OSART Good Practices

TRAINING AND QUALIFICATION

Qualification and training of personnel

Forsmark, Sweden

Mission Date; 12-28 Feb., 2008

To use the training simulator to describe complex events and to demonstrate the work methods in the control room following a disturbance, to the media and other key groups.

A problem in communications in nuclear power is to be able to describe clearly complex events and the design of the safety systems that manage the events to people outside the nuclear power industry. Furthermore, it is difficult to present a picture of the orderly work methods in the control room during a disturbance by merely describing them.

There is a full scope simulator at Forsmark which is used to conduct training and refresher training for different categories of operations personnel. This simulator is an identical copy of the Forsmark 1 control room. It has been on the site since 2001 and is operated by KSU (Nuclear Training & Safety Center) at the Forsmark site.

After the July 25, 2006 event at Forsmark the media published and broadcast a number of inaccurate descriptions of the situation in the control room during the disturbance and of the impact of the disturbance on various surveillance systems.

The plant invited journalists in to the simulator to witness a simulation of the event, providing them with a much clearer picture of the sequence of events, which surveillance systems were affected and which were intact as well as the orderly work methods of the control room personnel, which were in turn a result of the training and refresher training on the same simulator. Furthermore, it was made clear how the safety systems are designed, with redundant features and so forth. This effort contributed much to presenting a more balanced picture of the July 25th event which had been described in the media as a potential core meltdown.

Other groups have visited the simulator later to see the same run-through. Among others, SKI, the local safety board, the county administrative board's emergency preparedness organization and many national politicians have seen the simulation. Their perception of the July 25th event has also become much more balanced.

A contributing factor in the success of presenting a more balanced picture is that the personnel who work as instructors in the simulator are good teachers who are able to describe clearly complicated situations and relationships to the layman.

This positive outcome has resulted in Forsmark including the simulator as a communication resource in their emergency equipment.

Balakovo 4, Russia

Mission Date; 19 May-5 Jun., 2008

The extension of the full scope simulator configuration with the replica emergency control room is based on the necessity to achieve skills and psychological preparedness of the main control room personnel to act under conditions of the design-based and beyond design-based accidents and under extreme situations.

The plant puts into operation a version of the full scope simulator, equipped with the replica of the emergency control room. The simulator operates as a unified complex using the common software load. Such construction is beyond the applied standards.
This technical solution provides the simulator with the following advantages:

- It considerably expands the capabilities for the proper simulation of the conditions, close to the software model limits.
- It facilitates the training of operating personnel for design basis and beyond design basis accidents.
- It improves the capabilities for verification and validation of operation documentation, especially emergency procedures.

The feedback from operators, instructors and management is definitely positive. The annual and periodical plant reports indicate the considerable improvement of the training quality. On the basis of these results the operating organization considers the possibility to encourage all the subsidiary plants to implement the innovation.

Balakovo 4, Russia

Mission Date; 19 May-5 Jun., 2008

The psychological training of managers, operation and maintenance staff.

The scope of psychological training at Balakovo NPP is extended to the personnel other than control room staff.
The objective of training is to establish and maintain a psychological attitude, orientation and priorities, psychological qualities and skills important to profession, psychological readiness to act in case of emergency, psychological stability in stress and emotional-tense situations.

The training includes three specific areas: general psychological training special psychological training and target psychological training. There was performed the special project dedicated to psychological aspects of different types of pre-job briefings. The training is carried out in the form of the problematic situations with the use of the modern methods.

The combination of different training settings in frame of the training programmes significantly decreases the psychological burden during training and allows the trainees to effectively perceive the material. This training improves the self-control skills in order to carry out the complex tasks, conduct the responsible negotiations and improve the ability to make the decisions in case of time stress.

The results of different surveys show the sustainable satisfaction of the trainees and confirm the successfulness of this approach which can be considered as good practice.

Arkansas, USA

Mission Date; 15 Jun.-2 Jul., 2008

Good staffing and plant knowledge improves the effectiveness of training provided to the plant.

The training organization is staffed with highly experienced and knowledgeable personnel. All operations instructors have obtained training and experience as licensed control room operators, and most have been control room supervisors or shift managers. All instructors have experience at the plant in the disciplines they instruct. Through development of training materials and implementing training, the knowledge and operating experiences of these instructors is captured for future trainees as well as current trainees.

Rotational assignments from the line organizations to the training department are made in each training area (operations, technical and maintenance), which allows high performing job incumbents to participate in training development and delivery. These opportunities allow them to enhance their knowledge of the training process while sharing their current plant experience with trainees. Training department personnel support plant activities such as refueling outages and other plant assignments which in turn keeps their technical knowledge current.

Several members of the training staff have formal degrees in education, including specific training courses in adult learning theory and learning styles for young generation learners now entering the workforce. They provide instruction to the remaining training staff in techniques that improves the effectiveness of the training provided to the plant.

The plant's Operations Department owns and works directly with Operations Training. An Assistant Operations Manager from each unit is assigned to training and is responsible for the oversight of the Operations Training Process. Currently, in operations training, there are 22 individuals in the training department who hold or have held a Senior Reactor Operator license at ANO, and an additional 4 individuals who hold a Reactor Operators license.

Arkansas, USA

Mission Date; 15 Jun.-2 Jul., 2008

Comprehensive training facilities for radiation protection combined with different mockups and number of classrooms are used to enhance plant performance.

The Training department maintains numerous mock-ups of plant equipment that provide hands-on training opportunities for improving worker knowledge and human performance. The line organizations supply resources to either purchase or develop mockups when needs are identified. In many cases, subject matter experts develop the associated training materials and conduct the training under the oversight of the training organization.

For example:

- In the radiation protection training programme a simulator that mimics the plant's radiological monitoring system (RADS) is used to train technicians how to monitor dose rates and accumulated dose for individual workers involved in high risk evolutions, as well as area dose rates throughout the plant. Scenarios are developed that require the trainee to perform system operation and monitoring activities such as alarm response; use of human performance tools such as communication skills; procedure use; place-keeping, and exercise knowledge of procedure requirements. Radiation worker practical factors training walks the staff through the entire RP Radiological Controlled Area training aspects, which include RP basics such as dosimetry issue and return, dress out training for contamination controlled areas through to hazards identification of boric acid on plant items, requirements for high dose rate areas, respirator use, use of RADS, hotspots, locked high radiation areas, active leaks, contaminated tools, foreign material exclusion equipment, use of whole body monitors and small article monitors, radiological hazards of working at heights, use of respiratory equipment, scaffolding and filtered ventilation units.

- Mockups in the Instrument and Controls group include various electronics cabinetry and instrumentation, such as control drive system and integrated control system. The mockups allow trainee to gain detailed knowledge of these systems, practice human performance techniques and provide a means for performing troubleshooting plant issues without incurring potential plant risk associated with on-line troubleshooting.

The extensive use of mockup training provided to staff members serves to improve worker technical knowledge, develop skills, and reinforce expectations and desired behaviors.

Rovno 3/4, Ukraine

Mission Date; 24 Nov.-11 Dec, 2008

The simulator for welders' training

A unique simulator for welders' training was designed and implemented in the Rivne NPP Vocational school with the main objective of reducing the duration and costs of welders' training whilst assuring required level of training quality.

The purpose of the simulator.
The simulator is dedicated for electric welders' drill and initial training in manual arc welding practices. The aim of the simulator is to ensure the following skills for the welders:

- Excitation of welding arc and sustainability of its defined length.
- Assurance and maintenance of the specified position of electrode holder (welding torch) in relation to the welding surface of the item.
- Maintenance of thermal conditions of welding pool.

List of tasks conducted on the simulator:

- Simulation of welding with the use of real low-amperage welding arc.
- Set up of initial parameters of the simulated welding process (length of arc space, heat input, slope angle of electrode).
- Recording of information of training session on length of arc space, slope angle of electrode and heat input.
- Generation of acoustic feedback signals in case of violation of boundary values of controlled parameters.
- Change of complexity of training tasks according to all the parameters or specific parameters.
- Statistical manipulation and assessment of training results.
- Documentation of training results in the form of tables and graphics on paper form.

Use of low-amperage current source for simulator operation assures maximum correspondence between simulated welding and the real process that will significantly reduce the adaptation period during work on the real equipment.

This simulator is only a section of the training for welders which is composed of training of welders according to the corresponding programmes (theoretical and practical, on-the-job training, qualification tests of welders and knowledge check). After passing all tests of these different sections, welders are certified by the Rivne NPP welder's examination committee.

The performance gained is measurable in the interest of the students with advanced technology, reduction of costs and improvement of the general quality of the welder activities.

Mihama 3, Japan

Mission Date; 20 Jan.-5 Feb., 2009

The instructors at the Nuclear Operations Support Center (NOSC) and Nuclear Power Training Center (NPTC) have been selected from among those with senior experience and skills in the nuclear power station.

The instructor qualification process has been established to provide additional skills and training to the selected instructors in both technical areas such as simulator operation, evaluative methods, communications, and others subjects. This process ensures a high level of instructor competence which then results in efficient and effective training delivery and knowledge gain.

NOSC Instructors - Selected from highly experienced reactor control operators, after taking into consideration the individual's skills, leadership qualities, and communication abilities, all evaluated in a comprehensive manner. In addition, the instructors are required to be certified in a leadership training course, and must pass an interview with the General Manager of the Nuclear Operations Support Center. After approximately 2-3 years as an instructor, the individual is returned to shift operator duties with the additional knowledge and insights he has gained from being a simulator instructor.

