. As it turned out, one of the valves which would have been checked for proper alignment was not in the correct position for startup. The valve misalignment was the result of the valve not having been returned to normal position following the completion of an earlier maintenance test. The valve misalignment resulted in an essential plant system being effectively out of service. The out-of-service system caused the reactor to trip during the power increase.

This example shows the importance of managers adhering to the principle that all required tasks are carried out in a rigorous manner regardless of circumstances.

2.3.3. Qualifications and training

INSAG-4 Safety Culture Attribute

Managers ensure that their staff are fully competent for their duties.

Good practice 1

An operations manager observed and evaluated each crew's weekly simulator exercise. The manager analysed each exercise and communicated how individual crew members should respond to particular aspects of the event (e.g. when to enter the site emergency plan). The manager also used the exercises to reinforce and/or clarify required standards and expectations on crew member performance.

The operations manager's observations of the weekly simulator exercises provided direct first-hand knowledge of each crew member's competence to carry out assigned duties in response to an event. The manager's presence and involvement also ensured that deviations from expected performance were promptly recognized and corrected.

Good practice 2

Plant equipment operators and maintenance workers attended a nuclear safety awareness course to supplement their technical training. The one day course provided an improved understanding of the station, plant safety related systems design and the potentially adverse impacts of operational and maintenance activities. The course also clarified the regulatory and procedural requirements associated with staff activities and reinforced the understanding of their importance in ensuring plant safety. Another plant utilized a special course on safety culture and human error prevention that was supported by video tapes involving actual managers to describe specific work activities at the plant.

The example illustrates the managers' responsibilities to ensure that individuals broadly understand the potential for their activities to degrade plant safety. Such training also promoted a more questioning attitude towards assigned work.

Good practice 3

The managers and supervisors at a utility attended a management course on safety culture to supplement their management skills training. The two day course provided the line managers with the awareness and skills necessary to better understand and manage safety culture improvement initiatives. The course provided fundamental management techniques in implementing safety culture improvements and identified the priority actions (e.g. leadership and communications related to safety).

The example illustrates the importance of ensuring that line managers have experience or training in improving safety culture.

Good practice 4

As a way of supporting the training of new plant employees, an experienced plant employee with a good safety attitude was used as a role model and paired with new recruits. This approach improved the contact between the new and the experienced employees and allowed the new employee to develop the good habits and approaches of the desired safety culture much more efficiently.

This approach allows transfer of safety culture aspects in an efficient way and leads to improved communication.

Good practice 5

Audio and video tape recordings were used during training on the full scope simulator exercises to improve the performance feedback process by providing safety information. This helped trainees to learn from their performance errors and omissions and from the good performance of others.

Full scope simulator training involving major accidents often included field equipment operators in the training scenarios. While the full scope simulation was in progress, the field operators walked through their local procedures in the actual plant and remained in communication with the control room operators on the simulator facility. This allowed the local equipment operators to practice their required actions and to check for any difficulties. At the end of the simulator exercise all operators, in the simulator and in the field, conferred and analysed any findings.

The use of integrated training was effective in ensuring that the control room and local operators were capable of carrying out their combined tasks during a major accident.

Good practice 6

The harmonization of the utility and contractor training in the areas of quality and safety, risk prevention and ALARA ensured that contractors were trained to a common level. This generates greater confidence in the work carried out by contractors at the utility sites and results in a better working relationship between the contractors and the plant staff.

Since the staff of the plant may be doubled during outages compared to normal operation and the time schedules are very tight, good communications and a close working relationship are very important. The recognition of this and the measures implemented are steps taken towards a good safety culture.

To facilitate consistency in training, all permanent and temporary contractors were required to be trained on safety and quality. A videotape explained the main rules to be followed on procedure adherence, self-checking and the prevention of human error. This training included radiological protection and applicable emergency plan requirements.

