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FOREWORD

The safe and reliable operation of nuclear power plants requires a strong commitment to excellence. This commitment is especially necessary for maintaining and enhancing the competence of nuclear power plant personnel. Training is widely acknowledged to be essential for attaining personnel qualifications and competence.

The preparation and publication of this publication was recommended by the IAEA International Working Group on Nuclear Power Plant Personnel Training and Qualification. This TECDOC represents a unique compilation of important information on all aspects of NPP personnel training from 23 Member States and 129 training organizations — training departments and nuclear training centres.

The main aims of this survey are: to provide a worldwide overview of all aspects of NPP personnel training; to foster both international and regional co-operation between organizations involved in nuclear training; to provide a mechanism for exchange of experiences and practices, in particular the systematic approach to training (SAT).

The survey provides information for each responding country on the: national system and organization of training; job positions for which SAT is used; training programmes for key operations, maintenance, instructor and other jobs; role of management and the regulatory body; training facilities; recommended training practices; availability of training to personnel from organizations outside of the country; and contact points. The main parts of the survey are the summary, the analysis of training programmes for each job position and analysis of training resources, and the country reports.

The survey was developed through a series of consultants meetings and a meeting of an Advisory Group which provided review, comments and input for the final version of the report. Appreciation is expressed to all those who participated in the preparation of the World Survey and to Member States for their support in providing experts from nuclear power plants, nuclear training centres, operating organizations and regulatory bodies to assist the IAEA in this work. Particular thanks are expressed to J. Gasper for his extensive contribution to the preparation of this publication. The IAEA officer responsible for the World Survey was F. Mautner Markhof.

CONTENTS

PART III. COUNTRY REPORTS

PART I. SUMMARY

1. PURPOSE

This Survey represents a single, authoritative source of information on the main aspects and current global status of nuclear power plant (NPP) personnel training. The Survey is intended to:

- Foster co-operation between and among Member States by providing a listing of training services and equipment of NPP training organizations in various countries which are available to Member States.
- Identify and encourage the adoption of effective training practices
- Provide a means for exchange of experience related to NPP personnel training.

This technical publication presents the results of a survey of NPP personnel training in IAEA Member States. The survey covered the status of training programs, the resources allocated to training and the availability of training to NPP personnel from other countries.

Responses were received from 102 NPP training departments and 29 training centres. Training organizations in 24 of the 30 Member States which have operating NPPs provided information for this Survey. The number of NPP training organizations represented in the Survey are shown in Table 1.1, which also identifies the countries where training is available to personnel from other organizations and countries.

2. USERS AND USES OF THIS SURVEY

The intended users of the survey are all those with responsibilities for the training and competence of NPP personnel, including: training managers, training instructors, NPP plant management, regulatory body staff, as well as IAEA staff whose duties are related to the training of NPP personnel.

The Survey provides information on the following: national NPP training systems and organizations; nature and extent of NPP personnel training programs and aids in Member States; role of management; examples of specialized training programs and aids; training which could be available to NPP personnel and organizations of other Member States; responsible contact persons in Member States.

3. BACKGROUND ON THE PREPARATION OF THE SURVEY

The technical publication provides the results of a survey, conducted and analyzed by the IAEA, of NPP personnel training. The survey instrument, a questionnaire, was developed at an IAEA consultants meeting in December 1995. The survey was designed to identify in various Member States: the use of the SAT (systematic approach to training) methodology; the settings and duration of training programs for 12 positions; recommended training practices; management's roles and responsibilities for training; training budget; and the salaries of training personnel compared to other station personnel. This Consultants Meeting also developed the list of country contacts to which the survey was sent.

The survey was sent to country contacts, who were responsible for collecting the data for each country. A second consultants meeting assembled the country data into the country reports, which are summaries of the data for each country. Each country report was reviewed by the respective country contact to revise as necessary and to provide additional data where needed. The data from the Country Reports were loaded into a database and analyzed for this survey. An Advisory Group meeting in November 1996 revised where needed and approved the completed publication.

TABLE 1.1. MEMBER STATES RESPONDING TO THE SURVEY

Country	Number of NPPs with training facilities providing information	Number of Training Centres providing information	Availability of Training to External Personnel
Brazil	1		Yes
Bulgaria	1		Yes
Canada	1	2	Yes
China		2	Yes
Czech Republic	2	1	Yes
Finland	2		Yes
France		4	Yes
Germany	12	4	Yes
Hungary	1		Yes
Japan	10	2	
Kazakhstan	1		No
Korea, Republic of		3	Yes
Lithuania	1		Yes
Mexico	1		
Romania	1		Yes
Russia	8	2	Yes
Slovakia	2	1	No
Slovenia	1	1	
Spain	4	1	Yes
Sweden	6	1	Yes
Switzerland	4		No
Ukraine	5		Yes
United Kingdom	14	5	Yes
United States of America	24		Yes

4. SURVEY CONTENTS

The main parts of the survey cover the following: a summary; an analysis of initial and continuing training programs for each job position and analyses of training resources; and the country reports.

4.1. ANALYSIS OF INITIAL AND CONTINUING TRAINING PROGRAMS FOR EACH JOB POSITION AND ANALYSIS OF TRAINING RESOURCES

- Twelve types of training program were surveyed. These were for the following positions:
    - plant or station shift supervisor
    - unit or control room supervisor
    - control room operator
    - field operator
    - electrical maintainer
    - mechanical maintainer
    - instrumentation and control technician

- QA/QC inspector
- radiation protection technician
- chemistry technician
- instructor
- simulator instructor

Part II provides an analysis of the training programs for each of these job positions. The analysis summarizes the data from all responding countries for each job position. Three tables are presented for each job position:

- Entry level requirements for the job
- Initial training program results
- Continuing training program results.

The latter two tables are presented as percent of total time in the training program in each of the different training settings used for that job position.

4.2. COUNTRY REPORTS

Each country report in Part III of the survey summarizes the survey responses from all organizations in that country which completed the questionnaire. The country reports cover the training system, training organizations, training programs, training aids and management role in training. Each report contains the following:

(1) Summary and conclusion based on the information provided by the training organizations in that country.

(2) Description of the training system for that country.

(3) Description of the role of the regulatory body with respect to training.

(4) List of the positions for which training is available.

(5) Discussion of the co-operation among training organizations within the country.

(6) List of training organizations including contact points, recommended practices and availability of training to personnel from outside organizations and from other countries.

(7) Results on management's role and responsibilities, including training budgets and salaries.

(8) Results on the training programs for the 12 job positions including settings and duration and the number of personnel participating in the training programs.

(9) Results on training organizations including training aids, training department and training centres staffing.

(10) Number and types of control room simulators.

(11) Mechanical and electrical maintenance training equipment available at the training organizations.

(12) Summary of computer and audio visual aids used for training.

A list of all responding organizations, the appropriate contact points and information regarding the availability of training to personnel from other organizations and other countries is included in Section 2 of the country reports part of the survey.

5. MANAGEMENT ROLE AND RESPONSIBILITIES

Definition:

Management - The functional levels in the operating organization comprising those individuals assigned overall responsibility for safe and reliable operations of the plant(s) including their administrative aspects.

To assess management roles and responsibilities in the training process the survey posed the following questions:

- Is there a plant or operating organization training policy?
- Does plant management routinely monitor training?
- Is training audited by a non-regulatory organization external to training department?
- Is plant management directly involved in establishing training needs?
- Is management and supervisory skills training provided?

A summary of the responses is provided in the Table 1.2.

TABLE 1.2. MANAGEMENT ROLES AND RESPONSIBILITIES

	Policy	Monitor	Audit	Involvement	Management Skills	General Safety Training	Emergency Preparedness Training
Brazil	Y	Y	Y	Y	Y	Y	Y
Bulgaria	Y	Y	Y	Y	Y	Y	Y
Canada	Y	Y	Y	Y	Y	Y	Y
China	Y	Y	Y	Y	Y	Y	Y
Czech Rep.	Y	Y	N	Y	Y	Y	Y
Finland	Y	Y	Y	Y	Y	Y	Y
France	Y	Y	Y	Y	Y	Y	Y
Germany	Y	Y	Y	Y	Y	Y	Y
Hungary	Y	Y	Y	Y	Y	Y	Y
Japan	Y	Y	Y	Y	Y	Y	Y
Kazakhstan Republic	Y	Y	Y	Y	Y	Y	Y
Korea, Rep. of	Y	N	N	N	Y	Y	Y
Lithuania	Y	Y	N	Y	Y	Y	Y
Romania	Y	Y	Y	Y	Y	Y	Y
Russia	Y	Y	Y	Y	Y	Y	Y
Slovakia	Y	Y	Y	Y	Y	Y	Y
Slovenia	Y	Y	N	Y	Y	Y	Y
Spain	Y	Y	Y	Y	N	Y	Y
Sweden	Y	Y	Y	N	Y	Y	Y
Switzerland	Y	Y	N	Y	Y	Y	Y
Ukraine	Y	Y	Y	Y	Y	Y	Y
UK	Y	Y	Y	Y	Y	Y	Y
USA	Y	Y	Y	Y	Y	Y	Y

Y = More than half of the reporting organizations answered "Yes" for most of the programs. The individual country reports should be consulted for more information.

N = More than half of the reporting organizations answered "No" for most of the programs. The individual country reports should be consulted for more information.

Assuming that management consists of the plant manager and plant department managers including training department managers, based on the data provided in the country reports the following conclusions can be drawn:

- All countries have an overall training policy which deals with training, qualification and performance of NPP personnel.
- Nearly all countries reported that management regularly monitors the conduct of training.
- Most countries reported that they use non-regulatory organizations external to training departments for audits. Countries using external audits found it very useful and countries which do not presently use external audits may wish to consider doing so in the future.
- Most countries reported direct management involvement in establishing the training needs,
- Most countries reported that the management and supervisory skills training is provided,
- All reporting countries provide general safety and emergency preparedness training.

6. ORGANIZATION OF TRAINING AND TRAINING ORGANIZATIONS

Definitions:

Organization of Training - the way the operating organization and/or NPP has established the structure, responsibilities, and accountability for training of NPP personnel

Training Organizations - internal organizations (e.g. NPP training departments) or external organizations (e.g., training centres) that are responsible for providing training products and services for NPP personnel training and which are accountable to the operating organization and/or NPP.

The organization of resources to provide training for NPP personnel depends on the specific requirements of each country, operating organization and NPP. The organization of training for the countries surveyed ranges from centralized to decentralized systems. Training for personnel from several NPPs is provided at one or more dedicated training organizations in the centralized model. Training for personnel from one NPP is provided at the NPP site in the decentralized model. Variations on these models are found in several countries, where some training is provided at a central training facility while other training is provided at the NPP. The country reports provide a description of the organization of training in each country. Figure 1.1 is representative for the organization of training in most countries.

For most NPPs the training organizations report directly to the plant managers, and other plant department managers are peers. In other organizational structures the training organization is a part of the operating organization separate from the NPP. In such cases, the plant organization and training organization come together only at the highest levels of the operating organization.

7. APPLICATION OF SAT METHODOLOGY

Definition:

SAT - The systematic approach to training is an approach to training that provides a logical progression from the identification of the competencies required to perform a job to the development and implementation of training to achieve these competencies, and subsequent evaluation of this training. (IAEA Technical Reports Series No. 380)

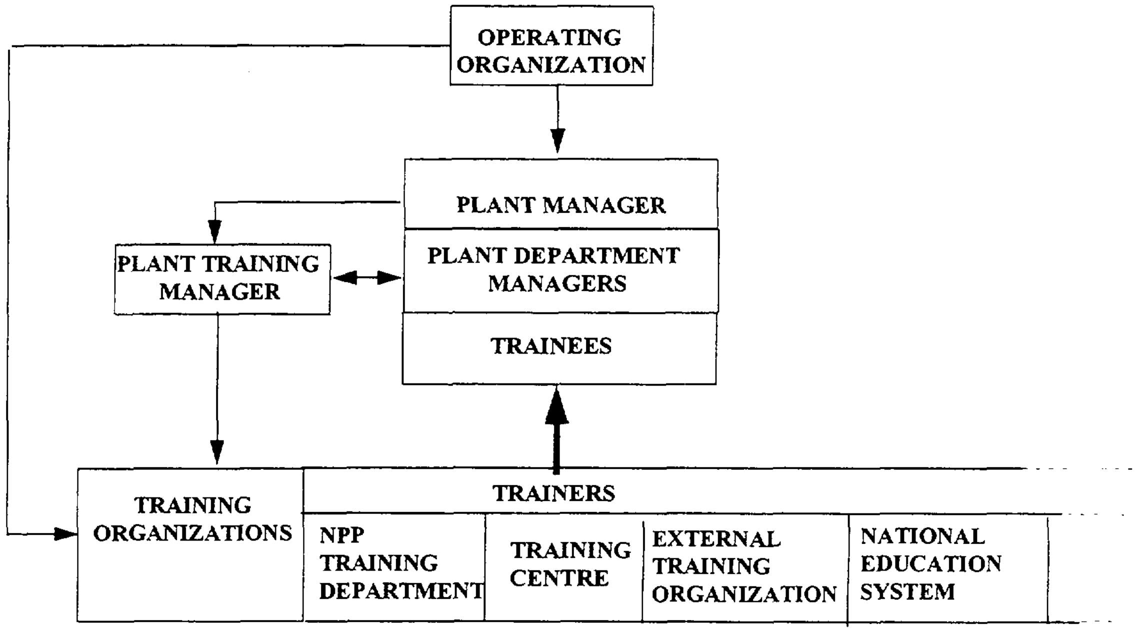

FIG. 1.1. Typical organizational arrangements for the training of NPP personnel.

SAT is the international best practice for training and qualification to ensure the competence of NPP personnel. The IAEA recommends that SAT be used in the training of all NPP personnel. This guidance is contained in the IAEA Guidebook on Nuclear Power Plant Personnel Training and Its Evaluation, Technical Reports Series No. 380, IAEA Vienna, 1996. The Executive Summary of the Guidebook is available in English, French, Russian and Spanish.

The SAT approach to training provides a comprehensive method to ensure the completeness and effectiveness of training. The five phases of SAT — analysis, design, development, implementation and evaluation - are linked to ensure personnel receive the training and competence necessary to perform their job functions. To assess the degree to which SAT methodology has been implemented, the following questions were asked in survey:

- Is the systematic approach to training used?
- Is job analysis used to determine training needs?
- Are training needs used to design measurable training/learning objectives?
- Are training materials based on training/learning objectives?
- Does training implementation involve assessment and evaluation of whether training/learning objectives are achieved?

Table 1.3. summarizes the country responses to these questions for the various job positions.

On the basis of the data collected from the country reports, the following conclusions can be drawn:

- SAT methodology is most frequently applied in training of operations personnel.
- SAT methodology is less frequently applied in the training of maintenance, chemistry and radiation protection personnel.

