2007 International Nuclear Atlantic Conference - INAC 2007
Santos, SP, Brazil, September 30 to October 5, 2007
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: 978-85-99141-02-1

EXPERIENCE OF IPEN – CNEN/SP IN THE EXECUTION OF THE FIRST PHASE OF THE SAFETY CULTURE ENHANCEMENT PROGRAMME AT IEA-R1 RESEARCH REACTOR

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ABSTRACT

This paper presents the methodology applied and the main results achieved in the implementation of the first phase of the safety culture enhancement programme at IEA-R1 research reactor. This methodology consisted of the following steps: a) safety culture assessment; b) identification of weak points related to safety; c) elaboration and implementation of an action plan aiming at the enhancement of safety culture in the organization. The safety culture assessment was performed using a triangulated approach. The safety culture assessment was carried out in two stages: safety perception survey and safety culture self assessment.

1. INTRODUCTION

During the whole 19th century and most of the 20th century, the safety improvement of technological processes improvement was almost obtained exclusively through the improvement of technical aspects of engineering systems. During most of this period this approach revealed a good result to guarantee a gradual and continuous decrease in the rates of accidents, especially, in the industries involved with critical aspects of safety [ ]. However, in the last decades of the 20th century, it was verified that this approach was not good enough to guarantee the safety of these processes because the human factors, management systems and safety culture turned to be more important [1]. Examples of accidents of this type were: Chernobyl (1986), London King's Cross Underground Station fire (1987), the passenger train crash at Clapham Junction (1988), Piper-Alpha oil platform in the North Sea (1988), Tokaimura Criticality Accident (1999), Spaceshuttle Columbia (2003), among others [2].

More recently, two significant incidents were reported in the nuclear industry: a) Davis Besse Nuclear Power Station Incident (2002) and b) Paks Fuel Damage Incident (2003). Both were caused by inconsistent and incomplete company policies on safety, inadequate organizational commitment to safety and inadequate share of safety information. Fortunately, they were identified sufficiently early to prevent their escalation to a major accident [2].

In this way, the focus of the efforts in safety improvement changed gradually from the technological systems to human factors and organizational administration.

This perception was mentioned, in the report elaborated by the International Atomic Energy Agency (IAEA, 1986) after the occurrence of the nuclear disaster of Chernobyl [3], when the term f the term "safety culture" was used for the first time, attributing the break of the safety culture of the organization as the main cause to an accident. Some years later, in 1991, the concept "Safety Culture" was detailed by the Nuclear International Safety Advisory Group in INSAG-4, published by the International Atomic Energy Agency [4]. In this document safety culture is defined as:

"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."

This definition emphasizes that safety culture involves as much the organization as the individuals, concerning their characteristics and attitudes. On the other hand, it doesn't recognize that all organizations have a safety culture which can be good, bad or indifferent. It doesn't also say anything on competence and proficiency, which are prerequisites to reach and to maintain a good safety culture.

A number of definitions have been developed aiming the improvement of the definition proposed by IAEA. One of the most widely used is that developed by the Advisory Committee on the Safety of Nuclear Installations (ACSNI) [5]. ACSNI's definition is given below:

"*The safety culture of an organization is the product of 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 safe and by confidence in the efficacy of preventive measures".

This definition is based on the interpretative view that culture cannot be considered as a simple thing that can be bolted on to an organization.

Since 1986 the International Atomic Energy Agency has been publishing guides with the objective to improve safety culture of nuclear facilities, namely the Safety Series No. 75-INSAG-4, "Safety Culture" [4]; IAEA-TECDOC-1321, "Self-assessment of safety culture in nuclear installations" [6]; IAEA-TECDOC-1329, "Safety culture in nuclear installations" [7], and others. Although these documents focus mainly nuclear power reactors, basic guidelines for implementation in research reactors are presented and have been used in the safety culture enhancement programme at the High Flux Reactor (HFR) Petten, NL [8].

2. SCOPE OF THE WORK

This work describes the experience gained in the execution of the first phase of the Safety Culture Enhancement Programme to be implanted in the IEA-R1 Research Reactor at IPEN-CNEN/SP. This work covered a period from September 2002 to December 2006. The main results of the study are presented.

The IEA-R1 is a 5 MW pool-type reactor, cooled and moderated by light water, and it uses graphite and beryllium as reflectors. First criticality was achieved on 16 September 1957 and the reactor has been operating regularly and safely for almost 46 years. The reactor building is located within the premises of IPEN/CNEN-SP, one of the Brazilian institutes for energy and nuclear research, inside the campus of the University of São Paulo.

The safety culture enhancement programme started when the general manager of the Research Reactor Centre instituted a Safety Culture Enhancement Working Group, with the objective to formulate and implement the first phase of the Safety Culture Enhancement Programme. The group included senior professionals representing diverse areas such as radiation protection, quality management, probabilistic safety assessment, managers of reactor operation and services and the general manager of the research Reactor Centre. The group meetings were held every week to discuss different issues involved in the programme.