Ineffective practice 1

Almost half of the 50 control room operators at one plant either had not attended or not completed refresher training in the prior 12 months as was required by the regulatory body safety regulations. Station management also had not complied with its own requirement that individuals who missed training must either complete a refresher class within 12 weeks or be removed from shift duties. Affected individuals included shift supervisors, assistant shift supervisors and reactor operators.

The example shows that where management attitudes hold training to be of lower importance, safety knowledge and skills will diminish over time and staff may no longer be fully competent for their assigned duties.

2.3.4. Rewards and sanctions

INSAG-4 Safety Culture Attribute

> *Ultimately, satisfactory practice depends on the behaviour 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.*

It is essential for each organization to carefully assess the manner in which rewards and sanctions are to be conducted. The specific rewards and sanctions policies and practices which are developed must be consistent with the values and beliefs of the local culture if they are to be effective in instilling a positive effect on the organization's safety culture. The following are examples of rewards and sanctions that were considered good or ineffective safety culture practices in their respective local culture:

— Each month an employee was selected as STAR player of the month and each year one of them was selected for the reward of STAR player of the year. Each reward was announced in the utility's monthly journal.
— A plant manager gave each plant shift supervisor a small sum of money to award to members of their staff who exhibited high safety standards during the shift.
— A plant manager sent a personal letter to individuals who exhibited a high level of safety performance. The letter was sent to the individual's home and was more widely publicized at the discretion of the individual.
— A site director established an 'employee of the month' policy to recognize employees who have exhibited an exceptional safety approach during the previous month. The employee who was selected each month was recognized in the plant newsletter and was given a choice parking space with a sign which read 'employee of the month'.

2.3.5. Audit, review and comparison

INSAG-4 Safety Culture Attribute

> *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 programmes, staff appointment procedures, working practices, document control and quality assurance systems.*

Good practice 1

A safety culture questionnaire was used by management to better understand and gauge the perceptions, attitudes and beliefs of site staff. The questionnaire was developed using a focus group to identify topics and issues to be covered. Following trial use, the questionnaire was distributed throughout the organization. To provide independent analysis of the findings the completed questionnaires were assessed by off-site personnel. The questionnaire was used to supplement other monitoring techniques such as audits to identify safety culture issues.

Many weaknesses in safety attitude were identified using the safety culture questionnaire, allowing management to develop an action plan to address the deficiencies.

INSAG-4 Safety Culture Attribute

> *Managers make arrangements to benefit from all sources of relevant experience, research, technical developments, operational data and events of safety significance, all of which are carefully evaluated in their own contexts.*

Good practice 2/Ineffective practice 1

A corporate engineering organization conducted a very comprehensive technical assessment to identify plant equipment problems which could potentially affect safe plant operation. The assessment included design, maintenance, testing and operations aspects and identified over 50 potential vulnerabilities which were comprehensively documented in a detailed technical report. The report was forwarded to the plant manager for review and follow-up. An external audit of the station conducted nine months after the report was issued found that station management had initiated no follow-up actions to resolve the issues identified in the report. Detailed follow-up reviews were immediately initiated by the on-site technical organizations. The follow-up reviews determined that certain safety equipment would not be capable of performing its intended function in all required situations, necessitating immediate corrective actions.

The comprehensive and well implemented vulnerability study, which was conducted by the off-site engineering organization, indicated a strong positive attitude by engineering management in ensuring plant safety. However, plant management's untimely response to the issues identified in the study indicated weaknesses in their safety attitudes and responsibilities towards potentially significant safety information.

Good practice 3

A plant manager made use of an externally developed audit and review procedure as part of his overall assessment of station performance. This audit and review system comprised a ranked list of good safety practices which was used by the plant manager to assess the extent and effectiveness of plant safety practices as a way of improving safety culture. The assessments were used to benchmark plant performance against that of other plants and utilities which had used the same audit and review system on their own plants and organizations. The list of good practices was also used as a source of ideas for future improvement.

