OSART Good Practices
TRAINING AND QUALIFICATION
Training Programmes for Control Room Operators and Shift Supervisors

Bugey 2/5, France

Mission Date; 8-25 March, 1999

A multifunction simulator and the SIPACT (accident simulator) are used both to enhance operator skills (refresher training) and to develop skills and knowledge during initial training. Both the SIPACT simulator and the multifunction simulator are a complement to the full-scope simulator. Each tool has specific functions and is used in different contexts. While the SIPACT and the multifunction simulator use three work stations which do not reflect the same human machine interfaces as those in the control room and thus cannot completely replace the full scope simulator, they are an effective supplement to that training.

The multifunction simulator is mainly used in the training of operators as follows:

- For control room operators, it is used in the review of operating procedures and review of the theory on physical phenomena. In this application, the simulator is a visual support which helps to review operating strategies and the application of procedures.

- For field operators, training sessions are aimed at explaining and visualizing operating principles and their impact on field operators activities. (i.e. why an action is required in a given situation).

- For both groups, it is used for the review of the organization and application of operation sheets and for analysis of communications between field operators and control room operators.

In addition to the training sessions given by the operating training support team, the multifunction simulator is available for shift crews to use on their own for individual or team training.

The SIPACT simulator has been in operation since May 1997. To date, this tool has been reserved for use in initial training of control room operators and supervisors and for refresher training of shift crews. To use this simulator during initial training, trainees are expected to have the skills required for the accident operating module on the full-scope simulator and have knowledge of thermo-hydraulic principles for normal, incident and accident operation. This training tool contributes to the mastering of normal, abnormal and emergency situations. SIPACT enables trainees to acquire an accurate and thorough vision of physics and thermo-hydraulic phenomena and a mental model of the conditions in the reactor vessel, pressurizer, steam generators and connecting piping thus enabling them to have a better overall understanding of these processes during transient and accident conditions. SIPACT provides for both individual and team training on the following situations:

- Start up and shutdown of reactor coolant pumps.

- Control of primary pressure.

- Variation in boron concentration.

- One phase and two phase heat transfer and natural circulation.

- Control of steam generators during normal or abnormal operation.

- Steam generator tube ruptures.

- Secondary and primary circuit breaks.

- Safety injection sequences.

- ATWS.

- Total loss of feedwater supply to the steam generators.

SIPACT uses exactly the same thermo-hydraulic model as is used for the full scope simulator, while the multifunction simulator uses a more simplified model. Thus, for all situations SIPACT provides simulation consistent with the full scope simulator. The SIPACT presentations of thermo-hydraulic conditions have been integrated into the simulator instructor displays in the full scope simulator. During debriefing sessions of team training on the full scope simulator the SIPACT displays can be used to assist the shift team to understand the conditions during the scenario and how their actions affected these conditions. SIPACT provides a visual representation of thermo-hydraulics equivalent to that provided through a "glass model". However, SIPACT can represent a broader range of conditions and parameters than can be demonstrated through a glass model, as the reactor physics and radiation levels can also be presented.

Mühleberg, Switzerland

Mission Date; 6-23 November, 2000

The Plant has implemented a unique and effective approach to accomplishing meaningful and significant quantities of continuing training during late and night shifts. The process involves teamwork and coordination between the shifts, the operations training section and the operations line management.
During late shifts, pikett engineers lead shift crew discussions on nuclear safety topics, such as Operating Experience (OPEX) events and World Association of Nuclear Operations, (WANO) operating events. Licensed and non-licensed staff participate in these discussions. New topics are jointly selected by operations managers and the training sections manager on six week intervals.
Additionally, ongoing review sessions of operating documentation are routinely scheduled for night shifts. These sessions are led by the shift supervisor and include detailed reviews of plant procedures, including operating manuals and operating instructions. The process is very straightforward. Lists of documents to review is periodically prepared via the Integrated Operation Management System (IFBS) and sent to the shifts. The shift supervisor and available crew members conduct the reviews. The process has been in place since 1994, and records have been kept of all documents reviewed to date.
Both programs are well received by the shift organization, and supplement the normal simulator based continuing training program. For example, of 22 hours of continuing training received by the licenced staff in1999, 7 hours were accomplished by the above processes.

Angra 2, Brazil

Mission Date; 12-31 October, 2002

The training program for licensed operators at Angra-2 includes the requirement for candidates to complete an intensive 3-week program at a Research Reactor in Brazil. This program includes both classroom sessions on Reactor Physics, Radiation Protection, and, Thermodynamics, as well as, practical experience at manipulating the research reactors reactivity controls. Aside from giving students a solid grounding in reactor core behavior, it gives candidates some feel for the effects of reactivity movements in a Nuclear Reactor and respect for the need to adequately control reactivity.