NPTC Instructors - Selected from highly experienced individuals after taking into consideration the individual's skills, leadership qualities, and communication abilities, all evaluated in a comprehensive manner. In addition, the individuals receive additional training and competency evaluation (annually) in "planning, implementation, assessment, and improvement in training". Additional training is also provided in specialized instructor skills to ensure strong instructor skills for effective training delivery. Likewise, NPTC instructors are rotated back to the nuclear power plant divisions after 2-3 years to spread and capitalize on their gained knowledge and expertise.

Oskarshamn, Sweden

Mission Date; 16 Feb.-5 Mar., 2009

Training materials.

The training provided to plant personnel benefits from the use of objective based, high quality training materials. These materials include such features as detailed graphics (i.e., colour, imbedded plant photos, and flow/logic diagrams). The materials are developed early in the training process, using input from plant personnel and instructors, in order to provide opportunity for quality review of their accuracy. Also incorporated into many sets of training materials are innovative graphic simulations of plant system operation. The training materials are standardized so that whatever plant organization receives training, they each receive the same high quality materials. In addition, the materials are utility system-wide available for use. This results in enhanced understanding of system location, layout, interfaces, and design.

Oskarshamn, Sweden

Mission Date; 16 Feb.-5 Mar., 2009

"Hands on" training

Many methods of providing effective and creative "hands on" training are available to plant personnel. This form of training provides a realistic method for initial and continuing training. Examples noted include the following:

- Plant personnel receive realistic"hands-on" human performance and safety culture training, as well as maintenance fundamentals courses are provided at the shutdown Barseback nuclear power plant.
- Plant utilizes a graphic simulator (G-Sim) as a platform for basic training for operators. The simulator includes graphics that are similar to the plant and is able to simulate neutronics effects seen when control rods are manipulated.
- The control room simulator is also used for field operator advanced basic training (a 1-week course) and engineer on duty training – it is used as a tool to highlight applied theoretical concepts and practical applications.
- Use of the flow-loop simulator capabilities (ETEC facility) provides a unique opportunity to work with actual system measurement and control devices that are very similar to those in use at OKG. In addition, a flow loop facility at the shutdown Barseback plant provides opportunities to conduct training in a very realistic environment.
- Prior to refueling activities at all three plants on-site, a one-tenth scale refueling control system and simulator assist in preparing maintenance workers for the task.

Vandellos 2, Spain

Mission Date; 21 Sep.-8 Oct., 2009

The plant has introduced a new interactive work tool for licensed operator candidates that facilitates improved learning and assimilation by the candidates. The tool is a Tablet PC that provides access to all operator training materials and operations procedures. The tool also has the capability to store digital documentation and multimedia, as well as the ability to take notes on the screen minimizing the use of paper as well as collecting notes from the instructor.

The tool has a virtual whiteboard that allow the instructor to make digital annotations in real time to a projected presentation while each candidate is viewing his or her equipment. Another advantage the tool offers the candidate is a virtual control room simulator. This allows the candidate to learn the positioning of the controls and panels prior to the practical phase in the full-scope simulator.

Another application that relates to on-the-job training, is an interactive tool known as project CAMPO. This application provides virtual and real-time simulations to reinforce learning on systems, their locations, alignment in operations, and identifying images and interrelation with basic training documentation.

Vandellos 2, Spain

Mission Date; 21 Sep.-8 Oct., 2009

The plant has developed a turn-over procedure for managers that augments the competencies necessary to carry out the duties of the position. The aim of this document is to provide the opportunity for an incoming manager to acquire strategic and tacit knowledge of the position from their predecessor.

The procedure contains a checklist that provides a tool to follow that enables them to identify aspects of strategic knowledge which may not be formal as well as tacit knowledge gained by the out-going manager that is relevant to the position.

Benefits associated with the use of the turn-over guide
Following the checklist gives the managers a tool for reflection which enables them to identify aspects of strategic knowledge which is not formal/official and therefore not included in the Training Plan or in the organizational structure, in order to:

- Communicate it to his/ her successor during the overlap period
- Consider whether it is advisable to make this tacit knowledge formal and include it within corporate knowledge

Scope

1. Personal contacts.
2. Personal software applications.
3. List of books, regulations, magazines, web pages etc of frequent use or for consultations.
4. Activities which are not formal and tacit knowledge.
5. Associations, work groups and forums to which he/ she belongs.
6. Documents generated within the service. Past records. Personal archive.
7. Knowledge of the service collaborators.
8. Training Plan.
9. Service and supply contracts.
10. Historical analysis of the budget. Investment projects.
11. Unit installations.
12. Monitoring of the objectives and indicators. Actions pending.
13. Review of the audits and inspections.
14. Medium and long-term strategies. Task pending.

Ringhals 3/4, Sweden

Mission Date; 1-18 Mar., 2010

Comprehensive training facilities

There is a comprehensive site commitment to the conduct of realistic training and the necessary supporting training facilities. This is evidenced by the following examples:

- At the nearby Barseback training center (shutdown nuclear power plant), maintenance personnel and field operators train in a uniquely realistic environment. This facility provides the workers with an opportunity to conduct realistic in-plant tasks in a low dose environment.
- At the on-site Testen maintenance training facility, refueling and primary systems (steam generator) maintenance personnel practice tasks that result in significant time and dose savings during outages.
- At the on-site fire training facility, plant personnel can train in challenging fire-fighting techniques along with local fire protection personnel.
- Operations training personnel have created a field operator radiological protection practical training facility so that operators may practice their radiological and observation skills.

Doel, Belgium

Mission Date; 8-25 Mar., 2010

The defense-in-depth principle as a strategy for nuclear safety is integrated into all training courses and programs.

This strategy is based on the three types of barriers: design, methods and behavior.

At the plant, when a training program is developed or updated, this principle of defense in depth is highlighted, and the training objective focuses on the relevant barriers. This is done for all types of training (initial and continuous training programs for Electrabel staff as well as for contractors) and all functions (e.g. work planners in maintenance, and licensed and non-licensed operators). The idea is supported by visual aids such as posters, documentation and an introduction in all training material.

At each session in classroom training, e.g. .human performance training for all personnel, the defense-in-depth principle is emphasized in analysis of behavior-and knowledge-based errors. All three barriers are analyzed as one of the most important parts of full-scope simulator and field simulator sessions.

To further enhance the effectiveness of the training, and to reinforce management expectations, management carries out observations in the field. The three barriers are re-evaluated on the basis of events to identify possible improvements.

This practice ensures a good balance in training between technical, procedural and behavioral subjects, and raises overall awareness and understanding of nuclear safety among all personnel. It also provides guidance to focus management attention, and makes people more aware of their role in preventing or mitigating events by using human performance tools.

St. Alban, France

Mission Date; 20 Sep.-6 Oct., 2010

A training facility, reproducing real field conditions, has been created to teach workers the correct actions and behaviour.

The worksite training facility has simple pieces of mechanical plant belonging to both the inside and outside of the controlled area. It represents various work situations with numerous scenarios e.g. contamination, irradiation, use of hazardous materials, working in a confined area, at heights or in a tank, electrical risk, floor level hazard awareness, allowing the plant and contractor personnel to train. All this equipment is controlled from a control room.

It facilitates the application of error prevention techniques during activities such as the installation or removal of devices and the manipulation of plant equipment while in contact with the control room. Errors can be simulated without having real consequences. Work situations having led to deviations can be “replayed” until the correct action and behaviour are achieved.

As a result, maintenance and operating activities can be performed in a calm environment. Workers are then ready to undertake complex actions. Poor working situations are analysed for full understanding in order to avoid repeat defects. Satisfactory partnerships tend to develop with the contractors using the worksite training facility. They also become more committed to improving plant operation.

St. Alban, France

Mission Date; 20 Sep.-6 Oct., 2010

Training to boost new trainees’ memory.

All new recruits follow a lengthy training course:

- 14 weeks to learn the common aspects of the various crafts
- 20 weeks to learn the specific aspects of their future craft speciality e.g. operations, I&C, electrical, fuel, testing, maintenance. In view of this large volume of information to be assimilated, an initial course called « Boost your memory » has been designed to improve the trainees’ ability to absorb information.

The interactive games incorporated in this extra course, presented by a cognitive memory specialist also helps to create an excellent team spirit amongst the trainees. Trainees retain the information taught in the various courses and have a more serene approach to the various evaluations. The final training results of these evaluations and the managers’ assessments have confirmed the effectiveness of this course.

Metzamor, Armenia

Mission Date; 16 May-2 Jun., 2011

The plant has introduced a plant simulator (mock up) utilizing a panel and components from the shutdown (unit 1) turbine systems.

The simulator is located within the turbine hall and fully replicates the plant conditions both operation's and maintenance staff will be exposed to. The plant simulator is utilized for operator training in the correct use of procedures and communication with other plant areas from a noisy plant area, it allows the operators to practice plant evolutions and the simulator is able to be configured to replicate turbine system operational faults. The simulator is also being used to train electrical technicians in the appreciation and understanding of fault symptoms in the turbine electrical control systems and safe methods of rectifying them.

Dukovany, Czech

Mission Date; 6-23 Jun., 2011

Comprehensive station blackout training.