This example shows the benefits of using external comparisons when reviewing plant performance.

Good practice 4

Plant managers in nearby utilities developed a peer review process (similar to an OSART mission) for their plant, but conducted by the utilities. A team of experts from other sites within the utility and from the plants of other utilities conducted an in-depth review of the management of station operations. The review examined a wide range of issues including operations management, maintenance management, emergency preparedness and training. Each plant has such a review conducted every three or four years. The process allows the evaluated plant to be given a peer review of their programmes and practices that contribute to nuclear safety.

This example describes an effective process for the rigorous review of plant practices by experienced plant evaluators who are independent of the units being examined. The voluntary self-assessment with 'fresh eye' peer reviewers provides an effective means of applying high level external safety performance standards to the evaluated plant. This provides the opportunity to raise the actual performance standards of the evaluated plant.

Good practice 5

A computer based system is used to analyse safety system unavailability and reliability as input for the plant PSA. The safety system unavailabilities are also presented and discussed as a performance indicator in the monthly report of the nuclear safety department. Ways of minimizing the unavailability of the safety related components are regularly discussed between operation, maintenance and safety teams. The computer based system allows for the optimization of maintenance and testing activities and helps meet the challenge of reducing the unavailability of safety systems. The unavailability of safety systems has been reduced by a factor of three in less than three years.

This practice underlines the benefits of taking advantage of new analytical methods to enhance safety margins.

2.3.6. Commitment

INSAG-4 Safety Culture Attribute

> *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.*

Good practice 1

An operations department section manager or shift supervisor periodically accompanied and observed the performance of equipment operators while making their rounds. During the rounds the managers provided equipment operators with guidance and feedback on specific surveillance activities and communicated their standards and expectations for performing the duties assigned to the equipment operators. A manager or supervisor was paired with an equipment operator about once every six weeks. Several months after the programme was implemented equipment operator deficiency reporting and plant 'housekeeping' in equipment areas had improved.

The example shows the importance of managers effectively communicating their standards and expectations to their staff and the positive impact that this has on staff attitudes and work performance.

Good practice 2

A site director sent a memorandum to his staff to communicate his commitment to plant safety and emphasize his expectations on safety matters having a direct bearing on each employee. This letter was attached to the safety handbook and distributed to each department.

The personal message from the site director to every worker communicated the importance and priority he gave to the safety issues.

Ineffective practice 1

An off-site engineering organization conducted a detailed engineering study to determine whether selected safety related valves in the plant were vulnerable (failure

to open) under certain design conditions. The analysis was conducted in response to an operational experience feedback document received from an outside safety organization. The feedback document was based on experience with valves and corrective action undertaken at several nuclear plants. The off-site engineering study concluded that a similar vulnerability for safety related valve failures existed at both units of its nuclear station. The off-site engineering organization forwarded its study report to site management and recommended that corrective action be promptly implemented on selected safety related valves. The site manager rejected the recommended modification based on the fact that no valve failures or degradations of the sort experienced at the plants outside the utility had ever been reported by either unit at the station. About three years later during an outage of the plant, one safety related valve was found to have failed (closed) and another safety related valve was severely degraded. Subsequently, all potentially affected valves in the shutdown unit were modified prior to plant startup and the vulnerable valves in the operating unit were modified during its next outage.

The example shows the importance of management commitment to safety and the importance of ensuring that their staff vigorously respond to an established framework of practices such as the process for evaluation and response to outside operational experience.