Nogent, France

Mission Date; 20 Jan.-6 Feb., 2003

Setting up of a professionalism programme specific to trainees supplemented by the use of expertise follow-up logs in the operations department.
A member of the shift staff is seconded onto days and assigned as a shadow trainer to support the training of new recruits.
The operations department training manager acts as a tutor for trainees. Meetings are organized periodically between the trainee and the shadow trainer and tutor to take stock of the experience the trainee has acquired in terms of professionalism. To enable the trainee to take ownership of their training a logbook has also been developed.
The log contains three sections:
- A list of infrequently performed activities due to be carried out at fixed intervals.
- A less restricted part in which the trainee keeps a record of the activities carried out that he considers as "noteworthy" or "significant".
- A section containing generic performance based objectives.

The manager then validates the trainees completion of these activities. The log is also being incorporated into the qualified staffs continuing training programme and may form the basis for dialogue between the staff member and his manager during annual authorization interviews.

Kashiwazaki 3/6, Japan

Mission Date; 1-18 Nov, 2004

The simulator exercise review room had three large, wall mounted plasma screens to replay key data such as the sequence of events, graphs of the main parameters against time, a schematic of the plant showing plant status and a video of the control room. All of these displays were synchronized during replay. The control of these recordings was simply done by dragging a cursor along the time axis of the chart display and starting/stopping the replay. These recordings were available immediately following the simulator exercise to provide an excellent review tool.

Blayais, France

Mission Date; 2-19 May, 2005

The plant develops specific simulator scenarios for assessment of safety engineer's competency and for improving coordination between I&C technical staff and operators. This intervention of the plant is a part of the reactor scram reduction plan. Such practice has following strengths:
-Train participants in prevention of human performance related risks and operational communication.
-Make and apply risk assessments and carry out pre-job briefings of good quality by pooling I &C and operations skills on full-scope simulator.
-Improve quality of risk assessments and pre-job briefings.
This practice leads to increasing of effectiveness of simulator training and improving the competences of so called "sensitive" staff. The results achieved are:
-Human error reduction to prevent scrams.
-Reduction in significant operating event risk related to human performance.
-Better understanding of I & C and operations requirements and constraints.
-Systematic review of risks and countermeasures by maintenance and maintenance/operations participants during sensitive work (risk of scrams and load reduction).
-Training, observation and improvement concerning I & C and operations practices.
-Simulator training without incurring any risks related to nuclear safety and availability.
-Joint debriefing of I & C and operations staff, improving understanding of strengths and weaknesses in the areas of operational communication and craft-specific constraints.
-Investment of upper supervisory levels in evaluating the quality of joint I &C and operations pre-job briefings and participants' control room behaviour.

Borssele, Netherland

Mission Date; 8 Nov.-7 Dec., 2005

The plant has developed an innovative method for continuous evaluation of trainee performance during initial and continuing simulator training, which is efficiently and consistently used.

This method has been developed based on management expectations, as outlined in the booklet "The guiding Markers for safe and reliable work in the control room". These expectations are further delineated into 20 performance indicators (evaluation criteria) describing expected behaviours (performances). Performance indicators are grouped as follows: communication, leadership, decision-making, team performance, individual performance, procedure knowledge and system knowledge.

The performance indicators are numbered and referred at appropriate points in the simulator exercise guide. During one-week course, approximately 1100 points are collected, representing good base for relevant statistical analysis.

The simulator trainer keeps track of accomplishment of each performance indicator, as it appears during conduct of the training scenario sequence. The shift team will get feedback based on these performance indicators after each exercise.

After all shifts have completed the weekly refresher simulator course, the simulator trainer enters all collected points into one common data table and produces a graph. This graph gives a good overview of the performance of all shifts. These results are used to determine training objectives for the next refresher courses.

All shift teams are assessed once a year by either operations manager, deputy operations manager or training manager. This assessment is based on the same performance indicators as described before. Management assessments results are compared to the results provided by the instructors. This comparison provides an indication of shift team performance as well as quality of assessments performed by simulator instructors.

To obtain ranking of each shift performance, additional evaluations are performed based on time spent to complete certain expected actions while performing specific emergency procedures. Four time-based indicators have been developed (Time spent in the E0 procedure (Reactor trip or Safety Injection) for every occasion; time the YZ (Safety injection) signal was by passed (reset); time needed to isolate ruptured steam generator; time needed to equalize pressure of the ruptured steam generator with primary pressure). These evaluations are summarized from all groups and provide indication of low performing shift if result fall below expected range which would then warrant remedial actions. These indicators are monitored the same way as abovementioned 20 performance indicators. This evaluation is scenario dependant and only specifically designed scenarios are appropriate for this kind of evaluation.

The following are valuable features of the above described method:

-provides effective support to collect good observable facts and their allocation to trainee respective shift function;

-is a tool that assures evaluating all crews the same way (consistency across operations);

-provides as established standard to identify areas to be improved;

-brings all evaluators at the same level;

-it is clear and concise;

-provides additional insights to particular evaluation criteria - for example, it will be evident if one operator would perform tasks of another;

-provides a good base for setting training goals for next simulator training course.

This is a transparent and effective method that is practical for evaluation of individual team performance as well as for effective analysis of overall performance and identification of weak points in overall operations control room personnel performance, supporting identification of items to be addressed in future training.