The plant has developed and implemented in-depth, cross-functional training scenarios for the simulation of station blackout. The plant risk analysis indicates that, for external events, station blackout is the dominant contributor to core damage frequency. This training was developed and is conducted with plant safety engineering, grid operators, transmission personnel, nuclear emergency response personnel, main control room operators, field operators and training personnel. The training includes actual grid disturbance models, realistic personnel response times, power restoration actions and has extended scenario durations to observe operator decision making, communications and teamwork. Scenarios include unit “island” operation, regulation of units to the self-consumption mode, total automatic reserve substitution and total loss of power supply. The training provides opportunities for improvement of plant and external organization operating procedures and communications. A specific improvement was the coordination and documented prioritization of communications methods including phone numbers and contact names. The training also highlights opportunities to improve power restoration times. Station blackout training participants from various organizations throughout the country meet at the plant full scale simulator for overview presentations, briefings, participation and observation of the scenarios. Training feedback forms are used to capture improvement opportunities. This integrated team training has been conducted for five years and it provides external organizations with an opportunity to gain a deeper understanding of their role in supporting nuclear safety.

Dukovany, Czech

Mission Date; 6-23 Jun., 2011

An innovative approach to operator and technical training for the parallel installation of instrumentation and control system modernization and power upgrade projects at a multi-unit plant.

A key success factor for effective implementation of complex modifications at operating units is efficient scheduling, coordination and implementation of high quality training for employees who need new knowledge and skills to design, operate, maintain and manage new equipment and technology. In a phased approach, the Training Department in cooperation with line management prepared comprehensive training plans to implement the design, installation and operational phases of two complex projects on four units over a period of approximately eight years.

Phase one included a sequential familiarisation and fundamentals training for those employees involved in the design of both projects. This training provided knowledge and skills to employees who would implement the design phase of the projects.

Phase two was implemented once the instrumentation and control (I&C) system technology was selected. Basic and advanced training was implemented for I&C technicians including theory and practical elements. Training was conducted initially at the vendor’s facility and subsequently at the newly installed practical training centre, full scale simulator and display simulator. As a result, technicians were ready to support actual instrument installation and testing as new equipment was placed in-service and provide surveillance testing and equipment troubleshooting on a long term basis. For the duration of the project, I&C technicians maintained their qualification on both old and new technologies. The practical training centre supports I&C initial and continuing training.

Phase three was implementation of the modernization and power reserve modifications. Since there would be an eight year span for the full implementation of these modifications, the training and operations departments partnered to develop a sequential training regime for licensed operators. The strategy included maintaining operator qualification and proficiency on older technology while preparing for sequential implementation of the upgrades on each unit. This strategy included training on new technology, simulator practice and qualification. In order to accomplish this, a unique approach was used in conjunction with regulatory approval. An investment was made in a display simulator to be used in coordination with the existing full scale simulator. Licensed operator training schedules, the project implementation sequence and simulator software validation for both the full scale simulator and the new display simulator were key coordination elements for this phase. A full scale simulator modernization was coordinated during phase three to complete the final hardware implementation for on-going operator training.

Effective coordination of multi-discipline, multi-year training requirements in support of the I&C modernization and power upgrade projects resulted in on-going successful implementation of these complex modifications without significant plant events. Key contributors to this success included, a phased approach to training, partnership between training and line management, a detailed sequential implementation plan, the use of both full scale and display simulators and the investment in supporting hardware, software and vendor training.

Smolensk, Russia

Mission Date; 5-22 Sep., 2011

Modern and State-of-the-Art Training Infrastructure and Facilities, such as:

a) Maintenance Training Facility:

i. Flange Connection Simulator.

The Maintenance Training Centre is equipped with a Flange Connection Simulator, which can be used with 6 different types of flange connections with gaskets. This facility is very important to provide practical training to the maintenance personnel to improve and develop their knowledge and hands-on skill as well as correct behaviour in the areas of tightening force, correct measurement, flange inspection etc.

The facility has also the provision for hydraulic testing to assess leak tightness of the flange connection made.

ii. Multimedia-based Smart Board for equipment maintenance.

The Smart Board simulator is user-friendly information on the main plant equipment maintenance and intended to conduct training for different maintenance activities. The activities include study of construction and functioning of equipment, provide information on maintenance technologies and evaluate knowledge of trainees.

The simulator includes scenarios for repair of complex plant equipment, such as:

- main circulation pump;
- generator;
- low pressure steam-generator;
- refuelling machine;
- gas compressor;
- switches 6, 20 kV;
- other equipment, total number of scenarios – 24.

The simulator also includes the following mathematical models:

- 3D models of imitated equipment fully identical to actual units.
- 3D graphics of maintenance operations – assembly / disassembly, relocation, measurement, adjustment – on command of a trainee or an instructor.

b) Multimedia Simulator “Refueling Machine”:

Refueling machine simulator imitates refueling process and allows trainees to observe 3D mechanisms which can’t be seen in reality due to constructional features of the refuelling machine as well as due to high radiation fields.

The simulator model reproduces the whole reactor refueling cycle and allows control of refuelling machine simulator from touch-pad monitors identical to actual unit panels.

The refueling machine simulator consists of a mathematical model, 6 PCs and 12 screens. 7 of the screens reflect refueling machine control panels, and 3 others display refuelling machine in virtual reality. 2 monitors are used by the instructor to run the simulator. Such a simulator configuration allows conduct of refueling under control of instructor.

The refueling machine simulator is used for initial and continuous training of refuelling operators to achieve a high level of knowledge and skills during practical training.

c) Safety Training Facilities:

i. Occupational Safety Shop:

Training Ground for training in underground facilities and enclosed compartments.

The plant has constructed a training ground to imitate conduct of works in underground facilities and enclosed compartments (confined space) in close to real conditions. Training on the ground is used to develop and maintain trainees' skills in conduct of works in high risk production conditions.

The ground is comprised of the following features:
- mock-up of well with fire hydrant;
- mock-up of well with water supply lines;
- mock-up of pumps fitting unit (thermal) compartment;
- mock-up of pipeline trench;
- mock-up of drain shaft;
- training classroom with equipment mock-ups.

The ground is used to achieve the following goals:
- to obtain and train practical skills of conduct of works in the enclosed compartments;
- to use personal protective equipment correctly;
- to ensure individual safety during conduct of works in the enclosed compartments;
- to use error prevention tools;
- to train actions in case of emergency;
- to drill evacuation plan in case of emergencies;
- to provide first aid to the injured.

The training ground is a unique training facility which to issued in training for high risk works in real conditions of underground and enclosed compartments. Such kind of training contributes to further decrease of production risks, increase individual worker safety and develop safety culture.

ii. Radiation Safety Shop:

Electronic Knowledge Assessment equipment (SKZ).

The Training Department has developed and uses a computerized system of knowledge control "SKZ" for "Radiation safety" training courses.
The system comprises: 20 trainees' panels, basic station, software. This system allows rapid testing of personnel during classes. "SKZ" may be used for operating and maintenance personnel during initial and/or continuous training. Test results of each trainee are displayed on the instructor's screen and can be also demonstrated on a large screen (if required). Reports are stored as HTML files in the system archive.

SKZ is used to:
- conduct routine, entrance and exit assessments;
- conduct objective analysis of training efficiency;
- store, print individual and final assessment reports;
- efficiently generate tests, add and delete questions;
- conduct training in 2 modes i.e. control and self-training;
- create interest of training results to trainees.

iii. Industrial Safety Training:

The Industrial Safety Shop in the training department is well equipped with all the devices and equipment of a very high standard which are necessary meet the NPP working situations. Even during the classroom training many practical hands-on activities are carried-out to give a feel for actual usage of the equipments.

Also a virtual interactive ‘industrial safety training room’ (virtual replica of the real IS training room with videos, training materials) is available on the plant intranet, to support workers’ self-study before regular re-examination on industrial safety.

iv. Fire Safety Shop:

Psychological Fire Simulator.

At Russian nuclear power plants in case of fire and impossibility to de-energize safety significant equipment due to necessity to ensure nuclear safety, it is allowed to extinguish fire at powered high voltage equipment.

To create psychological readiness of the personnel as well as to form the skills of fire extinguishing in electrical installations up to 6.3 kV a psychological simulator was developed and is used at Smolensk NPP. This simulator provides 6 kV power supply to the mock-up of electrical installation.

The simulator is used to train the electrical personnel to be involved in fire extinguishing until the fire brigade arrives.

The simulator comprises:

- electrical installation powered mock-up;
- 6 kV power source connected to the electrical installation mock-up;
- fire extinguishing equipment with the use of sprayed water stream.

Use of psychological simulator allows:

- to develop and maintain psychological readiness to fire extinguishing;
- to develop and maintain psychological stability under stress and emotional pressure.

The training process involves qualified specialists for training of fire response team skills of cooperation between the plant personnel and fire response team in case of fire.

Hongyanhe, China

Mission Date; 6-23 Feb., 2012

Implementation and development of the digital control system simulators has resulted in unique capabilities or results.

- To solve the problem of how to monitor operator human performance with a digital control system, the plant developed the use of a “mirror” display of 10 interface panels of control room panels for use by the booth instructors. By using such “mirror” displays, simulator instructors in the booth have the ability to observe the control manipulations being implemented by the operators during transient situations.

- Actual plant digital control system information has been validated using the simulator. As a result, several logic, graphics, and procedure problems have been identified early and provided back to the plant designer.

