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## **KHMELNITSKY NPP PERSONNEL TRAINING SYSTEM IMPROVEMENT**

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### **Introduction**

Khmelnitsky NPP is located in the north-west part of Ukraine, 160 km from Khmelnsky city - the capital of the region and 40 km from Rovno. According to design, Khmelnsky NPP is a four power units plant with standard water-water Reactors VVER - 1000. Total capacity 4000 MW. Construction of the plant was initiated in 1981. The First Unit was commissioned in December 1987. The plant was constructed with participation of Eastern Europe countries in the frame of Council for Mutual Economic Aid.

The power in the amount of 50 billion kW/h was produced during past 8,5 years. During overall period of operation there were no violations of radiation safety at KhNPP site and within 30 km area. In respect of all technical indicators (safety, reliability, installed capacity factor) the first power unit could be considered as one of the best in Ukraine.

Construction and commissioning works at unit 2, 3, and 4 were stopped in 1990 due to "Moratorium for construction of new nuclear power plants on the territory of Ukraine". Completion level of the power units was the following: KhNPP 2 - 85 %; KhNPP 3 - 35%; KhNPP 4 - 20%. Commissioning of KhNPP 2 was planned for 1990 and KhNPP 3 and 4 for 1992 and 1993 accordingly. Currently the moratorium is canceled, completion of construction and commissioning of KhNPP 2 is restrained by insufficient funding from the Government of Ukraine.

All Infrastructure (power facility, special water treatment, water processing, drainage, transport, communication, fuel storage and rad wastes storage, etc.) is included in the NPP. NPP comprises maintenance and repair division, (it is determined by the need to perform 60 - 70 % of all repair works on it's own.). NPP is responsible for the city of Neteshin and due to that Housing and Communal Services Department is included in organizational structure of the plant. The plant has a farm. Taking into account all areas of work the total number of the plant employees is 6248, including production industrial personnel - 2859.

## 1. Need for personnel training system reorganization and it's principles

By the commissioning time of KhNPP 1 the plant had a complete number of highly qualified personnel. Experienced specialists from different NPPs, manufacturing plants of Russia and Ukraine came to Khmelnytsky NPP which was the newest and modern plant of the Ex-Soviet Union. In accordance with the regulatory documentation requirements, before commissioning of KhNPP 1 (1987), all personnel of the plant had been trained in the frames of Nuclear Industry Personnel Training System which was available for that time. Responsible operating personnel was trained in the primary training institution for NPPs with the reactor VVER-1000 - Novovoronezh Training Center and received OJT at similar type reactors. Managers and engineers were trained in the system of requalification, including Central Institute of Qualification Improvement, different departments in Universities, OJT at similar NPPs.

Even in that time it was apparent that the off-site training system had significant shortcomings, e.g. the personnel was away from normal environment, and their families for a long period of time required for adaptation; equipment and training materials of Novovoronezh NPP and other NPPs were different from KhNPP's. Considering all that, KhNPP arranged personnel training directly on-site. Training department of KhNPP was established in 1987. The main purpose of the training department was to ensure coordination and organization of the training process. Training department performed continuous training of the Operations Personnel.

Training Department obtained license of the regulatory board for training and annually received a permit of State Nuclear Inspection to perform continuous training for the plant personnel.

During last years the works in the area of Personnel Training System were significantly improved due to some new factors and requirements for training of the personnel for Ukrainian NPPs.

Starting from the year of 1991 we have lost opportunity to train personnel in the industrial training centers, which appeared to be abroad (in Russia)

Because of moratorium and difference in salary in Russia and Ukraine in 1992-1994 there was a large flow of employees from KhNPP to plants in Russia (560 men during 1993-1994)

The Specificity of our plant is that only one power unit is in operation now and the rest of the units are at different levels of construction. There is a need to train large number of personnel for commissioning and operation of these new units.

The important factor, which required modification of conventional personnel training system, was hardening of the Regulatory Board requirements to qualification level of the personnel and methods of qualification control, including licensing of the operations personnel in the Regulatory Board.