Yongwang, Korea

Mission Date; 17 Apr. - 4 May, 2007

YGN 5&6 has developed and implemented a simulator test contest that strongly measures training effectiveness and good performing operators and shift crews.

Motive of Development and Needs:
- Setting the basis for safe power plant operation
- Advocating the awareness of safety culture such as utilization of techniques to prevent human errors
- Improving the capability of operators to respond to normal, abnormal and emergency operation
- Enhancing training effects by measuring training effects and reflecting the results
- Raising the interest of the management on education and training

Summary:
- YNG 5&6 has opened a simulator test contest in each power plant annually since 2005. A team is proposed with a group of main control room operators consisting of SRO, RO, TO and EO. The contest takes about an hour for the evaluation. Judges consist of the power plant management. Professors (training instructors) participate as a judge or working committee member. Each team is given a scenario combining normal, abnormal and emergency operating situations. The best team and the best operators are selected and awarded prizes.

Results:
- Improve the shift crews capability to respond to abnormal and emergency power plant transient operational conditions
- Strengthening the teamwork of shift crews in analyzing and solving emergency situations

Areas of Application and Utilization:
- Measuring training effectiveness and reflecting the results (i.e. feedback) back into training programs

Establishing a system to identify good-performing operators and senior operators.

Yongwang, Korea

Mission Date; 17 Apr. - 4 May, 2007

YGN 5&6 has developed innovative training techniques to improve problem solving and learning capabilities of operating crews and individuals, called "Action Learning".

Motive of Development:
- Utilizing proven educational techniques that have achieved good business performance in world-class firms such as GE and Samsung, as a means of management innovation
- Searching for solutions to current issues of the power plant positively and effectively
- Applying and spreading new educational techniques to improve the problem-solving and learning capabilities of individuals and organizations.

Origin and Needs:
- Realization of OJT through timely solution of current power plant issues:
  - Raising interests on current power plant issues, performing in-depth analysis and searching for solutions during education periods
  - Contributing to management innovation by running subject-based customized education and training programs
  - Expanding various problem-solving type education instead of cramming education
  - Continuously improving education and training programs to strengthen the job and task competency of operators

Expanding debate-based problem-solving education instead of lecture-based one.

Summary:
Since the end of 2005, in one of 3 annual operator requalification training periods, each lasting 3 weeks, YNG 5&6 has allocated 32 hours to' Action Learning.' In 'Action Learning', participants are from the entire members of a duty group (12 persons) and a training center professor as a facilitator. The subjects handled in 'Action Learning' are selected by each group relating to current power plant issues.

Among 'Action Learning' are included various activities such as investigation and review of real plant data, site inspection, bench marking, consulting with experts and self study on related subjects. Also, through several meetings attended by the entire members, the group reviews and analyzes the methods of solution, share the contents individually learned, and conducts feedback and reflection on the activities developed.

On the last day, the group presents to the sponsor (power plant management) the contents and results of its 'Action Learning.' The sponsor evaluates the results, encourages the group, and makes final decision whether to accept the results, through which the group conducts final feedback and reflection.

Basis of selecting 'Action Learning' subjects:
- A current issue of the power plant presently in progress and an important subject that has been planned
- A subject planned for each department which may provide a learning opportunity
- A subject whose implementation, the final decision maker (power plant manager), may approve of

Result of carrying out 'Action Learning'
- Subject implementation plant (jointly prepared)
- Feedback and reflection sheet (individually prepared)
- Presentation data (jointly prepared)

Learning result report (individually prepared)

Key Points:
- Can be operated as part of education and training programs with the characteristics of adult training reflected
- Strengthening the advantage of debate-based problem-solving subjects instead of cramming lectures
- Professor's (training instructor) support on current power plant issues and timely solutions
- Building a structure to pursue ways to solve current power plant issue even during training periods
- Seeking effective solutions through the professional support and utilization of the faculty
- Improving the problem-solving capability of individuals and organizations and reinforcing teamwork
- Activating technical transfer between experienced employees (company career 20 years or longer) and new ones (5 years or less) (by providing natural opportunities for mentoring and OJT)
- Raising individual participation in problem solving, providing opportunities to learn diversified problem-solving methods, and increasing personal price on problem-solving subjects
- Improvement in teamwork was confirmed by comparing ‘Team Role balance’ between before and after ‘Action Learning.’

Areas of Application:
- ‘Action Learning’ can be applied in all education and training courses as problem-solving type education method with the characteristics of adult training considered.
- It can be applied as problem-solving type management innovation technique in all departments in the power plant including those for administrative support and R&D.
- KHNP has been implementing ‘Action Learning’ in the reeducation training period since 2005 and now plans to expand the targets gradually.
- Under the leadership of the head office, KHNP is implementing ‘Action Learning’ to make it an innovation part of life and create visible achievement of innovation through reinforced innovation study.

Results:
If ‘Action Learning’ is utilized as means to expand opportunities for the transfer of experience and technology between experienced and new employees under current aging phenomena, it will contribute to improved safe operation and improvement in operational safety and technology. Thus, it is necessary to spread this innovative technique to nuclear power plants world-wide.