Rajasthan, India

Mission Date; 29 Oct.-15 Nov., 2012

The station developed and utilizes animation based multifunctional simulator for fuel handling training. Fuel handling operation can be easily visualized in this simulator through the animation along with each step of fuelling operation. Fuel handling operation can be run in auto/semiauto or auto/manual mode and repetition of similar operation in different modes develops the operator competency in station. The training on the simulator is helping the operator in understanding the following:

- Refuelling operation, each step of the refueling program;
- Abnormal operations and corrective actions to be taken;
- Evaluation of trainee’s performance can be assessed by the simulator.

The Station Fuel Handling Simulator (FHS) uses PC based soft panels. These soft panels are simulations of hard panels of actual plant for manoeuvring controls while all operations can be visualized on large monitors through animations. This FHS is used to impart training to Candidate Control Engineer of fuel handling operation personnel as well as Candidate Assistant Shift Charge Engineer of main station operations. The PC based FHS has models for normal & abnormal fuel handling operations. The simulator has capabilities for refuelling operation having each step of the refuelling program as well as simulating fuel handling system malfunctions. The simulator has proven to be excellent tool for better understanding the intricacies of on-power refuelling operations.

Figure 1. Station Computer based Multifunctional Fuel Handling Simulator

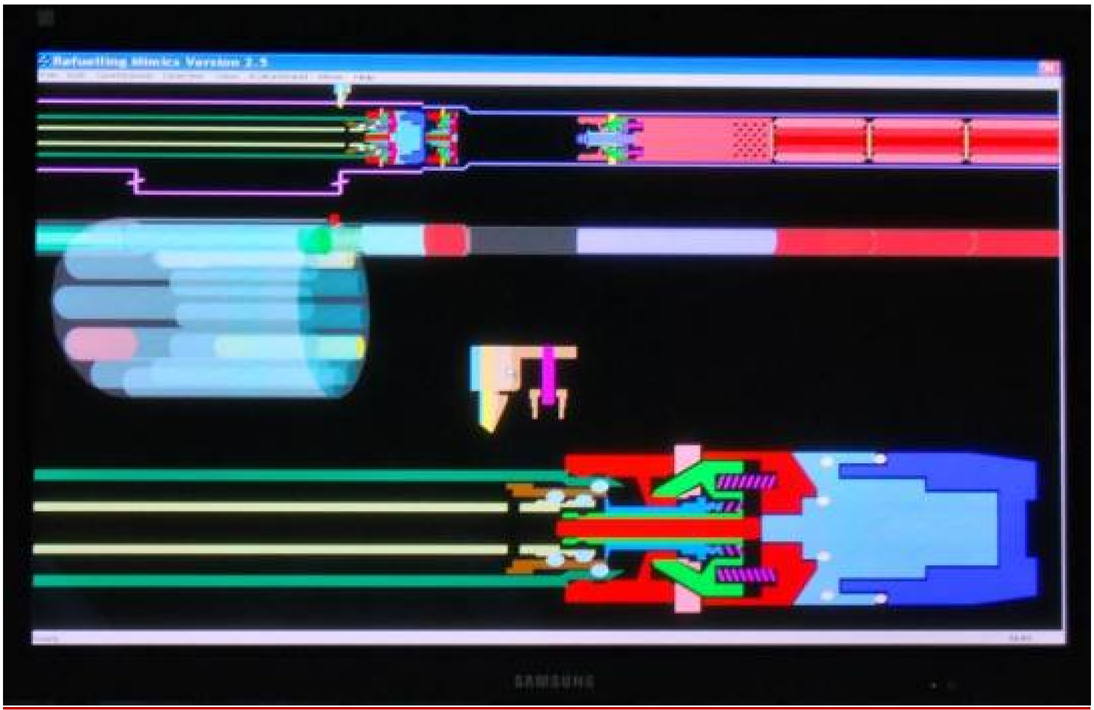


Figure 2. Refuelling sequence on the LCD screen on FHS

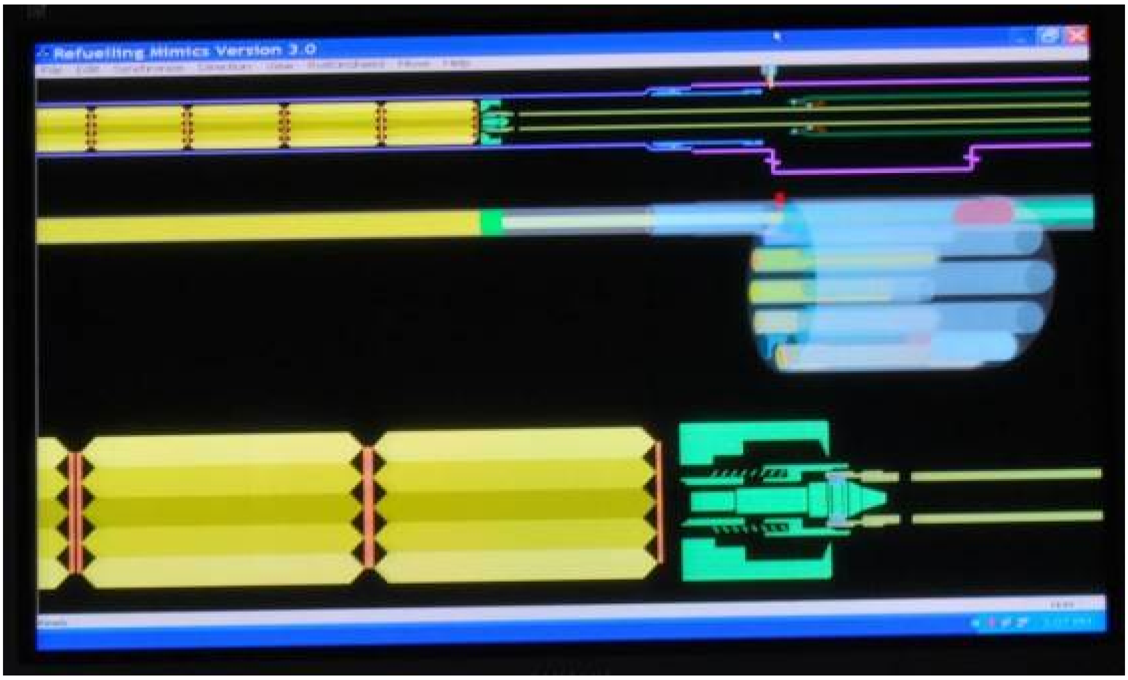


Figure 3. Fuel bundle movement on FHS

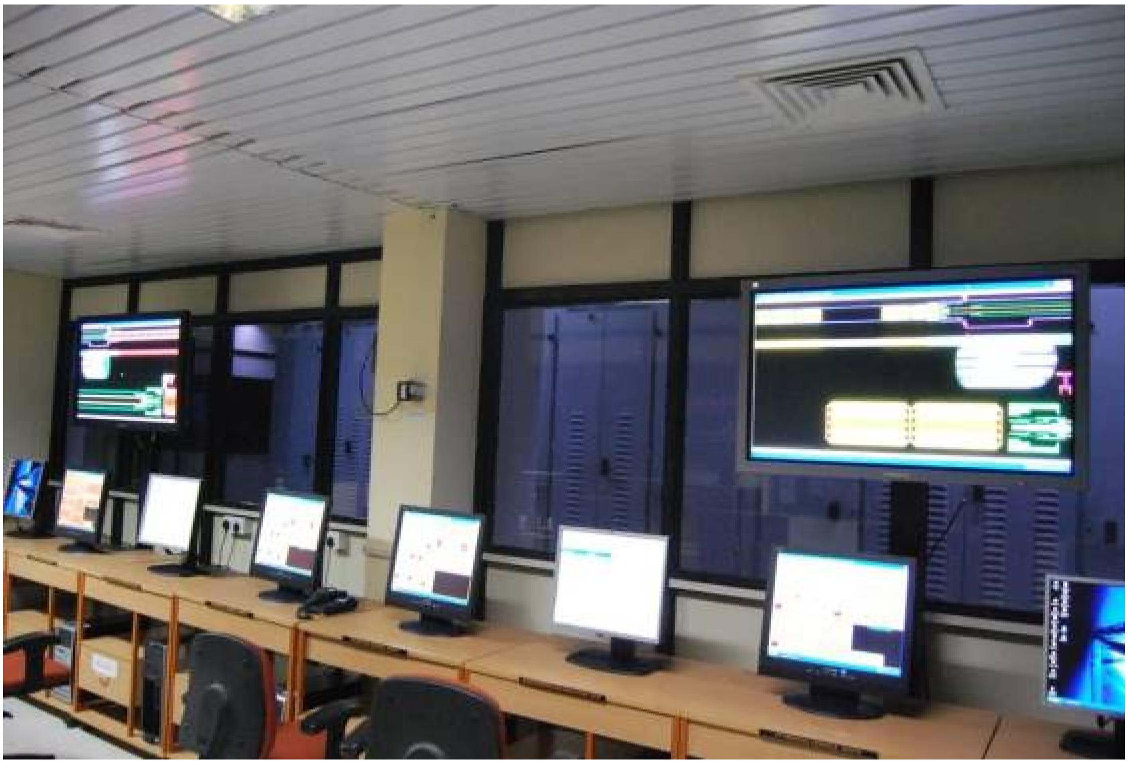


Figure 4. Fuel bundles pushed by RAM assembly on FHS

Kozloduy, Bulgaria

Mission Date; 26 Nov.-13 Dec., 2012

Shared duties of simulator instructors and Main Control Room (MCR) Shift Supervisors
Full Scope Simulator (FSS) instructors must be licensed shift supervisors and are required to work in the MCR of the plant for at least three months a year.