2.4. RESPONSE OF INDIVIDUALS

2.4.1. Questioning attitude

INSAG-4 Safety Culture Attribute

> *The response of all those who strive for excellence in matters affecting nuclear safety is characterized by a questioning attitude.*

Good practice 1

During a refuelling outage, a pressurizer relief valve was removed and refurbished in the maintenance shop. At the end of the outage, the valve was reinstalled, in situ tested and requalified. The requalification test was in accordance with procedures and all characteristics were verified. However, a maintenance contractor discovered a small seal ring lying on the floor, near the valve. When the detailed tools and spare parts remaining after the maintenance activity were evaluated, the ring was determined to be surplus. The contractor questioned this determination and immediately reported the surplus ring to the mechanical department manager. The concern was brought to the attention of the operations manager who decided to delay the plant startup and to

bring the reactor to cold shutdown. The valve was reinspected and the small seal ring was found to be missing from the valve.

The example illustrates the importance of a questioning attitude to plant safety.

Good practice 2

Management established the safety policy that the control room annunciator panel would be maintained in as near a 'black board' (i.e. lights out) condition as possible during plant operation. In pursuit of this objective, degraded or failed equipment in the plant involving control room annunciator panel lights was promptly repaired to enable the annunciator panel to be returned to a near black board condition as quickly as possible. Additionally, all safety related equipment areas and rooms were maintained in a visually 'clean' appearance through maintenance of equipment, floors, walls and ceiling surfaces painted to a 'like new' condition.

These safety policies and practices enhanced the ability of equipment operators and maintenance staff to spot unusual conditions and circumstances and thereby promoted a questioning attitude among plant workers.

Ineffective practices 1

The following ineffectual practices were observed at different plants:

(a) Although prohibited by procedure, two safety system pumps were operating while their associated heat exchanger was tagged out-of-service. The condition was not recognized for over three hours despite control room indications.
(b) Control room annunciators/alarms were not always investigated and thoroughly questioned as to their cause.
(c) A main feedwater pump and turbine were spun without lubricating oil. A feedwater pump bearing which caused a high temperature alarm was not questioned or investigated.
(d) A shutdown cooling alarm was not thoroughly questioned by control room operators and was a factor in allowing the temperature in the shutdown cooling return line to drop well below the minimum allowable value.
(e) On a walk down during a regulatory agency inspection, one of the fastening bolts on a main steam isolation valve was found to be missing.

The above observations involving undetected problems show the importance of individuals having a questioning attitude.

2.4.2. Rigorous and prudent approach

INSAG-4 Safety Culture Attribute

> *The response of all those who strive for excellence in matters affecting nuclear safety is characterized by a rigorous and prudent approach.*

Good practice 1

To improve the rigour with which maintenance activities were evaluated from a safety standpoint a risk assessment methodology was developed. All activities planned on a function or system (in priority safety related) are now evaluated by a multidisciplinary team, focusing on the risk of human error (e.g. common cause failures). Changes in maintenance plans are subject to risk analysis and cannot be implemented without the authorization of the team leader.

The use of risk assessment enables maintenance activities to be conducted to a schedule and in a manner which more rigorously accounts for maintenance related risks.

Good practice 2

Some utilities have adopted the use of team or quality circles to discuss and identify improvements to safety and working practices. The use of such teams and circles is becoming more widespread and success depends upon factors such as the style and receptiveness of management within the organization and the motivation and ability of individuals chosen as leaders of the group. A wide range of topics are covered and management provides support and resources for such groups. The reasons for adopting certain proposals and rejecting others are fed back to the group. Training is also supplied as necessary in analysis and decision making techniques.

This approach has proved successful in motivating staff and engendering a sense of ownership and participation in decisions affecting safety.

Good practice 3

A simple mnemonic device (STAR) is used by some utilities to prompt individuals before beginning any safety related task. This involves:

Stopping before starting the work.

Thinking about issues which may negatively impact upon safety.

Acting, if satisfied with the responses to the above questions.

Reviewing the action to see if it went according to plan and if any lessons could be learned.

The initiative has proved successful in promoting a questioning attitude owing to its simplicity and the support which it has received from senior utility and regulatory staff.

