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IMPROVEMENT IN PLANT PERFORMANCE BY EFFECTIVE USE OF OPERATING EXPERIENCE

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Introduction

Tarapur Atomic Power Station 1&2 (TAPS # 1&2) is a twin Boiling Water Reactor (BWR) nuclear power station, with each unit operating at 160 MWe and has completed 41 years of successful operation.

Station has an effective Operating Experience (OE) programme. Throughout the operating history, station has been effectively utilizing in-house, national and international OE information.

Based on this information, station has incorporated various modifications in the plant systems and practices.
Introduction (Contd.)

Information on in-house as well as overseas industry experience is reviewed in a systematic manner by the Operating Experience Review Committee (OERC), comprising of members from different sections.

Station OE organization and OE programme including review, analysis, dissemination and application of OE information for enhancing safety and reliability of plant are discussed in this paper.
OE Input

IAEA, WANO, USNRC, NPCIL and Indian nuclear regulatory body Atomic Energy Regulatory Body (AERB) contributed to sharing of operating experience among the industry. They encourage information exchange and communication among the nuclear industry.

Major areas of thrust are:

- Operating Experience.
- Peer Reviews.
- Technical Support and Exchange.
OE Input (Contd.)

These programmes assist members to identify and propose solutions to known problems, which ultimately result in improvements in nuclear safety and reliability.
OE Organization at TAPS # 1&2

• Station already had an effective programme to utilize national and international OE information.

• However, in the year 2001, a formal organization, namely, Operating Experience Review Committee (OERC) comprising of members from different sections such as Operation, Maintenance, Technical Services, Quality Assurance and Training was constituted to systematically review and implement lessons learned from operating experience of other NPPs.
OE Organization at TAPS # 1&2 (Contd.)

• OERC is functionally responsible to Station management.

• Information on in-house and industry operating experience are reviewed by the OERC and are communicated to various sections and Station Operation Review Committee (SORC).
OE Review Procedure

A well-laid procedure exists for the Operating Experience Review. The objectives of this procedure are:

- To conduct OERC meeting once in a month.
- To review technical information received from various agencies.
- To disseminate operating experience of various NPPs and to implement lessons learnt.
Document Review Methodology

All documents received from IAEA, WANO, USNRC and Indian NPPs are assigned a specific OERC registration number.

Then they are sent to members in respective field of specialisation for detailed study and review with respect to their relevance to TAPS.

Screening and analysis of Operating Experience documents is done as per the WANO Guidelines for Operating Experience at Nuclear Power Plants (WANO-GL-2003-01).
OERC member, who receives the document will review them in detail and indicate their comments in the standard feedback format.

Feedback reports are sent back to Member-Secretary, OERC to put up the same in the next OERC meeting for detailed discussion.
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<tr>
<th>Sr. No.</th>
<th>ITEM FEEDBACK</th>
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<tbody>
<tr>
<td>1.</td>
<td>Title of the Report</td>
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<td>2.</td>
<td>OERC Reference Number</td>
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<td>3.</td>
<td>Report Reference Number</td>
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<td>4.</td>
<td>Agency – (GE/USNRC/INPO/WNA,WANO,IAEA, INDIAN NPP)</td>
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<td>5.</td>
<td>Name of NPP</td>
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<td>8.</td>
<td>Whether relevant to TAPS - (Yes / No)</td>
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<td>9.</td>
<td>Justification in brief (Pl. see 9.1 – 9.5)</td>
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<td>9.1</td>
<td>Whether the event had potential to affect nuclear safety? How?</td>
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<td>9.2</td>
<td>Whether the event had potential to affect plant reliability? How?</td>
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<td>9.3</td>
<td>Whether the event had potential to affect personnel safety? How?</td>
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<td>9.4</td>
<td>Whether the event had potential to affect public safety? How?</td>
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<td>9.5</td>
<td>What is the likelihood of occurrence of the event at TAPS? How?</td>
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<td>10.</td>
<td>Cause of the event (Procedural Deficiency, Programmatic Deficiency, Equipment Deficiency, Human Performance Deficiency)</td>
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<td>11.</td>
<td>Lesson to be learnt (Indicate Procedural changes to be made, Engineering changes to be made, Training to be imparted etc.</td>
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<td>12.</td>
<td>Feed Back Report Prepared by:</td>
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To, Member Secretary, OERC |

13. | OERC Meeting No. |
14. | OERC Deliberation |
15. | OERC Recommendation |
Conduct of OERC Meeting

Meeting of OERC is conducted once in a month to review feedback reports and associated documents.