Currently, some Unit Shift Supervisors (USS) and Plant Shift Supervisors (PSS) act as part-time FSS instructors as well. Prior to this, these shift supervisors have individual training programmes including special courses to acquire pedagogical skills. According to plant's requirements it is obligatory for a USS, who is obtaining a license for a PSS, to provide FSS training to MCR operators for at least a three months period during his/her professional development. After obtaining their license, they must continue to provide simulator training for three months annually.

The novelty of this arrangement is that FSS instructors and Shift Supervisors rarely share duties in other NPPs around the world. Power plants, having the required amount of MCR operators, may take this approach into consideration.

The benefit for the instructors is that they remain familiar with the real operations and may detect additional training needs for the MCR operators at an early stage. At the same time, active Shift Supervisors acquire and improve their training and coaching skills.

Clinton, USA

Mission Date; 11-28 Aug., 2014

Clinton Power Station Strong Mentor Programme

Clinton Power Station, as part of the Exelon fleet, utilizes a mentor programme for students in initial training programs as well as crew training mentors for license requalification training crews. The mentors are involved with the students from the beginning of their training programme to ensure the students have all the necessary resources available for them to be successful in class.

An operations management mentor is assigned to each initial license and equipment operator training class. The mentor is the single point of contact for class conduct, management observations, and trainee performance monitoring. The mentor meets regularly with students to discuss student performance, help needed, class progress, etc.

Additionally, a shift mentor is assigned to each initial training student to supplement their on-the-job training (OJT) time. Each shift mentor meets with their respective student to ensure OJT progress is being made, answer questions about the plant, administrative processes, etc.

A training mentor is also assigned to the initial license training students. This mentor is the person who regularly works with the student to ensure they are participating in class, answer any questions, etc. The training mentor also works with the instructors to get feedback on their student on class participation, note taking, study habits, student questions, etc.

An experienced engineer is assigned as a mentor for each unique certification which new engineers are assigned to complete. The engineering mentor not only serves as an instructor to assist the new engineer with completing the certification but the mentor is also involved in evaluating student performance.

An experienced First Line Supervisor (FLS) is assigned as a mentor (Peer Coach) to assist each FLS Candidate in the qualification process and to help guide the FLS Candidate's development. The Peer Coach provides feedback to the candidate on completion of their Qualification Book on a weekly basis.

While the mentor concept is not unique to the industry, Clinton Power Station has implemented the mentor programme such that the mentors and the students feel there is a team approach to the students' success. Both the mentor and the student feel responsible for the success of the student. The training mentors are extremely involved and very intrusive in their student's performance. The line department mentors have internalized their responsibility to both the students and the station to ensure the students are well trained and qualified when they gain their qualification.

Since the implementation of this robust mentoring programme, Clinton Power Station has greatly improved their throughput in initial training programmes, with 97% of students successfully completing the last five initial operator training programmes.

Clinton, USA

Mission Date; 11-28 Aug., 2014

Clinton Power Station, as part of the Exelon fleet, has a comprehensive Supervisory Development Programme (SDP). This programme provides guidance on the selection, training and development of First Line Supervisors (FLS), limited qualification of FLS candidates, and temporary supervisory upgrades for personnel selected to perform supervisory duties on a temporary basis. The programme includes guidance on the selection of continuing training topics for enhancement and development of supervisory skills and knowledge.

Initial Supervisor Training consists of several parts:

- A three week SDP course provides basic supervisory skills training and must be completed within one year of assignment to the FLS position.
- An additional week dedicated to subjects important to nuclear supervisors. Topics were selected based on corrective action programme data, performance management results, and nuclear industry operating experience. The training is presented by Exelon nuclear executives and subject matter experts.
- Each candidate is assigned a qualification book which tracks the completion of selected training topics, interviews with senior managers, and reading assignments. A Peer Coach is assigned to provide guidance and assistance in completing the qualification book.
- To verify alignment of standards and expectations, the last step of the FLS qualification is satisfactory completion of an interview at an Oral Review Board conducted by the candidate's Department Head, the Plant Manager and Site Vice-President. Final qualification approval is granted by the Site Vice President.

Continuing development (training and non-training activities) maintains and improves the technical, administrative, supervisory, and leadership skills of the incumbent FLS and provides them with an understanding of the bases of procedures, systems and components, and integrated plant operations.

The station also conducts a Supervisor Boot Camp for all supplemental foremen, supervisors, and managers prior to each refueling outage. Topics include foreign material exclusion, temporary power, scaffolding requirements and Clinton Power Station standards. This training has improved outage performance and reduced supplemental worker error rates. The Supervisor Boot Camp training is enhanced prior to each outage to further strengthen supplemental supervisor performance.

The initial first line supervisor training programme includes nuclear industry specific training in addition to supervisory soft skills training topics.

A strong first line supervisor training programme ensures that new supervisors possess the skill sets needed to ensure high levels of personnel performance, improved efficiency, and excellent overall plant performance.

Kola, Russia

Mission Date; 10-27 Nov., 2014

Professional psychologists provide individual support to operators for the better management of stressful situations that may arise in the workplace.

The plant has introduced a local requirement for operators to undertake a 3 day training course each year to receive psychological support that is delivered on an individual basis by psychologists, who are also trainers, which provides theoretical and situational training on work related stress, and includes the following features:

- Role-playing to experience stressful situations and respond to them.
- Training in psychological techniques to reduce stress in the workplace.
- Opportunity to identify and analyse stressful situations before they develop.
- Opportunity to discuss managing stress in the working environment.
- Management of potential conflict situations.

The plant has also developed measurement techniques using a device to provide an indication of the level of stress being experienced by personnel based on physiological parameters that they use to give an objective indication of the effectiveness of the psychological support sessions on reducing stress in the workplace.

The benefits of the approach are that it assists management to:

- Inform operations personnel to improve recognition of potentially stressful situations at work before they escalate.
- Help personnel to take action to avoid or manage stressful situations that may develop in the workplace.
- Make personnel aware of the potential for conflict in the workplace and its possible effect on safety.
- Help personnel to take action to avoid or manage conflict situations that may develop in the workplace.
- Inform operations personnel to help them recognise when they are experiencing the effects of stress personally.
- Help personnel to take action to avoid or manage the effects of stress affecting themselves.

The provision of psychological support to operations staff provides a verified reduction in the effects of stress in the workplace that should benefit safety at the plant.

Kola, Russia

Mission Date; 10-27 Nov., 2014

The plant has introduced an interactive multi-functional simulator for providing fire-fighting training to all personnel.

The plant has obtained and deployed an interactive computer controlled multi-functional fire-fighting simulator (MFFS) that is used for training all NPP personnel, which provides the means to train and exercise personnel interactively in fire-fighting using fire-extinguishers, and includes the following features:

- Inclusion of a number of different locations for fires.
- Inclusion of different sources of fires.
- Inclusion of alternative types of fire extinguisher.
- Identification of the steps to take in response to discovering a fire.
- Identification of the sequence of steps necessary to fight a fire using a fire-extinguisher.
- Simulation of the sequence of steps necessary to fight a fire by means of a fire-extinguisher using an interactive link between the fire-extinguishers and the fire-simulation displayed on the simulator screen, including detection of the position of the fire-extinguisher.
- Assessment of the correctness of the steps taken to fight a fire.
- Assessment of success in extinguishing a fire.

The benefits of the approach are that it assists management to train and exercise personnel to:

- Respond appropriately on discovery of a fire.
- Follow the correct sequence of steps to fight a fire.
- Recognise the importance of the location of a fire.
- Recognise the importance of the source of a fire.
- Recognise the correct type of extinguisher to use to fight a fire.
- Use a fire extinguisher effectively.
- Recognise when a fire has been successfully extinguished.

The use of the MFFS has helped improve the knowledge and ability of personnel to respond effectively to fires that may occur on the plant and challenge safety.

The provision of the MFFS has benefited fire-safety at the plant.

Kashiwazaki 6/7, Japan

Mission Date; 29 Jun.-13 Jul., 2015

The station has made a significant commitment to using training to improve performance and ensure a high state of readiness in response to design extension conditions.

- The simulator used for U6/U7 training has been modified to model severe accident conditions. This enhances operator and ERO training;

- Operators and selected ERO personnel receive specific training on how to deal with the physical and mental stress that could occur during an extended large scale event such as experienced at Fukushima Daiichi. This includes understanding how the body reacts to stress and specific actions that can be taken to manage the stress. To enhance this training, role plays are conducted in which stress is introduced, heart rate and blood flow are monitored to show personnel how the body responds;

- Training for restoration team members on the use of portable equipment includes working in harsh environmental conditions and this is practiced in the field:
  - Radiation – wearing full face respirators, tungsten impregnated body shielding, and protective clothing and rubber gloves/boots;
  - Low light levels / night – practicing in the dark using portable lights;
  - Bad weather – practicing using rain suits, cold weather gear;

- Practical drills are arranged weekly and about 70 persons from TEPCO's Radiation Safety Department participate. The drills include emergency sampling, management of Alarming Pocket Dosimeters (APDs) during an emergency, set up of the movable radiation monitoring stations, contamination control for the Technical Support Centre and Main Control Room (MCR) during the emergencies and movable Whole Body (WB)-counting devices, among others;

- To supplement maintenance personnel qualified to operate emergency equipment, the station has requested 100 employees to become licensed to operate heavy machinery and be trained for debris removal following an emergency coincident with a natural disaster. The goal is to minimize the vulnerability of this key emergency capability to personnel losses and still maintain an effective capability to deploy and operate critical emergency equipment. This is a good example of the cross-functional training implemented by the station to improve its resilience to disasters.

