



**THAI - CANADIAN  
NUCLEAR HUMAN RESOURCES DEVELOPMENT  
TRAINING PROGRAM**

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**OPERATIONAL SAFETY REVIEW**

**OF**

**NUCLEAR POWER PLANTS**

**LECTURE NOTES FOR THE COURSE ON**

**PEER EVALUATION TECHNIQUES**

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## **OPERATIONAL SAFETY ADVISORY REVIEW TEAM (OSART)**

### **1.0 OBJECTIVE OF PRESENTATION**

The OSART process is discussed. The origins of the process and its development are reviewed. Its purpose and objectives are enumerated. A description of how the OSART missions are conducted including the evaluation criteria and the follow up process are summarized. The reporting process, including who the customers are, is discussed. The future outlook for the process is predicted.

### **2.0 GENERAL**

Since its formation, the IAEA has conducted missions to facilitate the provision of advice and assistance to Member States in nuclear safety matters. Until the early 1980s, industry safety activities focused mostly on plant design and construction. Then, as more plants completed construction and began operation, the industry recognized the growing importance of achieving high standards of operational safety and reliability. In addition, the industry began to realize the benefits of achieving a higher level of safety than the minimum standards set by regulatory authorities for the protection of the public and the environment. The efforts needed to achieve high levels of operational safety, such as careful planning, conservative decision-making and attention to detail, also contribute directly to enhancing plant reliability and production.

In 1982, the Agency added the Operational Safety Review Team (OSART) programme to its services. Under this programme, international teams of experts conduct three-week in-depth reviews of operational safety performance at individual nuclear power plants. These reviews are conducted at the request of the government of the host country.

The OSART programme provides an opportunity for nuclear power plant operators in all countries to assist other operators through the dissemination of information on the best international practices. Each OSART mission is conducted by a team of experts from several countries. Each of these experts has extensive experience in some aspect of nuclear power plant operation. Guidelines used by the teams to review plant programmes and performance are based on best international practices, and are applied in light of the experience of the entire team.

OSARTs focus on the safety of plant operation. They review the operation of the plant and the performance of the plant's management and staff rather than the adequacy of a plant's design. Factors affecting plant management and the performance of personnel, such as organizational structure, management goals, and the qualification of personnel are reviewed. Adequacy of programmes and performance related to operational activities are given particular attention.

In the course of detailed discussions with plant personnel, review of documents and observation of plant activities, the teams identify performance strengths that can be shared with others and areas where improvements could be achieved. Team members often discuss possible remedies for problem areas with their host utility counterparts.

The first OSART was conducted at the Ko-Ri nuclear power plant in the Republic of Korea in August 1983. By the end of July 1997, a total of 95 missions had been carried out at 70 nuclear power plants in 29 countries, including all the continents that have nuclear power plants. In addition, 30 follow-up visits have been conducted since this became a standard feature of the OSART programme in 1989.

### 3.0 PURPOSE

The purpose of the OSART programme is to assist Member States in enhancing the operational safety of specific nuclear power plants and to promote the continuous development of operational safety within all Member States by the dissemination of information on good practices.

In support of the OSART purpose, the key objectives of the OSART programme are:

- to provide the host countries (plant and utility management, the regulatory authority and other governmental authorities) with an objective assessment of operational safety at the host plants with respect to proven international performance and practices;
- to provide the host plants with written recommendations in areas where performance should be improved to meet proven international performance and practices;
- to provide the host plants with written suggestions where performance could be enhanced by use of proven good programmes and practices;
- to provide key staff at the host plants with informal assistance or advice on ways improvements might be achieved;
- to identify good practices at the host plants which are unique and worthy of bringing to the attention of others;
- to provide all Member States with information regarding good practices identified in the course of the review;
- to provide experts and observers from Member States and the IAEA staff with opportunities to broaden their experience and knowledge of their own field;
- to give experts and observers the opportunity to learn review methodology which will enhance their management skills.

OSART missions are peer reviews conducted by international teams of experts who have current knowledge of the area which they are reviewing. OSART reviews are not an audit against set codes and standards, rather they are a technical exchange of experiences and practices at all levels. They are a joint search by team members and designated plant personnel (counterparts) to identify strengths and opportunities for improvement in a plant's programmes and performance. Judgements of performance are made based on the combined expertise of the teams. OSART teams do not attempt to assess a plant's adherence to regulatory requirements or a plant's overall safety. Neither do they attempt to compare or rank nuclear power plants' overall safety performance. Each mission starts with the expectation that the plant meets the safety requirements of the host country.