TAB LE 1.3. SUMMARY OF RESPONSES ON THE USE OF SAT

	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Opertor	Field Operator	Mechanical Maintenance	Electrical Maintenance	I & C	QA/QC	Radiation Protection	Chemistry	Instructor Teaching Skills	Simulator Instructor Teaching Skills
Brazil	N	N	N	Y	N	N	N	N	N	N	N	N
Bulgaria	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Canada	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y
China	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Czech Republic	Y	Y	Y	N	N	N	N	N	N	N	-	Y
Finland	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
France	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y
Germany	-	Y	Y	Y	-		-	-	-	-	-	Y
Hungary	Y	Y	Y	Y	Y	N	Y	Y	N	N	-	-
Japan	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Kazakhstan	N	N	N	Y	N	N	N	N	Y	Y	-	-
Korea, Republic of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lithuania	N	N	N	N	N	N	N	N	N	N	N	-
Romania	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Russian Federation	Y	Y	Y	N	N	N	N	N	N	N	Y	Y
Slovakia	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y
Slovenia	N	N	N	N	N	N	N	N	N	N	N	N
Spain	N	N	N	N	N	N	N	N	N	N	N	N
Sweden	-	Y	Y	Y	N	N	N	N	Y	N	N	Y
Switzerland	N	N	N	N	N	-	Y	Y	N	N	N	N
Ukraine	N	Y	Y	Y	Y	N	N	N	N	N	Y	N
UK	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
USA	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y

Y = More than half of the reporting organizations answered "Yes" for most of the programs. The individual country reports should be consulted for more information.

N = More than half of the reporting organizations answered "No" for most of the programs. The individual country reports should be consulted for more information.

The full SAT process, all five phases, is applied in the training programs of only a few countries. The most commonly omitted phase is the analysis phase. In some countries SAT is not utilized for any training programs. There are some cases where SAT has not been applied to all job positions in a given category, e.g. operations, maintenance, etc. Continued efforts are necessary to improve the extent of application of the SAT process.

8. RECOMMENDED PRACTICES AND EXAMPLES OF SPECIALIZED TRAINING AIDS FOR THE TRAINING OF NPP PERSONNEL

The list presented below represents the recommended practices and examples of specialized facilities which have been specified by at least one of the countries replying to the survey as being significantly valuable for the effectiveness of their training programs.

Information on these practices and aids are provided in each country's report. However, because of the manner in which the Survey was conducted and analyzed, the fact that one country's overview does not specify one of the recommended practices or specialized training aids on the lists does not mean that the country does not make use of or endorse such a practice or aid.

8.1. LIST OF RECOMMENDED PRACTICES

all these practices have been classified into three categories: training programs, training aids, and management and organization. Simulator training was recommended by nearly all countries.

8.1.1. Training Programs

NPP managers regularly provide lectures as part of the overall training programs for the NPP personnel.

CBT for maintenance personnel

Requalification testing of authorized station control room staff

Safety culture training

Fire fighting training

Module training scheme

Multifunctional simulator training

Use, during simulator sessions, of the entire operation team to improve communications and relations between members of the team

Radiation protection group prepares own employees and personnel of other NPPs for examinations

Stress seminar for reactor operators and shift supervisor

Training on "Rules of communications for plant operation"

Self-study training

Trainee assessment

Full-scope simulator training

Providing radiation protection training to all NPP personnel

Switchgear maintenance course

Team training conducted by shift supervisor

Training for contractors personnel

Regional courses on nuclear power and safety in co-operation with IAEA

Simulator training for I & C personnel

On-the-job training

Periodic retraining of operators and after refueling

Maintenance training

Nuclear technology course for engineers

Training in material and corrosion for technical staff

Off-site monitoring training

Coaching for performance

Use of simulator training for non-operations personnel

Use of full-scope simulator for emergency exercises

Health physics competence-based training scheme

Engineering and operational skills training

Manager training

Use of basic principles simulators

Involvement of shift engineers in operator training and assessment

Use of accelerated learning techniques

Use of remedial training and re-examination policy

8.1.2. Training Aids

Fire-fighting training

Multifunctional simulator

Full-scope simulator training

Training using video aids

Use of interactive graphic simulator for training non-licensed personnel

Use of cut-away training aids

Use of video to track the instructor during continuing training presentation

Use of fluorescent dye to simulate contamination for Radiation Protection and Chemistry technicians training

8.1.3. Management and Organization

Training improvement proposal: a process whereby an individual can recommend or suggest a change which they believe will improve a training program

Computerized training records, qualifications, scheduling and billing

Training management control of overheads and maintaining courses

Periodic meetings of instructors about training practices

Instructors for operations personnel all hold a current shift supervisor license

Information exchanges between personnel of different departments of NPP

Computer-based training

Instructor training and retraining

SAT application

Performance discrepancy analysis: a process which analyses performance deficiencies and generates recommendations either for training or for working environment

A policy through which training organization broaden the services by providing performance improvement services

Production of norms and standards for NPP personnel training

Preparation of requirements for annual programs of continuing training for NPP personnel

Special instructor and training organization licenses

Training system upgrade conceptual document, approved by the plant

Training specifications

Use of industry peers as part of internal self assessment process

Periodic meetings between trainers, plant manager and workers to identify training needs

User of an SRO licensed instructor to define specific training needs of each crew

Interdepartmental integrated training

Job rotations between trainers and first line supervisors

Instructors are assigned as crew mentors for each crew

Use of maintenance personnel as part time instructor

Training management action request system allows all site personnel to request training department action.

8.2. EXAMPLES OF SPECIALIZED TRAINING AIDS

The examples of specialized training aids have been classified into three categories: equipment, simulators, mock-ups.

8.2.1. Equipment

Mechanical seals lapping training facility (Canada)

Transparent power plant model (China)

Well-equipped maintenance training centres (Hungary, Japan, Republic of Korea, Canada)

Video studio (Hungary)

Control boards (UK)

Self-checking trainer (USA)

Operation piping skid (USA, Canada)

8.2.2. Simulators

Compact simulator (Japan, Republic of Korea, Germany, Ukraine)

I & C simulator (Republic of Korea)

Interactive graphic simulator (Spain)

Multifunctional simulator (Russia, Czech Republic, Ukraine)

Basic principle simulator (Ukraine)

Part-task simulator (France, UK)

Mobile switching simulator (UK)

ALARA work area radiation simulator (USA)

8.2.3. Mock-ups

Real RPV, SG for maintenance training (Hungary)

Rigging practice facility (Canada)

Real equipment for fuel handling (dummy fuel...) (France, Spain, Japan)

Steam generator for inspection and manipulation (France, Spain, Japan)

RCP for study and maintenance training (France, Spain, Japan)

Functional power plant mock-ups (France, USA)

PWR glass model (Biblis, Germany)

Mock-ups for plant components (France, Republic of Korea, UK)

Steam generator pilot-operated relief valve actuation circuitry (USA)

9. CONCLUSIONS

The large interest in and importance attached to the survey is reflected by the many countries and organizations which responded to the Survey questionnaire. This is a positive indication of the need and wish to have information on a world-wide basis on NAP personnel training. The survey is a summary of a wide range of data on NAP personnel training and is a good starting point and resource for future work on NAP personnel training.

All countries have an overall policy on the training and qualification of NPP personnel.

The systematic approach to training (SAT) is widely applied to the training of control room personnel, but not widely to other key groups, especially maintenance personnel.

All countries have training programs for control room personnel and all use simulators for training these personnel.

Most countries have training programs for personnel in the other job positions surveyed or they report that such training programs are under development.

There is wide variation in the duration of the initial training programs. There is little correlation between the duration of initial training programs and the prerequisite educational requirements for these programs. Figure 1.2 shows the duration of the plant or station shift supervisor initial training programs in selected countries and the corresponding educational prerequisites. The reason for these variations is not known.

There is less variation in the duration of the continuing training programs.

The following abbreviations are used in Fig. 1.2 and throughout the Survey:

- GE = graduate engineer or diploma engineer degree (4-6 years university study)
- E = engineering degree (2-3 years university study)
- TS = technical school diploma
- SS = secondary school diploma

Almost half of the organizations indicated that they would be able to provide technical assistance, including loaning personnel, for the training of other NAP's personnel or instructor staff. Most of these organizations indicated that fees for such assistance would be applied. The IAEA encourages the organizations involved to establish, whenever applicable, co-operations programs such as exchanges of experience and regional courses with other organizations within the same regional

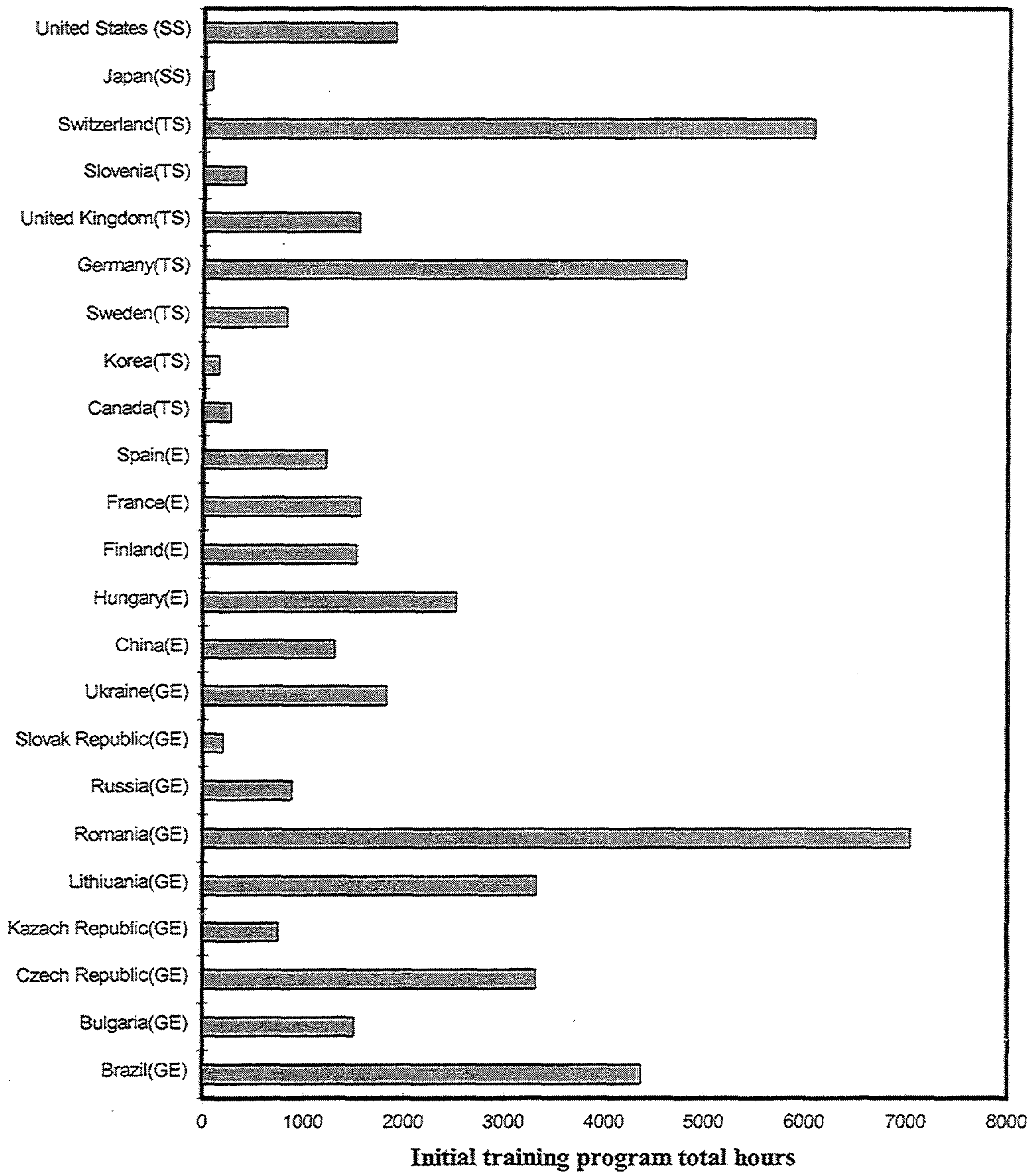

FIG.9.1. Plant or station shift supervisor initial training program educational prerequisite and corresponding program duration

area. The table included at the front of the country reports section lists each training organization, the contact person, the contact person's telephone and fax numbers and the availability of training services and resources to outside organizations for all those training organizations which responded to the questionnaire.

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PART II. ANALYSIS OF INITIAL AND CONTINUING TRAINING PROGRAMS FOR EACH JOB POSITION AND ANALYSIS OF TRAINING RESOURCES

1. DATA FOR THE TRAINING PROGRAMS FOR EACH JOB POSITION

This section of the Survey provides the data for the training programs for each job position surveyed. Three tables are presented for each position:

- Entry level requirements for that position
- Initial training program results
- Continuing training program results.

The latter two tables are presented as percent of the total time in the training program in each of the different settings used for training in that position.

Where possible, general statements are made concerning the data presented. However, the contents of the tables cannot in every case be directly compared because of many different conditions and assumptions that are inherent in each country's data. To better understand these data and differences, the reader is encouraged to refer to Section III containing individual Country Reports (Summaries).

1.1. DEFINITIONS

The following definitions are provided to understand better the data presented in the tables for each job position. In cases where countries significantly deviated in responding from the definitions, notations are made and the individual Country Report should be consulted.

1.1.1. Entry Level Requirements (Prerequisites)

Combination of education, work experience, and training required for entry into the initial training program for a specified position.

Definitions Associated with Prerequisites:

Education

Knowledge, skills and competencies acquired in an educational institution and/or vocational program

Training

A defined training program/modules that is required for entry into the specified program

Years of experience

Time in position during which knowledge, skills and competencies are developed and enhanced

1.1.2. Initial training

A combination of one or more of classroom, laboratory/workshops, simulator and on the job training and self-study required to achieve certain qualification and competency for the specified position.

Definitions associated with Initial Training:

Classroom hours

Time spent at work associated with classroom instruction including reading, self-study, lectures and written examinations.

Workshop/laboratory hours

Time spent at work associated with workshop or laboratory activities including reading, self-study, demonstrations, practice and task evaluation.

Simulator hours

Time spent at work associated with simulator activities including reading, self-study, demonstrations, practice and evaluation.

On-the-job training hours

Time spent at workplace associated with training activities including reading, self-study, demonstrations, practice and evaluation.

Self-study hours

Self-study is any training in which trainees learn at their own pace without continuous presence of an instructor.

Comments:

(1) There are various definitions of self-study.

(2) Countries reported self-study time for one or more of the following:

(3) Study time between lectures, courses, demonstrations or evaluations

(4) Defined period of self study within a course or program

(5) Time spent on self study while not at work

(6) The resulting data are not a consistent representation of how much self-study time is required or utilized for each program.

(7) Self-study is used almost universally in NPP training programs.

(8) The survey data should be used with caution for comparing the relative usage of self study time.

1.1.3. Continuing Training

Periodic combination of one or more of classroom, laboratory, workshops, simulator and on the job training/self-study, and testing required to maintain certain qualification and enhance competency for the specified position.

Definitions associated with Continuing Training:

Classroom hours

Time spent at work associated with classroom instruction including reading, self-study, lectures and written examinations.

Workshop/laboratory hours

Time spent at work associated with workshop or laboratory activities including reading, self-study, demonstrations, practice and task evaluation.

Simulator hours

Time spent at work associated with simulator activities including reading, self-study, demonstrations, practice and evaluation.

On-the-job training hours

Time spent at workplace associated with training activities including reading, self-study, demonstrations, practice and evaluation.

Self-Study hours

Self-study is any training in which trainees learn at their own pace without continuous presence of an instructor. The comments included in the discussion of initial training are also applicable here.

1.2. PLANT OR STATION SHIFT SUPERVISOR

This position is defined as a senior person on shift in charge of plant operation. This is a licensed position. Table 2.1. shows the prerequisites for the plant/station shift supervisor job position.

