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Operational experience feedback in the World Association of Nuclear Operators (WANO)☆

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Abstract

Operators in high-risk industries need to be learning organisations, learning from themselves and from the others. This presentation will describe how the nuclear industry is dealing in an integrated manner with the feedback of operating experience (OE), both internal and external, to increase the safety and reliability of power plants; it will describe how it

- investigates events
- reports events and analyses trends
- shares information to prevent recurrence
- performs corrective action and training
- performs assessments to verify effectiveness

The plants have achieved great improvements in performance overall, and to improve further, the industry is evolving. Instead of just learning from past events (reactive) it is now focusing on lower level indications of problems (precursors) through low level events reporting, trending and analysis. A hallmark of the industry is its desire to be self-critical. Emphasis is placed on improving the bottom quartile performing plants.

Keywords: Learning organisations; Operating experience feedback; Events reporting; Investigation

1. Introduction: what is WANO

The generation of electric power with nuclear energy is among the high-risk industries. All high-risk industries need to learn from their own experience and from the experience of others, so that accidents can be prevented.

The accident at Three Mile Island (TMI) nuclear plant in 1979 made evident this need: the same initiating failures had occurred at two plants shortly before. If TMI had known, the accident might not have happened. “Might not” is the proper term, as being informed is not enough; what you do with the information is at least as important. The TMI accident led to the creation of the Institute of Nuclear Power Operations (INPO), a private non-profit group of all nuclear plants in the USA, as required by the Kemeny Investigation Commission. In 1989, the Chernobyl disaster led similarly to the creation of World Association of Nuclear Operators (WANO), a private world-wide association where membership is voluntary, but to which all the nuclear plants (453) of the world belong. WANO immediately endorsed operating experience (OE) as a cornerstone programme to identify precursors and prevent events.

WANO has no association with governments or with regulators. It is not either an internal regulator nor a lobbying organisation. It was set up purely to help its members achieve the highest practicable levels of operational safety by giving them access to the world-wide community of operating experience. Its confidentiality policy is essential in assuring the confidence of the members and the effectiveness of its actions.

WANO has now four regional centres, in Tokyo, Moscow, Paris and Atlanta, and a co-ordinating centre in London, each of them governed by a Board comprised of representatives from the member utilities, and staffed with employees seconded by the members.

WANO’s mission is: “to maximise the safety and reliability of the operation of nuclear power plants by exchanging information and encouraging communication, comparison and emulation amongst its members”.

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This definition encompasses most of the attributes of a learning organisation, which is imperative for an operator in a high-risk industry:

- focused leadership;
- performance assessments;
- operating experience feedback;
- benchmarking and technical exchange;
- training and development.

always striving for excellence and for continuous improvement. Thus, the other cornerstone programmes in WANO are

- peer reviews;
- technical exchange (which includes performance indicators, technical support missions, guidelines); and
- professional development (which includes training courses, seminars, workshops, experts meetings).

2. OE integrated approach

WANO's model for operating experience is a proactive and integrated cyclic process: investigation of events, development of databases, analysis of the databases for trends and common weakness areas, reports with recommendations to prevent occurrences, implementation of recommendations, which are checked in the peer reviews, identification of areas for improvement, application of corrective actions and of technical missions to address these areas, and verification of their effectiveness by self-assessments and by the evolution of performance indicators.

The plants have achieved great improvements over the last decade in overall performance, as shown by the steady improvement in performance indicators, and now that the situation is almost asymptotic, to improve further, the industry needs to evolve. Instead of just learning from past events (reactive to lessons learnt) it needs a new focus on reporting, trending and analysis of lower level events.

A hallmark of the industry is its desire to be self-critical. Emphasis must be placed on improving the bottom quartile performing plants, but even in the best performers there are areas for improvement.

3. Investigate and report events

Nuclear operators have developed events databases at various levels: internal to each station, at the utility level and at the national level. They include their own events and information from various sources such as the IAEA, the regulatory bodies, and also from INPO and WANO.

An OE central team located in the Paris Centre maintains the WANO-wide OE database. It includes individual events reports described below, and other OE products (that is documents resulting from events analysis), such as significant event reports (SERs), significant operating experience reports (SOERs) with lessons learnt and recommendations and a just-in-time (JITs) library for use in pre-job briefings: the website also includes the guidelines developed by WANO and identified good practices of the members. The plants awareness and application of OE techniques is enhanced through training courses (on event investigation, conservative decision making, human performance and pre-job briefings), workshops and seminars.