### 4.0 MISSION TYPES

The activities which must be carried out at a nuclear power plant and have an impact on reactor safety can be divided into discrete functional areas. These activities will be different depending on whether the plant is under construction, under commissioning or in full operation.

Various types of missions are available within the OSART programme. The scope and depth is decided during a preparatory visit and can be tailored to the desires of the host country and the needs of the plant. The most common missions are 'full scope' covering all of the areas applicable to the mission type.

OSART teams also specifically review the safety culture at each plant visited. 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.* At the conclusion of each mission, an assessment of the safety culture at the plant is included in the report of the mission.

#### **4.1 OSART missions (to plants in operation)**

OSART missions can be conducted at any time after a plant is placed in commercial operation. They are not normally conducted during the first year of operation, nor until completion of the first refuelling cycle outage for light water reactors. These missions focus on the performance of management processes and plant personnel in achieving safe operation. OSART missions usually review performance in the eight areas shown below. They can cover fewer areas, but must include the first five areas in order to provide an overview of plant safety and performance.

- Management, Organization and Administration
- Training and Qualification
- Operations
- Maintenance
- Technical Support
- Radiation Protection
- Chemistry
- Emergency Planning and Preparedness

#### **4.2 Pre-OSART missions (to plants under construction/commissioning)**

Pre-Operation Safety Review Team (Pre-OSART) missions are conducted during the construction and commissioning phase of a plant's life. The purpose of these missions is to assist the utility in achieving high standards of engineering and construction and to help ensure effective preparations for commissioning and operations. The areas reviewed are based on the status of the plant with regard to construction and commissioning. Pre-OSARTs which are conducted close to the time of initial startup normally review the same areas as a regular OSART mission plus commissioning activities. Pre-OSARTS conducted earlier in the construction phase normally review the following areas:

- Commissioning
- Project Management
- Civil Engineering and Construction
- Mechanical Equipment Installation
- Electrical and Instrument and Control Equipment Installation
- Quality Assurance in Construction and Commissioning
- Preparations for Start-up and Operation

#### **4.3 Safety Review missions (to plants in operation)**

Safety Review missions consist of a regular OSART mission, combined with an in-depth examination of design features most closely related to safe and reliable operation. These missions were developed to assist nuclear plants in addressing both human performance issues and recognized design weaknesses in an integrated way.

#### **4.4 Technical Exchange missions (to power plants under construction or in operation)**

The term Technical Exchange missions is used to describe types of missions other than those already described. To date, seven Technical Exchange missions have been conducted. A limited number of areas are reviewed, focusing on specific topics. In each case, the depth and scope of review is carried out in accordance with the wishes of the host country and the needs of the host plant. However, since the scope of Technical Exchange missions is limited, they are not intended to provide comprehensive information on operational safety other than for the topics covered.

#### **5.0 FOLLOW-UP VISITS**

Follow-up visits are carried out at the request of the host country approximately one year to eighteen months after an OSART mission. They have become so universally requested that they are now considered an integral part of the OSART process. Their purpose is to provide an independent assessment of progress in the resolution of issues identified in the OSART mission. There is also opportunity to assist with the clarification of issues and their resolution where necessary. Follow-up visits also help the IAEA measure the effectiveness of the OSART programme and provide information that can be shared with the nuclear industry on the successful resolution of problems.

#### **6.0 THE PROCESS**

Missions consist of four stages:

- preparing for an OSART
- carrying out the review
- following up after the mission
- reporting results to the industry.

##### **6.1 Preparing for an OSART**

OSARTs are initiated by a request from a Member State to review performance at a specific nuclear power plant. Preparation for an OSART mission starts shortly after, with formal confirmation and establishment of contacts with liaison officers at the utility or nuclear power plant and regulatory authority. Arrangement of a preparatory meeting with the plant management and other organizations involved, and the recruitment of experts for the review team are then carried out. These activities are organized by the OSART liaison officer, who assists the team leader during the preparation for the mission and while it is in progress. The liaison officer also reviews a specific area as a member of the team.

A preparatory meeting is held at the plant site and is usually attended by the team leader and the OSART liaison officer. It takes place about one year prior to the start of the OSART mission. Other organizations involved, such as regulatory authorities and emergency planning authorities are welcomed at this meeting. If desired, separate preparatory meetings may also be conducted with the regulatory authority. These meetings allow those responsible for ensuring that the OSART review is carried out effectively to meet and reach a common understanding on the conduct of the OSART. The participants discuss the main features of the OSART programme, and the plant's preparations for the review. They also discuss the preparation of an advance information package for team members, logistic support,

arrangements for reporting mission results and any intended involvement of the media. The meeting includes a tour of the plant for the IAEA staff members.