TABLE 2.1. PLANT/STATION SHIFT SUPERVISOR PREREQUISITES

Country	Education or certification prerequisites	Prerequisite years of experience
Brazil	GE	3
Bulgaria	GE	5
Canada	E	6-8
China	GE	6
Czech Republic	GE	7.5
Finland	GE	5
France	GE	4
Germany*		
Hungary	GE/E	6
Japan	SS	20
Kazakhstan	GE	5
Korea, Republic of	GE/E	10
Lithuania	GE	3
Mexico	E	
Romania	GE	0
Russia	GE	8
Slovakia	GE	6
Slovenia	GE/TS	4
Spain	E	0
Sweden		
Switzerland	GE/E	7
Ukraine	GE	0
United Kingdom	GE/E/TS	3
United States of America	SS	7

*This job position does not exist in Germany

In general, this job position requires a graduate engineer or diploma engineer degree. On average six years of experience are needed.

Table 2.2. shows the initial training program results for the plant/station shift supervisor as percentage of time spent in various training settings.

TABLE 2.2. PLANT SHIFT SUPERVISOR INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	39%	1%	1%	34%	24%	4370
Bulgaria	0%	0%	7%	84%	9%	1102
Canada	32%	0%	12%	35%	22%	3280
Czech Republic	33%	1%	7%	3%	56%	3654
France	48%	0%	14%	0%	38%	1560
Hungary	0%	0%	0%	33%	67%	1440
Japan	42%	0%	58%	0%	0%	82
Kazakhstan	0%	0%	0%	81%	19%	744
Korea, Republic of	61%	22%	17%	0%	0%	23
Lithuania	0%	0%	8%	39%	53%	2016
Mexico	59%	0%	18%	0%	24%	5100
Romania	49%	0%	5%	14%	32%	7040
Russia	28%	1%	16%	16%	39%	1439
Slovakia	25%	0%	18%	18%	37%	160
Slovenia	74%	0%	0%	0%	26%	400
Spain	28%	0%	9%	38%	25%	1220
Switzerland	32%	13%	13%	21%	21%	4600
Ukraine	17%	0%	4%	19%	60%	992
United Kingdom	22%	0%	12%	9%	57%	1292
United States of America	42%	15%	15%	9%	20%	967

In general, half of the total training time is spent as on-the-job training, one third is spent as classroom training, and simulator training constitutes about 10% of the training time. Self-study training is widely used and laboratory/ workshop training is rarely used.

Based on the information in Table 2.2. the following observations are made:

- There is a large variation in total training hours reported
- Laboratory and workshop training is rarely used.
- Classroom, on-the-job and simulator training are frequently used.
- The classroom setting is used for 20% to 50% of the total training hours.
- The on-the-job setting is used for 20% to 60% of the total training hours.
- The simulator setting is used for 10% to 20% of the total training hours.

Table 2.3. shows the continuing training program results.

TABLE 2.3. PLANT/SHIFT SUPERVISOR CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	48%	0%	24%	28%	0%	250
Bulgaria	28%	0%	55%	0%	17%	64
Canada	46%	0%	31%	23%	0%	175
Czech Republic	38%	0%	31%	23%	8%	260
France	60%		40%			200
Hungary	29%	0%	29%	29%	14%	280
Japan	46%	23%	31%	0%	0%	75
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	44%	11%	32%	13%	0%	154
Lithuania	25%	0%	50%	25%	0%	80
Mexico						130
Romania	40%	0%	40%	20%	0%	1760
Russia	56%	1%	38%	5%	0%	80
Slovakia	48%	0	35%	17%	0	230
Slovenia	78%	0%	22%	0%	0%	129
Spain	85%	0%	15%	0%	0%	130
Switzerland	38%	2%	11%	30%	19%	265
Ukraine	53%	1%	26%	19%	2%	119
United Kingdom	32%	0%	34%	12%	21%	109
United States of America	48%	5%	35%	6%	6%	221

The variation in total training hours is not as large as that for initial training. Approximately 50% of the total training hours are delivered in the classroom setting and 25% of the total training hours use the simulator. Self-study and on-the-job training are used for the remainder of the training time. Laboratory/workshop training is seldom used.

1.3. UNIT OR CONTROL ROOM SUPERVISOR

This position is defined as a person in charge of control room activities for a single unit. This is a licensed or authorized position.

TABLE 2.4. UNIT OR CONTROL ROOM SUPERVISOR PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE	3
Bulgaria	GE	4
Canada	E or TS	7
China	GE/E	5E
Czech Republic	GE	5
Finland	E	3
France	E	8
Germany	GE/E/TS	0-5/0-4/3-5
Hungary	GE/E	5
Japan	SS	15
Kazakhstan	GE	3
Korea, Republic of	E/TS	6
Lithuania	GE	2
Mexico	E	
Romania	GE	
Russia	GE	5
Slovakia	GE	5
Slovenia	GE/TS	2
Spain	E	
Sweden	E/TS	9
Switzerland	TS	7
Ukraine	GE	
United Kingdom	GE/E/TS	2
United States of America	SS	4

In general this job position requires an engineering degree with 5 years of experience as a prerequisite.

TABLE 2.5. UNIT OR CONTROL ROOM SUPERVISOR INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	39%	1%	1%	34%	24%	4370
Bulgaria	5%	0%	5%	83%	7%	1505
Canada	15%	0%	4%	7%	74%	272
China	14%	2%	8%	0%	77%	1305
Czech Republic	36%	1%	7%	3%	53%	3306
Finland	44%	0%	15%	0%	41%	2424
France**	-	-	-	-	-	-
Germany	56%	16%	6%	9%	13%	4800
Hungary	16%	0%	8%	38%	38%	2520
Japan	42%	0%	58%	0%	0%	83
Kazakhstan	0%	0%	0%	81%	19%	744
Korea, Republic of	70%	1%	16%	13%	0%	155
Lithuania	0%	0%	2%	36%	61%	3316
Romania*	49%	0%	5%	14%	32%	2200
Russia	15%	1%	18%	24%	42%	882
Slovakia	25%	0%	19%	0%	56%	215
Slovenia	0%	0%	0%	20%	80%	400
Spain	23%	0%	10%	41%	26%	1220
Sweden	26%	0%	7%	0%	67%	822
Switzerland	49%	10%	9%	16%	15%	6080
Ukraine	8%	0%	3%	16%	73%	1825
United Kingdom	21%	0%	14%	12%	53%	1548
United States of America	35%	15%	16%	8%	26%	1904

**Comes from R.O./special training program as being implemented

Based on the information shown in Table 2.5. the following observations are made.

- There is a large variation in the total number of training hours
- Training is seldom conducted in the laboratory or workshop setting.
- Between one-third and two-thirds of the total training is conducted on the job.
- The classroom setting is used for between 20% to 50% of the total training time
- Training is conducted in the simulator setting in almost all countries but the number of training hours varies greatly.

TABLE 2.6. UNIT OR CONTROL ROOM SUPERVISOR CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	48%	0%	24%	28%	0%	250
Bulgaria	28%	0%	55%	0%	17%	144
Canada	44%	0%	56%	0%	0%	90
China	27%	8%	27%	0%	38%	260
Czech Republic	38%	0%	31%	23%	8%	260
Finland	40%	0%	33%	22%	5%	183
France	67%	0%	33%	0%	0%	240
Germany	67%	0%	17%	17%	0%	240
Hungary	29%	0%	29%	29%	14%	280
Japan	48%	12%	40%	0%	0%	104
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	44%	11%	32%	13%	0%	308
Lithuania	25%	0%	50%	25%	0%	80
Romania	40%	0%	40%	20%	0%	200
Russia	56%	1%	38%	5%	0%	80
Slovakia	48%		35%	17%		230
Slovenia	78%	0%	22%	0%	0%	129
Spain	81%	0%	19%	0%	0%	135
Sweden	60%	0%	40%	0%	0%	156
Switzerland	42%	2%	12%	26%	18%	285
Ukraine	51%	1%	26%	19%	3%	122
United Kingdom	38%	0%	30%	12%	21%	109
United States of America	46%	9%	34%	6%	6%	286

Based on the information shown in Table 2.6. the following observations are made.

- There is less variation in the total number of training hours than for the initial training program
- Training is seldom conducted in the laboratory or workshop setting.
- The self-study and on-the-job settings are less frequently used than in the initial program.
- The classroom setting is used for between 20% to 50% of the total training time
- The amount of training conducted in the simulator setting accounts for 33% to 50 % of the total training time.

1.4. CONTROL ROOM OPERATOR

This position is defined as a person who manipulates the controls in the control room. This is typically a licensed or authorized position.

TABLE 2.7. CONTROL ROOM OPERATOR PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	TS	3
Bulgaria	GE	2
Canada	TS/SS	7
China	E/TS	2
Czech Republic	GE	3
Finland	TS	2
France	E/TS	5
Germany	TS/SS	0-4/4-5
Hungary	GE/E	4
Japan	SS	7
Kazakhstan	GE	0
Korea, Republic of	E/TS	4
Lithuania	GE	2
Mexico	E	
Romania	SS	
Russia	GE	2
Slovakia	GE	2.5
Slovenia	GE/TS	
Spain	E	
Sweden	E/TS	5
Switzerland	TS	4
Ukraine	GE	
United Kingdom	GE/E/TS	1
United States of America	SS	

In general this job position requires a technical school diploma with 4 years of experience as a prerequisite.

TABLE 2.8. CONTROL ROOM OPERATOR INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	38%	1%	1%	35%	25%	4270
Bulgaria	6%	0%	3%	61%	29%	2454
Canada	30%	0%	13%	36%	21%	4480
China	33%	1%	10%	11%	44%	2400
Czech Republic	41%	1%	7%	3%	48%	2811
Finland	44%	0%	15%	0%	41%	2424
France	16%	6%	13%	0%	65%	3240
Germany	56%	16%	6%	9%	13%	4800
Hungary	24%	3%	8%	26%	39%	2480
Japan	22%	2%	13%	8%	55%	2376
Kazakhstan	0%	0%	0%	81%	19%	744
Korea, Republic of	37%	2%	48%	13%	0%	393
Lithuania	53%	0%	5%	15%	27%	1700
Mexico	63%	0%	10%	0%	27%	4000
Russia	25%	1%	20%	18%	36%	823
Slovakia	43%	0%	7%	7%	43%	2140
Slovenia	46%	2%	0%	28%	24%	1778
Spain	56%	0%	7%	16%	21%	2290
Sweden	23%	0%	22%	5%	51%	1588
Switzerland	59%	13%	6%	12%	10%	4700
Ukraine	10%	0%	2%	32%	55%	1191
United Kingdom	21%	0%	12%	12%	56%	1226
United States of America	43%	9%	16%	11%	21%	2087

Based on the information shown in Table 2.8. the following observations are made.

- There is a large variation in the total number of training hours but the variation is smaller than that for the control room supervisor training program
- Training is seldom conducted in the laboratory or workshop setting.
- Between one-third and one-half of the total training is conducted on the job.
- The classroom setting is used for between 20% to 50% of the total training time
- The simulator setting is used for approximately 10% of the total number of training hours.

TABLE 2.9. CONTROL ROOM OPERATOR CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	48%	0%	24%	28%	0%	250
Bulgaria	28%	0%	55%	0%	17%	144
Canada	30%	0%	40%	30%	0%	135
China	37%	11%	0%	0%	53%	260
Czech Republic	38%	0%	31%	23%	8%	260
Finland	40%	0%	33%	22%	5%	183
France	67%	0%	33%	0%	0%	240
Germany	67%	0%	17%	17%	0%	240
Hungary	29%	0%	29%	29%	14%	280
Japan	10%	1%	10%	0%	79%	450
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	43%	11%	31%	13%	4%	320
Lithuania	25%	0%	50%	25%	0%	80
Mexico						130
Russia	56%	1%	38%	5%	0%	80
Slovakia	48%		35%	17%		230
Slovenia	78%	0%	22%	0%	0%	129
Spain	81%	0%	19%	0%	0%	135
Sweden	59%	0%	41%	0%	0%	151
Switzerland	49%	0%	10%	20%	20%	245
Ukraine	52%	1%	26%	19%	2%	119
United Kingdom	38%	0%	12%	19%	31%	94
United States of America	49%	4%	35%	6%	6%	235

Based on the information shown in Table 2.9. the following observations are made.

- There is less variation in the total number of training hours than for the initial training program
- Training is seldom conducted in the laboratory or workshop setting.
- The self study and on-the-job settings are less frequently used than in the initial program.
- The classroom setting is used for between 33% to 50% of the total training time
- The amount of training conducted in the simulator setting accounts for 25% to 50 % of the total training time.

1.5. FIELD OPERATOR

This position is defined as a person who manipulates the controls and equipment outside of the control room. This position does not hold a license/authorization.

TABLE 2.10. FIELD OPERATOR PREREQUISITES

Country	Education or certification prerequisites	Prerequisite years of experience
Brazil	GE/TS	
Bulgaria	TS	2
Canada	SS	4.5
China	GE/E/TS	3
Czech Republic	GE/E/TS/A	1
Finland	SS	
France	TS/SS	7
Germany	TS/SS	2-3/0-2
Hungary	TS/SS	1
Japan	SS	12
Kazakhstan	SS	
Korea, Republic of	E/TS	1.5
Lithuania	E/TS/SS	1
Mexico	TS	
Romania	SS	
Russia	E/TS	1
Slovakia	TS/SS	1
Slovenia	TS	
Spain	TS	
Sweden	E/TS	
Switzerland	SS	2
Ukraine	TS	
United Kingdom	E/TS/SS	
United States of America	SS	

In general this job position requires a secondary school diploma with two years of experience as a prerequisite.

TABLE 2.11. FIELD OPERATOR INITIAL TRAINING

Country	lassroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	26%	0%	0%	21%	54%	1950
Canada	36%	18%	0%	44%	2%	2760
China	22%	2%	0%	0%	77%	1300
Czech Republic	44%	11%	0%	4%	40%	975
Finland	39%	0%	2%	0%	59%	1275
France	50%	0%	0%	0%	50%	1900
Germany	19%	6%	0%	13%	63%	4800
Hungary	25%	3%	0%	13%	60%	1600
Japan	25%	7%	8%	13%	47%	1512
Kazakhstan	23%	0%	0%	23%	55%	264
Korea, Republic of	48%	1%	0%	8%	43%	1220
Lithuania	14%	0%	0%	39%	47%	1160
Mexico	21%	0%	0%	0%	79%	1264
Romania	41%	0%	0%	18%	42%	1816
Russia	16%	1%	5%	6%	72%	953
Slovakia	38%	0%	0%	0%	63%	640
Slovenia	40%	0%	0%	20%	40%	808
Spain	95%	0%	0%	0%	5%	420
Sweden	18%	0%	0%	0%	81%	2144
Switzerland	34%	1%	1%	19%	45%	1150
Ukraine	14%	1%	0%	20%	65%	771
United Kingdom	17%	0%	7%	23%	52%	807
United States of America	38%	3%	2%	15%	42%	1651

Based on the information shown in Table 2.11. the following observations are made.

- There is a large variation in the total number of training hours but the variation is smaller than that for the control room supervisor training program
- Training is seldom conducted in the laboratory, workshop or simulator settings.
- Between one-half and two-thirds of the total training is conducted on the job.
- The classroom setting is used for between 20% to 33% of the total training time

TABLE 2.12. FIELD OPERATOR CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	48%	0%	24%	28%	0%	250
Canada	160%	0%	0%	0%	0%	95
China	37%	11%	0%	0%	53%	260
Czech Republic	69%	0%	0%	26%	5%	65
Finland	6%	0%	9%	30%	0%	66
France	67%	0%	33%	0%	0%	240
Germany	74%	0%	0%	26%	0%	190
Hungary	29%	0%	29%	29%	14%	280
Japan	10%	1%	10%	0%	79%	384
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	43%	11%	31%	13%	4%	320
Lithuania	25%	0%	50%	25%	0%	80
Mexico						130
Romania	31%	0%	0%	21%	48%	260
Russia	48%	18%	27%	6%	0%	66
Slovakia	37%				63%	760
Slovenia	78%	0%	22%	0%	0%	129
Spain	81%	0%	19%	0%	0%	135
Sweden	59%	0%	41%	0%	0%	151
Switzerland	49%	0%	10%	20%	20%	245
Ukraine	52%	1%	26%	19%	2%	119
United Kingdom	38%	0%	12%	19%	31%	60
United States of America	49%	4%	35%	6%	6%	235

Based on the information shown in Table 2.12. the following observations are made.