Sizewell B, UK

Mission Date; 5-22 Oct., 2015

Desktop Simulator written in Visual Basic for Microsoft Excel is available for all Station personnel.

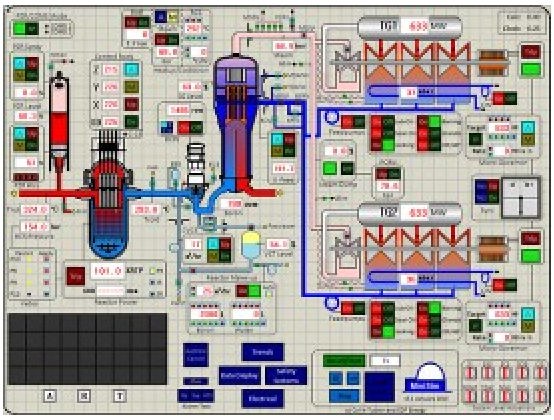
MiniSim provides a Sizewell-specific desktop simulator for use in introducing the principles of PWR operations. Unlike other such packages, it is written in Visual Basic for Microsoft Excel and so can be easily copied and run on any computer at work or at home.

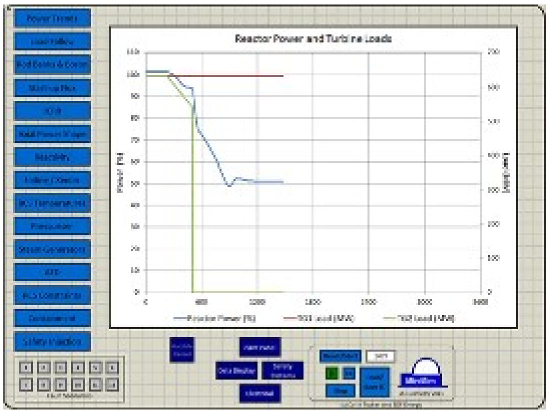
It has developed in response to requests from trainers and it can be easily adapted as future requests or training needs arise. Detailed instructions are included, together with a Station Operating Instruction for station start-up and power-raising, station cool-down/heat-up, post-trip actions load-follow operations.

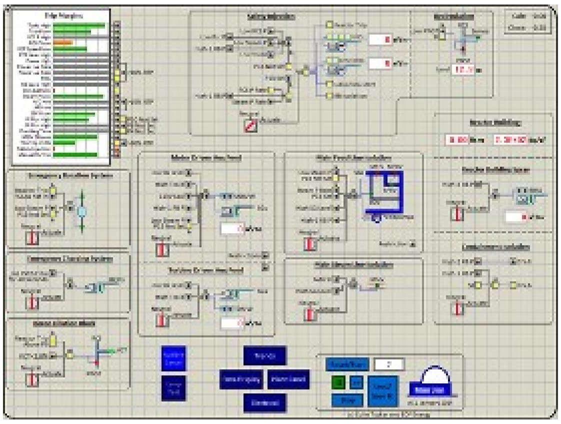
The key use for the package is in introducing new starters/graduates to the main station systems and to the behaviour of the station in both automatic and manual modes. The package includes modelling of Safety and Electrical Systems and covers a range of fault scenarios (e.g. station blackout, small LOCAs etc.) in addition to normal station operations.

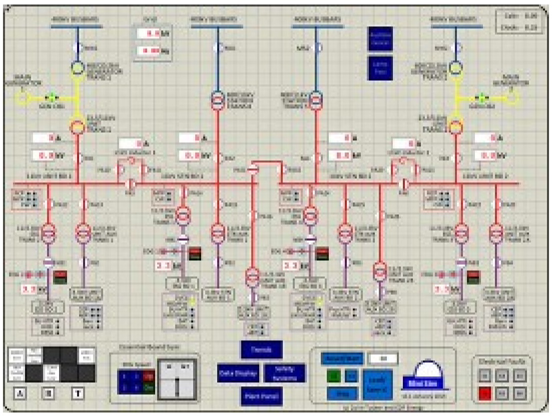
Its use is formally included within the Mentor Guides for Nuclear Safety Group Graduate Attachments.

A second 'Generic' version of MiniSim (a single Turbine model, which can be run in French or English) has been cleared for wider distribution and is in use at a number of UK universities.









Novovoronezh, Russia

Mission Date; 9-26 Nov., 2015

The plant has connected the unit 5 full-scope simulator to an analytical simulator to integrate field operator crews into the FSS training sessions. Communication between MCR operators and field operators can be tested and practiced in particular in accident conditions (emergency procedures).

The analytical simulator consists of the instructor workstation and 6 workstations in two separate rooms,, one for the reactor crew and one for the turbine crew. It is integrated into the mathematical model of the FSS. During emergency scenarios the main field operator currently receives instructions from the MCR through telephone and subsequently gives field operators instructions on the work to be done. Actions like opening/closing valves, starting/stopping pumps or verifying specific measuring instruments are simulated on the screens. Field action information is automatically communicated to the MCR as it occurs on the plant.

Three ways communication can be tested between the main field operator and his crew as well as between the main field operator and the MCR.

Chashma1, Pakistan

Mission Date; 23 Nov.-10 Dec., 2015

The plant adopted an approach to include daily operation logbooks screening in the refreshing training program of operators and to replicate operational events on the simulator to improve training effectiveness.

At the beginning of each refresh training day for MCR operating personnel a session of classroom Log-Book review is scheduled. Logs of previous shifts from all plant units are displayed on the classroom monitor and the instructor conduct the discussion on unexpected occurrence and significant events identified. Automatic actions and operator action for discussed events are checked immediately using relevant operating documents retrieved from plant network (LAN). If necessary, events can be replicated in a separate session at the simulator, for better understanding of the events.

Benefits:

- Operations and training personnel remain updated with the latest plant conditions and status through daily study and discussion of MCR Log-Books;
- It helps in improvement of training material and simulator exercises in the light of latest events and near misses at MCR;
- Significant log events undergo critical review with reference to human error reduction tool and operator fundamentals. Deficiencies encountered thereafter are focused during subsequent training;
- The significance of different components, equipment, Operation Instruction, temporary and permanent modifications is highlighted for the participants during these sessions.

Bruce B, Canada

Mission Date; 30 Nov.-17 Dec., 2015

Providing a wide range of engaging training settings and dynamic learning activities

The plant uses a wide range of engaging training settings to provide learning and development opportunities. The range extends from a purpose built fire training facility, to advanced simulator modelling on a fuelling simulator, to dynamic learning activities (DLAs) with mock-ups and replicas.

A full scope fuel handling simulator with touch panel replicas is used for operator training. Advanced modelling of the fuelling machine with included interaction properties allow instructors to cause virtually any key component to stick, seize, or break free letting them recreate virtually any past event as well as train on new failure scenarios. Along with the physical modelling of the fuelling machine, a fully coupled 3D graphical representation is created. Visualisation of the actions enables trainees to develop mental models faster, leading to heightened learning progress.

A state of the art fire training facility on site allows fire response staff to train and practice a range of different scenarios including turbine fires, pump motor fires, high angle rescues, and vehicle fires. Emergency response crews and plant operations staff can prepare for operating in stressful situations with open flames and smoke around. The indoor training settings of the facility allow training to take place around the year and it is used for the training of municipal fire fighting forces.

Maintenance training DLAs include a welding mock-up from inside containment, allowing weld testing while in plastic suits, providing proof of proficiency in realistic circumstances. An overhead cab crane simulator provides a high fidelity environment to simulate crane operation, fault response and operator perspective. A complete replica of power conversion equipment enables practising and evaluations in a training environment rather than on live, critical station equipment. Sampling simulators have been designed and implemented in chemistry training. While some DLAs are designed for use with one curriculum area or workgroup, more and more are now integrating multi-layered content (more than one curriculum area or more than one workgroup) into larger, more complex and challenging scenarios.

A location based simulated dosimetry system is used in DLAs to reinforce proper radiation protection practices in a safe trainer-controlled simulated radiation environment.
The scope and variety of available training settings is a testament to the commitment and support of management, and the engagement and drive of instructors to create and use such a range of activities to continually increase trainee proficiency.

Pickering, Canada

Mission Date; 19 Sep. -6 Oct, 2016

Comprehensive candidate selection process increases overall throughput on certification courses.

Candidates for the Initial Training Program for Authorized Nuclear Operator (ANO) and Control Room Shift Supervisor (CRSS) go through a rigorous selection process to determine their potential for successful completion of the Authorization Training Program and future certification as ANO and CRSS.