3. METHODOLOGY

The first task of the working group was to acquire knowledge about the state of the art in safety culture. This task was accomplished through seminars given by invited speakers and panel sessions where the participants made presentations based on literature studies in this area. The relevant literature studies consisted of guidelines and reports published by the International Atomic Energy Agency (IAEA), the U.S. Nuclear Regulatory Commission (NRC), Health and Safety Executive (HSE), DuPont and Brazilian nuclear organizations (Eletronuclear, INB, IEN and CNEN) among others.

After the completion of literature survey and the detailed analysis of different approaches which could possibly be used in our context, the working group developed a proper methodology to be used in the first phase of the Safety Culture Enhancement Programme at IEA-R1 Research Reactor consisting of the following steps:

a) Safety culture assessment at IEA-R1 Reactor;
b) Identification of weak points related to safety;
c) Elaboration and implementation of an action plan aiming at the enhancement of safety culture in the organization.

3.1. Safety Culture Assessment

As safety culture exists at different levels and crosses several dimensions, a range of measures is required for its assessment. The safety culture assessment was carried out in two different kinds of assessment: a) safety perception survey, b) safety culture self assessment.

3.1.1. Safety perception survey [9]

The safety perception survey evaluated the main aspects of safety culture based on the reactor employee's attitude, opinion and perception. The survey method used was a quantitative written questionnaire composed of 42 questions. These questions were divided into 14 dimensions that presented different safety culture aspects. The questionnaire was answered by 34 people involving only part of the staff of Reactor Centre, more specifically those who work at the reactor Operation and Maintenance Division, the Irradiation Service Division as well as the technicians of the Radiation Protection Division. The data were compiled,

statistically analyzed, documented in a technical report, and the main conclusions were presented to the employees in the form of a seminar.

Based on the opinions of IEA-R1 employees, some safety dimensions still inadequate for the accomplishment of the activities in the installation could be identified. Following a descending order of satisfaction level, these aspects were:

- Compliance with regulations and procedures 64,7 %
- Priority to safety/importance given to safety related issues 64,7 %
- Training 61,8 %
- Openness and communications 61,8 %
- Quality and adequacy of documentation and procedures 61,8 %
- Top management commitment to safety 61,8 %
- Assessment of the safety level in the organization 58,8 %
- Safety management 38,2 %

On the other hand, the safety culture aspects considered adequate by the same group of employees were:

- Motivation and job satisfaction 88,2 %
- Notions on risk prevention 85,3 %
- Employee's attitude towards safety 79,4 %
- Commitment and responsibility of the employees 76.5 %
- "Absence of safety versus production" conflict 67,6 %
- Working conditions regarding safety 67,6 %

3.1.2. Safety culture self assessment

The aim of this assessment was to evaluate safety culture at the reactor objectively. For this purpose, the working group used the self assessment questionnaire proposed in the document safety series No. 75-INSAG-4 published by the IAEA. This questionnaire is composed of 13 parts, each one representing a dimension to be evaluated. Each question was accurately analyzed, discussed and compared to evidences before being answered in a consensual way by the group. The appraised dimensions were:

1. Corporate level safety policy
2. Safety practices at corporate level
3. Definition of responsibility
4. Training
5. Selection of managers
6. Review of safety performance
7. Highlighting safety
8. Work-load
9. Relations between plant management and regulators
10. Attitudes of managers
11. Attitudes of individuals
12. Local practices
13. Field supervision by management

Important improvement opportunities in the safety of the reactor were identified in all these appraised dimensions. The results of the self assessment task as well as an outline of improvement actions were documented in a technical report which was placed at the disposal of the staff of the IEA-R1 Reactor.

3.2. Identification of Weak Points

A workshop is planned to be held in the second semester of 2007, with the participation of employees of the IEA-R1 Reactor. In this workshop the main concepts of safety culture and the results of the two previously mentioned safety assessment approaches will be presented. Discussions on these issues among the participants should lead to the identification of the weaknesses and strengths of the safety culture of the organization.

The conclusions and recommendations would be taken into consideration for the elaboration of a formal action plan for the safety culture enhancement.

3.3. Elaboration and Implementation of the Action Plan

The elaboration of the action plan will occur after the accomplishment of a workshop in which the largest possible number of workers of the reactor will participate. In this workshop the main concepts of safety culture and the results of the assessments mentioned above will be presented, and then thoroughly discussed by the participants resulting in the identification of the strong, weak and consensual points of effective safety culture in the organization.

The conclusions and recommendations obtained in the workshop will be formalized in a plan with actions improvement of the safety of the organization. In this plan the implementation schedule is specified along with the respective appraisal of the necessary resources.

4. FUTURE DEVELOPMENTS

The second phase of the Safety Culture Enhancement Programme at the IEA-R1 Research Reactor will be started after the implementation of the action plan, when further evaluations will be performed. Studies in the area of social capital theory of safety culture (SCT) are expected to be incorporated to phase 2. The application of SCT of safety culture to IEA-R1 Reactor will used in the identification of the number of social dimensions of the organizational environment that impact on worker behavior and perceptions of the safety work environment. Finally, training in safety culture will be given for the reactor personnel.

3. CONCLUSIONS

The experience gained with the Safety Culture Enhancement Programme helped with the identification of tacit problems related to safety and the planning of corrective actions. In addition, safety turned to be treated in more systematic and effective way.

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