There is an increase of control of personnel qualification level from the side of IAEA (OSART mission in October 1995), public and different government organizations of Ukraine. Practically simultaneous effect of all these factors places the plant in a very complicated situation and the issues of personnel training and retention of qualified personnel at the plant came forefront.

Some urgent actions were taken to solve these problems, the most important among them are the following:

- Reorganization of the personnel training system at the plant
- Motivation of the personnel to upgrade qualification and to study new jobs.
- Raise of salary level of the responsible personnel to the level of Russian NPPs

The following principles were used as the basis for reorganization of personnel training system in 1993-1994:

- Comprehensive training: which means that all types of training (initial, continuous etc.) should be provided to all categories of personnel (operations, maintenance & repair, engineering support and administrative-technical)
- Decentralized system: training is provided at the plant. Limited number of staff and specific courses (when course development at the plant is not economically feasible) are trained in specific training institutions.
- Systematic approach to training and training materials.
- Maximum participation of the personnel in joint works with organizations and companies of USA and other countries in the frames of Lisbon initiative and TACIS with the purpose to analyze and adapt advanced experience to specific features of KhNPP.
- Use of modern technical means of training , including full-scope simulator, local simulators, specific course equipment of training workshops and laboratories, equipment of psycho-physiological tests and rehabilitation.

## **2. Creation of Training Center**

To provide the performance of traditional & newly appeared tasks in personnel training, Khmel'nitsky NPP Training Department was transformed into Training Center (TC) in 1994. In 1993 a job position of Deputy Chief Engineer on Personnel Training & Plant Information System was established to direct & coordinate the work of all divisions in the area of personnel training. Training Center is directly subordinate to Deputy Chief Engineer.

Experienced plant personnel was employed into Training Center; among them qualified operations & maintenance specialists (Training Center Manager - used to be Plant Shift Supervisor; the Head of Operating Personnel Training - used to be Unit Shift Supervisor, Department Shift Supervisor; Deputy of Training Center Manager - used to be the Head of Repair Shop, etc.).

The following departments are included in the Training Center:

### **Training departments**

- Operating Personnel Training Department;
- Maintenance Personnel Training Department;
- Psycho-Physiology Laboratory)

### **Supporting departments**

- Department of Hardware & Software;
- Personnel Training Organization Department.

Training Center organization chart with indication of staffing is given on a scheme. Main characteristics of Training Center activities in the area of personnel training are listed in the Table "Information about training process for 1995".

#### **4. Development of training courses based on SAT methodology**

4.1 First course was a pilot course for a technician on maintenance & repair of motor driven valves that was developed by GP & KhNPP based on SAT methodology. This development was started in April, 1994 All SAT stages could be explained by this example.

##### **1. Analysis.**

Overall job analysis in the scope of Centralized Maintenance & Repair Department, & task analysis in the scope of Pipes, Valves & Vessels Shop was performed.

##### **2. Design.**

Course was designed in the scope of Pipes, Valves & Vessels Shop.

##### **3. Development.**

Only pilot course for Turbine Department motor operated valves technician was developed - "Motor Operated Valves (MOV) Introduction". A complete file for training based on SAT methodology was created:

1. Lesson plan for classroom instruction.
2. OJT (on-the-job-training) lesson plan.
3. Procedure of gearbox & yoke assembly maintenance & repair.
4. JPM- Job Performance Measure.
5. Exam Bank Question.
6. Study Guide.
7. Transparent materials

##### **4. Implementation.**

The course was implemented in April, 1994. The course was presented during 5 days by a trained in accordance with SAT shop supervisor from Centralized Maintenance & Repair Department; it consisted of classroom instruction & hands-on OJT.

Representatives of all Ukrainian NPPs attended the course presentation; documentation was sent to NPPs of Ukraine & to Balakovo NPP (Russia). Members of Ukrainian-American Expert Working Group attended the final classroom instruction & OJT.