Typical levels and types of reporting within the utilities with the best OE programmes may be about 1000 events per unit per year, of which:

- Nine hundred are low-level events or deviations from expected conditions, such as resulting from walk downs, inspections, operations or maintenance, which enter the company database for trending and statistics.
- One hundred occurrences with some lesson to learn; a direct cause or root cause analysis by one person is performed.
- Ten events significant for the plant, for which a root cause or full investigation is carried out.
- Only rarely is there one real accident or near miss, with deep reaching investigation and consequences.

Reporting from plants to the WANO database varies widely. Most plants make a clear distinction between events that their regulator requires to report and all others, and for that reason they usually report to WANO only those which respond strictly to eight specific criteria for reporting. Thus WANO receives now about 100 event notification reports (ENRs) or event analysis reports (EARs) per year from all plants, and another 100 miscellaneous event reports (MERs) without full coding or root cause analysis. Ten years ago these numbers were much higher.

Building on the events reports, WANO then produces four or five SERs and a couple SOERs with the most important events and issues observed.

To widen the database of events on which these documents of analysis are built, WANO is now requiring its members to report any event for which they answer "yes" to the question: "if this had happened at another plant, would I have wanted to know about it?", instead of finding out the good reasons for not reporting it. The number of reports is already increasing in early 2003.

All the plants can access the full WANO event database via secure connections. WANO is now promoting the widening of database access to all potential users in the operators' staff.

Examples of some of the reports mentioned above will be shown in the oral presentation.

4. Analyse events

Nuclear plants use several techniques to analyse root causes of events, sometimes several in parallel. The technique most frequently used is the event investigation analysis (EIA), based on INPO's human performance enhancement system (HPES). It is taught in the WANO training courses.

Other methodologies often used are IAEA's ASSET teams, the management oversight and risk tree analysis (MORT) and recently the safety through organisational learning (SOL) with high emphasis on organisational factors.

The EIA methodology consists of five stages: What happened?; How and Why?; Corrective actions?; Lessons learned?; Effectiveness review? You recognise here the elements of the integrated cyclic approach to OE.

The analysis of the causes of the event (how and why), is made by one or more of the following HPES techniques, depending of the type of event and the familiarity and knowledge of the operators about the initiating event:

- Task analysis: divide event into small steps, identify potential problems in the office and then in a walk-through.
- Barriers analysis, physical and administrative (training, procedures, communication)
- Event and causal factors charting: for each step, starting from the terminal event, analyse "cause–effect" of broken barriers, and identify direct causes and contributors.

The event analysis reports are then introduced in the database with a coding system that includes consequences, direct causes, and root causes and contributing factors.

5. Analyse trends and issues

The database is continuously scrutinised to detect common trends and recurring causes. If an important issue is identified which requires quick attention of the plants, an SER or an SOER may be proposed, approved and initiated at any time; or a "hot topic" may be developed and posted in the website. At the end of the year, an annual report is distributed to the members, highlighting the common areas of weakness in "events with significant learning points". For example, the areas of potential weakness discussed in the 2001 report are as follows:

- inadvertent draining from the reactor vessel;
- emergency power reliability;
- operational decision making;
- primary system component leakage;
- refuelling operations.

and in the 2002 report:

- control of contract personnel;
- fuel handling events;
- foreign material exclusion.

For each of these areas, there is a discussion of the relevant related events, identification of some underlying common contributors to these events, and a section entitled "Prevent Events: Discussion Points For Managers".

Frequently, these areas become the subject of an SER or SOER the following year. In 2002, an SOER has been issued on emergency power reliability, as well as two SERs on inadvertent draining from the reactor vessel and on reactor vessel head leakage and corrosion. We are now preparing an SOER on operational decision making, which we believe of high importance in light of some recent events in advanced countries, which have caused long plant shutdowns and subsequent regulatory action.

Each SOER includes an in-depth analysis of the occurrences and their fundamental causes, and provides recommendations that each WANO member is expected to address. It also includes a set of training materials, including a supporting slide presentation. The SOER recommendations are used by the plants to perform self-assessments of their situation and, where needed, determine corrective actions. The WANO peer review teams now systematically verify their implementation.

A further analysis of common causes or meaningful trends in significant events and near misses identifies among them the following:

- pressure to continue operating;
- operators becoming overly focused on a subset of necessary plant indicators;
- ineffective application of operating experience.

