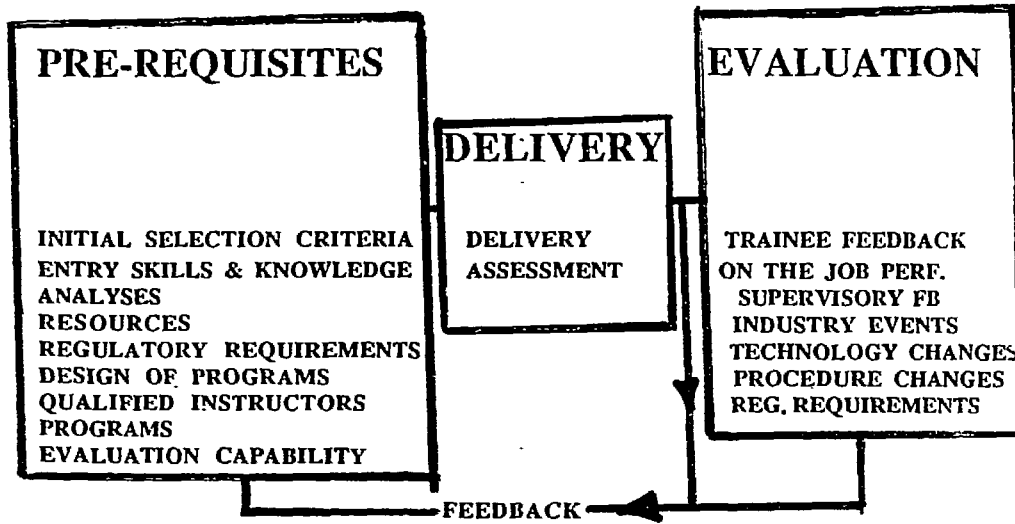


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# MODEL OF A SYSTEMATIC APPROACH TO TRAINING

AECB CANADA



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IAEA Technical Co-operation Meeting on Personnel Training  
Requirements and Programme for WWER-Type NPPs  
Vienna, October 11 - 15, 1993

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The Czech Republic Programme and Experiences on Training and  
Qualification for NPPs Personnel

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The nuclear power programme in the Czech Republic is based on commercial use of WWER - type reactors. The development of nuclear programme in our country is relatively large.

Nuclear Programme Present/Actual

Site: NPP Dukovany  
Units per site: 4  
Type of reactors: PWR, WWER 440 MWel, type V 213  
Operational status: commercial operation

Nuclear Programme Future

Site: NPP Temelin  
Units per site: 2  
Type of reactors: PWR, WWER 1000 MWel, type V 320  
Operational status: under construction, physical start-up of the 1st unit is presupposed in 1996

There are still 3 research reactors in operational status in the Czech Republic and 1 research reactor is under decommissioning.

Assurance of the nuclear safety in the Czech Republic is based on the organizational, regulatory and responsibility approach which is very similar to the world practice. Present trends in our activities are to improve the level of qualification and competence of all workers and managers in various posts in the field of nuclear power technology use by a better and more individually tailored training system.

There is a wide specialized research, construction and licensing work which have to be performed in the next short

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period of time. For example: for NPP Dukovany: replacement of the I+C system by a more advanced one to improve the nuclear safety, reliability and efficiency of this plant, development, construction and start-up of the new own full-scope simulator etc. For NPP Temelin it is the replacement of the I+C system and nuclear fuel by systems Westinghouse. These both contracts (on I+C and nuclear fuel) between Westinghouse and Czech Power Company have been signed this year during summer time in Prague.

Detailed technical and administrative instruction relative to design, construction, commissioning and operation of nuclear facilities are given in legal regulations published by the State Office for Nuclear Safety of the Czech Republic (former Czechoslovak Atomic Energy Commission). The NPP personnel training and qualification requirements are stipulated in regulations of two government and power company levels:

- Act No. 28/1984 on State Supervision over Nuclear Safety.

- Criteria of the NPP personnel training (issued in 1991) by former Federal ministry of Economy with close cooperation of former Czechoslovak Atomic Energy Commission). Last month the revision work has been started. The purpose of this State Office revision activities is to implement more detailed and larger the requirements of the systematic approach to NPP personnel training which are described in IAEA TECDOC 525. Now, the translation of TECDOC 525 (without appendices) into the Czech language is underway.

- Decree No. 191/1989 of the former Czechoslovak Atomic Energy Commission by which a way, terms and conditions for verification of special professional qualification of selected workers of nuclear facilities are determined.