- There is less variation in the total number of training hours than for the initial training program
- Training is seldom conducted in the laboratory or workshop setting.
- The self-study and on-the-job settings are less frequently used than in the initial program.
- The classroom setting is used for between one-third to two-thirds of the total training time
- The amount of training conducted in the simulator setting accounts for 10% to 25% of the total training time.

1.6. MECHANICAL MAINTAINER

The mechanical maintainer job position typically does not hold a license. In most countries the education prerequisites for appropriate training programs differ from GE/E to TS/SS and AG. Also the prerequisite years of experience for this job position range from one to eight years.

TABLE 2.13. MECHANICAL MAINTAINER PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE/TS	
Bulgaria	TS	
Canada	TS/SS	4.5
China	GE/E/TS	3
Czech Republic	TS/AC	
Finland	SS	
France	GE/E/TS	8
Germany*		
Hungary	TS	1
Japan	SS	2
Kazakhstan	GE	
Korea, Republic of	E/TS	1.5
Lithuania	GE/E/TS	1
Mexico	TS	
Romania	SS	
Russia	GE	3
Slovakia	GE/TS/SS	1
Slovenia	GE/TS	
Spain	GE/TS/SS	
Sweden	TS/SS	
Switzerland	E/TS	3
Ukraine	SS	
United Kingdom	GE/E/TS/SS	varies
United States of America	SS	2

* In Germany, most mechanical and electrical maintenance is performed by manufacturers and vendors. Therefore, NPPs and training centres in Germany typically do not do this training.

TABLE 2.14. MECHANICAL MAINTAINER INITIAL TRAINING

Country	**Classroom Hours**	**Laboratory/ Workshop Hours**	**Simulator Hours**	**Self-Study Hours**	**OJT Hours**	**Total Hours**
Brazil	100%	0%	0%	0%	0%	1014
Canada	22%	77%	0%	0%	1%	1630
China	31%	4%	0%	15%	50%	1690
Czech Republic	50%	0%	0%	8%	42%	420
Finland	25%	0%	0%	8%	67%	1200
France	11%	0%	0%	0%	89%	3580
Hungary	56%	0%	0%	44%	0%	360
Japan	10%	15%	3%	0%	71%	712
Kazakhstan, Republic of	0%	0%	0%	29%	71%	204
Korea, Republic of	46%	3%	0%	10%	41%	1040
Lithuania	27%	13%	0%	35%	25%	300
Mexico	9%	0%	0%	0%	91%	1096
Romania	41%	0%	0%	18%	42%	1816
Russia	26%	1%	2%	7%	64%	478
Slovakia	38%	0%	0%	0%	63%	640
Spain	67%	0%	0%	0%	33%	360
Sweden	88%	13%	0%	0%	0%	80
Switzerland	6%	3%	0%	4%	86%	442
Ukraine	5%	10%	0%	13%	71%	277
United Kingdom	30%	0%	14%	25%	31%	1506
United States of America	26%	13%	6%	3%	51%	1465

TABLE 2.15. MECHANICAL MAINTAINER CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	24
Bulgaria	44%	0%	0%	0%	56%	44
Canada	100%	0%	0%	0%	0%	20
China	30%	9%	0%	0%	61%	115
Finland	88%	0%	0%	0%	12%	64
France	100%	0%	0%	0%	0%	75
Hungary	40%	0%	0%	40%	20%	200
Japan	4%	4%	4%	0%	89%	300
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	41%	19%	0%	9%	31%	53
Mexico						36
Romania	31%	0%	0%	21%	48%	260
Russia	64%	11%	13%	9%	3%	107
Slovakia	100%	0%	0%	0%	0%	96
Spain	100%	0%	0%	0%	0%	35
Sweden	50%	50%	0%	0%	0%	20
Switzerland	15%	9%	0%	18%	59%	340
Ukraine	34%	13%	0%	20%	33%	71
United Kingdom	44%	7%	9%	11%	29%	84
United States of America	46%	26%	0%	5%	23%	86

In most countries the majority of the mechanical maintainer training is conducted in the classroom and on-the-job. Laboratory/workshop training is provided in 10 countries. Four countries utilize a simulator in both initial and continuing training.

1.7. ELECTRICAL MAINTAINER

The electrical maintainer job position typically does not hold a license. In most countries the education prerequisites for appropriate training programs varies from GE/E to TS/SS. Also the prerequisite years of experience for this job position differ from 8 to 1 years.

TABLE 2.16. ELECTRICAL MAINTAINER PREREQUISITES

Country	Education or certification prerequisites	Prerequisite years of experience
Brazil	GE/TS	
Bulgaria	TS	
Canada	TS/SS	4.5
China	GE/E/TS	3
Czech Republic	TS/	
Finland	SS	
France	GE/TS	8
Germany		
Hungary	TS	1
Japan	SS	2
Kazakhstan	GE	
Korea, Republic of	E/TS	1.5
Lithuania	GE/E/TS/SS	1
Mexico	TS	
Romania	SS	
Russia	GE	3
Slovakia	GE/TS/SS	1
Slovenia	GE/TS	
Spain	GE/TS/SS	
Sweden	TS/SS	
Switzerland	E/TS	3
Ukraine	SS	
United Kingdom	GE/E/TS/SS	varies
United States of America	SS	2

TABLE 2.17. ELECTRICAL MAINTAINER INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	1262
Canada	21%	68%	0%	11%	1%	1850
China	36%	0%	0%	0%	64%	1560
Czech Republic	50%	0%	0%	8%	42%	420
Finland	22%	14%	0%	7%	57%	1400
France	12%	0%	0%	0%	88%	4530
Hungary	56%	0%	0%	44%	0%	360
Japan	10%	15%	3%	0%	72%	712
Kazakhstan	0%	0%	0%	29%	71%	204
Korea, Republic of	46%	4%	0%	10%	40%	1040
Lithuania	24%	0%	0%	37%	40%	340
Mexico	9%	0%	0%	0%	91%	1096
Romania	41%	0%	0%	18%	42%	1816
Russia	29%	2%	10%	8%	52%	479
Slovakia	38%	0%	0%	0%	63%	640
Spain	67%	0%	0%	0%	33%	360
Sweden	88%	13%	0%	0%	0%	80
Switzerland	3%	2%	0%	5%	91%	3750
Ukraine	4%	14%	8%	30%	43%	385
United Kingdom	30%	0%	14%	25%	31%	1671
United States of America	28%	9%	2%	6%	54%	1398

TABLE 2.18. ELECTRICAL MAINTAINER - CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	24
Bulgaria	63%	0%	0%	0%	38%	64
Canada	100%	0%	0%	0%	0%	22
China	30%	9%	0%	0%	61%	115
Finland	70%	20%	0%	0%	10%	80
France	100%	0%	0%	0%	0%	75
Hungary	40%	0%	0%	40%	20%	200
Japan	4%	4%	4%	0%	89%	300
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	38%	21%	0%	10%	31%	52
Mexico						22
Romania	31%	0%	0%	21%	48%	260
Russia	62%	13%	15%	9%	2%	93
Slovakia	100%	0%	0%	0%	0%	96%
Spain	100%	0%	0%	0%	0%	35
Sweden	50%	50%	0%	0%	0%	20
Switzerland	15%	9%	0%	18%	59%	340
Ukraine	34%	13%	0%	20%	33%	71
United Kingdom	44%	7%	9%	11%	29%	84
United States of America	46%	26%	0%	5%	23%	86

In most countries, the majority of electrical maintainer training is conducted in the classroom and on the job. Eight countries use the laboratory/workshop setting for this program. Five countries use simulators in the initial training programs and three countries use simulators in continuing training.

1.8. INSTRUMENTATION AND CONTROL TECHNICIANS

The instrumentation and control technicians job position typically does not hold a license. In most countries the education prerequisites for appropriate training programs differ from GE/E to TS/SS. Also the prerequisite years of experience for this job position range from one to eight years.

TABLE 2.19. INSTRUMENTATION AND CONTROL TECHNICIANS PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE/TS	
Bulgaria	GE/TS	
Canada	TS/SS	5
China	GE/E/TS	3
Czech Republic	TS	
Finland	GE/E	
France	GE/E/TS	8
Germany*		
Hungary	TS	1
Japan	SS	2
Kazakhstan	GE	
Korea, Republic of	E/TS	1.5
Lithuania	GE/E/TS	1
Mexico	TS	
Romania	SS	
Russia	GE	2
Slovakia	GE/TS/SS	1
Slovenia	GE/TS	
Spain	GE/E/TS	
Sweden	TS	
Switzerland	GE/TS/SS	3
Ukraine	GE	
United Kingdom	GE/E/TS/SS	varies
United States of America	SS/TS/E	3

*See Country Report of Germany

TABLE 2.20. INSTRUMENTATION AND CONTROL TECHNICIAN INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	972
Canada	21%	68%	0%	11%	1%	1850
China	43%	3%	3%	0%	50%	2100
Czech Republic	45%	0%	0%	4%	51%	927
Finland	25%	2%	0%	8%	65%	1220
France	15%	3%	0%	6%	75%	5305
Hungary	100%	0%	0%	0%	0%	200
Japan	22%	13%	3%	0%	63%	832
Kazakhstan	0%	0%	0%	29%	71%	204
Korea, Republic of	48%	1%	0%	8%	43%	1220
Lithuania	11%	24%	0%	32%	33%	1323
Mexico	21%	0%	0%	0%	79%	1264
Romania	41%	0%	0%	18%	42%	1816
Russia	38%	9%	2%	9%	42%	706
Slovakia	41%	0%	0%	0%	59%	680
Spain	77%	0%	0%	0%	23%	520
Sweden	88%	13%	0%	0%	0%	80
Switzerland	8%	0%	0%	13%	79%	600
Ukraine	24%	1%	4%	32%	38%	647
United Kingdom	30%	0%	14%	25%	31%	373
United States of America	35%	11%	1%	3%	50%	1691

TABLE 2.21. INSTRUMENTATION AND CONTROL TECHNICIAN CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	24
Canada	100%	0%	0%	0%	0%	22
China	47%	7%	0%	0%	47%	150
Czech Republic	57%	14%	0%	29%	0%	70
Finland	75%	25%	0%	0%	0%	80
France	0%	92%	8%	0%	0%	206
Hungary	40%	0%	0%	40%	20%	200
Japan	4%	4%	4%	0%	89%	300
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	40%	26%	0%	10%	24%	50
Mexico						22
Romania	31%	0%	0%	21%	48%	260
Russia	73%	1%	21%	1%	3%	67
Slovakia	100%	0%	0%	0%	0%	96
Spain	0%	0%	100%	0%	0%	70
Sweden	50%	50%	0%	0%	0%	40
Switzerland	13%	0%	0%	17%	71%	390
Ukraine	38%	5%	8%	38%	11%	98
United Kingdom	39%	8%	10%	12%	31%	73
United States of America	41%	17%	2%	3%	37%	135

In most countries, instrumentation and control technicians training is conducted in the classroom and on-the-job settings. The laboratory/workshop setting for initial and continuing training programs is used in some countries. Six countries utilize the simulator in initial I&C technician training and nine countries utilize the simulator in continuing training. While in most countries the number of training hours of initial and continuing training for mechanical and electrical maintainers are similar, the number of hours for instrumentation and control technicians is higher than for the other maintenance training programs.

1.9. QA/ QC INSPECTOR

This position conducts quality assurance audits and/or quality control activities. The entry level requirements for this position, are presented by country in Table 2.21. The QA/QC inspector job position typically does not hold a license. In most countries the education prerequisites for appropriate training programs range from GE to TS. Little experience is typically required for entry into this position.

TABLE 2.21. QA/QC PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE/TS	0
Bulgaria	GE	0
Canada		
China	GE/E/TS	3
Czech Republic	GE/TS	2
Finland	GE	0
France	GE	0
Germany		
Hungary	TS	2
Japan	SS	0
Kazakhstan	GE	0
Korea, Republic of	E/TS	1.5
Lithuania	GE/E/TS	1
Mexico	TS	
Romania	TS	0
Russia	GE	0
Slovakia	GE/TS	1
Slovenia	GE/TS	0
Spain	GE/E/TS	0
Sweden	TS	0
Switzerland	GE/E/TS	2
Ukraine		
United Kingdom	GE/E/TS/SS	varies
United States of America	SS	2

Initial Training

The initial training program results, in percentage of total time for each setting are presented in Table 2.22.

TABLE 2.22. QA/QC INSPECTOR INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	64
China	40%	0%	0%	0%	60%	1325
Czech Republic	67%	0%	0%	4%	29%	927
Finland	43%	0%	0%	14%	43%	700
Hungary	20%	32%	0%	16%	32%	1000
Japan	100%	0%	0%	0%	0%	42
Kazakhstan	0%	0%	0%	29%	71%	204
Korea, Republic of	82%	18%	0%	0%	0%	57
Mexico	21%				79%	1264
Romania	50%	0%	0%	15%	35%	360
Russia	37%	0%	1%	1%	61%	377
Slovakia	58%	0%	0%	0%	42%	1120
Spain	88%	13%	0%	0%	0%	80
Switzerland	36%	36%	0%	23%	5%	220
Ukraine	19%	19%	0%	55%	7%	73
United Kingdom	33%	0%	15%	12%	40%	412
United States of America	31%	15%	0%	27%	28%	371

Continuing Training

The results for the continuing training program for the QA/QC position are presented in Table 2.23.

TABLE 2.23. QA/QC INSPECTOR CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	24
China	50%	0%	0%	0%	50%	70
Czech Republic	100%	0%	0%	0%	0%	40
Finland	100%	0%	0%	0%	0%	80
Hungary	29%	0%	0%	71%	0%	56
Japan	100%	0%	0%	0%	0%	5
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	30%	17%	0%	0%	52%	23
Mexico						24
Romania	100%	0%	0%	0%	0%	40
Russia	92%	0%	0%	0%	8%	53
Slovakia	100%	0%	0%	0%	0%	96
Spain	0%	0%	100%	0%	0%	25
Sweden	75%	25%	0%	0%	0%	40
Switzerland	22%	22%	0%	54%	3%	185
Ukraine	31%	17%	0%	52%	0%	29
United Kingdom	32%	8%	10%	12%	38%	62
United States of America	50%	17%	0%	0%	33%	22

1.10. RADIATION PROTECTION TECHNICIAN

This position is defined as a person who performs radiation protection activities. These activities may include, but are not limited to: measurement and surveillance on radiological hazards, calibration of the RP instruments, planning for radiological work, personnel dosimetery, etc.

The country's entry level requirements for training in this position is presented in Table 2.24.

TABLE 2.24. RADIATION PROTECTION TECHNICIAN PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE/TS	0
Bulgaria	TS	0
Canada	TS/SS	6
China	GE/E/TS	3
Czech Republic	TS	1
Finland	GE	0
France	E/TS	0
Germany		
Hungary	TS	0.5
Japan	SS	2
Kazakhstan	TS	0
Korea, Republic of	E/TS	1.5
Lithuania	GE/E/TS	1
Mexico	TS	
Romania	SS	0
Russia	GE	2
Slovakia	GE/TS/SS	1
Slovenia	GE/TS	0
Spain	GE/E/TS	0
Sweden	TS	3
Switzerland	GE/TS	2
Ukraine	GE	0
United Kingdom	GE/E/TS	varies
United States of America	SS/TS	1

Initial Training

The initial training program results in percentage of total time for each training setting are presented in Table 2.25.