2.4.3. Communication

INSAG-4 Safety Culture Attribute

> *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.*

Good practice 1

A series of awareness raising workshops for team leaders, section heads and station management were initiated at a station seeking to improve its safety culture. The purpose of the workshops was to achieve a site-wide consensus on the significant safety culture issues and to generate ideas for improvement. The identified issues included misunderstanding of safety priorities and suspicions that specific individuals were being assigned blame for events. The workshops broadened acknowledgement of the need to address the identified problems and strengthened the ownership for subsequently proposed improvement initiatives.

The example shows the importance of managers listening and involving staff in improvement initiatives. The success of any initiative is dependent on both its acceptance by the individuals affected and their technical ability.

Good practice 2

Each month a senior nuclear executive selected several plant workers with whom to have lunch in order to enhance vertical communications within the organization. The individuals were given the opportunity to raise questions as well as issues and concerns. The senior executive used the meeting to gauge lower level concerns without middle managers filtering the message and to clarify management standards and expectations. The monthly meetings helped to identify employee concerns and issues which negatively impacted organizational safety performance and helped to prompt corrective actions.

The example shows the importance of a communicative approach and of procuring useful information from others so that actions may be initiated where appropriate in order to improve safety.

Good practice 3

A 'safety availability watch' was established by management within the context of the safety review group meetings. The watch consisted of a review and discussion of the conservatism of the decisions made during the previous month associated with actions which involved a choice between safety and power production.

The most informative cases are presented to the plant departments to illustrate the importance placed on safety.

Good practice 4

A weekly meeting was established by management to report on the week's safety related events to the field operators and the maintenance staff. The meeting is conducted by the operation's supervisor on shift and information for the meeting is prepared by the safety engineer on call. The significant events and decisions related to safety are presented and explained. Safety issues are discussed and field operators and maintenance foremen are encouraged to report on events and provide additional information. A weekly report of the meeting is prepared and includes a short list of basic actions decided upon by the staff to improve safety. This report is distributed to plant management and the key results are presented at the weekly management committee meetings.

This weekly meeting significantly improves communication between safety engineers, and operating and maintenance staff. The safety related decisions are much better understood and motivation for safety is promoted within the field staff.

Good practice 5

Management established an ongoing communication programme and procedure to monitor the effectiveness of previous communication of information relevant to safety on those workers occupying the lowest levels in the plant organization. For communication of selected significant safety policies, expectations and directives, short simple written questionnaires were prepared to evaluate whether information previously transmitted to the organization by plant management had been received and understood by plant workers at the first line supervisor and worker levels. The plant secretarial staff were used to conduct telephone interviews with a small random sample of plant workers using the simple questionnaires. The results of these interviews were used to evaluate the effectiveness of the past communications and to decide whether additional action was needed.

The telephone survey demonstrated the emphasis plant management placed on effective communication of information important to safety. It was viewed as a very effective means of verifying that the safety information developed and transmitted by

the upper level managers had been received and understood by individuals at the lowest levels in the organization.

Good practice 6

On a weekly basis reactor and turbine operators undertook plant tours with equipment operators. Procedures existed to designate the plant area to be toured, ensuring the whole plant was covered weekly. These tours were viewed from the differing perspectives of reactor and turbine operators and can result in operational improvements.

The presence of control room operators in the field improves their communication with field operators. It also helps the control room operators to refresh and maintain their knowledge about the actual plant conditions. This practice indicates the commitment to improve the performance of operators and the striving for excellence and safety in their activities.

3. EFFECTING SAFETY CULTURE IMPROVEMENT

The process of managing safety culture improvement comprises the following:

— Need for change. Management and staff must be made aware of the need to improve.
— Will to change. Once a need for change is identified there needs to be a commitment to change among all staff and managers.
— What to change. There is a need to identify the critical issues requiring change; those which will bring most benefit in a given period of time.
— How to change. Those activities required to bring about the change need to be identified.
— Need to pilot change. If the change is going to impact the whole site, there may be benefits in piloting the change in a single work area or work team. This ensures that enough management attention and resources can be devoted to make the change a success. Once the pilot change is successful, it can be used as an example to others.
— Need to reinforce change. Once the change has been introduced, it is essential that the process is reinforced to ensure the change process is followed through and successfully implemented.