- Detailed Instruction for NPP personnel training worked out in 1992 by the Czech Power Company.

- Decree No. 436/1989 on Quality Assurance of Selected Equipment with Regards of Nuclear Safety of Nuclear Facilities.

Training Programme Status and Existing Training Programmes for NPP Personnel

The NPP personnel in Czech Republic is classified/divided into the following categories:

- Category I., selected personnel, only these people are licensed personnel because they have direct impact on nuclear safety and plant operational availability. These are control room operators, it means: shift engineers, chiefs of the reactor units, operators of the primary circuit and operators of the secondary circuit. We suppose that in future will be here in this category also safety engineers, unit operators and control room supervisors. In the group of selected personnel are also inspecting physicists and shift scientific chief for reactor physical start up. All people in category I. must have university degree education. Licenses are issued on the basis of successful examination before the State Examination Commission by the State Office for Nuclear Safety in Prague.

- Category II., management personnel, technical and economical personnel. This personnel has university degree or secondary school education. Personnel in this category is not licensed.

- Category III., servicing shift and operating personnel. These are high technicians, technicians, chief masters, masters and workers working in the shifts. Personnel in this category is not licensed.

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- Category IV., maintenance personnel, these are technicians, workers, masters and chief masters. Personnel in this category is not licensed.

- Category V., other personnel.

After Decree No.436/1989 of the former Czechoslovak Atomic Energy Commission (which is still valid) the following activities are included among the safety related ones:

- operations and maintenance management,
- performing the operational tests, functional tests and in-service inspection,
- fresh and spent fuel handling,
- ra-wastes handling,
- nuclear safety,
- radiological safety and environment protection,
- personnel training,
- metrology
- external contracts and spare parts management,
- documentation work.

The NPP personnel assigned for nuclear safety related activities is trained in accordance with the programmes which are or will be given in the QA operations programme. The QA programme for NPP Dukovany operation was approved (after above mentioned Decree) by the former Czechoslovak Atomic Energy Commission in Prague. At present the new QA programmes for NPP Temelin personnel training have been approved by the State Office for Nuclear Safety.

The people of maintenance: - electrical  
- mechanical  
- I+C systems,  
and radiation protection and chemistry and reactor

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engineering/systems engineering are not licensed. All people working in the safety related posts (it is practically all working places in the NPP operations and maintenance and technical support) must have authorization for their working activities issued by the NPP top management.

There are training programmes in Czech Republic for all these groups of NPP personnel: it means for professional groups of:

- primary and secondary circuits,
- electrical and mechanical equipment,
- I + C,
- fuel management,
- chemistry,
- dosimetry,
- nuclear safety,
- QA/QC,
- in service inspections,
- waste management,
- decontamination,
- information and computers systems,
- project management,
- plant construction.

The new modular system was work out by Czech Power Company NTC at Brno in close cooperation with NPP Dukovany. The goal of this programme is to improve the training results and to increase the knowledges of trainees by changing of the theoretical and practical parts of training. The more intensive feedback from the area of NPP operation to the training programme was supposed. The training of control room personnel is divided into 10 moduls, each of them contains 3-5 weeks of theoretical training and 2-4 weeks of on-the-job training. Moduls No. 8 and 9 contain

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full-scope simulator training. Modul No. 10 is preparation on final exams. Total time schedule is about 70 weeks. After that another on-the-job training and preparation follow for examination before State examination commission.



Example of a new modular training programme for NPP Dukovany control room personnel (category I - selected personnel)

	lecture (hours)	self-study (hours)	exam (hours)
<u>Modul No. 1 (3 weeks)</u>			
NPP Dukovany outline description	6	16	1
Reactor theory and construction I	33	3	1
Safety of work I	9	1	1
Informatics I	19	2	1

Self-study 7 hours, exam in writing, evaluation and feedback discussion 5 hours

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NPP Dukovany technical visit 1 day  
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<u>Modul No. 2 (3 weeks)</u>			
Reactor theory and construction II	23	22	1
Nuclear safety	15	1	1
Safety of work II	9	1	1
Hydromechanics	19	1	1

Self-study 5 hours, exam in writing, evaluation and feedback discussion 5 hours

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NPP Temelin technical visit 1 day  
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<u>Modul No. 3 (3 weeks)</u>			
Reactor theory and construction III	30	2	1
Thermomechanics	20	2	1
Radiation protection I	18	2	1
Electrotechnics	15	2	1

