



Different regulatory strategies in regulation of nuclear power projects An Indian experience

Sohail Ahmad Khan[†]

Nuclear Projects Safety Division,
Atomic Energy Regulatory Board of India,
Mumbai, India.

Presented by Error! Unknown document property name.

Abstract. Regulatory strategy needed for management of safety and safety culture involves careful planning and use of engineering concepts keeping in mind feasibility to implement certain safety requirements. It also requires adequate attention on working environment and mental conditions of designers, operating & maintenance staff and regulators. Different strategies followed during safety review and regulatory inspection of nuclear power projects for improving status of safety management and safety cultures have given certain results. The present paper brings out certain experience gained during regulation of Indian Nuclear Power Projects by Atomic Energy Regulatory Board of India in the area of management of safety and safety culture.

1. Introduction

The International Nuclear Safety Advisory Group (INSAG), in its publication on 'Safety Culture' in IAEA Safety Series No. 75-INSAG-4 [1], defines safety culture as: "*Safety Culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance*". To achieve the mission for ensuring adequacy of safety management and safety culture at nuclear power projects/plants (NPP) at various stages of design, construction, commissioning, operation and decommissioning, an effective regulation is needed, which is a highly specialised task and require a lot of efforts.

2. Scope

Nuclear power plants being regulated in India are of different types viz. boiling water reactors (BWR), pressurized heavy water reactors (PHWR) and pressurized water reactors of VVER-1000 type (VVER-1000). At present 14 NPP units are under operation (e.g. 2 × 160 MWe BWR, 4 × 200 MWe PHWR, 8 × 220 MWe PHWR) and 8 units under construction (e.g. 4 × 220 MWe PHWR, 2 × 540 PHWR and 2 × 1000 MWe VVER-1000). Design of a proto type Fast Breeder Reactor (PFBR) of 500 MWe capacity is under review.

Atomic Energy Regulatory Board (AERB) of India, which was constituted by the Government of India in 1983, has grown up to a mature level. AERB has been regulating these NPPs effectively and independently by adopting different strategies to improve quality of work and working environment. Significant improvement in management of safety and safety culture as well as a downward trend in safety related incidents have been achieved by performing intensive safety review and regulatory inspections during last 15 years.

[†] The Author is an M.Tech. (Mechanical Engineering) from Indian Institute of Technology Kanpur, India and Scientific Officer (F) in Atomic Energy Regulatory Board (AERB) of India.

3. Objectives

While regulating an NPP, one of the objectives set by AERB is to improve management of safety and safety culture at all stages by way of working out certain strategies as given below:

- (1) Provide good regulatory documents to the regulator, designer, operator and the public.
- (2) Granting of authorization to NPP for specific activities after detailed safety review in line with AERB regulatory safety codes & guides.
- (3) Conduct planned and reactive inspections and enforcement actions.
- (4) Exchange feedback experience gained during safety review and regulatory inspections to improve safety review/inspection strategies.
- (5) Continuous updating of knowledge to keep on improving technical competence of AERB staff.
- (6) Publish important findings and keep public informed about important safety issues.

4. Strategies

To achieve above objectives for meeting dynamic requirements of effective regulation following strategies were adopted by AERB, which include: internal re-organization; development of regulatory documents; improvements in techniques for safety review; and regulatory inspection of NPP.

4.1 Re-organisation of regulatory activities related to NPP

AERB, since its constitution, has re-organized its internal structures time to time to suit dynamic requirements for effective regulation of NPPs through various Technical Divisions and associated Safety Review Committees and Advisory Committees. These Technical Divisions have optimum trained and qualified staff and facilities for carrying out safety review, regulatory inspections and development of regulatory documents.

4.2 Development of regulatory documents

AERB has taken up speedy preparation of several Codes of Practices and Safety Guides in the area of design, operation and quality assurance. Certain published regulatory documents are being revised incorporating feedback experience gained during safety review, regulatory inspections and published international documents such as revised IAEA Safety Standards.

4.3 Enhancement in technical competence and related abilities of regulators

AERB has been training its staff through training courses conducted by AERB, IAEA and other national/international bodies and use of internal library resources for self-studies. Every computer terminal of AERB has been connected to Internet to provide access to rich information available on the net.

4.4 Availability of guidelines for safety reviewer and regulatory inspectors

AERB staff have been equipped with necessary national and international standards, codes, guides, manuals and other reference tools required for safety review/assessment and regulatory inspection activities. Based on these standards and safety guides, necessary

manuals and checklists are prepared as per requirements and followed during safety review process and regulatory inspections.