Based on the OERC deliberations, documents are classified as:

(a) Relevant to TAPS

(b) Not relevant to TAPS.

Minutes of OERC meetings are issued and distributed to all concerned.
If OERC has given any recommendation during the deliberations, such documents along with minutes of meetings are sent to concerned agencies for implementation.

In case of documents relevant to TAPS, following actions are initiated:
Conduct of OERC Meeting (Contd.)

- If the implementation of OERC recommendations requires change in plant operating procedures or modification in plant systems, such recommendations are discussed in SORC.

- If OERC recommendations are for information dissemination, such documents along with OERC minutes of meetings are sent to concerned sections and Nuclear Training Centre for discussion among plant staff.
Documents on such discussions are maintained by concerned sections and Member-Secretary, OERC for records.

- Among the documents relevant to TAPS, in which no action is required in view of the adequacy of prevailing station practices, such documents are sent to TAPS library.
Follow-up of OERC Proceedings

- Quarterly summary of OERC proceedings is discussed in the SORC.

- Implementation status of OERC recommendations is reviewed in all OERC meetings.

- OERC proceedings are maintained in OERC Web site.
Ways of OE Information Dissemination

- Minutes of OERC meetings are e-mailed to all technical staff and the same is posted in OERC web site also.

- Sectional discussions and training programmes are conducted on OE matters.

- Information on OE can be accessed through OERC web site.

- OE matters are discussed in SORC.
Analysis of OE Information

Analysis indicates that by improving human performance and equipment performance factors many of the events can be prevented.

Improvements in human performance factors can be achieved by extensively practicing error reduction techniques such as three-way communication, self-checking, peer-checking, STAR principles, and by adherence to procedures.
Equipment performance can be improved by giving more attention to material condition and improving preventive and condition-based maintenance.

Balance events can be prevented by improving quality and contents of procedures and by improving the existing programme for O&M and inspection.
Analysis of OE Information (Contd.)

Since its inception in the year 2001, up to year 2010 OERC has conducted 112 meetings and reviewed about 1141 national and international documents. OERC has given about 350 recommendations.

Out of these about 71% were for sectional discussion, 16% were for station procedure revision or review and 13% were for imparting training to plant personnel.

All OERC recommendations have been implemented.
Analysis of OE Information

- Sectional Discussion: 71%
- Procedural Revision: 16%
- Training: 13%
Utilization of OE Programme

Station has been effectively using the OE information for improving operation, maintenance and inspection of systems, structures and components. OE programme has benefited the station.

Based on the operating experience feedback from national and international events, station has carried out several modifications to increase safety and reliability of plant.
Post TMI Accident Modification

1. Installation of Additional Reactor Level Monitor:

Initially Reactor Level monitoring was limited to a range starting from above the top of the fuel.

A wide range level instrument, which can monitor reactor water level starting from the bottom grid plate of the reactor core was commissioned.
Post TMI Accident Modification (Contd.)

2. Installation of Second Start-up Transformer:
   Initially there was only one start-up transformer for the two Units. A second Start-up Transformer was installed to improve the off-site power availability.

3. Installation of Second 240 V DC Battery Bank:
   In the original design, there was only one 240 V DC battery bank common for both the Units.

   The original battery bank capacity was increased and second battery bank was installed at a different location. This modification has increased reliability of 240 V DC systems considerably.
Post Chernobyl Accident Modification

Subsequent to Chernobyl accident in the year 1986, major modifications such as installation of Station Black Out-Diesel Generator (SBO-DG) were done.

The SBO DG is located at a different location away from the station Emergency Diesel Generators.
OE Utilization- Inspection

Based on operating experience feedback, station has augmented the inspection methodologies in the plant:

1. Subsequent to River Bend NPP, USA incident in year 2000, in which during a monthly sampling of standby liquid poison tank water, several pieces of plastic sheets were found.