Self-study 5 hours, exam in writing, evaluation and feedback  
discussion 5 hours

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4 weeks on-the-job training on NPP Dukovany outline description,  
Nuclear safety, Safety of work, Primary and Secondary circuit

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1 week preparation and passing oral exam from following subjects  
from modules 1-3: Reactor theory and construction, Hydro- and  
Thermomechanics, Nuclear safety and Safety of work

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Modul No. 4 (5 weeks)

NPP Dukovany primary circuit I	21	2	1
NPP Dukovany primary circuit II	21	2	1
NPP Dukovany primary circuit III	36	2	1
NPP Dukovany secondary circuit I	30	2	1
Chemistry I	17	2	1
Chemistry II	18	1	1

Self-study 10 hours, exam in writing, evaluation and feedback  
discussion 5 hours

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4 weeks on-the-job training on NPP Dukovany primary circuit and  
Chemistry

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Modul No. 5 (5 weeks)

NPP Dukovany secondary circuit II	30	2	1
NPP Dukovany secondary circuit III	27	2	1
Chemistry III	21	2	1
NPP Dukovany electro components I	24	2	1
NPP Dukovany electro components II	20	2	1
I+C I	21	1	1

Self-study 10 hours, exam in writing, evaluation and feedback  
discussion 5 hours

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 4 weeks on-the-job training on NPP Dukovany secondary circuit,  
 Chemistry and Electro components  
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Modul No. 6 (5 weeks)

NPP Dukovany electro components III	37	2	1
I+C II	23	3	1
I+C III	27	3	1
Radiation protection II	21	2	1
Informatics II	20	3	1

Self-study 24 hours, exam in writing, evaluation and feedback  
 discussion 5 hours  
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4 weeks on-the-job training on NPP Dukovany Electro components,  
 I+C and Radiation protection  
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2 weeks preparation and passing oral exam from following subjects  
 from modules 4-6: NPP Dukovany primary and secondary circuit,  
 Radiation protection, Electro components, I+C, Chemistry  
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Modul No. 7 (3 weeks)

NPP Dukovany operation I	31	2	1
NPP Dukovany operation II	30	2	1
NPP Dukovany maintenance I	13	2	1
QA/QC I	10	1	1

Self-study 5 hours, exam in writing, evaluation and feedback  
 discussion 5 hours  
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4 weeks on-the-job training on NPP Dukovany primary and secondary  
 circuit and in the control room  
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Modul No. 8 (3 weeks)

NPP Dukovany operation III	43	2	1
NPP Dukovany maintenance II	16	1	1
QA/QC II	9	1	1
Informatics III	18	1	1

Self-study 5 hours, exam in writing, evaluation and feedback  
discussion 5 hours

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2 weeks on-the-job training on NPP Dukovany maintenance and  
QA/QC, 3 weeks simulator training on basic operational situations  
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Modul No. 9 (3 weeks)

NPP Dukovany accidents and emergencies I	22	2	1
NPP Dukovany accidents and emergencies II	16	2	1
Organization and management in power industry	19	2	1
Sociology and psychology	16	2	1
PSA	8	1	1

Self-study 5 hours, exam in writing, evaluation and feedback  
discussion 5 hours

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2 weeks on-the-job training on NPP Dukovany accidents and  
emergencies, Organization and management, 2 weeks simulator  
training on accidents and emergencies situations  
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1 weeks preparation and passing oral exam from following subjects  
from modules 7-9: NPP Dukovany operation, NPP Dukovany  
maintenance, NPP Dukovany accidents and emergencies  
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4 weeks preparation and passing the NTC final exam, applicants  
are awarded the NTC Certificate about final exam  
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For turbine operators:		For reactor operators:
10 weeks on-the-job training		6 weeks on-the-job training
for working post of engineer		for working post of engineer
(foreman) of turbogenerator		(foreman) of primary circuit
and engineer of feedwater pumps		

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4 - 8 weeks on-the-job training in the control room, preparation for the State examination  
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In writing, oral and practical State examination before State Examination Commission, applicants are issued the State Office for Nuclear Safety Certificates authorizing them to perform the functions independently  
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The NPP Dukovany operational exam, applicants are awarded authorization by NPP management. This arrangement implies that the NPP management takes over the responsibility for personnel training and its independent working activity.  
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The position of the nuclear training centre and other training facilities within the organizational set up of the Czech Power Company

At present situation the Czech Power Company is transferred into the private organization of shares. The NPP Dukovany mechanical and I+C maintenance department is also transferred into the private organization. We will have to work out new training programmes or transferred existing ones to these new private (outside) organizations. It means that up to now no additional (no special) nuclear training programmes exist for outside personnel supporting the NPP.

