# IMPLEMENTATION OF ASSET CONCEPT IN INDIA

by
**Jaharlal Koley**
Operating Plants Safety Division
**A E R B**
Mumbai, INDIA

**Abstract**

The paper presents a retrospective assessment of the use of ASSET methodology in India since the first ASSET seminar organised by IAEA in collaboration with the Atomic Energy Regulatory Board, India(AERB) in May, 1994. The first ASSET seminar was organised to initiate the spread of idea among operating and research organisations and regulatory body personnel. The participants were carefully chosen from various fields and with different levels of experiences to generate teams with sufficiently wide spectrum of knowledge base. AERB took initiative in leading by example and formed ASSET teams to carry out the first ASSET reviews in India. These teams at the instance of AERB carried out ASSET review of three Safety Related Events, two at Nuclear Power Plants and one at Research Reactor. This paper describes the outcome of these ASSET studies and subsequent implementation of the recommendations. The initiative taken by the regulatory body has led to formation of ASSET teams by the utilities to carry out ASSET study on their own. The results of these studies are yet to be assessed by the regulatory body. The result of the ASSET experience reveals the fact that it has further potential in improving the safety performance and safety culture and bringing in fresh enthusiasm among safety professionals of Indian Nuclear Utilities.

## 1.0 BACKGROUND

India has ten Nuclear Power Units in operation with a total installed capacity of about 2000 MWe and four more Units of 220 MWe, each in different stages of

construction. In addition there are three high power research reactors. The Atomic Energy Regulatory Board (AERB) is the Regulatory Body vested with the responsibility of training and enforcing safety regulations envisaged in the Atomic Energy Act of India, 1962, in all the nuclear installations. The primary responsibility to maintain safety of these installations rests with the Chief Executives of these installations. The routine and periodic safety review of the Nuclear Power Plants and other nuclear facilities is carried out through a multi-tiered hierarchy of Safety Committees at -

(a) Atomic Energy Regulatory Board - Constituted by Government of India, with membership drawn from public.

(b) Regulatory level - Safety Review Committee for Operating Plants (SARCOP), constituted by AERB.

(c) Unit level - Unit Safety Committee, constituted by SARCOP.

(d) Plant level - Station Operation Review committee, constituted under the provision of Technical Specification approved by SARCOP.

Organisationally, this multi-tiered system of Safety review by a hierarchy of Safety Committees, is working on management by exception principle in order of increasing authority.

## 2.0 INCIDENT REVIEW PROCESS

The safety significant events are reported by the utilities as per a well laid out reporting criterion as defined in the Technical Specifications, within the operating organisation as well as to the Regulatory Body. These incidents and the related investigations get reviewed in the appropriate level of the multi-tiered system of Safety Committees as warranted by their safety significance. In each of these stages of review, experts scrutinize the root-causes of the events and identify appropriate corrective measures which are subsequently implemented to eliminate root causes and enhance safety. Periodic safety review for renewal of authorisation is done once in five years. During this time all the incidents and the overall safety performance of the plants are reviewed in detail. India has been an active participant in the Incident Reporting System of IAEA. In addition we have been sending information to IAEA on safety related incidents of interest after assessments in the INES scale too.

## 3.0 INCIDENT ANALYSIS

Formal introduction to analysis for root cause of events by ASSET methodology was given to the regulators and nuclear utilities in India during the ASSET seminar organised jointly by IAEA and Atomic Energy Regulatory Board (AERB) in May 1994. About thirty professionals from the nuclear industry having wide range of experience in various fields had participated in this seminar. This helped in developing a rich bank of experts in root cause analysis with sufficiently wide spectrum of knowledge base.

Shortly after the ASSET seminar, AERB constituted a team to carry out ASSET review of an incident in one of the research reactors in India, viz. CIRUS. This review brought to the focus the need for some systemic and procedural modifications. Being inspired by the success of this mission, AERB constituted another team to review a power

rise incident in one of the Indian standard PHWRs, viz. Narora Atomic Power Station (NAPS). This was followed by further ASSET reviews in which two safety significant events of Kakrapar Atomic Power Station(KAPS) were analysed. Presently NPC, the operating organisation, has set up a system for in-house ASSET review programme. Results of these reviews, in the form of reports, are submitted to AERB for peer review.

## 4.0 ASSET FUNCTIONS AND FOLLOW UP

ASSET functions consist of three stages of activity (1) PRE-ASSET incident review, (2) ASSET review and (3) POST-ASSET follow-up. The PRE-ASSET review is already an integral part of the incident review scheme in the existing regulatory frame-work. All the incidents are reviewed by the multi-tiered system of Safety Committees. During these reviews, if it is felt that ASSET review of certain incidents could help in improving Safety Performance and Safety Culture, expert teams are constituted for detailed ASSET studies.