TAPS had carried out inspection of standby liquid poison tank. No foreign material or any other abnormality was found.

A surveillance programme has been established for poison tank inspection.
2. Carbon steel pipelines in turbine extraction system and feed pump recirculation lines were subjected to erosion corrosion. Station has replaced all these lines with more erosion resistant Chrome-Moly pipelines. This has eliminated the frequent problem of leaks in these lines.

3. In the year 2004 at Mihama NPP in Japan, failure of condensate line due to Flow Accelerated Corrosion (FAC) was reported. Considering this aspect, a detailed study was carried out and the existing inspection programme was further strengthened.
OE Utilization- Inspection (Contd.)

4. In June 2005, at Fitzpatrick NPP, a crack was observed on the torus support of suppression pool. In view of this, visual inspection of primary steam relief valve discharge line supports of both the Units were carried out and no abnormality was noticed.

5. In order to facilitate prompt notification of hydrogen leak from generator casing, a hydrogen leak detection system with alarm facility was commissioned.
OE Utilization- Inspection (Contd.)

6. Adequacy of the existing conventional type fire detection system was reviewed.

Based on the type of combustible materials present in the area, addressable fire alarm system with appropriate type of detectors such as ionization, optical, heat, flame detectors etc. have been installed.
Improvements and modifications in NPPs design and safety is a continuous process. Design and safety review of the plant was done. The detailed review was done and the proposed modifications were mainly about:

- The change in equipment layout and Unit-wise segregation of electrical and mechanical systems.
- Replacement of the 3 x 50 % capacity emergency diesel generators with 3 x 100 % capacity diesel generators at different locations.
OE Utilization- Plant Up gradation (Contd.)

- Seismic up grades.

- The shared systems have been segregated Unit-wise.
  - Control rod drive hydraulic system,
  - Reactor shutdown cooling water system,
  - Delinking of fuel pool cooling water system from reactor shutdown cooling water system and
  - Power supply to the neutron monitoring system.
OE utilization- Low Level Event (LLE)

Low Level Events are precursor of the events and the significant events.

For increasing effectiveness of Low Level Events (LLE) reporting technique pertaining to TAPS, Line managers take part in job observation and plant walk down for observing material condition on a regular basis.

Line managers make quarterly presentation of Low Level Events to the management.

Trending of the events are done to find the area requiring further attention.
Post Fukushima Review

Recently, WANO SOER 2011-2 on Fukushima Daiichi Nuclear station fuel damage caused by earthquake and tsunami was received by the station. The recommendations given in SOER are being reviewed. Station has done self-evaluation and is;

1. EOPs are available for handling design basis accidents like:
   • Earthquake,
   • Fire,
   • Flood,
   • Station black out,
   • Tsunami.

These EOPs were reviewed and found executable.
Post Fukushima Review (Contd.)

2. Round-the-clock shift operators are regularly trained at Training Centre through a structured programme for:
   • EOP,
   • Use of First Aid & BA sets,
   • Industrial & Fire Safety.

3. Emergency drills are being conducted regularly for:
   • Radiation emergency,
   • Fire emergency,
   • Chlorine leak,
   • Communication exercise,
   • Diesel leak.
4. Mitigating actions required by station design for SBO condition as per EOP were reviewed and found functional and valid.

5. Mitigating systems are ensured to be available by routine testing of
   - Emergency condenser,
   - 240V battery banks,
   - Supplementary control room,
   - Emergency lights,
   - Diesel fire pump.

Committee of experts in this field is reviewing the plant systems further in detail.
OE- Benefits to Station

1) Information on OE documents has helped station to identify training needs on topics such as foreign material exclusion, human performance, reactor chemistry etc.

2) Dissemination of OE information has helped station personnel to get information on various aspects such as: Operational decision making, Error reduction techniques, Prevention of foreign material intrusion, Flow Accelerated Corrosion (FAC).

3) OE feedback helped to revise several O&M procedures in a different perspective.
Conclusion

The station has been effectively utilizing the OE information for augmenting its systems, structures, components and O&M procedures.

This Systematic approach followed at TAPS 1&2 for using Operating Experience & LLE reporting and rectifying them has resulted in improvement in safety & also plant availability of TAPS Units.
THANK YOU