##### **5. Evaluation.**

Upon the completion of the pilot course trainee & instructor critiques were collected & analyzed. The same feedback was collected from representatives of different NPPs. Upon completion of the course some of trainees were qualified for higher grades. Nine months critiques were analyzed as well.

Critiques analysis showed that the course was acceptable & required no substantial corrections. Only some editing & drawing-up of the course material were made to comply with documentation requirements established at KhNPP. A wish was expressed to extend this training course for different jobs performed within the shop.

#### 4.2 Development of other courses

The development of other three pilot courses (CRTO, reactor repair technician, soldering technician) was done in the same way. Now three additional pilot courses are being developed. The list of courses and their status are given in the Table (CRRO, Refueling Floor Operator, Chemistry Operator). The course for CRRO is not pilot one but a complete course for this job position which is vital for safety.

It is planned to develop a series of courses including pilot courses for Unit Shift Supervisor, Shift Supervisor of Electrical Department, Shift Supervisor of I&C Department. These works will be performed mainly by KhNPP personnel under methodical guidance of GP.

US representatives together with KhNPP are paying efforts in development of important courses on general engineering, such as: "Safety Culture", "Nuclear Safety, Radiation & Fire Protection & Industrial Safety". We intent to complete these works & to proceed with the development of additional general courses on Nuclear Physics, Thermal Hydraulics, Management Training & Quality System. These courses were incorporated in initial training programs for all personnel of NPP as separate modules. In parallel a specific attention is paid to TC instructors training. A program for instructor training was developed & initial training based on SAT methodology had been already conducted; qualification maintaining programs were established as well.

#### 4.3 Creation of normative-methodical basis.

It's necessary to highlight joint work with US companies on development of methodological materials. This work was initiated in 1993 when Mr. Thomas Mazur made a presentation of introductory course "Systematic Approach to Training" for NPP, divisions & TC management.

Then in 1994 joint development of the "Guidelines for training materials development" manual was started. This manual summaries the whole previous experience of joint work in the area of courses development at KhNPP. It covers & specifies all procedures to be met at all stages (analysis, design, development, implementation, evaluation). This material is approved & will be accepted by KhNPP as a standard for a plant.

"Regulations for Personnel Training System" are established. These regulations are the quality assurance program for personnel training. Now "Training Procedures Manual" is being developed at the plant.

Upon completion of these works a normative-methodical base will be created at NPP to implement systematic approach to training & training itself.

Problem - existing normative-technological documents at the State level don't meet the modern requirements & require to be upgraded as soon as possible, otherwise it will restrain the progress & spreading of SAT at NPP.

## **5 Development of Training Hardware**

We understand that it's impossible to create a training system meeting the enhanced requirements without using the up-to-date training hardware. Great attention is given to this issue at KhNPP as long as considerable funding is provided. We are also getting substantial support from the USA in the scope of the Lisbon Initiative. British and French governments are also contributing a lot to the equipping of Khmel'nitsky Training Center with modern technical means.

### **5.1 Training Facilities Design and Construction**

In 1996 it's planned to accomplish the construction of the Training Center complex, built under the design provided by a specialized organization - the Kharkov Institute for Training Facilities Design (GIPROUZ). It consists of 4 buildings:

- simulator facility
- training facilities
- administrative building.

The total area of the Training Center is 9, 100 m<sup>2</sup>.

The Training Center has not only classrooms and workshops but also rooms for personnel psychological and physical rehabilitation:

- gymnasium
- fitness room
- psychological relaxation room.

The Training Center also includes a canteen for a hundred places.

Thus, the Training Center, constructed under the GIPROUZ design, is an integrated complex providing initial and continuous training, personnel psycho-physiological rehabilitation and besides a whole number of services required for the adequate organization of the training process.

The layout of the main rooms of the Training Center is shown at the attached tables and drawings.

Additionally it is planned to build some specialized "hangar"- type facilities to accommodate the samples of big-size NPP equipment for maintenance personnel training (Maintenance Ground). The estimated area of the Ground is 4, 600 m<sup>2</sup>, that will allow to organize maintenance training with the use of actual samples or fragments of the equipment from power units # 1 and 2. The layout of the Maintenance Ground workshops is shown at the attached drawing.