Experts in R & D, operation, management and regulatory activity form members of the ASSET team. This team goes into detail of the incident, study all the relevant cases, analyses their consequences and impact on overall safety of the plant and gives its findings and recommendations in the form of ASSET review report. Findings of the ASSET team and its recommendations are peer reviewed by the regulatory body. The recommendations, after review of the feasibility and its overall impact on safety, are followed up for implementation within a time frame.

All the recommended changes in procedures, managerial activities and training programmes are implemented as early as possible. If any changes in system or hardware

are required that need capital investment and long plant shutdown, these are implemented in long term.

## 5.0 ASSET REVIEWS CARRIED OUT IN INDIA

Some of the highlights of ASSET reviews carried out in India are described below. A brief description of the events followed by major findings, recommendations of the ASSET teams and its implementations are also given.

### 5.1 NAME OF THE INCIDENT

**Degradation in cooling of irradiated fuel rod during transfer in CIRUS.**

### 5.1.1 BRIEF DESCRIPTION

During removal of the irradiated fuel assembly from the reactor, cooling water was not provided to the transfer flask due to oversight.

### 5.1.2 OBSERVATIONS AND COMMENTS

Procedures for fuel handling at the plant was not up-to-date. There were no check lists to ensure fulfillment of the pre-requisites at different stages of the job. The flow meter provided for confirmation of the cooling water flow to the fuel transfer flask was not legible due to masking by dirt and the meter was located in an area with poor illumination. The mechanism for obtaining feed-back from operation to the plant management was poor.

### 5.1.3 IMPLEMENTATION STATUS OF RECOMMENDATIONS

A mechanism has been constituted to periodically review and revise all the operating procedures at regular intervals to incorporate feed back from the operations.

Station has constituted a committee for analysis of human performance in operations for giving feed back to management.

## 5.2 NAME OF THE INCIDENT

**Flooding of Turbine building basement resulting in non-availability of certain safety related equipment in Kakrapar Atomic Power Station.**

### 5.2.1 BRIEF DESCRIPTION

Due to heavy rains, water level in the nearby Lake increased and resulted in flooding of plant premises. Flood water backed up through some underground cable tunnels which did not have proper sealing, caused submergence of certain equipment located in the turbine building basement affecting availability of the normal channel to ultimate heat sink. Core cooling was maintained by injection of fire water to the shutdown cooling heat exchangers.

### 5.2.2 OBSERVATIONS AND COMMENTS

The increase in Lake water level was due to unprecedented heavy rains, flash floods and blocking of the outlet gates by huge chunks of grass with roots and weeds. The invert level of the pipe and cable tunnel was below the design basis flood level for the plant and did not have any proper sealing. Though flooding incidents had been experienced at other plants, adequate flood prevention measures were not taken by the plant prior to onset of monsoon.

### 5.2.3 IMPLEMENTATION STATUS OF RECOMMENDATIONS

The cable entry point were raised. The existing tunnel entry points have been sealed by RCC wall. Instrumentation has been provided to indicate water level in plant

water pump house. A spillway weir has been constructed in the lake to ensure that the water level does not rise to unacceptable level. Hydrology review and capacity survey of the Lake were done. A system was instituted for periodic desilting of the lake and flushing of weeds before every monsoon. A system was developed for proper feedback of experience, including action taken for prevention of recurrence of such incidents among the operating plants and projects.

## 5.3 NAME OF THE INCIDENT

**Reactor Regulating System(RRS) fails to limit increase in reactor power in Narora Atomic Power Station.**

### 5.3.1 BRIEF DESCRIPTION OF THE EVENT

In Unit-1 of Narora Atomic Power Station, when the reactor was operating at 130 MWe, the reactor power increased steadily on its own and reached 147 MWe. The reactor power was brought down by manual intervention. The reactor power increased due to 'trimming up' of the Set(Demand) Power in two of the triplicate RRS channels resulting in cumulative increase in the actual reactor power.

### 5.3.2 OBSERVATIONS AND COMMENTS

The incident occurred due to design deficiency in RRS. The root cause of the event was insufficient visualisation of disturbance conditions by the designers which could result in unlimited trim action by reactor regulating system.

### 5.3.3 IMPLEMENTATION STATUS OF RECOMMENDATIONS

In absence of any limit on trim action, the reactor demand power can change cumulatively in one direction i.e. up or down. To rectify this, the cumulative trim action

is limited to 3% FP around the demand power by a design modification. As a long term solution to improve the system design, the reactor power control was decided to be based on the corrected linear neutron power signal instead of the differential temperature signal. For eliminating the root cause of the weakness in RRS design, the ASSET recommended to institute a systematic process to obtain operational feedback on a continuous basis.

## 6.0 CONCLUSION

Introduction to ASSET methodology, being structured and user friendly, has improved efficiency of the already existing system of root cause analysis in India. ASSET helped in rectifying inadequacies in procedures and surveillance programme. AERB now takes a closer look into the station surveillance programmes which are defined in the station policy document. Appropriate surveillance method has the capability to detect weak links in the system much before it actually fails.