## **6.2 Team composition**

An OSART team usually consists of one experienced nuclear power plant expert for each area of the review except for operations, where there are usually two. Typically, two thirds of the team are senior managers from nuclear power plants outside the host country, the remaining one third are IAEA staff. The objective is that approximately 50% of the industry experts will have had previous experience either on OSARTs or on self evaluation teams. Occasionally, a member of a regulatory body from outside the host country is a team member, provided that he/she has the required experience. The team includes up to three observers from countries where the nuclear programme is in transition or in the course of significant development. The cumulative experience of the team in the nuclear industry often exceeds 200 years. Experts are recruited based on their technical skills in the area they will review, their investigative skills and their knowledge of the OSART working language (English). These experts change from one OSART mission to the next. The IAEA staff members also have experience in the nuclear industry and have demonstrated evaluation skills. Staff members have taken part in many evaluations and help provide consistency in the OSART process, as well as a knowledge of various national practices.

The team leader and assistant team leader of each OSART mission are senior IAEA staff members and are responsible for the overall conduct of the mission. This includes co-ordination and liaison with the host utility, the host plant and the regulatory authority. Additionally, they provide training and guidance to the teams, to help ensure coherent and consistent reviews.

## **6.3 Advance information**

To enable an OSART team to perform effectively and efficiently while on site, the nuclear power plant prepares an advance information package. This package is sent to the team members prior to the OSART, so they can familiarize themselves with the plant organization, administration, layout, performance and general design before they begin the review. This package usually includes a section dedicated to each review area including information on the plant counterparts. It also contains information on radiation protection, and general logistics such as hotel and transportation arrangements. The requirement for the information is minimized to avoid undue translation requirements on the plant personnel.

## **6.4 Carrying out the review**

When the OSART members arrive at a plant site, they are already familiar with the plant's main features, operating characteristics, history, regulatory provisions, technical specifications, procedures, organization and key personnel as a consequence of their study of the advance information package. The first day is used for plant entrance formalities, and to brief the team members on applicable security, radiation protection and industrial safety requirements. The experts also meet their plant counterparts, who are the designated plant experts in the area being reviewed. Together they carry out an initial plant tour and make final arrangements for their review.

The standard OSART schedule shows the activities of the team during the three weeks of the mission. Deviations from the schedule are possible, to take account of local conditions and the availability of plant counterparts, so long as the overall coverage of each topic is not compromised. The review of each topic often starts with a brief presentation outlining the

power plants' programmes and performance in the subject area. This is followed by a question and answer period and observations in the field to determine whether operational safety performance is consistent with good international practice. It is the intention that most experts will spend the majority of their time in field observations. The OSART team meets each day to review the results of the day's activities and, by discussion, develops a team consensus on emerging issues. These meetings are also an opportunity for the team leader to reinforce the review methodology and to provide additional training as required.

Throughout the mission, there are detailed discussions with the plant counterparts to verify that the OSART team has a correct understanding of the plant's strengths and opportunities for improvement. The contribution of the plant counterparts is essential to verify that the experts' observations are correct: to make sure that they understand the written material, that they are not misled by any shortcomings in translation or interpretation, and that the practices observed are representative. This plant counterpart is a member of the plant staff, who has current responsibility for the area being reviewed. In parallel, the experts present their observations and conclusions to their fellow team members at the team's daily meetings. The team's discussions help ensure that all team members are well informed on the progress of the review and allow team members to benefit from other experts' observations. Ultimately, the team's recommendations, suggestions and good practices are arrived at by the consensus of the team rather than as a consequence of an individual's opinion. These recommendations and suggestions are required to have significance to improving safety performance and must be based on facts.

As the review proceeds, the team leader informs the plant management (and the regulatory authority if requested) on the progress made. Opportunities for improvement and areas of uniquely outstanding performance are discussed as the issues emerge. The last days of the mission are reserved for rechecking any open topics, for completing the Technical Notes and discussing them in their entirety with the counterparts. Additionally, each team member drafts a summary of his area for the Technical Notes and his/her oral presentation at the exit meeting.

## **7.0 EVALUATION CRITERIA**

Experts are selected to ensure that a variety of national approaches to operational safety are represented. Each expert has, in addition to his particular area of expertise, knowledge of other review areas, so that the relevance of issues identified by individual team members can be discussed by the whole team. These discussions are based on IAEA Nuclear Safety Standards (IAEA Safety Series No. 50), International Basic Safety Standard for protection against ionizing radiation and for the safety of radiation sources (IAEA Safety Series No. 115-I), OSART guidelines (IAEA-TECDOC-744) and OSART Supplementary Guidance and Reference Material.