4.5 Safety review strategy

AERB Safety Manual on 'Governing the Authorization Procedure for Nuclear Power Plant/Projects' [4], is being followed for granting stagewise authorization to an NPP for carrying out construction and commissioning activities. Detailed requirements regarding submission of necessary documents along with application, for Authorization for each stage of construction, commissioning and operation, within stipulated time frame for review are given in the manual. It prescribes format for safety analysis reports, design basis reports and the applications. The safety review follows 3-tier review process. Levels of authorization are defined to decide levels of review. The three levels of reviews and clearances are: review by Project Design Safety Committee (PDSC); review by Advisory Committee for Project Safety Review (ACPSR); and review by AERB Board. Nuclear Projects Safety Division (NPSD), a Technical Division of AERB, monitors the safety review process through a programme evaluation and review technique (PERT) chart (in line with that followed by an NPP) to ensure timely completion of safety review. Compliance of implementation of safety requirements in design and commissioning documents is checked by a working group chaired by Head of the NPSD.

4.6 Regulatory Inspection and enforcement strategies

Regulatory inspections are conducted in parallel to safety review for checking compliance of regulatory requirements by the NPPs. Applicable AERB Safety Guide and associated Manuals are followed for regulatory inspections [3]. As per need a field check-list is prepared on the basis of outcome of safety review and other technical documents. Depending upon the stage of the NPP and schedule of certain special tests, inspection programmes are planned and implemented. These inspections include planned team inspections as well as reactive inspections. These are either announced or unannounced. In case of commissioning, resident inspectors are posted at NPP site itself for continuous monitoring of NPP activity for management of safety and safety culture. Special attention is paid on quality assurance (QA) programme of the utility during all activities and protection of commissioned equipment. Inspection programme is updated incorporating feedback experience from inspections as well as safety review.

5. Effects of strategies on improvement in management of safety and safety culture

Even though safety culture can not be mandated, AERB has been able to get this mentioned in its safety documents [3]. Various strategies followed during safety review and regulatory inspections yielded certain results time to time. Some of them are brought out here:

5.1 Frequent re-organisation of regulatory functions

Dynamic organisation of AERB has established better structure for carrying out regulatory work, through Technical Divisions by optimum use of expertise and resources, and providing good opportunity to every individual to have exposure to different types of works and enhance their knowledge. This helps in ensuring adequate backup staff for safety review and regulatory inspection activities for all types of NPPs. Thus regulatory works do not suffer in case of unavailability of an individual and every body has capability of effectively monitoring of NPP for management of safety and safety culture. Documentation system ensures retrievability of required information in time from an established data bank for each NPP. Also, regulatory staff get more job satisfaction as psychological load is minimum and they

feel more comfortable in carrying out safety review and regulatory inspections of any type of NPP. Communication gap regarding technical information between different persons is minimised and same quality of regulatory work is almost assured.

5.2 Safety review

The three tier safety review process has been effective in resolving safety related issues in time at different level of management. Defined levels of Authorizations help in controlling NPP activities as per importance of safety requirements at its various stages. To ensure implementation of recommendations of various safety committees and AERB, following method has been adopted:

5.2.1 Categorisation of safety issues

Safety issues emanating from safety review of an NPP are categorised into following categories:

- (1) **Category-A:** to be resolved before Phase-A commissioning (i.e cold or hot run of the systems without fuel loading in the core);
- (2) **Category-B:** to be resolved before fuel loading in the core;
- (3) **Category-C:** to be resolved before initial criticality and low power physics experiments;
- (4) **Category-D:** to be resolved before raising initial power of the reactor from 0.1% full power to 100%full power; and
- (5) **Category-E:** requiring research and development and of long term nature.

Close follow-up for implementation of recommendations of safety committees as per the above categories is done by way of having interaction among regulatory staff, designers and operators. Necessary safety analysis and safety review are carried out quickly to resolve outstanding safety issues. However, trend to request change in category of a safety issue, by the utility to get more time, is observed and a regulator needs to take a stand at appropriate level.

5.2.2 Assistance to utility in resolving safety issues

During safety review, experts of various safety committees give certain advices how to improve the systems to meet certain safety requirements. These guidelines are not a part of recommendations of AERB but for helping designers to share experts' experience. This approach has given very good results.

5.3 Regulatory inspections

Regulatory inspections are carried out with alertness and keeping its objectives in mind. Planned inspections are generally carried out with announcement at short period to assess more realistic status of management of safety and safety culture of an NPP. However, announced inspection results in temporary corrections in certain areas. Unannounced inspections are generally carried out in case of an unusual occurrence to ensure that evidences are not lost. This gives an opportunity to assess the incident to find out the real root cause to compare with the reported one.

5.3.1 Regulatory inspection and enforcement techniques

During an inspection, a dynamic field-checklist is prepared and modified/augmented at NPP site as per requirements. Discussion with an NPP staff is held in a strategic manner. Absence of boss while discussing with the NPP personnel gives true picture of most of the deficiencies at NPP which exist for want of resources. Positive attitude and friendly approach brought a lot of improvement in managing safety and safety culture. Site personnel become more open if design support is assured based on inspection. Similarly, during inspection of maintenance areas, true history of failures at NPP is revealed if availability of more spares and tools is assured because of inspection. Based on inspections and enforcement actions, AERB creates an interface between NPP site and design organization. This helps in solving design-related problems and improving safety. Repeated direct observations with small time gap help detection of unsafe situation or violation at times. In case of serious violations, strong enforcement actions improve safety culture. Initiation of enforcement actions based on categorization of inspection findings, as given below, has improved the safety culture:

- (1) **Category-I:** Direct Violation of Technical Specifications or Mandatory Safety Requirements;
- (2) **Category-II:** Serious problems discovered which require urgent safety review;
- (3) **Category-III:** Design related and generic deficiencies;
- (4) **Category-IV:** Inadequacy in procedures and their compliance or deficiencies in equipment/quality assurance related deficiencies; and
- (5) **Category-V:** General observations which are of minor nature but NPP have to correct themselves.