### **5.2 Simulator Complex Development**

In order to organize the adequate operations and maintenance personnel training on the basis of the Training Center, the simulator complex is being developed, the Unit 1 full scope simulator is the main element of simulator complex.

This simulator is being developed with the help of the US Government (DOE) within the framework of the Lisbon Initiative. A simulator developer from the American side is S3-Technologies. The function of technical management and control of simulator development is assigned by DOE to Brookhaven National Laboratory. The work accomplishment is scheduled to August 1997.

Under the joint project KhNPP supplies control panels, consoles and instruments of the Main Control Room and the Emergency Control Room and the American side is in

charge of computers, input/ output device and software. The American side is also developing and providing training material for 100 hours of simulator training.

An important place in the personnel training is occupied by a local simulator complex "Klotik", created on KhNPP order by a number of organizations in Sevastopol: the instrument-making plant "Parus", the Navy Institute and the scientific technical enterprise "Impulse-2". Seven simulators "Klotik", providing training of operations personnel of nearly all departments (Reactor, Turbine, Electric, Chemical, Radiation Protection and I&C departments), have been already developed.

An important feature of these simulators is the provided possibility to test the knowledge of operations personnel working outside the Main and the Emergency Control Rooms and not involved in the full scope simulator program. The OSART Mission, that reviewed Khmelnitsky NPP work in October-November 1995, found it a good practice that KhNPP used the local simulators "Klotik" for training ops personnel working outside the Main Control Room.

For "Klotik" simulator hardware, diminished and simplified mockups of control panels and consoles of the corresponding control rooms are used (the Main Control Room, the Electric Control Room, the Specialized Water Purification Control Room, the Chemical Water Purification Control Room and other local control rooms). They are equipped with the diminished copies of instruments and controls.

Simplified simulation of plant processes is carried out with the help of the computer complex IBM AT486, joined in the common simulator network.

Functional simulator "CORYS" (manufactured by the "CORYS" company, France) was supplied to KhNPP at the expense of the French government in accordance with TACIS program with the assistance of FRAMATOM. This simulator allows to simulate the processes of the Reactor and Turbine departments with the help of computer complex "Sun". The simulator is used for initial training of Control Room Reactor and Turbine Operators, for review and analysis of technological situations, taking place on-site.

At present a simulator for Refueling Floor Operator training is being developed. This simulator includes:

- Refueling Floor Operator control console with test and graphic information displays
- instruments and controls
- measurement and positioning systems
- instructor's workstation at the basis of IBM PC.

With the help of the operator's console controls, simulation of all refueling machine components actions is performed with the output of the required signals to the console and the acceptance of control signals from an operator.

An instructor determines the required sequence of operations and follows a trainee's work on the duplicate display.

The simulator enables to conduct the following training:

- operator's initial training
- continuous training while performing technical operations both without operational modes violation and involving different deviations due to equipment failures.

The refueling floor simulator is built with the help of the American financial support. It'll serve as training hardware for the Refueling Floor Operator training course,



developed in compliance with the training material development program with the US support within the framework of the Lisbon Initiative.

### **5.3 Training Hardware for Training Material Development and Lesson Performance**

Khmelnitsky Training Center develops training material with the use of up-to-date computer copying machines. Training performance also involves the use of computer technique (computer training systems, interactive game systems, knowledge evaluation systems), as well as audio and video technique and overhead projectors. The Training Center was equipped mostly with the technical aid of the US and British governments.

Thus, for example, from the USA we've got 13 computers AT-486, 2 copiers, overhead projectors, fax machines and some furniture for classrooms and offices. More equipment for the Training Center is coming in June-July 1996 (computers and technique for training material development).

Considerable contribution to the equipment of the Training Center with modern hardware was made by the British Government, which allocated financial resources for these purposes.