TABLE 2.25. RADIATION PROTECTION TECHNICIAN INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	78%	0%	0%	0%	22%	724
Canada	51%	27%	0%	0%	21%	1310
China	40%	0%	0%	0%	60%	1325
Czech Republic	58%	0%	0%	5%	37%	727
Finland	25%	0%	0%	8%	67%	1200
Hungary	28%	2%	0%	10%	60%	1680
Japan	24%	6%	0%	0%	70%	808
Kazakhstan	12%	3%	0%	68%	16%	606
Korea, Republic of	48%	1%	0%	8%	43%	1220
Lithuania	9%	0%	0%	49%	43%	1643
Mexico	21%	0%	0%	0%	79%	1264
Romania	38%	6%	0%	0%	56%	656
Russia	30%	2%	12%	5%	52%	392
Slovakia	45%	0%	0%	0%	55%	1160
Sweden	81%	19%	0%	0%	0%	132
Switzerland	54%	27%	0%	14%	5%	370
Ukraine	22%	1%	4%	19%	54%	563
United Kingdom	25%	3%	17%	0%	55%	1182
United States of America	27%	9%	0%	19%	45%	1840

Radiation protection technician training is predominantly conducted in the classroom and on-the-job settings. In a few cases the laboratory or simulation setting is used.

Continuing Training

The results for the continuing training program, by percentage of total time for each setting is presented in Table 2.26.

TABLE 2.26. RADIATION PROTECTION TECHNICIAN CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	24
Canada	14%	14%	0%	0%	71%	56
China	50%	0%	0%	0%	50%	70
Czech Republic	100%	0%	0%	0%	0%	20
Finland	100%	0%	0%	0%	0%	80
Hungary	40%	0%	0%	40%	20%	200
Japan	5%	4%	0%	0%	91%	330
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	40%	26%	0%	10%	24%	50
Mexico						70
Romania	50%	50%	0%	0%	0%	80
Russia	100%	0%	0%	0%	0%	30
Slovakia	100%	0%	0%	0%	0%	96
Spain	0%	0%	100%	0%	0%	35
Sweden	47%	53%	0%	0%	0%	38
Switzerland	62%	15%	0%	8%	15%	325
Ukraine	38%	3%	12%	29%	17%	86
United Kingdom	38%	7%	15%	16%	24%	137
United States of America	58%	11%	2%	3%	26%	125

1.11. CHEMISTRY TECHNICIAN

This position is defined as a person who performs activities in support of maintaining plant chemistry. These activities may include, but are not limited to, measurement and surveillance of the plant chemistry parameters.

The country's entry level requirements for training in this position presented in Table 2.27.

TABLE 2.27. CHEMISTRY TECHNICIAN PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE/TS	
Bulgaria	TS	
Canada	TS/SS	5.5
China, Republic of	GE/E/TS	3
Czech Republic	TS/AC	
Finland	GE	
France	E/TS	2
Germany		
Hungary	TS	0.5
Japan	SS	2
Kazakhstan	SS	
Korea, Republic of	E/TS	1.5
Lithuania	GE/E	1
Mexico	TS	
Romania	SS	
Russia	GE	1
Slovakia	GE/TS/SS	1
Slovenia	GE/TS	
Spain	GE/E/TS	
Sweden	TS	3
Switzerland	E/TS	2
Ukraine	GE	
United Kingdom	GE/E/TS/SS	varies
United States of America	SS/TS	1

Initial Training

The initial training program results as the percentage of total time for each training setting are presented in Table 2.28.

TABLE 2.28. CHEMISTRY TECHNICIAN INITIAL TRAINING - PERCENT OF TIME IN EACH SETTING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	84%	0%	0%	0%	16%	442
Canada	44%	0%	0%	0%	56%	890
China	34%	6%	0%	0%	60%	1240
Czech Republic	50%	0%	0%	4%	46%	807
Finland	27%	0%	0%	9%	64%	1100
France	8%	21%	0%	21%	50%	6380
Hungary	21%	21%	0%	11%	46%	1400
Japan	13%	2%	0%	0%	85%	704
Kazakhstan	11%	53%	0%	11%	26%	564
Korea, Republic of	48%	1%	0%	8%	43%	1220
Lithuania	17%	0%	0%	51%	32%	820
Mexico	35%	5%	0%	0%	60%	1664
Romania	23%	0%	0%	0%	77%	700
Russia	29%	1%	7%	7%	55%	624
Slovakia	45%	17%			38%	1160
Sweden	79%	21%	0%	0%	0%	129
Switzerland	3%	2%	0%	4%	91%	2500
Ukraine	23%	0%	4%	24%	48%	599
United Kingdom	39%	6%	28%	0%	27%	713
United States of America	29%	4%	2%	21%	44%	2217

Continuing Training

The results for continuing training program, in percentage of total time for each training setting, are presented in Table 2.29.

TABLE 2.29. CHEMISTRY TECHNICIAN CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	24
Canada	60%	0%	0%	0%	40%	40
China	50%	0%	0%	0%	50%	70
Czech Republic	73%	0%	0%	27%	0%	55
Finland	100%	0%	0%	0%	0%	80
France	0%	100%	0%	0%	0%	75
Hungary	40%	0%	0%	40%	20%	200
Japan	4%	4%	0%	0%	93%	300
Kazakhstan	0%	0%	0%	71%	29%	84
Korea, Republic of	40%	26%	0%	10%	24%	50
Lithuania	50%	0%	0%	50%	0%	80
Mexico						76
Romania	63%	38%	0%	0%	0%	64
Russia	84%	4%	12%	0%	0%	51
Slovakia	100%	0%	0%	0%	0%	96
Spain	0%	0%	100%	0%	0%	35
Sweden	47%	53%	0%	0%	0%	38
Switzerland	36%	36%	0%	11%	17%	280
Ukraine	57%	4%	2%	19%	19%	81
United Kingdom	33%	0%	18%	20%	29%	102
United States of America	62%	14%	0%	0%	25%	118

Chemistry technician training is predominantly conducted in the classroom and on-the-job settings. The laboratory setting is used in a minority of countries.

1.12. INSTRUCTOR

This position is defined as a person who conducts training and is involved in activities such as analysis, development and evaluation of training.

The entry level requirements for this position for the reporting countries are presented in Table 2.30.

TABLE 2.30. INSTRUCTOR PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE	
Bulgaria	GE	
Canada	TS/SS	7
China	GE	3
Czech Republic	GE/E/TS	3
Finland	GE/E	
France	GE	4
Germany		
Hungary	GE/E	5
Japan	SS	
Kazakhstan		
Korea, Republic of	GE/E	1.5
Lithuania	GE/E	2
Mexico	E	
Romania	GE	
Russia	GE	3
Slovakia	GE/TS/SS	1
Slovenia	GE/TS	
Spain	GE/E	2
Sweden	E/TS	8
Switzerland	E/TS	6
Ukraine	GE	
United Kingdom	GE/E/TS/SS	varies
United States of America	SS	4

Most countries report a GE or E with an average of 3 years of experience. Tables 2.31. and 2.32. give percentage of time spent in various training settings.

TABLE 2.31. INSTRUCTOR INITIAL TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	13%	0%	0%	0%	87%	1210
Canada	40%	31%	0%	27%	3%	109
China	45%	0%	4%	0%	51%	1570
Czech Republic	67%	0%	0%	3%	30%	1015
Finland	25%	0%	0%	0%	75%	400
France	100%	0%	0%	0%	0%	150
Hungary	5%	19%	0%	19%	57%	840
Japan	18%	47%	18%	15%	2%	260
Korea, Republic of	5%	2%	0%	1%	92%	488
Lithuania	33%	0%	0%	29%	38%	420
Mexico	100%	0%	0%	0%	0%	900
Romania	58%	18%	0%	18%	5%	220
Russia	38%	1%	8%	28%	25%	347
Slovakia	86%				14%	116
Spain	86%	9%	0%	0%	6%	140
Sweden	100%	0%	0%	0%	0%	260
Ukraine	33%	9%	0%	26%	33%	363
United Kingdom	38%	0%	26%	0%	36%	488
United States of America	29%	10%	24%	18%	18%	111

Initial training time varies between 100 and 1500 hours with the average being about 400 hours. The majority of time is spent in on-the-job training and classroom training. The laboratory, workshop, simulation, and self-study settings are used less frequently in most countries.

TABLE 2.32. INSTRUCTOR CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	100%	0%	0%	0%	0%	24
Canada	100%	0%	0%	0%	0%	36
China	29%	0%	29%	0%	42%	170
Czech Republic	12%	0%	0%	44%	44%	180
Finland	80%	0%	0%	0%	20%	100
France	50%	%	0%	50%	0%	150
Hungary	13%	6%	0%	81%	0%	124
Japan	44%	11%	0%	44%	0%	50
Korea, Republic of	30%	13%	0%	4%	52%	23
Lithuania	44%	0%	11%	44%	0%	180
Romania	29%	0%	0%	0%	71%	56
Russia	45%	2%	2%	14%	38%	116
Slovakia	100%	0%	0%	0%	0%	120
Spain	100%	0%	0%	0%	0%	129
Sweden	100%	0%	0%	0%	0%	35
Ukraine	37%	8%	0%	25%	30%	108
United Kingdom	34%	0%	16%	0%	50%	48
United States of America	31%	11%	19%	2%	38%	31

Continuing training varies significantly between countries with the average being 90 hours.

1.13. SIMULATOR INSTRUCTOR

This position is defined as a person who conducts simulator training and could also be involved in activities such as analysis, development and evaluation of simulator training.

The entry level requirements for training in this position for the reporting countries are presented in Table 2.33.

TABLE 2.33. SIMULATOR INSTRUCTOR PREREQUISITES

Country	**Education or certification prerequisites**	**Prerequisite years of experience**
Brazil	GE	
Bulgaria	GE	
Canada	TS/SS	8
China	GE	3
Czech Republic	GE/E/TS	3
Finland	E	
France	GE	4
Germany	GE	3-5
Hungary	E/TS	5
Japan	SS	
Kazakhstan		
Korea, Republic of	GE/E	1.5
Lithuania	GE	2
Mexico	E	
Romania	E	
Russia	GE	varies
Slovakia	GE	4
Slovenia	GE/TS	
Spain	GE/E	3
Sweden	E	6
Switzerland	E	8
Ukraine	GE	varies
United Kingdom	GE/E/TS/SS	varies
United States of America	SS	5

In general this job position requires a GE or E degree and three to four years of experience. Tables 2.34. and 2.35. give the percentage of time spent in various training settings.

TABLE 2.34. SIMULATOR INSTRUCTOR INITIAL TRAINING

Country	**Classroom Hours**	**Laboratory/ Workshop Hours**	**Simulator Hours**	**Self-Study Hours**	**OJT Hours**	**Total Hours**
Brazil	13%	0%	0%	0%	87%	1210
Canada	67%	0%	2%	16%	16%	322
China	32%	0%	14%	0%	54%	2800
Czech Republic	54%	2%	9%	4%	32%	1995
Finland	20%	0%	32%	0%	48%	620
France	100%	0%	0%	0%	0%	150
Germany	36%	6%	25%	13%	20%	5120
Hungary	4%	15%	19%	15%	46%	1040
Japan	7%	17%	55%	17%	3%	220
Korea, Republic of	5%	2%	0%	1%	92%	488
Lithuania	0%	0%	36%	43%	21%	336
Mexico	100%	0%	0%	0%	0%	1164
Romania	59%	0%	14%	14%	14%	296
Russia	37%	0%	48%	3%	12%	98
Slovakia	64%	0%	0%	0%	36%	220
Spain	27%	0%	13%	0%	60%	150
Sweden	33%	0%	29%	0%	38%	840
Switzerland	16%	0%	11%	36%	36%	550
Ukraine	14%	0%	13%	51%	22%	236
United Kingdom	30%	0%	24%	0%	47%	683
United States of America	23%	8%	24%	0%	45%	66

TABLE 2.35. SIMULATOR INSTRUCTOR CONTINUING TRAINING

Country	Classroom Hours	Laboratory/ Workshop Hours	Simulator Hours	Self-Study Hours	OJT Hours	Total Hours
Brazil	70%	0%	60%	0%	0%	60
Canada	29%	0%	71%	0%	0%	112
China	26%	0%	0%	0%	74%	340
Finland	80%	0%	0%	0%	20	100
France	50%			50%		
Germany	25%	0	0	25%	50%	160
Hungary	0%	50%	0%	50%	0%	150
Japan	20%	0%	13%	33%	33%	300
Korea, Republic of	13%	6%	0%	81%	0%	124
Lithuania	32%	0%	34%	10%	24%	74
Romania	4%	0%	0%	0%	96%	208
Russia	57%	0%	42%	0%	0%	47
Slovakia	55%	0%	0%	0%	45%	176
Slovenia	31%	0%	0%	27%	42%	126
Sweden	57%	0%	43%	0%	0%	47
Switzerland	100%	0%	0%	0%	0%	24
Ukraine	67%	0%	0%	33%	0%	120
United Kingdom	32%	0%	34%	10%	24%	74
United States of America	50%	0%	0%	0%	50%	80

Based on the information shown in Table 2.35. the following observations are made.

- There is a large variation in the total number of training hours
- Training is seldom conducted in the laboratory or workshop setting.
- The self-study and on-the-job settings are less frequently used in continuing training than in the initial program.
- The classroom setting is used for between one-third to two-thirds of the total training time
- The amount of training conducted in the simulation setting varies widely

2. STATISTICAL ANALYSIS OF TRAINING RESOURCES

The survey requested data on the resources available at the various training centres and plants. Specifically, information on budgets, salaries, staffing, simulators, maintenance training equipment, computers and audio visual equipment was requested for each training organization.

2.1. BUDGETS & SALARIES

Table 2.34. shows the training budgets as a percent of the total operating budget. It also shows training salaries as compared to comparable positions in the plant. Because accounting practices vary between countries and organizations, the data shown may not be completely consistent with each

other. The data give only a general indication of the training budget. The average training budget is 3.7% of the station's operating budget. In general, training salaries are comparable to those for similar positions in the plant.

TABLE 2.34. TRAINING BUDGETS AND SALARIES

Country	Budget (% of total)	Salary Compared to Plant Position
Brazil	3.00%	Same
Bulgaria		Lower
Canada	4.50%	Same to higher
China	2.00%	Same
Czech Republic	1%	Same
Finland	2.5%	Same
France	12.00%	Same
Germany	1.00%	Same
Hungary	2.50%	Same
Japan		Same
Kazakhstan		Same
Korea, Republic of		Same
Lithuania		Lower
Romania	1.6%	Same
Russia	1.75%	Same to Lower
Slovakia	1.00%	Lower
Slovenia	1.50%	Same
Spain	3.00%	Same
Sweden	5.00%	Same
Switzerland	3.00%	Same to higher
Ukraine	0.50%	Lower
United Kingdom	2.00%	Same
United States of America	4.40%	Same

2.2. STAFFING

Table 2.35. shows the on-site training staffing for the countries in the Survey. Table 2.36. shows the comparable staffing for training centres.

2.3. SIMULATORS

A variety of simulators are used to train NPP personnel. The following definitions are provided to classify the simulators reported by the reporting facilities.