Warning flags of potentially declining performance have been also identified in an analysis of plants which have had extended shutdown periods:

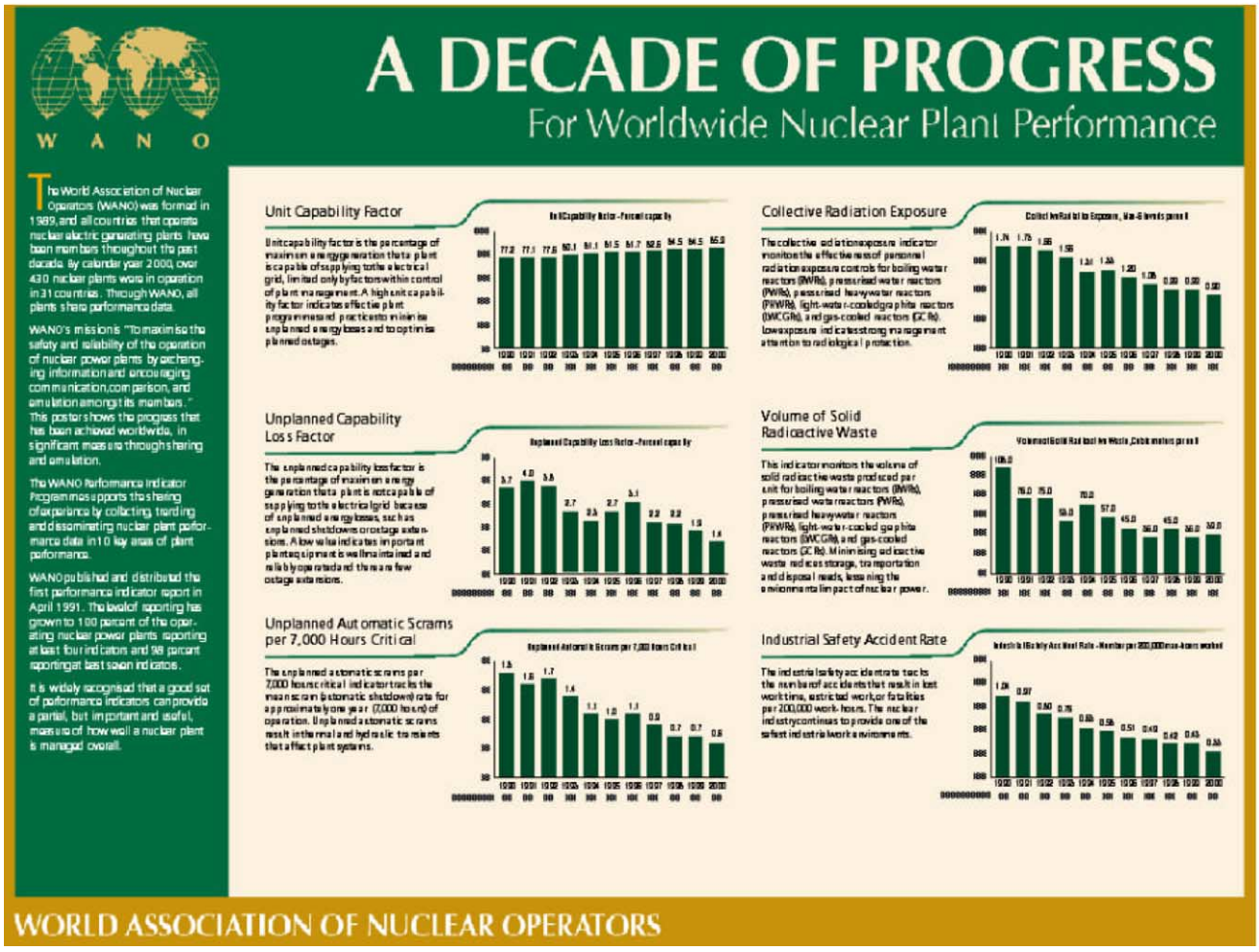
- overconfidence: living on past successes;
- isolationism: few interactions, few benchmarking trips, lagging behind and not knowing it;
- weak relationships: defensive relation with regulator, reporting problems not valued by the management;
- production priorities: important equipment problems not fixed;
- operations and engineering: weak standards and discipline, operations focus overshadowed;
- managing changes: organisational changes not well managed;
- plant events: events not correctly addressed, organisational causes not explored;
- nuclear leaders: senior managers without the right experience or not involved in operations;
- weak self-critical attitude: assessment of problems not critical enough, they do not find or correct problems.

6. Conclusion: present areas of focus

Overall plant performance has generally and significantly improved over the years. For this trend to continue, and to be effective in assisting its members to maintain it, WANO needs to improve its programmes and their effectiveness. Our efforts and the plants' efforts are thus focused on the following areas:

- Improve the operating experience programmes at all plants and utilities. Management commitment is needed to provide the plants adequate resources to implement the full circle of OE.