There is a centralized training system for NPP personnel in

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the Czech Republic. We have one NTC at Brno near the NPP Dukovany mainly for theoretical training (lessons) for personnel of both NPP Dukovany (in operation) and also for NPP Temelin (under construction). Practical training, mainly on-the-job and shadow training and special theoretical training connected with simulator training is/will be provided by NPPs own special training departments. It means, that the responsibility for job analyses, workout of training programmes, practical and shadow training and evaluation of training system is on the NPP. Responsibility for theoretical training process is on our NTC at Brno.

Up to now the NTC at Brno is in organizational and financial structure of NPP Dukovany. But it is also the special nuclear training centre for all Czech Power Company it means for both NPPs Dukovany and Temelin.

There are no other organizations (up to now) supporting the special nuclear training for NPP personnel in Czech Republic. It is true that the special branches of studies exist in our Technical Universities: for example: nuclear power technology, nuclear electro-power technology, nuclear reactor technology etc.

#### Nuclear training centre at Brno

The nuclear educational and training centre has been established in 1978. At present, 42 persons are affiliated to the centre. Our training specialists (lecturers) can train control room operators, technical staff, operating and shift staff and also maintenance staff (all categories of NPP personnel). The NTC is divided into three departments:

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Head of NTC department

Tasks: taking care of property, supplies, financial planning and contract routines, accommodation and boarding services, maintenance, construction and operation of a representative teaching room of the centre, commercial training activities.

Department of the theoretical training

Tasks: carrying out research and development projects and their implementation, preparation of conception and supervising or methodic guidance of a group of training specialists, training activities, information science, administration NOVELL NETWARE 3.11., network, technical supervision over construction and operation of the representative teaching room.

Psychological laboratory (for all Czech Power Company)

Tasks: solving problems in the field of psychology and sociology based on modern and scientific methods, experimental examination, verification, search, analyses and evaluation, determination of human factor in operation of nuclear and also of conventional power stations or heating plants, particularly considering the performance reliability and safety of work for professions with a heavy neuropsychic loading and considering requirements for improvement of management in the interpersonal relations.

The key requirement for our NTC organization is the ability to provide a precise and fast reaction of the centre on needs of participants, NPPs and power engineering in general. There is so called cluster organization in our NTC which reflects best steadily increased needs of employees to become involved in

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success of their companies by their independent and professional activity.

In 1993, will be trained 787 participants in various types of courses. 1993. The department of psychology and sociology examined 2500 workers (for all Czech Power Company) in the entry check-ups and 285 workers in the periodic check-ups in 1993.

Training tools: Current tools are used in our nuclear training centre: for example: Video/slides projector, transparencs projector, overhead projectors, VVER PWR 440 MW model, NPP equipments models, pictures, films, videotapes.

Simulator:

After dividing of Czechoslovakia the Czech Republic has no NPP full scope simulator. For practical training of our control room operators we use the full scope simulator VVER 440/type 213 which is now located in Slovakia in the Research Institute of NPP at Trnava. We have no basic principals simulators or mock-ups or special extra laboratories (I+C, rad. protection or chemical) for practical training. For practical or on-the-job training (for example chemical), we use the laboratories which is directly in operation in NPP Dukovany.

Training Personnel (Instructors) in the NTC Brno

- Organization: "cluster organization" in special professional groups for example for NPP mechanical, electro or I+C equipment, or for special categories of trainees (category I.- V).

- Management: Head of the NTC, heads of NTC individual departments. They all have the University education and a long term skills in nuclear power field.



- Instructors for each discipline: NTC own staff, or lecturers directly from NPP Dukovany operations.
- Development and maintenance of training tools: NTC own staff in the Head of NTC department, a special cooperation with some Czech company exists in this area.
- Administrative support (clerk, receptionist): NTC own staff in the NTC head department.

After change of the I+C system (1997 or later) in NPP Dukovany we will want to start-up our own full scope simulator directly in the site of this plant.