Scottish Nuclear Station Hunterston, involved in the twinning program with Khmelnitsky NPP, has actively participated in the implementation of the technical aid project. At the earliest possible date Hunterston personnel have purchased and delivered to KhNPP modern equipment for taking and playing training videos and slides, copiers and computers. This equipment was officially transferred to Khmelnitsky NPP in May 1996 in the presence of the UK Consul General in Ukraine Mr. Jenkins.

We want to express our sincere gratitude to the Governments of the USA, the United Kingdom and France for giving technical aid, as well as to our colleagues in BNL, S3-Technologies, FRAMATOM, CORYS, Hunterston Nuclear Station for highly qualified and efficient support in the implementation of the projects for equipping Khmelnitsky Training Center with modern hardware.

## SUMMARY

1. Development of the up-to-date personnel training system at Khmelnitsky NPP is an important factor of enhancing plant operation safety. The importance and role of the training system increases in connection with the new requirements of the regulatory bodies for introducing personnel licensing.
2. Three-year-experience of studying and practical usage of Systematic Approach to Training at KhNPP proves that, as a whole, it meets the plant needs of developing a comprehensive personnel training system, and it has the advantages compared to the traditional training system. SAT was adopted as a basic method for developing training material, lesson performance and training quality control.
3. Effective and up-to-date methodical support in improving personnel training system at KhNPP, provided by the USA, Great Britain and France, allowed to train the instructors how to develop pilot courses using Systematic Approach to Training methodology. Currently the Training Center has sufficient number of SAT-trained instructors and it develops training courses on its own. Great assistance in experience transfer was rendered by the personnel of American companies General Physics Corporation, Path and Mazur.
4. The new Training Center facility built at KhNPP and including a simulator facility, classrooms and maintenance workshops as well as rehabilitation facilities will allow to ensure adequate training and qualification maintenance for the personnel of the operating power unit and those under construction
5. Of great help is the technical aid provided by the USA, Great Britain and France in supplying the Training Center with full scope and functional simulators, modern computers, video equipment, projectors and copiers for training material development and performance of training. Specially should be mentioned the assistance of S3T, CORYS and Hunterston personnel in the implementation of the technical aid project.
6. The use of "Klotik", the local simulator complex manufactured by Sevastopol organizations, and qualified by the OSART Mission as good practice, allows to organize simulator training not only for the Control Room staff but for all shift personnel.

### 3. Milestones of mastering & introduction of Systematic Approach to Training (SAT)

In 1993-1994 activities on analysis & mastering of SAT methodology were started. An experience of creation of similar systems in Germany (Training Center Karlstein), in France (workouts in EDF, creation of simulators in CORYS) & in USA (introduction of SAT at US NPPs) was studied. SAT methodology was chosen as a base for further development due to its comprehensiveness & good elaboration of structure & content. Now SAT is being developed & implemented at Khmelnitsky NPP with the assistance of USA under Lisbon Initiative.

Implementation of Systematic Approach to Training at KhNPP is being performed in 6 stages:

1. Needs analysis & expediency of implementation; identification of high priority areas for use in practice the principles of systematic approach. The analysis was done by Ukrainian-American Expert Working Group, GP company with plant specialists participation.
2. Plant & TC Management training on methodology of systematic approach to training (cycle of lectures by US specialists at the plant & 3 managers training in GP company (US) during 2 months).
3. Development of pilot courses for operating & maintenance personnel training made by GP with participation of plant specialists & simultaneous training of TC instructors, plant specialists.
4. Implementation of pilot courses.
5. Development of normative-methodical basis for creation & implementation of training system in accordance with systematic approach. Materials for procedures development are being prepared. Following documents have been already developed:
  - "Guidelines for training; materials development" manual for TC instructors, managers, & NPP supervisors;
  - "Regulations for Training Center";
  - Regulations for different divisions & job position descriptions of TC personnel;
  - "General regulations for personnel training system".
6. Independent development & implementation of the courses with methodical consultation from GP. Development of two training courses (CRRO, Chemistry Operator) was started.