The various safety improvement programmes identified are normally integrated into the plant's overall business plan. This allows the normal business planning

processes to be used for assigning and prioritizing resources and monitoring progress. In particular, the improvement programmes can be routinely monitored to identify any unexpected difficulties and associated corrective actions, together with any need to reallocate resources.

Experience shows that the management of safety culture improvement has to be undertaken in the same manner as with any other station business objective. Safety needs to be an integral part of managing the business, it is not a bolt on extra. However, there needs to be a mechanism for separately identifying safety culture improvements which often require long term initiatives and which may link to other business objectives, e.g. those related to human resources, production and maintenance.

A number of techniques are available for improving safety culture. All of the techniques are considered important to some extent. Table I ranks the techniques in terms of their relative strength in changing the safety culture of individuals, groups and organizations as indicated by prior research, experience and studies.

TABLE I. TECHNIQUES ORGANIZATIONS USE TO CHANGE THEIR CULTURE[a]

Level of importance	Technique
Most important	— Senior management visibly and vigorously demonstrates its commitment and support for safety culture values
	— Staff is trained to convey and develop skills related to safety culture values
Very important	— Safety culture value statements are developed
	— Safety culture values are communicated to staff
	— Management practices are consistent with desired safety culture values
	— Rewards, incentives and promotions are offered to encourage individual practices compatible with safety culture values
	— Meetings are used to convey and support safety culture values
	— The organizational structure is made compatible with safety culture values
	— Systems, procedures and processes which are compatible with the safety culture values are established[b]
Moderate importance	— The responsibilities of employees who do not support the desired safety culture values are replaced or changed[b]
	— Anecdotes and stories are used to convey safety culture values
	— Employees who demonstrate exemplary safety culture are made company heroes
Some importance	— Employees who possess or are willing to accept safety culture values are recruited[b]
	— Slogans and signs are used to symbolize safety culture values
	— A manager or group primarily responsible for safety culture change efforts is established

[a] GENERAL ACCOUNTING OFFICE, Organization Culture: Techniques Companies Use to Perpetuate or Change Beliefs and Values. Rep. GAO/NSIAD-92-105, GAO, Washington, DC (1992).

[b] Views of the importance of this technique vary significantly among company officials.

Appendix

SAFETY CULTURES OBSERVED BY THE IAEA

From the feedback received from the national presentations on safety culture initiatives in specific countries, which is a standard lecture in every ASCOT seminar, and from the reviews performed in conjunction with other services several points are apparent:

- Most organizations had a fairly good safety culture, but all had areas for improvement.
- Some organizations had already employed considerable resources for self-assessment and further enhancement of safety culture.
- The root cause of many problems could be related to intangible factors. Therefore, it was necessary to continue efforts to better understand, promote and enhance safety culture.

Apart from the above general conclusions the following are the more specific aspects identified in particular organizations:

- In some organizations safety policy statements at corporate and plant level were inadequate and had not been communicated to all staff.
- Nuclear safety and the overriding importance of safety was not incorporated in company policy statements.
- Corporate nuclear safety review committees were not established and in some plants no formal safety review committee existed.
- Training programmes did not include safety culture topics.
- Appraisal forms for promotion did not include specific sections on candidates' attitudes to safety.
- No means for recognition of good safety performance existed.
- Managers and supervisors needed to hold periodic meetings to convey and reinforce the safety policy to all staff.
- Supervisors needed to check the conduct of work more often, especially on safety related equipment.
- Operational feedback, lessons learned and examples of shortcomings were not used to educate staff or to highlight safety awareness.
- There was a lack of any effective communication systems for management/workers to inform each other on safety issues.

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