Full Scope Simulator:

The most common example of a full scope simulator is the full scope control room simulator which usually allows for simulation of the full range of operations that can be performed from the main control room. Such simulators are usually plant referenced and replicate as many systems as possible, including communications, as well as duplicating the actual control room environment.

TABLE 2.35. STAFFING OF ON-SITE NPP TRAINING DEPARTMENTS (AVERAGE FOR THE REPORTING NPP TRAINING DEPARTMENTS IN EACH COUNTRY)

	Operations Instructors	Maintenance Instructors	Rad Protection Instructors	Chemistry Instructors	Other Instructors	Management	Simulator Support	Maintenance Support	Material Development	Educational Spec	Other Support	Total Staff
Brazil	14	3	1	1	0	1	2	1	4	1	0	28
Bulgaria	5	3	2	1	6	7	3	7	5	1	16	56
Canada	7	0	0	1	0	1	5	0	0	0	4	18
China												
Czech Republic	10	2	2	2	8	1	1	1	0	0	0	27
Finland	4	3	1	0	3	1	1	0	1	0	1	15
France*												
Germany	2	0	0	0	0	0	0	0	0	0	0	2
Hungary	18	4	2	1	5	6	8	2	5	1	15	67
Japan	2	3	2	1	2	3	3	4	0	0	1	20
Kazakhstan												
Korea, Republic of												
Lithuania	4	2	0	1	0	1	1	1	0	1	0	11
Mexico	10	3	1									14
Romania	12	7	4	2	5	1	9	2	0	0	0	41
Russia	7	4	1	1	2	2	1	2	1	1	3	25
Slovakia	0	0	0	0	0	4	6	0	0	0	3	13
Slovenia	7	0	1	1	1	1	0	0	0	0	2	13
Spain	3	2	1	0	2	1	0	0	1	0	2	12
Sweden	7	0	1	0	4	1	0	3	1	2	2	21
Switzerland	3	3	1	0	1	2	5	2	3	1	0	20
Ukraine	9	5	1	1	1	2	2	2	2	1	2	28
United Kingdom	1	8	2	0	3	2	0	1	0	0	2	19
United States of America	20	10	6	2	8	5	6	1	1	2	6	67

*Data only for operation training centres

The numbers reported by each country for this table are for personnel who provide training at the NPP and who are typically employed by the NPP.

TABLE 2.36. TRAINING CENTRES STAFFING (AVERAGE FOR THE REPORTING CENTRES IN EACH COUNTRY)

	Operations Instructors	Maintenance Instructors	Rad Protection Instructors	Chemistry Instructors	Other Instructors	Management	Simulator Support	Maintenance Support	Material Development	Educational Spec	Other Support	Total Staff
Brazil												
Bulgaria												
Canada	15	14	7	1	21	12	25	0	9	1	11	113
China	13	10	2	2	6	6	4	2	1	0	8	54
Czech Republic	5	1	2	1	16	1	2	2	1	0	10	41
Finland												
France*	41	3	0	1	18	6	11	0	0	1	0	81
Germany	40	2	6	2	1	2	40	1	12	0	14	120
Hungary												
Japan	35	0	0	0	0	3	2	1	0	0	5	45
Kazakhstan												
Korea, Republic of	34	33	8	3	24	3	5	5	3	6	24	147
Lithuania												
Romania												
Russia	18	6	1	3	0	6	5	9	14	1	28	89
Slovakia	15	3	1	1	0	4	8	5	0	0	0	37
Slovenia	6	0	1	0	0	1	0	0	2	0	1	11
Spain	27	1	3	1	0	4	8	0	3	3	3	52
Sweden	42	0	0	0	0	3	28	8	8	2	0	91
Switzerland												
Ukraine	18	8	1	3	4	6	8	4	13	1	1	67
United Kingdom	6	3	1	0	2	3	2	1	2	0	2	22
United States of America												

*Data only for operation training centres

The numbers reported by each country for this table are for personnel who provide training to NPP personnel at training organizations separate from the NPP. These personnel are typically employed by organizations external to the NPP.

Part Task Simulator:

A part task simulator is designed for achieving particular training objectives associated with specific plant items or phenomena.

Basic Principles Simulator:

A basic principles simulator represents in a simplified way the basic phenomena of NPP behavior. It is used to understand the principles of a complex system and to achieve specific objectives.

Multifunctional Simulator:

A multifunctional simulator has the same model as a Full Scope Simulator but with simplified controls and indications. This simulation is generally represented as mimics through a graphical interface. These kind of simulators can achieve general or enabling objectives except those related to the control room environment.

Computer-Based Training:

Computer-based training uses a PC system which allows the trainee to achieve a particular objective answering to questions or performing operations. This can be done by the trainee himself or with the help of an instructor.

The numbers and types of simulators reported by all facilities within a country are shown in Table 2.37. The country reports section of this survey should be consulted to obtain additional information on the simulators available in each country.

2.4. MAINTENANCE TRAINING EQUIPMENT

The survey requested information on the type and quantity of mechanical and electrical training aids available at each training organization. The availability of maintenance training aids within a country was classified in accordance with the following criteria.

- Extensive — The type of training aid is available at many training organizations in the country
- Average - t — The type of training aid is available at some training organizations in he country
- Minimal - — The type of training aid is available at a few training organizations in the country
- None - — The type of training aid is not available in the country

Table 2.38. shows the data for mechanical maintenance training aids. Table 2.39. shows the data for electrical maintenance training aids.

TABLE 2.37. SIMULATORS

Country	Full Scope Simulators	Part Task Simulators	Basic Principles Simulators	Multi-functional Simulator	Specialized Simulators	Fuel Loading Simulator
Brazil	1	0	0	0	0	0
Bulgaria	1	1	1	1	0	0
Canada	6	0	0	0	0	1
China	2	0	2	1	0	0
Czech Republic	0	0	1	0	0	0
Finland	2	0	0	0	1	0
France	11	12	0	0	0	1
Germany	16	1	2	4	0	1
Hungary	1	1	1	1	10	0
Japan	11	0	12	3	0	2
Kazakhstan	0	0	0	0	0	0
Korea, Republic of	3	1	0	0	0	1
Lithuania	0	0	1	0	0	1
Mexico	1					
Romania	1	0	0	0	0	0
Russia	7	8	2	4	0	4
Slovakia	2	0	1	2	1	0
Slovenia	0	0	0	0	0	0
Spain	3	0	3	0	0	0
Sweden	7	3	0	1	0	0
Switzerland	1	2	0	2	0	0
Ukraine	3	2	4	0	2	0
United Kingdom	8	1	5	1	1	0
United States of America	28	0	1	0	0	0

2.5. COMPUTERS AND AUDIO-VISUAL EQUIPMENT

Table 2.40. shows the number of reporting organizations within a country that utilize computers for the purposes identified in the survey. Most countries use computer-based training (CBT). CBT utilizes a PC system which permits the trainee to achieve a particular objective by answering questions or performing operations. This can be done by the trainee himself or with the help of an instructor. All facilities reported having the fundamental audio visual aids of white boards, overhead projectors, slide projectors, and flip charts. Most reporting organizations utilize video equipment while fewer utilize computer projection. A few organizations, predominantly in the United Kingdom and United States of America, utilize video conferencing .

TABLE 2.38. MECHANICAL MAINTENANCE TRAINING AIDS (AVAILABILITY IN EACH COUNTRY)

Country	Reactor Components	Steam Generator Components	RCP Or Recirculation Pump Components	Fuel Manipulation	Welding	Laser Alignment
Brazil	None	None	None	None	None	None
Bulgaria	Average	Average	Average	None	None	None
Canada	Average	N/A	Average	Average	Average	Average
China	Average	Average	Average	None	None	None
Czech Republic	Average	Average	None	None	None	None
Finland	None	None	None	None	None	None
France	Extensive	Extensive	Average	Extensive	Average	None
Germany	Average	Average	Average	Extensive	Average	Average
Hungary	Average	Average	Average	Average	None	Average
Japan	Extensive	Extensive	Extensive	Extensive	Extensive	Average
Kazakhstan	None	None	None	None	None	None
Korea, Republic of	Average	Average	Average	Extensive	Average	None
Lithuania	None	Minimal	Minimal	Average	Average	None
Romania	Average	Average	Average	Average	Average	None
Russia	Average	Average	Average	Average	Average	Average
Slovakia	Average	Minimal	Average	None	None	None
Slovenia	Minimal	Minimal	None	Minimal	None	None
Spain	Average	Average	None	Average	None	Average
Sweden	Average	None	Average	Average	None	Average
Switzerland	Average	Average	Average	Average	Average	Average
Ukraine						
United Kingdom	Extensive	Average	Average	Average	Average	Average
United States of America	Extensive	Extensive	Extensive	Extensive	Extensive	Extensive

TABLE 2.39. ELECTRICAL MAINTENANCE TRAINING AIDS (AVAILABILITY IN EACH COUNTRY)

Country	Switchgear	RCP Motor	Control Rod Drive	Local Control Boards	Instruments	MOV Testing	Digital Control	NDE Equipment
Brazil	None	None	None	None	None	None	None	None
Bulgaria	Average	None	None	None	Minimal	None	None	None
Canada	Average	None	Average	Average	Average	Average	Average	None
China	None	None	Average	Minimal	Average	None	None	None
Czech Republic	None	None	None	None	None	None	None	None
Finland	Average	Average	Average	Average	Average	Average	Average	
France	Average	None	Average	Average	Average	Average	Average	Average
Germany	Average	Average	Average	Average	Average	Average	Average	Average
Hungary	None	None	None	Minimal	Minimal	Average	None	Average
Japan	Extensive	Average	Extensive	Extensive	Extensive	Average	Extensive	Extensive
Kazakhstan	None	None	None	None	None	None	None	None
Korea, Republic of	Average	None	Average	Average	Average	Average	Average	Average
Lithuania	None	None	Minimal	Minimal	Minimal	Average	Average	Average
Romania	Average	Average	Average	Average	Average	Average	Average	None
Russia	Average	Average	Average	Average	Average	Average	Average	Average
Slovakia	None	Average	None	None	None	None	None	None
Slovenia	None	None	None	None	None	None	None	None
Spain	None	None	None	None	Minimal	None	None	Average
Sweden	None	Average	None	Minimal	Minimal	None	None	None
Switzerland	Average	Average	Average	Average	Average	Average	Average	Average
Ukraine								
United Kingdom	Extensive	Average	Average	Average	Extensive	Extensive	Extensive	Average
United States of America	Extensive	Extensive	Extensive	Extensive	Extensive	Extensive	Extensive	Extensive

TABLE 2.40. NUMBER OF FACILITIES UTILIZING COMPUTERS FOR THE PURPOSES INDICATED

Country	CBT	Interactive Video	Training Database	Exam Generation	Student Records	Produce Training Material
Brazil	0	0	1	0	1	1
Bulgaria	1	1	1	1	1	1
Canada	3	1	3	2	3	3
China	1	0	2	1	2	2
Czech Republic	2	1	3	3	3	3
Finland	1	0	1	1	1	1
France	1	1	1	0	1	1
Germany	14	4	14	10	12	17
Hungary	1	1	1	1	1	1
Japan	10	3	4	8	6	8
Kazakhstan, Republic of	0	0	0	1	0	0
Korea, Republic of	1	2	3	1	3	3
Lithuania	1	0	1	1	0	1
Mexico	0	0	1	1	1	1
Romania	1	1	1	1	1	1
Russia	10	5	10	6	8	10
Slovakia	2	0	3	0	2	1
Slovenia	0	0	2	1	1	2
Spain	0	1	5	3	5	5
Sweden	1	0	5	3	5	6
Switzerland	2	0	3	2	1	4
Ukraine	5	0	0	0	0	0
United Kingdom	19	19	19	4	18	19
United States of America	18	14	24	22	24	24

PART III. COUNTRY REPORTS

1. INTRODUCTION

Each country report summarizes the survey responses from all organizations in that country which compiled the questionnaire. The country reports cover the training system, training programs for 12 job positions, training organizations and management role in training.

Each report contains the following:

(1) Summary and conclusion based on the information provided by the training organizations in that country.

(2) Description of the training system for that country.

(3) Description of the role of the regulatory body with respect to training.

(4) List of the positions for which training is available.

(5) Discussion of the co-operation between/among training organizations within the country.

(6) List of training organizations including contact points, recommended practices and availability of training to personnel from outside organizations and from other countries.

(7) Results on management roles and responsibilities, including training budgets and salaries.

(8) Results on the training programs for the 12 job positions including training settings and duration and the number of personnel participating in the training programs.

(9) Results on training organizations including training aids, training department and training centres staffing.

(10) Number and types of control room simulators.

(11) Mechanical and electrical maintenance training equipment available at the training organizations.

(12) Summary of computer and audio visual aids used for training.

1.1. SURVEY CONTACTS AND AVAILABILITY FOR TRAINING PERSONNEL FROM OTHER COUNTRIES

Responses were received from 102 NPP training departments and 29 training centres. Table 1.1. of Part I shows the total number of training organizations in each country which responded to the survey questionnaire.

Table 3.1. lists, for all responding training organizations in each country, the name of the training organization, the contact person, the contact person's telephone and fax numbers and the availability of training services and resources to outside organizations for all responding training organizations.

TABLE 3.1. CONTACTS AND AVAILABILITY FOR TRAINING PERSONNEL FROM OTHER COUNTRIES.