After the interview process, the candidate is scheduled for a five day selection course which is structured as follows:

- During the first two days the candidates are provided with classroom-based lectures on two station systems and course notes for two additional station systems to self-study. The purpose of the course is to determine if the candidate is able to study and retain the required knowledge from both the lecture course material and self study. The candidate then writes a rigorous, essay-style examination to confirm learning.
- During the third and fourth days the candidate is introduced to simulator-based training. A qualified instructor provides the candidate with instruction on how to use operating procedures in the simulator in response to alarms and other events associated with the systems studied in the classroom. The candidate is provided the opportunity to practice the skills. During this period, the qualified instructor will assess the candidate's ability to learn new skills and to apply the knowledge gained in the classroom.
- On the fifth day, the candidates complete a simulator-based performance examination based on the previous day's training. The Operations Manager or his/her delegate is in attendance to observe candidate's performance.

The Training Department compiles the results from both written knowledge and the simulator skills portions of the course. Candidates are ranked based on their ability to retain and assimilate the knowledge gained, their ability to read and execute procedures and their ability to maintain composure under highly stressful conditions. Only candidates who are able to meet required standards are considered to entry to the certified training programme.

The Operations Department reviews the rankings provided by the Training Department and, based in part on their own observations, selects the candidates most suitable to proceed to the initial training program.

Since implementing this process in 2012, the candidate throughput has increased from 42% to 83%

Golfech, France

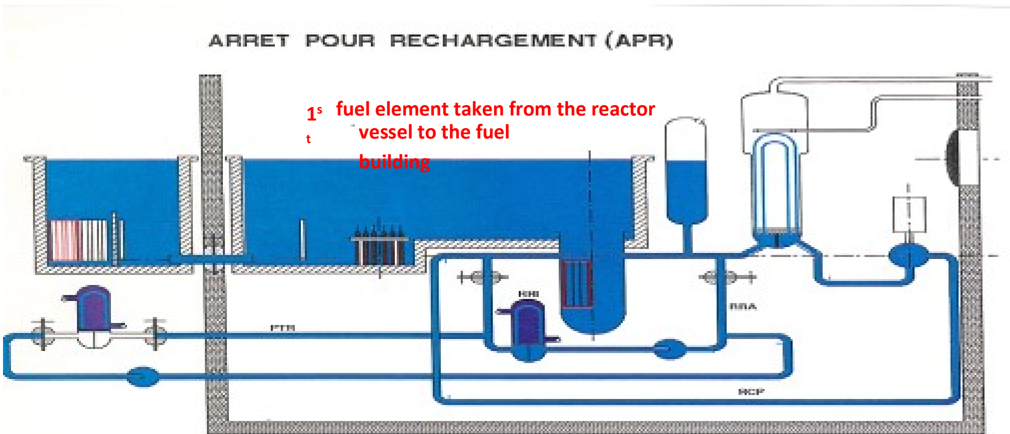
Mission Date; 10-27 Oct., 2016

Informative and very clear training package for new comers called “Outage for Dummies”.

In view of the large number of newcomers, the Risk Prevention department decided to compile a description of all major tasks affecting risk-prevention technicians during outage and developed and implemented an informative and very clear training material for new comers called “Outage for Dummies”. Produced by four risk-prevention technicians, this document identifies the risk-sensitive phases in each stage of an outage, while also matching the corresponding risk-prevention tasks to each of the phases. The document contains information on conventional safety, radiation protection and fire safety.

The booklet is geared towards recently hired and inexperienced radiation protection technicians. It illustrates the major risks associated with their professional activity, whether in the area of conventional safety, radiation protection or fire safety. For each of the reactor coolant system levels, the booklet lists:

- The technician’s main tasks
- All associated risks



•At least 1 fuel assembly inside the reactor building
•Pools are full (FB and RB)
•Boron concentration ≥ 2385ppm
•RCS av. temp. betw. 10 °C and 60 °C
•RHR connected to RCS
•RB accessible (RHR <90 °C)
•Vessel Head removed

Risk-sensitive tasks
- Unloading the core
- Lifting and transfer of upper internals
- Drainage and decontamination of SI sumps

Risk-prevention tasks
- Setting up a red area around the transfer tube for defueling
- Reactor cavity and fuel pool surface radiation survey for defueling
- Monitoring the lifting and transfer of upper internals

Taishan, China

Mission Date; 8-26 Jan, 2017

The plant has introduced a specific simulator training facility assembly to evaluate and therefore improve MCR crew performance.

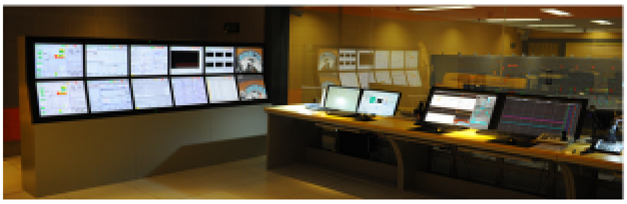
The plant has developed and implemented a highly effective simulator instructor training interface for monitoring and tracking of main control room crew performance. It includes a multi-screen monitoring system, parametric curve recoding system, central instructor control system and a state-of-art debriefing system.

This includes identifying performance gaps, correcting unsafe behaviours and improving shift crew teamwork. This facility is supported by an evaluation method, which supports the tracking and analysis of each shift role (via live recording, data recording and the generation of graphics). This facility captures evidence of the trainee's errors during the simulator exercises and helps trainees to identify their performance deviations and correct behaviors. The team recognizes this as a good practice.

The benefits of the approach are that it assists instructors to manage and debrief MCR crew training to:

- Observe the behaviours and operations of the crew in 360º and distinguish the cases that need feedback.
- Identify abnormal actions taken by trainees and add notes based on the changes of important parametric curves connected to those actions.
- Determine the focus of the trainee based on the mouse movements tracking from the individual operators MCR distributed computer system (DCS) monitors.
- Record and reproduce the communications with the shift crew in parallel with the relevant plant parameters.
- Provide evidence of errors made by the trainee during the simulator exercise.
- Support discussions inside the MCR and record instructor comments during the exercise.
- Help trainees to identify the performance deviations and develop corrections in behaviours by themselves.
- Support the teamwork debrief made by the simulator instructor after completion of the exercise.

The provision of the simulator training facility interface has allowed real time evaluation and improvement of MCR staff performance.



Barakah, UAE

Mission Date; 15 Sep. -3 Oct., 2017

The plant is leading the development of the qualification for nuclear positions administered by Nawah and their recognition by UAE National Qualification Authority (NQA), which will bring the benefit of shortening the time necessary for training of plant employees.

This process allows the plant to take credit for prior learning and qualification from another NQA accredited organization, thereby reducing the amount of training and time required to produce qualified employees.

Training department is developing the qualifications for nuclear power plant operators (certified and non-certified) and plant technologists/technicians who successfully complete the Operations and Technical Training programs. Four of the eight qualifications have been endorsed by the UAE National Qualification Authority with the other four to be completed by Dec 2017.

The plant is the first NQA registered training provider in the nuclear field in the UAE providing employees, and Emiratis in particular, with a clear path for professional development and progression.

Barakah, UAE

Mission Date; 15 Sep. -3 Oct., 2017

Main Control Room (MCR) simulators have been creatively designed and cost effectively implemented to meet demanding plant training schedules.

Confronted with demands for simulator time to support station needs that exceeded simulator availability (e.g. Operator Initial and Continuing Training, Emergency Plan scenario development and drills, Simulator Evaluation and Job Performance Measure development, Management SRO classes, Operating Procedure verification and validation, etc.), the plant found themselves in need of additional MCR simulators.

Within three months and with a budget of approximately 1% of the cost of a Full Scope Simulator, the Training Department Simulator team designed, built and certified (to ANSI/ANS-3.5) a 'Limited Scope' simulator in an existing classroom. The Limited Scope Simulator (LSS) uses the same simulation software and provides the operators with all the necessary interfaces (including five Operator stations) to perform virtually all training activities that the full scope simulators allow. Its development and implementation was so successful that an additional limited scope simulator was built to ensure station training needs could be met. Additionally, a third LSS will be built in late 2017 to help support the plant Management Senior Reactor Operator Course.

In addition, several 'Partial Task' simulators, each using a PC with a full simulation model and 6 PC monitors, were built. These simulators provide an effective platform for single operator training activities. They are also used extensively to develop training material, practice Job Performance Measures, make classroom presentations and demonstrate other single operator actions.

Finally, a 'Mini' simulator (similar to the LSS, but on a smaller scale) provides operator interfaces for 2 persons and will be stationed in a room just off the Unit MCR for Just-In-Time training activities.

Picture: Limited scope simulator for Barakah Unit1

Torness, UK

Mission Date; 22 Jan. - 8 Feb, 2018

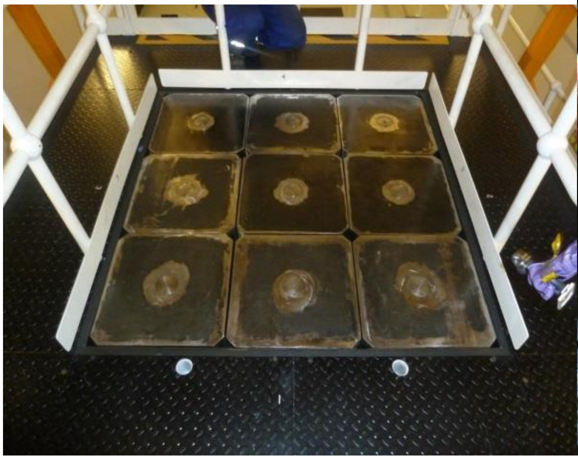
Advanced Gas Cooled Reactor Fuel Floor Mock-Up in support of improved Fuel Route Training.