The OSART review compares plant programmes and performance with successful safety practices found at other nuclear power plants. If the experts feel that safety performance might be strengthened or that a safety relevant practice is superior elsewhere, then they will bring it to the attention of the plant management and make a recommendation or a suggestion. The experts may also propose improvements in plant reliability and cost-effectiveness. Similarly, if a safety practice is observed which is markedly superior to those available elsewhere, the expert will take note of it to ensure that it is included in the mission report so that it can be made known to other nuclear power plants. The team's recommendations and suggestions for improvement are focused on what improvements should be achieved, but leave decisions on how to achieve them to the host plant.

## **8.0 FOLLOWING UP AFTER THE MISSION**

Approximately one year to eighteen months after the OSART mission, an OSART Follow-up visit is conducted. During the Follow-up visit, a group of three to four team members evaluate the progress made in resolving the issues raised by the OSART team. They do this by interviewing personnel, reviewing documentation and conducting field visits. The status of the response to each recommendation and suggestion is determined, and is included in the final report.

## **9.0 REPORTING THE RESULTS**

While at the site, the OSART members write technical notes on their observations and conclusions. These notes are the preliminary report of mission results to the host plant and are discussed in detail with the plant counterparts. They are also the basis for the oral presentation at the exit meeting at the conclusion of a mission. The technical notes are presented to the plant management before the team leaves. These technical notes are not the official report and are provided only to the host plant. They form the basis of the official report prepared by the team leader after each mission. This report summarizes the team's observations and conclusions, and includes reference to all recommendations and good practices identified by the team. Before the official report is finalized, the utility and regulatory authority concerned are given the opportunity to provide comments. The approved official report is then submitted through official channels to the Member State that requested the OSART. The distribution of each official report is initially restricted to the IAEA, the members of the OSART team and the utility and regulatory authority involved. Any further distribution at this time is at the discretion of the Member State. Ninety days after the official report is issued, it is automatically derestricted and made available for release to the public unless the host country requests otherwise. Alternative reporting arrangements may be possible if requested by the host country.

The results of follow-up visits are reported in a similar manner, with technical notes being presented to the plant management before the team leaves the site. An official detailed report is then prepared, using the detailed findings of the original mission augmented with the results of the follow-up visit. Publication of the official detailed report proceeds as before with an opportunity for the host country to comment, followed by initial restricted distribution and automatic de-restriction after 90 days unless the host country indicates otherwise. Since 1986, most of the OSART Reports have been de-restricted and are available to interested individuals and organizations.

Summaries of OSART Missions results and good practices from 1983 have been published in the following documents: OSART Results, IAEA TECDOC-458 (1986-87); OSART Results II, IAEA TECDOC-497 (1987-88); OSART Mission Highlights, TECDOC-570 (1988-89), TECDOC-681 (1989-90) TECDOC 797 (1991-92) and TECDOC 874 (1993-94)

In addition, a database has been developed, which contains the major results of all OSART missions from 1991 onwards and their follow-up visits. The database can, for example, provide information on OSART results for specific review areas and individual topics within those review areas for all OSARTs since 1991. This will enhance results and maximize their application in the industry. The database will be continuously updated with the results of future OSARTs and the active database will comprise records for the most current five year period. This data can be obtained by contacting the Operational Safety Section of the Division of Nuclear Installation Safety.



## 10 OUTLOOK

The IAEA re-evaluates the OSART programme almost continuously in an effort to increase its usefulness and effectiveness, incorporating new features and deleting outdated ones. The feedback of experience takes place in various ways. At the end of each mission, the OSART team members are requested to fill in questionnaires to provide feedback on the OSART process, including proposals for improvement. Similarly, the nuclear power plants and utilities are asked to comment on each OSART mission in general.

Consultants services and Technical Committee Meetings were held in 1988, 1990 1992, 1993 and 1994 to review aspects of the OSART programme. As a result, improvements to the service have been made, in particular regarding the mutual co-operation between the OSART organization and the nuclear power plant, as well as between the OSART experts and their plant counterparts. Future developments will include reviewing the structure of operational safety reviews in view of the Nuclear Safety Convention, improving team training and reinforcing the concept of basing findings on actual plant performance.

In order for the OSART programme to be effective in enhancing the international exchange of operating experience at the managerial and working level, the active participation of all countries with operating nuclear power plants is essential. In addition to requesting nuclear power plants to provide experts to participate in OSART missions, the IAEA will promptly respond to requests for OSART missions.