National Training Organizations			**Availability for Training Personnel from Other Countries**			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
Brazil	Angra NPP	Mr. Sergio Goncalves Mathias Tel: 55 243 623201 Fax: 55 243 623010	Yes	Yes	Yes	Yes
Bulgaria	Kozloduy NPP	Mr E.Vapirev Director of Kozloduy Training Centres Tel: (+359973) 7 3391 Fax: (+359973) 7 3670	Yes	Yes	Yes	Yes
Canada	Point Lepreau	Mr. Joseph J. McCarthy Tel: 1-506-659-2220 Fax: 1-506-659-2107	Yes	Yes	Yes	Yes
Canada	Western Nuclear Training Department	Mr. David McKenzie Tel: 1 519-361-4401 Fax: 1 519 361 5706	Yes	Yes	Yes	Yes
Canada	Eastern Nuclear Training Department	Mr. B. Harrison Tel: 1 905-839-1151 Fax: 1 905-839-1177	Yes	Yes	Yes	Yes
China, People's Republic of	Daya Bay	Mr. Liu Gexin Tel: 0755-3366566-3902 Fax: 0755-3365513	Yes	Yes	Yes	
China	Qinsham	Mr. Xi-You-Qin Tel: 0753-6023491-35010 Fax: 0753-6023491 36722	Yes		Yes	Yes
Czech Republic	Dukovany	Stanislav Valenta Head of Training Department Tel: +42 509 60 55 90 Fax: +42 509 92 24 18	Yes	No	No	Yes
Czech Republic	Temelin	Mr. Zdenek Casta Head of Temelin NPP Training Centres Tel: +420 334 4222 931 Fax: +420 334 4222 505	No	No	No	No
Czech Republic	NTC Brno	Mr. Roman Hajek Director of NTC Tel: +42 5 4522 2517 or +42 6012 22039 Fax: +42 5 4522 2068	Yes	Yes	Yes	Yes
Finland	Teollisuuden Voima OY (TVO 1-2)	Mr. Altti Lucander Tel: 358-38-381 3500 Fax: 358-38-381 3509	Yes	Yes	Yes	Yes
Finland	Imatran Voima OY Louiisa (1-2)	Me. Jusse Vaurio Tel: 358 19 5504700 Fax: 358 19 55 04435	Yes	Yes	Yes	Yes

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
France	All	Mr. J. C. Hazet Tel: 003302 3557 8656 Fax: 003302 3557 8605	Yes	Yes	Yes	Yes
Germany	RWE Energie AG Nuclear Power Plant Biblis	Contact: Herrn Dipl.-Ing. Ralph Reuhl Tel: +49 6245 21 4152 Fax: +49 6245 21 3180	Yes with conditions	Yes with conditions	Yes with conditions	Yes with conditions
Germany	HEW Kernkraftwerk Brunsbüttel Gmbh	Herrn Dipl.-Ing. Manfred Sickert Tel: +49 4852 89 2270 Fax: +49 4852 89 2209				
Germany	PreussenElektra Gemeinschaftskernkraftwerk Grohnde GmbH	Herrn H. Bohr Tel: +49 5155 67 2312 Fax: +49 5155 67 2380	Yes for OJT	No	No	No
Germany	Kernkraftwerk Isar 1	Herrn Robert Graf Tel: +49 8702 99 2214 Fax: +49 8702 99 2461				
Germany	Kernkraftwerk Obrigheim GmbH	Herrn Dipl.-Ing. F. Wensing Tel: +49 6261 65 501 Fax: +49 6261 65 390				
Germany	Kernkraftwerk Philippsburg GmbH Unit 1	Herrn Dipl.-Ing. Heiko Tabbat Tel: +49 7265 95 2299 Fax: +49 7256 95 2029				
Germany	Kernkraftwerk Philippsburg GmbH Unit 2	Herrn Dipl.-Ing. Martin Leverenz Tel: +49 7256 95 4554 Fax: +49 7256 95 2029				
Germany	Preussen Elektra Kernkraftwerk Unterweser	Herrn Dipl.-Ing. Bernd Spindler Tel: +49 4732 80 2577 Fax: +49 4732 8661				
Germany	Preussen Elektra Kernkraftwerk Brokdorf	Herrn Rietz Tel: +49 4829 75 2427 Fax: +49 4829 1666				
Germany	Kernkraftwerke Gundremmingen Betriebsgesellschaft mbH KRB II, Unit B and Unit C	Herrn Dipl.-Ing. Alfred Leinauer Tel: +49 8224 78 2150 Fax: +49 8224 78 2900	Yes	Yes	No	Yes
Germany	Kernkraftwerk Krümmel	Herrn Thurm Tel: +49 4152 15 2272 Fax: +49 4152 15 2099				
Germany	KSG Kraftwerks-Simulatorgesellschaft mbH / GfS Gesellschaft für Simulatorschulung mb	Herrn Dr.-Ing. Eberhard Hoffman Tel: +49 201 4862 108 Fax: +49 201 4862 290	No	Yes	No	Yes

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
Germany	Siemens AG KWU-Training Centre Karlstein	Herrn Dipl.-Phys. D. Gronau Tel: +49 6188 780 750 Fax: +49 6188 780 803	Yes	Yes	Yes	Yes
Germany	CAG Technologie Management Consultants Greifwald GmbH	Herrn Dipl.-Ing. Peter Reibert Tel: +49 3834 803 219 Fax: +49 3834 803 213	Yes	Yes	Yes	Yes
Germany	Forschungszentrum Karlsruhe Fortbildungszentrum für Technik und Umwelt	Herrn Dipl.-Ing. Dieter Schrammel Tel: +49 7247 82 3252 Fax: +49 7247 82 4857	Yes	Yes	Yes	Yes
Germany	Kraftwerksschule E.V.	Herrn Dipl.-Ing. Uwe Möller Tel: +49 201 8489 150 Fax: +49 201 8489 102				
Germany	Fachhochschule Ulm	Herrn Dipl.-Ing. Dietrich Ade Tel: +49 731 502 8214 Fax: +49 731 27649				
Hungary	Paks Nuclear Power Plant	Mr. Kálmán Babos, Head of Maintenance Training Centres Paks NPP Mr. Istvan Kiss Tel: +36 75 317 628 Fax: +36 155 1332	Yes	Yes	Yes	Yes
Japan	Hokkaido Electric Power Co. Tomari - 1-2	Mr. Toshihaki Kudo, General Manager Tel: 0135 75 3331, 4330 Fax: 0135 75 3069				
Japan	Tohoku Electric Power Co. - Onagawa 1-2	Mr. Junji Yamaki, Manager Tel: 0222 225 2792 Fax: 022 217 3567				
	Tokyo Electric Power Co. - Fukushima Daiichi 1-6	Mr. Takayoshi Tone, Manager Tel: 03 3501 8111 Fax: 03 3596 8538				
	Chubu Electric Power Company - Hamaoka 1-2	Mr. Yukio Ogura, Training Manager Tel: 0537 86 3481 Fax: 0537 85 4985				
	Hokuriku Electric Power Company - Shika - 1	Mr. Hideo Tabata, Manager Tel: 0764 33 9431 Fax: 0764 33 9963				
	Kansai Electric Power Co. Mihama 1-3, Takahama 1-3, Ohi 1-4	Mr. Hidekazu Shirasaki, Asst. Manager Tel: 06 441 8821 Fax: 06 443 2659				

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	Chugoku Electric Power Co. Shimane 1-2	Mr. Susumu Kugatani, Manager Tel: 082 242 6641 Fax: 082 244 1741				
	Shikolu Electric Power Co. - Ikata 1-3	Mr. Yasuhiro Saijo, Manager Tel: 0878 21 5061 Fax: 0878 25 3012				
	Kyusho Electric Power Co. - Genkai - 1-3	Mr. Takashi Saski, Manager Tel: 092 761 3031 Fax: 092 761 4622				
	Japan Atomic Power Company - Tsuruga 1-2	Mr. Fukuji Isbizaki, Manager Tel: 029 287 0111 Fax: 029 287 00112				
	NTC	Mr.Teiichi Yoshikawa, Managing Director Tel: 0770 23 5531 Fax: 0770 22 5662				
	BTC	Mr.Akira Kobayashi, Manager Tel: 0240 32 2795 Fax: 0240 31 0005				
Kazakhstan	Mangyshlak	Mr. Sergey Krechetov Tel: (007) 3272 639 364 Fax: (007) 3272 633 356	No	No	No	No
Korea, Republic of	Korea Atomic Energy Research Institute (KAERI)	Mr. In-Suk SUH, Vice President for Nuclear Training Tel: 82 42 868 2670 Fax: 82 42 861 5018/1395	Yes	Yes	Yes	Yes
	Korea Electric Power Corporation (KEPCO)	Mr. Hae-Dong Kang, Manager Training Development and Planning Tel: 82 51 726 6310 Fax: 82 51 726 6214	Yes	Yes	Yes	Yes
	Korea Power Plant Service Co. Ltd. Nuclear Maintenance Training Centres	Mr. Jin-Hwan Koh, Manager Education and Training Tel: 82 2 2500-421 Fax: 82 2 2500-408	No	No	No	No

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
Lithuania	Ignalina NPP	Mr. N. Trefilov, Head of Training Department Tel: +37066 28806 Fax: +37066 60396	Yes	Yes	Yes	Yes
Mexico	Laguna Verde NPP Units 1 and 2	Mr. Jesus Antonio Perez Gomez LVNPP Training Manager Tel:52 297 4 07 00 Ext. 1121 Fax:52 297 4 07 00 Ext. 1122 E-mail: aperezg @ cfe.gob.mx				
Romania	Cernavoda NPP	Mr. A. Silviu Idita, Training Manager Tel: +40 (41) 239 052 Fax:+40 (41) 239679 E.mail: cnts.cernavoda @logic.sprint.com	Yes	Yes	Yes	Yes
Russian Federation	Balakovo NPP	Mr. S. Berdjugin, Deputy of NPP Chief engineer in personnel training Tel: (007) 845 70 37542 Fax:(007) 845 70 32637	Yes	Yes	Yes	Yes
Russian Federation	Beloyarsk NPP	Mrs. L. Skryabina, Head of Training Department Tel: (007) 343 77 36251 Fax:(007) 343 77 31070	Yes	No	Yes	Yes
	Kalinin NPP	Mr. J. Kuchersky, Head of Training Department Tel: (007) 082 55 68822 Fax:(007) 082 55 44591	No	No	No	No
	Kola NPP	Mr. L. Kumkov, Head of Training Department Tel: (007) 815 32 682220 Fax:(007) 815 32 68140	No	No	No	No
	Kursk NPP	Mr. V. Galberg Deputy of NPP Chief engineer in personnel training Tel: (007) 071 31 46643 Fax:(007) 071 31 40629	Yes	No	No	Yes
	Leningrad NPP	Mr. M. Chudyakov Head of Human Factor Department Tel: (007) 812 69 62429 Fax:(007) 812 69 62429	Yes	Yes	Yes	Yes
	Novovoronege NPP	Mr. V. Gonchar Chief specialist of Training Department Tel: (007) 073 64 73163 Fax:(007) 073 64 73302	No	No	No	No
	Smolensk NPP	Mr. A. Kaigorodov Head of Training Department Tel: (007) 081 53 71580 Fax:(007) 081 53 71925	Yes	Yes	Yes	Yes

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	Novovoronege TC of Atomtechenergo	Mr. A. Ivanchenco, TC Chief Engineer Tel: (007) 073 64 20701 Fax:(007) 095 564 8154	Yes	Yes	Yes	Yes
	Smolensk TC of Atomtechenergo	Mr. J. Trigub, TC Director Tel: (007) 081 53 71507 Fax:(007) 081 53 71925	Yes with conditions	Yes with conditions	Yes	Yes
Slovakia	Mochovce 1,2 NPP	Mr Sabik Stefan *Tel: (421) 813 363582* Fax: (421) 813 391 120	No	No	No	No
	Bohunice	Mr Malovec Jan Tel: (421) 80521301 Fax: (421) 80524467	No	No	No	No
	Training Centre of NPP Research Institute Trnava Inc., VUJE	Ms.Marta Ziakova Tel: +421 805 569614 or +421 80546578 Fax: +421805569640 or 421 805501242	Yes	Yes	Yes	Yes
Slovenia	Nuclear Power Plant KRŠKO	Mr. Franc Pribozic Training Manager Tel: 386-608-22-410, 386-608-21 ext. 386 Fax: 386-608-21-528				
	Josef Stefan Institute	Mr. Andrei Stritar, Head Tel: +386 61 1885 363 Fax: +386 61 374 688	Yes	Yes	No	Yes
Spain	Central Nuclear de Almaraz	Mr. José María Gómez de la Torre Tel: 34 27 50 90 ext: 2048 Fax: 34 27 54 41 96	No	No	No	No
	C.N. José Cabrera	Mr. Luis Jaime Serrano Tel: 34 1 5212875 Fax: 34 1 521871	No	No	No	No
	ASCO	Mr. José María Isach Tel: 34 77 405000 Fax: 34 77 405 5181	No	No	No	No
	Trillo	1Mr. Julio Benavides Tel: 34 49 81 000 Fax: 34 49 81 0726	No	No	No	No
	Tecnatom S.A.	Mr. Francisco Martí Alarcó Tel: 34-1-6516700 Fax: 34-1-6541531	Yes	Yes	Yes	Yes
Sweden	Barsebäk Kraft AB	Ms. Eva Johansson, Training Manager Tel: +46 72 40 00 Fax: +46 72 37 43	No	No	No	No

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	Forsmarks Kraftgrupp AB	Mr. Stig Persson, Training Manager Tel: +46 173 81 000 Fax: +46 173 55 116	Yes	Yes	Yes	Yes
	Oskarohamns Kraftgrupp AB	Mr. Tomas Olofsson, Training Engineer Tel: +46 491 86 792 Fax: +46 491 86 745	No	No	Yes	Yes
	Vattenfall AB, Ringhals Unit 1	Mr. Per Gunnar Ceder, Operation Manager Tel: +46 340 66 71 00 Fax: +46 340 66 80 00	No	No	No	No
	Vattenfall AB Ringhals Unit 2	Mr. Lars Ottosson, Operation Manager Tel: +46 340 66 72 00 Fax: +46 340 66 80 00	No	No	No	No
	Vattenfall AB Ringhals Unit 3-4	Mr. Bengt Ljungquist, Training Manager Tel: +46 340 66 74 92 Fax: +46 340 66 73 05	No	No	Yes	Yes
	Nuclear Training and Safety Centres	Lars Erikson, Manager, Marketing and Development Tel: +46 155 26 35 00 Fax: +46 155 26 30 74	Yes	Yes	Yes	Yes
Switzerland	Mühleberg	Ulrich Ryf, Training Manager Tel: 031 754 7111 Fax: 031 754 7120	No	No	No	No
	Gösgen	Tel: 41 62 288 2001	No	No	No	No
	Leibstadt	Niklaus Hugentobler, Training Manager Operation Tel: 056 267 71 11 Fax: 056 247 14 37	No	No	No	No
	Beznan	Eberhard Wyrsch, Field Operator Tel: 056 266 73 53 Fax: 056 266 77 01	No	No	No	No
Ukraine	Rovno NPP	Mr. O. Fedorov, Head of Training Department Tel: (0038) 03636 62054	No	No	No	No
	South - Ukrainian NPP	Mr. S. Vybornov, Head of Training Department Tel: (003) 8 051 36 44504 Fax:(003) 8 051 23 50050	No	No	Yes	Yes

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	Chernobyl NPP	Mr. D. Ovcharenko, Deputy Head of Training Department Tel: (003) 8 294 42056	Yes	Yes	No	Yes
	Khmelnitsky NPP TC	Mr. V. Banchik, Head of Training Centre Tel: (003) 8 038 48 3656	Yes	Yes	No	Yes
	Zaporozhye NPP TC	Mr. S. Popov, Training Centres Manager Tel: (003) 8 061 39 36314 Fax:(003) 8 061 39 32099	Yes	Yes	Yes	Yes
United Kingdom	Bradwell Power Station	Mr. S. Butcher, Training & Development Officer Tel: 01621 873230 Fax: 01621 873299	Yes	Yes	Negotiable	Negotiable
	Hinkley Point 'A' Power Station	Mrs. Hayley Atkin, Head of Training & Development Tel: 01278 65445 Fax: 01278 654215	No	No	No	No
	Oldbury Power Station	Mr. Peter R. Hardman, Training Engineer Tel: 01454 416631 Fax: 01454 893733	No	No	No	No
	Sizewell 'A' Power Station	Mr. S. Jefferies, Training Engineer Tel: 01728 653484 Fax: 01728 653520	No	No	Yes	Yes
	Trawsfynydd Power Station	Mr. Colin Digweed, H.R. (Training) Tel: 017 665 43356	No	No	No	No
	Wylfa Power Station	Mr. Gordon M. Warren, Training Officer Tel & Fax: 01407/733387 Fax: 01407/733264	No	No	Yes	Yes
	Dungeness B Power Station	Mr. S.A. Johnson Tel: 01797 343345 Fax: 01797 343006	No	No	No	No
	Hartlepool Power Station	Mr. I. Emmerson, Training & Development Officer Tel: 01429 853342 Fax: 01429 853398				
	Heysham 1 Power Station	Mr. Ian McMinn, Section Head Training & Development Tel: 01524 8633246 Fax: 746 3246, 01524 855104	Yes	Yes	No	Negotiable