#### Information about the Temelin NPP Project

The NPP Temelin site is located in the southern part of the Czech Republic. There are two WWER 1000 PWR units under construction. The first one's civil works are almost completed and the technology installed to very advanced grade. The second unit is under construction with almost no technology in place. The technology equipment is manufactured almost in the Czech Republic under the former Soviet license in SKODA Works in Plzen. The other parts are designed and manufactured by SKODA and its Czech subcontractors. The plant is owned by the main electric power producer within the Czech Republic - the Czech Power Company utility

Due to the changed situation induced by the political changes an enhancement programme has been started at Temelin. Several audits and reviews have been made by the IAEA and other foreign companies at Temelin and brought additional items to this programme: replacement of the I+C system and the replacement of the nuclear fuel. Contracts for this replacement with WESTINGHOUSE EC was signed in May 1993.

The NPP Temelin personnel, operators as well as other personnel (technical support and maintenance), is trained in accordance with basic rules and standards. The basic problem is that the NPP Temelin is the first of the WWER 1000 type reactors within the former Czechoslovakia and the training in the past was concentrated on the WWER 440. All the personnel has been trained and qualified in the WWER 440 manner and then requalified for the NPP Temelin. At present the new decisions and the new organizational structure have been made in the Czech Power Company: the NTC at Brno has to start the theoretical parts of NPPs Dukovany resp. Temelin personnel training which will be directly focused to the WEER 440 resp. WWER 1000. Special training departments located on the NPPs Dukovany and Temelin will provide practical parts of training: on-the-job training and training on the full scope simulators in future.

It has been decided that full scope simulator WWER 1000 will be build and located directly on the Temelin site. The simulation itself is carried out and the simulation hardware is provided by a Czech company ORGREZ in a joint venture with General Physics International. The control room replica will be, in accordance with I+C contract, delivered by Westinghouse, including the information system of the real unit, including the post accident monitoring system and an interface to the simulation system. No auxiliary emergency control room has been contracted so far, but a space is provided for its accommodation. The NPP Temelin training centre, its building including a hall for full scope simulator, four well equipped classrooms and rooms for the instructors, lecturers and supporting personnel is under construction.

The goals to be achieved by the NPP Temelin training department:  
- build the full scope simulator, provide it with trained

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personnel, deliver a suitable training programme for it and put it into operation,

- established the so-called "training plant" which means besides the on-the-job training all parts of the retraining programme to be carried out in the classroom for all the plant personnel,
- carry out higher modules of the basic training of the personnel, starting with the control rooms operators.

As to the "training plant", it has been recently launched a first programme for continuing training of the operation personnel, so called "training days". It means that in a two year cycle the personnel should be given:

- repetition of what they learned in the basic training,
- information about changes, replacements and modifications in the relevant technology,
- overall information about company and other relevant legal regulations etc.

All shifts currently subdivided into 11 professional groups are involved. A "training day" per month is organized per shifts and included into the shift rotation.

In order to achieve the systematic approach to training, a list (of about 20) QA procedures has been developed for personnel training on NPP Temelin. QA procedures themselves are written step by step in cooperation with the plant QA department. The complete set of the procedures will be submitted with the accreditation application to the State Office for Nuclear Safety. Temelin.

Other aspects:

Capabilities: Czech Republic has some capabilities for NPP personnel training which can be used as a support for other east European Countries, mainly for theoretical lessons, courses etc. We have no possibility to provide training on the simulator. The same situation is for training of maintenance personnel because we have no models of NPP equipment which could be used for training.

Needs: To upgrade the NTC at Brno by more advanced technical equipment to achieve that the training activities would be more comprehensive and more effective. We need:

- 1 piece of no-break power supply for computer network
- 2 pieces of hard disc, capacity 1 GB for server
- 1 piece of streamer for server
- 3 pieces of hard disc, capacity 170 MB
- 11 pieces of computers 386 DX, 4MB RAM, SVGA color, 170 MB, mouse, monitor SVGA color
- 3 pieces of computers 486 DX, 16 MB RAM, SVGA color, 250 MB, mouse, monitor SVGA color
- 1 piece CD-ROM + SCSI Interface + software for NatWork, Windows, DOS
- 1 piece of working station with RISC processor (Sun, Silicon Graphics)
- 1 piece of monitor VGA color 20" (21")

Needs: To upgrade and build up the NTC at Brno the printer and acquisition centre for nuclear programme in the Czech Republic:

- 1 piece of scanner color A4
- 1 piece of sound card
- 1 piece of video card

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- 1 piece of notebook 486 SX, 8MB RAM, WGA color
  - 1 piece of notebook 386 SX, 4 MB RAM WGA mono monitor
  - 6 pieces of point printer Star LC-20
  - 1 ks color jet printer
  - 1 piece of HP Lasser jet 4L
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- upgrade of training programmes for operation and maintenance personnel
  - upgrade of instructors training programmes
  - equipment for maintenance training on sites
  - build up and upgrade the NPP Dukovany training centre with full-scope simulator WWER 440 type 213
  - build up and upgrade the NPP Temelin training centre with full-scope simulator WWER 1000 type 320
- 

- improving the level of classroom training and practical on-the-job training,
- specializing the training with regards to individual professional groups,
- making the training more comprehensive with regard to meeting its scope,
- performing the training in accordance with requirements of QA programmes

Information about the full-scope simulator VVER 440 MWel/type 213 in Slovakia has the following characteristic conceptual design features:

- type: VVER 440 MWel/type V 213,
- scope: Full scope, replica of NPP Dukovany and NPP V-2 Bohunice (Slovakia) control rooms
- date of service: 1983
- seller: ORGREZ Czechoslovakia

The simulator is designed and implemented in such a way that it corresponds to the class of the so called full-scale simulators with the preferential use as the technical means for plant personnel training.

It is a full-scale simulator simulating the behaviour of all systems of reference unit important for operation and training monitored and controlled from main control room. Besides technological systems the basic functions of the instrumentation and control system are simulated as well including selected monitoring and diagnostic functions.

The simulator simulates the functions of reference unit in its full working range with regard to the extent of operating modes and relations i.e.:

- Start-up from cold conditions and other intermediate conditions,
- Heat-up to operational values of parameters of working fluid,
- Power increase through individual power levels up to rated parameters,
- Operation at rated parameters,
- Planned and emergency shutdown of unit including cooldown,
- Preparatory manipulations and tests of functional availability of individual components and systems, performed and controlled

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from the control room,

- Management of transients and accident situations.

The simulation in the simulator comes from the solution of mathematical models describing the behaviour of individual parts of technological or instrumentation components and subsystems, including their interrelations. The models given are set on the basis of the description of physical laws of individual technological processes and have modular character.

The simulation in the simulator runs in real time with the possibility to accelerate slow technological processes and to slow down rapid technological ones.

The simulator includes the mock-up of the main control room that consists of counters and panels of operative part.

It is possible to simulate the other control centres (non-operative part of the control room, control room of dosimetry) by means of the functions of the working place of instructors, at least in the most needed relations and functional ranges.

The accuracy of the simulation of technological processes in the simulator is in line with the requirements and standards for this type of simulator at the time of its commissioning as recognized generally, i.e., peak deviations against reference values for steady conditions are in the range:

- $\pm 5\%$  of the rated value for main unit parameters,
- $\pm 20\%$  of the rated value for other unit parameters.

The working place of the trained personnel in the simulator represents highly authentic mock-up of the operative part of the main control room of reference reactor unit, from the point of

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view of both the disposal design of control and information elements for unit individual systems and the instrumentation including designation and colored design.

The communication of instructor with the simulator system goes in the dialogue mode of operation with the automatic options of relevant functions and the check of formal correctness of communication.

Maintenance of the simulator: by the personnel of NTC at Trnava or Research Institute for NPP at Trnava in Slovakia. Upgrading the simulator with plant modifications is provided permanently with cooperation of NPPs Dukovany and NPP Bohunice.

Simulator support:

- Organization: Research Institute for NPPs at Trnava, Slovakia,
- Number of persons: about 3,
- Both corrective and preventive hardware and software maintenance. All people for modelling, systems software and instructor's support are from Research Institute for NPPs at Trnava in Slovakia.

Occupation: The simulator in NTC at Trnava in Slovakia use the Czech NPP Dukovany (4 units) and Slovak NPP V-2 Bohunice (2 units/type V 213). It is also possibility (after some modifications) to train here the control room operators from Slovak NPP Bohunice V-1 (2 units/type V 230). It means that 8 NPP units use this simulator. Simulator session duration is usually 2 hours of theoretical preparation and after it follow 4 - 6 hours practical training on the simulator.

- Licensed personal per shift: 4: 1 shift engineer (for all NPP)  
1 unit supervisor  
1+1 operators of the primary



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and secondary circuits

- Number of simulator hours: in initial training: 5 weeks
- in requalification : 2 weeks
- in retraining: 2 weeks per each year  
(10 shifts/year)