The station has created a mock-up of the fuel floor of the reactor. The mock up allows training to be carried out in a controlled, low contamination and radiological environment as to not compromise Nuclear Safety. Trainees are able to learn without consequences in the event of an error or misunderstanding. The facility has been used in the training of Fuel Route Operations Engineers, Fuel Route Technicians and Health Physics Monitors in tasks such as:

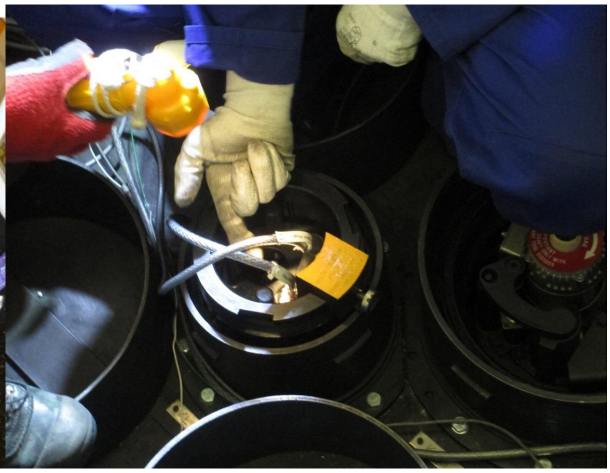
- Reactor fuel floor preparations
- Control rod actuator brake fitting and removal
- Fuel closure motor drive unit fitting and removal
- Fuel closure pressure leak tests
- Thermocouple tests
- Radioactive contamination training
- Human Performance Tools and Fundamentals

The mock up is used for initial and continuing training, On-the-Job Training, Task Performance Evaluation along with In-Service Inspection Training and Just-in-Time Training for outage rehearsals. This has contributed to reducing the In-Service Inspection Programme for statutory outages by 3 days in 2017.

Station performance improvement is evident through the reduction in events related to fuel floor preparations, events during control rod floor preparation and excellent radiological safety during refuelling and reactor outages. The number of personal contamination events has been reduced from 18 in 2014 to 8 in 2017.



Fuel Floor Simulator – Floor Intact



Trainees checking control rod cables – simulated contamination control area

Olkiluoto 3, Finland

Mission Date; 5-22 Mar., 2018

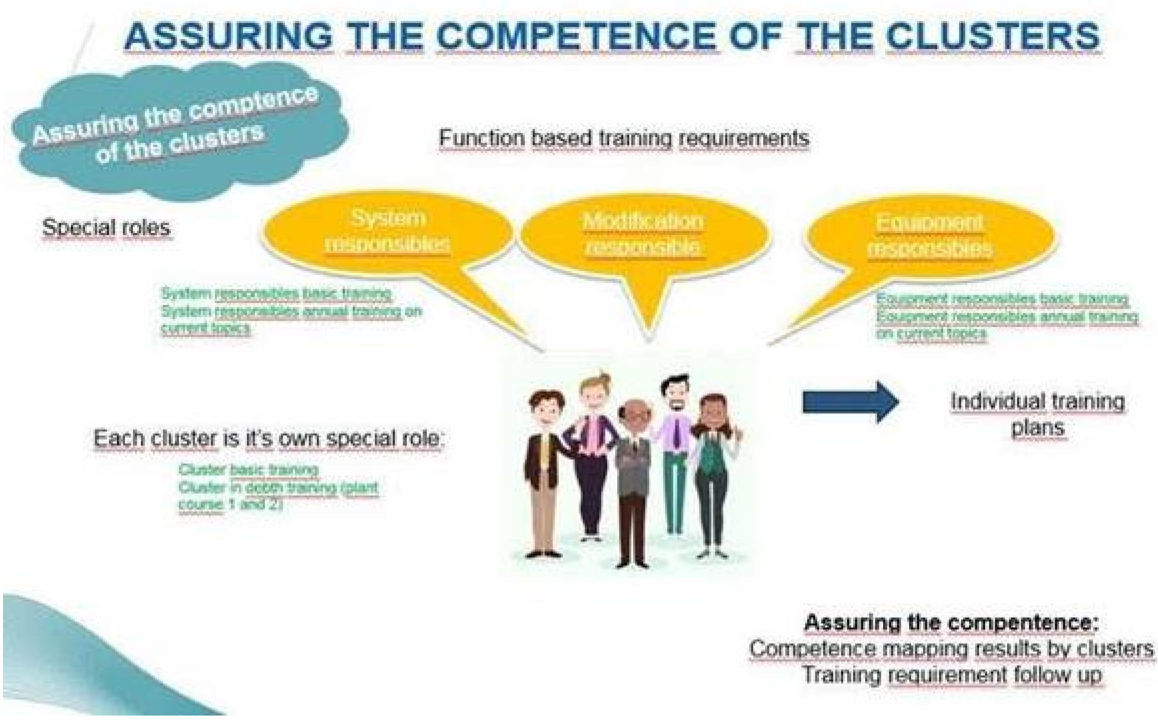
Clusters improve knowledge and skills

Plant systems, structures and components have been divided into 20 groups, called clusters. A cluster is a ‘know how ‘entity group of technical people that can support each other due to similarities in their technical skills. Clusters do not substitute in-depth training on EPR technology. However, they can be a very useful tool for collecting and sharing knowledge on particular systems.

A cluster consists of a multidisciplinary team of people responsible for systems, modifications and components. Depending on the level of criticality of the systems, responsibilities have been shared in some cases with five different people. Each cluster has a named responsible person who oversees the cluster.

Tasks are:

Sub-areas
Scope: Systems, Structures, Components
Documentation including Final Documentation
SW and parametrization files (KU)
TVO Design process
TVO V&V process
Configuration Management
Design basis
Engineering: Manuals, procedures, instructions
Maintenance: Manuals, procedures, instructions (KU)
Operational instructions, which are not in the scope of OM/ NTM/CTM like Periodical testing, parameterization, blockings, etc. (KU)
Design tools
Engineering models
Maintenance Tools inc. Parametrization and testing (KU)
Trainings and qualifications
Contracts with externals
Spare parts availability (KU)
Obsolescence inc. Qualifications
Aging management
Tasks from new YVL guides
Warranty period (later)



Status of development in the clusters is reported to upper management three times a year.

Benefits:

- New staff in engineering and maintenance have a support network from different expertise areas. Familiarization and training needs are identified and knowledge transfer is done inside the clusters. Assuring the competence of the clusters is described in the picture.

- Reduced individual work load sharing their tasks with other individuals and ensuring that knowledge and competences are not resting on single individuals.

- The management of the clusters documentation and changes needed in the plant configuration are identified faster than previously.

- Progress follow-up and traceability of remaining tasks are clearer than before.

- Competences and knowledge are shared between several people who can support each other.

Bushehr, Iran

Mission Date; 29 Sep. -17 Oct, 2018

Application of medical and psychological ‘fitness for duty’ examinations in the recruitment and examinations of personnel with tasks important for nuclear safety.

The objective of the medical and psychological ‘fitness for duty’ in the recruitment and examinations of the plant personnel with positions and tasks important for nuclear safety, e.g. main control room staff and management positions, is to acquire and maintain competent human resources for ensuring the safety of the plant. The psychological examinations are designed and performed so that competencies needed in these positions are confirmed with different psychological examinations and tools, and measured by international standards. The assessment includes: test of cognitive abilities using test of vital signs of the central nervous system, various test systems and batteries to test non - verbal intelligence, reaction time, sustained attention, distance, time estimation and attention, personality dimensions and compatibility of these with the job, determination of psychological health, and through interviews.

Benefits:

- Assessing abilities and personality, and additional behaviours
- High validity, minimizing errors, accurate measurement of response time of the candidates
- Comparison of individual's result with normal results, and with each other, for arrangement in the shift properly, promotion, succession plan
- Use of a data base for statistical analysis
- Organizing of workshops on safety culture based on results of psychological examinations
- Develop personal psychological interventions and cognitive rehabilitation

Flamanville 3, France

Mission Date; 17 Jun. - 4 Jul., 2019

Use of post-Fukushima Box for fuel handling in adverse conditions

FLA3 operators have developed a ‘Post Fukushima box’ (fig.1) filled with tools enabling them to place a fuel element in a safe position in case of plant blackout in the fuel building.

They include portable lights with batteries charged, autonomy phone, portable tools, breathing air sets with air bottles filled. The use of these tools in adverse conditions is described in a procedure provided in the box. with the main following steps:
- Deploy equipment of the ‘post Fukushima box’ in the dark;
- Use the spent fuel machine manually with specific marks (X,Y et Z) around the pools or cavities;
- Secure the fuel in safe position manually.

The box will be located nearby the pool, close to the spent fuel machine. All necessary equipment to operate fuel during blackout is maintained in good operational condition available and ready for use and monitored under the surveillance programme. A comprehensive approach has been developed to use the box and relevant training has been given to the relevant staff.

Benefits:
Enhanced readiness of teams in charge of fuel operations to deal with adverse situations.

Results:
The box enables staff to find and use easily all equipment needed to place fuel in a safe position in case of a blackout.

Fig.1 Post-Fukushima blackout box