Follow-up of previous inspection in the next inspection as per the above categories reduces the pending safety issues.

5.3.2 Areas of improvements at NPP

Role of top management positions: Top management positions having personnel of sharp brain and foresightedness with positive approach give better output in terms of maintaining good safety culture among NPP staff and effective safety management. They play catalytic role in understanding the difficulties or problems arising in various systems and process and working out on-the spot solutions to avoid further degradation in the system. Following a management approach rather than bureaucratic approach gives good results in preventing safety related incidents or in mitigating consequences of an incident, should it occur. This creates an environment of openness among the operating and maintenance staff.

Role of middle management positions: In-plant Operation Review Committee (IORC) plays an important role in solving the problem at NPP and recommend corrective measures at times. The Committee consists of members mainly from middle management positions. Immediate publishing of the root cause, of any problem and violations during NPP operation or maintenance, gives good operational feedback to all and similar problems are avoided in other NPPs. In view of this, keeping Member-Secretary of IORC independent of operation and maintenance group improves quality of record on deliberations of IORC. Middle management positions having hard working personnel and good communication become an important advisor to top management and an effective guide to the working level staff.

Role of working level staff: It is known fact that working level staff expect timely appreciation of their good works, else, they may lose interest in improving their performance in the area of safety management. Motivating of the staff, without wasting time and through

reward on the basis of their work and not due to good relation with bosses, increases competitiveness as well as friendly environment and eliminates feeling of comparison. Effective utilization of their skill, knowledge, hard working capability gives them job satisfaction and enhance interest in improvement of safety management and safety culture.

Differentiation between operators and maintainers: Giving importance to operator over maintainer creates a jealousy attitude and quality of maintenance work may suffer. This may result in safety related incidents. Thus avoidance of a comparative approach results in good coordination, friendship and better safety management.

Communication gap between designer and operator: During NPP operation certain design related improvements are required. However, due to a communication gap between designer and operator, sometimes design-related deficiencies remain unattended and operator has no choice and forced to violate safety requirements or some times misinterpret the write-up of the procedure. Thus interaction between designer and operator improves a safety culture a lot.

Coordination between regulator and utility: Relation between regulator and utility is very important in improving safety management and safety culture. Utility expects help from regulator and not a beaurocratic enforcement. Thus while conducting safety review and regulatory inspection an exchange of design/operational feedback really help very much to designers and operators to overcome certain difficulties. Beaurocratic approach is necessary only for enforment actions where serious violations are observed. Most of the time a good communication between regulator and utility solves several problems and better management of safety and safety culture is expected.

Safety awards: AERB gives safety awards in certain areas of industrial safety. These awards gives motivation to other projects to improve industrial safety. However, this award is given to the NPP who really has shown improvement and not merely only on comparative basis.

Strong database and information management: Providing of local area computer network has improved quality of documentation, better management of operational and design data, quick analysis of any problem and availability of required consultation at times. In parallel, provision of access to internet updates the knowledge level of operator, maintainers and designers with full utilization of feedback from worldwide NPPs and other institutions available on web sites.

6. Conclusion

Management of safety and safety cultures at an NPP are dependent upon many factors which include: availability of resources and expertise; healthy mental and environmental conditions of staff; and appreciating approach of top managements in the areas of design, construction, operation and regulation.

ACKNOWLEDGEMENTS

I acknowledge with thanks the guidelines provided by Shri Deepak De, Head, Nuclear Projects Safety Division of AERB, Shri G.R. Srinivasan, Vice-Chairman AERB and Prof. Suhas P. Sukhatme, Chairman AERB in development of this paper and giving an opportunity to contribute this paper in the IAEA "International Conference on Safety Culture in Nuclear Installations" 2002.

REFERENCES

- [25] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Culture, IAEA Safety Series No. 75-INSAG-4 (1991).
- [26] INTERNATIONAL ATOMIC ENERGY AGENCY, Guidelines for organizational self-assessment of safety culture and for reviews by the Assessment of Safety Culture in Organizations Team”, ASCOT Guidelines, IAEA-TECDOC No. 743 (May 1994).
- [27] ATOMIC ENERGY REGULATORY BOARD, Inspection and Enforcement by Regulatory Body in Nuclear and Radiation Facilities, AERB Safety Guide No. AERB/SG/G-4 (2002).
- [4] ATOMIC ENERGY REGULATORY BOARD; Governing the Authorization Procedure for Nuclear Power Plant/Projects, AERB Safety Manual No. AERB/M/NSD-3 (1989).