- Increase self-assessments and in-house analysis capabilities.
- Increase the volume and timeliness of event reporting. Generalise the tracking, trending and analysis of even minor events.
- Drive for the human performance and organisational factors issues in events.
- Generalise the habit of pre-job briefings and the use of just-in-time documents.
- Increase industry contacts through benchmarks, seminars and workshops, technical meetings and visits, as well as contacts with other industries.
- Increase senior management commitment to OE programmes, to technical assistance between members through increased support missions, and development of an inter-plants human performance experts network to review plans and practices in that area.



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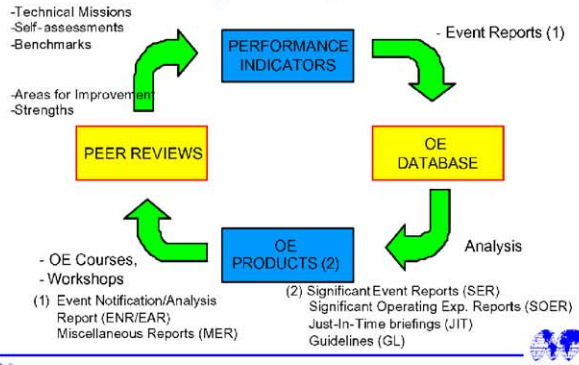
Operating Experience (OE) integrated approach



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OPERATING EXPERIENCE PROGRAMME

Slide 8

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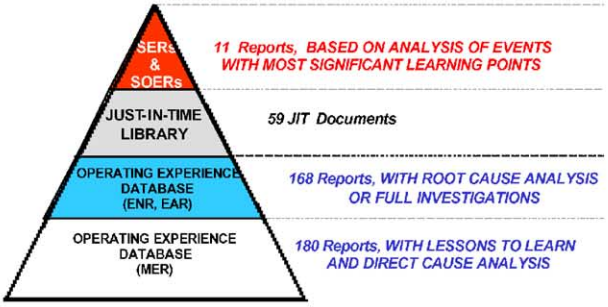
Inputs to WANO Central Data Base in 2001-2002



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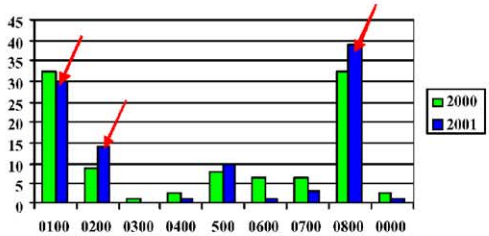
Direct Causes of Events 2000-2001



0100	MECHANICAL DEFICIENCY
0200	ELECTRICAL DEFICIENCY
0300	CHEMICAL or CORE PHYSICS DEFICIENCY
0400	HYDRAULIC AND PNEUMATIC DEFICIENCY
0500	CONTROL AND INSTRUMENTATION DEFICIENCY
0600	ENVIRONMENTAL (ABNORMAL CONDITIONS INSIDE THE PLANT)
0700	ENVIRONMENTAL (EXTERNAL TO THE PLANT)
0800	HUMAN FACTORS
0000	UNKNOWN

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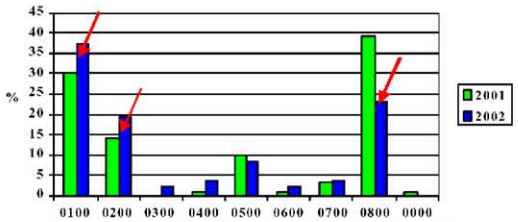
Direct Causes Events 2001-2002



0100	MECHANICAL DEFICIENCY
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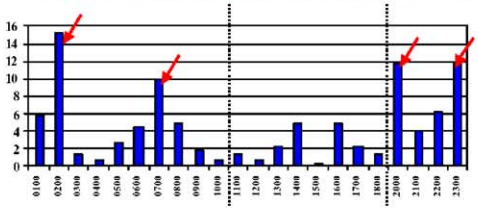
Root Causes and Causal Factors



HUMAN PERFORMANCE related (0100 to 1900 inclusive)

0100	VERBAL COMMUNICATIONS
0200	PERSONNEL WORK PRACTICES
0300	PERSONNEL WORK SCHEDULING
0400	ENVIRONMENTAL CONDITIONS
0500	MAN-MACHINE INTERFACE
0600	TRAINING / QUALIFICATION
0700	WRITTEN PROCEDURES AND DOCUMENTS
0800	SUPERVISORY METHODS
0900	WORK ORGANISATION
1000	PERSONAL FACTORS

EQUIPMENT related (2000 to 2300 inclusive)

2000	DESIGN CONFIGURATION AND ANALYSIS
2100	EQUIPMENT SPECIFICATION, MANUFACTURE AND CONSTRUCTION
2200	MAINTENANCE / TESTING / SURVEILLANCES
2300	EQUIPMENT PERFORMANCE

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