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	Heysham 2 Power Station	Mr. John Klotz, Training & Development Officer Tel: 01524 863890 Fax: 01529 863589	No	No	No	N/A
	Hinkley 'B' Power Station	Mr. N. Skelton Tel: 44 (0) 1278 654231 Fax: 44 (0) 1278 654389	No	No	No	N/A
	Sizewell B Power Station	Mr. R.W. Pooley, Training Section Head Tel: 01728 653261 Fax: 01728 653260	Yes	Yes	No	Yes
	Hunterston B	Mr. Ian Shaw, Training Engineer Tel & Fax: 01294 822311	Yes	Yes	Yes	Yes
	Torness Power Station	Mr. K. Barbary, Training Engineer Tel: 01368 8 63500	Yes	Yes	Yes	Yes
	British Nuclear Fuels	Mr. Chris Marlton-Thomas Tel: 01772 764154 Fax: 01772 763444	Yes	Yes	Yes	Yes
	Oldbury Training Centre, Nuclear Electric Limited	Mr. E.G. Bridges, Group Head, Training Development & Delivery Tel: 01454 422215 Fax: 01454 422332	Yes	Yes	Yes	Yes
	Cliff Quay Training Centre	Mr. G. Hodges, Principal Tel: 01473 292102 Fax: 01473 292111	Yes	Yes	Yes	Yes
	Agecroft Training Centre	Mr. C.D. Fowler, Training & Development Manager Tel: 01454 422257 Fax: 01454 422332	Yes	Yes	Yes	Yes
	Oldbury Training Centre , Magnox Electric plc	Mr. John Foulkes, Technology Training Team Leader Tel: 01454 422243 Fax: 01454 422330	Yes	Yes	Yes	Yes
USA	Energy Operations Inc., Waterford 3, James Cain, energy Education Centres	Mr. J.M. O'Hern, Training Manager Tel: 504 739 6000 Fax: 504 739 6007	Yes	Yes	Yes	Negotiable
	Entergy Operations, Inc., Grand Gulf Nuclear Station, Unit 1	Mr. Marion A. Dietrich, Manager Tel: (601) 437-9689 Fax: (601) 437-6363	Negotiable	Negotiable	No	Negotiable

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	Houston Lighting & Power Company, South Texas Project Elec. Generating Station, Nuclear Training Department	Mr. L. Glen Weldon Tel: 512-972-8365 Fax: 512 972 7797	Yes	Yes	Yes	Negotiable
	Commonwealth Edison Company, La Salle Training Department	Mr. Thomas C. Johnson, Projects Leader Tel: 815 357 6761 Ext. 1997 Fax: 815 357- 6761, Ext. 2048	Negotiable	Negotiable	Negotiable	Negotiable
	Washington Public Power Supply System Plant Support Facility (Training Centres)	Mr. William D. Shaeffer Tel: (509) 377 8266 Fax: (509) 377 8662	Yes	Yes	Yes	Yes
	Carolina Power and Light Co. Brunswick NP	Mr. George P. Barnes, Manager - Training Tel: 910 452 2197 Fax: 910 457 2803	Negotiable	Yes	Negotiable	Negotiable
	Carolina Power and Light Company, Harris Energy & Environmental Centres	Mr. Joe Collins, Harris Training Section Manager Tel: (919) 362 3332 Fax: (919) 362 3446	No	No	Yes	No
	Union Electric, Callaway Plant	Mr. Mark J. Milawski, Supervisor Tel: 573-676 8409 Fax: 573 676 4481	Yes (must be proficient in the English Language	Yes (must be proficient in the English Language	Negotiable	Negotiable
	Duquesne Light Company, Beaver Valley Power Station, Nuclear Training Centres	Mr. Ernest Chatfield, General Manager Tel: 412 393 5710 Fax: 412 393 5933	Yes	Yes	No	Yes
	Southern California Edison San Onfré Nuclear Generating Station, Units 2 & 3, Nuclear Training Division	Mr. Scott Wylie, Training Specialist Tel: (714) 368 8445 Fax: (714) 368 8996	No	No	No	NA
	Florida Power Corporation, Crystal River Unit 3	Mr. Rolf C. Widell, Director: Nuclear Operations Training Tel: 352 563 4529 Fax: 352 563 4620	Yes	Yes	No	Negotiable

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	New York Power Authority, Indian Point 3	Mr. Dale Spoerry, Training Manager Tel: 914 736 8901 Fax: 914 736 8943	No	No	No	NA
	Rochester Gas & Electric Corporation, R.E. Ginna, Nuclear Training	Mr. Gary D. Meier, Department Manager Tel: 716 771 6622 Fax: 716 724 8263	Yes	Yes	Yes (For short duration only)	Negotiable
	Arizona Public Service Co. Palo Verde Nuclear Generating Station, Nuclear Training Department	Mr. John C. Velotta Director Tel: 602 393 1785 Fax: 602 393 2487	Yes	Yes	Yes	Yes
	Pennsylvania Power and Light Co. Susquehanna Training Centres	Mr. William H. Lowthert, Manager Tel: 717 542 3328 Fax: 717 542 7017 or 717 542 3855	Yes	Yes	Yes	Yes
	IES Utilities Duane Arnold Energy Centres Training Centres	Mr. Keith Young, Training Manager Tel: 319 851 7229 Fax: 319 851 7571	Yes	Yes	Yes	Yes
	Duke Power Co. McGuire Nuclear Station	Mr. Lee N. Fester, Training & Technology Support Supervisor Tel: 704 875 4161 Fax: 704 875 4329	Yes	Yes	Negotiable	Yes
	GPU Nuclear Oyster Creek Training Department	Mr. Don Stellhorn, Administrative Support Tel: 609 971 4183 Fax: 609 971 2110	Yes	Yes	Negotiable	Yes
	Wisconsin Public Service Kewanee Nuclear Power Plant	Mr. James S. Guay Superintendent Nuclear Training Tel: 414 388 2560 ext. 2436 Fax: 414 388 0819	Yes	Yes	Negotiable	Yes
	Omaha Public Power District Fort Calhoun Station	Mr. Richard Conner Tel: 402 533 6010 Fax: 402 533 6115	Yes	Yes	No	Negotiable
	Entergy Operations, Inc. Arkansas Nsuclear One	Mr. Robert Holeyfield Tel: 501 858 6938 Fax: 501 858 6820	Yes	Yes	No	Negotiable

National Training Organizations			Availability for Training Personnel from Other Countries			
Country	**Facility**	**Contact**	**NPP Personnel**	**Training Personnel**	**Loan personnel to other countries**	**Fee for Services**
	TU Electric Comanche Peak Steam Electric Station (CPSES)	TU Electric Comanche Peak Steam Electric Station (CPSES	Yes	Yes	Yes	Yes
	Tennessee Valley Authotity Browns Ferry Units 2 & 3	Mr. Robert P. Greenman Tel: 205 729 3470 Fax: 205 729 3419	Yes	Yes	No	Negotiable
	Commonwealth Edison Braidwood Station	Mr. John Walker Tel: 815 458 2801 Ext. 2375 Fax: 815 458 3803	Yes	No	Yes	Negotiable

2. BRAZIL

2.1. SUMMARY AND CONCLUSIONS

Training organizations

- Angra training centre can provide training to NPP personnel from other countries.
- Management is fully involved in the training process.
- Three per cent of the total operating budget is dedicated to training and the salary of trainers is to be the same as the plant position salary.

Training programs

- Good entry level requirements are asked for NPP personnel, but SAT methodology does not seem to be fully implemented in the training programs (job analysis).
- Big efforts have been realized on initial training for operations and maintenance personnel but maintenance continuing training needs improvements.

Training facilities

- Physical facilities are fully provided for the trainees as well as for the trainers.
- Number of trainers for operations training is quite enough but needs improvement in maintenance training.
- Computers are used for training. It would be profitable to use computer for training.

2.2. OVERVIEW OF NPP PERSONNEL TRAINING SYSTEM

2.2.1. Organization

- The Angra-2 training centre provides training to personnel from Siemens I KWU-design PWR NPPs. It has done so since 1985.
- Management is fully involved in the training process .
- Per cent of the total operating budget is dedicated to training and the salaries of trainers is about the same as the salaries for the plant operators .

2.2.2. Programs

- Good entry level requirements are required for NPP personnel, but SAT methodology has not been fully implemented in the training programs up to now.
- Initial and continuing training for operations personnel is performed according to the best international practices .
- Continuing training of maintenance personnel is performed on-the-job at the Angra-1 NPP, but needs improvement, which is currently being implemented.

- Training for Angra-2 personnel started in July 1996. Practical simulator training for such personnel is scheduled to start in June 1997 .

- Simulator training for the operations personnel of the Westinghouse-design 657 PWR Angra-1 NPP is performed at training centres in the USA and in Spain.

2.2.3. Facilities

- Use of computers in the training programs is adequate .

- A full-scope training simulator is available for the training of personnel for the Siemens 1 KWU-design 1300 MW PWR Angra-2 NPP.

- Training centres for Angra-l, Angra-2 and specifically for maintenance personnel are available at the site. However, an Angra-1 simulator and equipment for practical training of maintenance personnel are not yet available .

- Number of trainers for the training of operations personnel is adequate, but needs improvement for maintenance training.

2.2.4. Important aspects of the Brazilian system for NAP personnel training

Brazil has one nuclear power plant in operation (Westinghouse design 657 M PWR-type Angra-1 NAP, in commercial operation since 1985), a second one under construction (Siemens/KWU-design 1300 M PWR-type Angra-2 NAP, scheduled to reach first criticality in March 1999) and a third one for which about 60% of the components are already stored at the site, but civil construction has not yet started (Siemens/KWU-design 1300 M PWR-type Angra-3 NAP). These three plants are located in Angra dos Reis, about 150 km south of Rio de Janeiro .

The construction operation of these three NPPs are under the responsibility of the electrical utility FURNAS CENTRAIS ELÉCTRICAS SA.

The electric power supplied by FURNAS corresponds to about one third of the total consumption in Brazil and is generated by seven hydroelectric plants, three oil-fired plants and also by transmission lines operated by FURNAS which deliver energy generated by hydroelectric plants operated by other Brazilian utilities .

Three training centres are operated by FURNAS at the Angora site: the Angra-1 Training Centre, the Angra-2 Training Centre and the Maintenance Training Centre.

All training activities for the Angra-1 operation personnel are performed in the Angra-1 training centre, with the exception of simulator training for the licensed control room operators, which is performed at training centres in the USA and in Spain.

International co-operation and assistance have been extensively used during the first years of operation of the plant. Today all training modules are developed and updated by the utility staff. Most of the instructors come from the operational staff.

The training methodology is characterized by modules which follow international practices. The courses are provided for several categories of plant personnel. Table 3.1 shows the modules corresponding to six categories of personnel: licensed operators (SRO & RO), field operators, health physics, chemistry & radiochemistry, maintenance and general employees.

The Table 3.1 shows the most important modules provided by the Angra-1 Training Centre. Under the category of specific operator courses, the training centre offers about a hundred training modules for personnel in charge of maintenance activities (mechanical, electrical, I&C and QA/QC), as well as training in specific areas such as health physics (radiological protection) and non-licensed operators (field operators) .

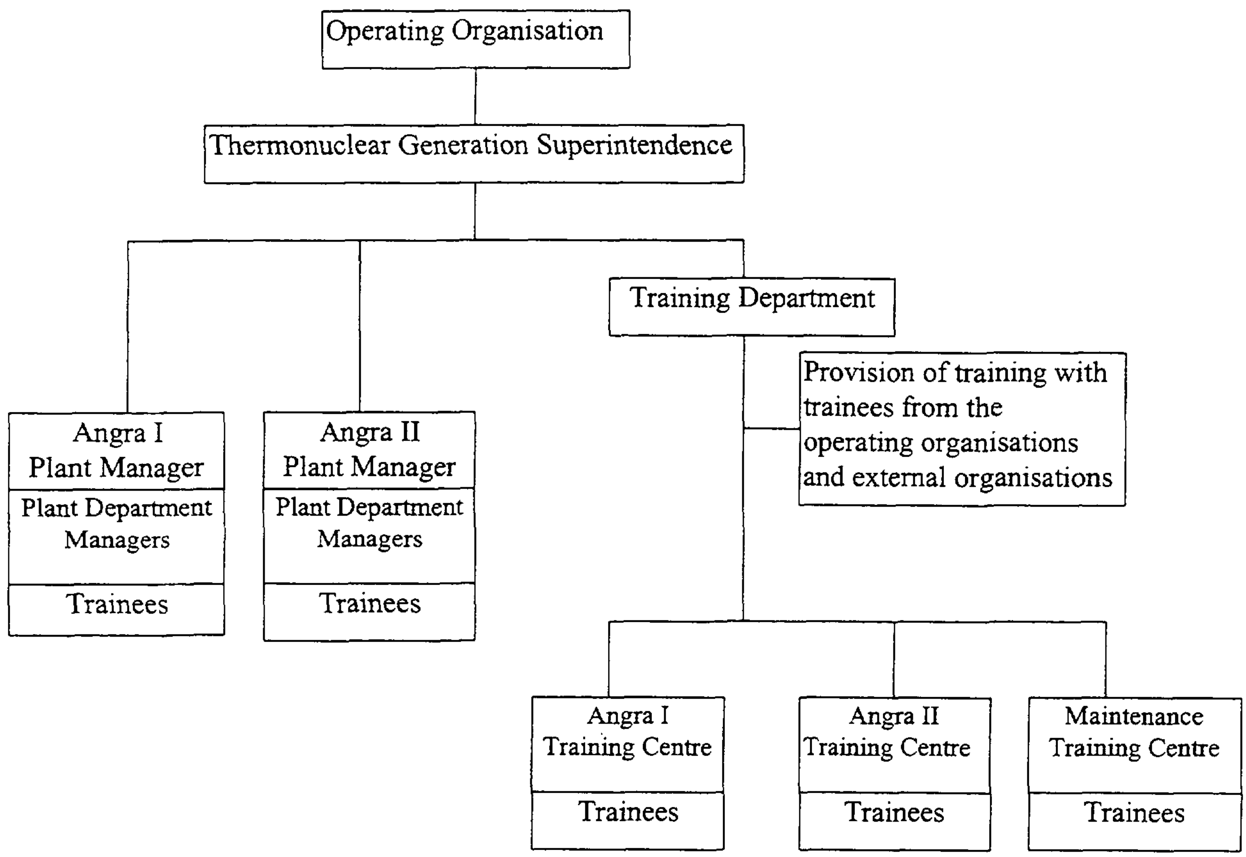


FIG. 3.1. Organizational arrangement for the training of NPP personnel in Brazil.

TABLE 3.1. NUCLEAR POWER PLANT PERSONNEL TRAINING - FURNAS CENTRAIS ELETRICAS S. A. - BRAZIL

MODULE/TRAINING	Licensed Operator	Non-Licensed Operator	Health Physics	Chemistry and Radiochemistry	Maintenance	General Employee
Nuclear Power Preparatory Training	●		●	●		
Thermal Plant Basic Operation Course		●		●		
Reactor Theory Course	●					
Licensed Operator Formation Course - NPP Basic Systems	●					
Research Reactor Operator Training Course	●					
Studies in Technical Specifications, Regulations and Procedures	●		●			
Emergency Procedures Studies	●		●			
Simulator Practices Studies	●					
Health Physics Course	●	●	●	●		
Shift Technical Advisor Course	●					
Specific Operator Courses (Aux. Panels, Turbine, Radwaste, etc.)		●	●	●		
Nuclear Plant Chemistry Course				●		
Nuclear Plant Radiochemistry Course				●		
General Employee Formation Basic Course	●	●	●	●	●	●
Physical Protection and Industrial Safety Course	●	●	●	●	●	●
Radiological Protection Basic Course					●	●
On-the-job Training (Specifics)	●	●	●	●	●	

For maintenance activities in the Angra-1 refueling outages, FURNAS usually contracts international companies to perform special services such as ECT in steam generator tubes and pressure vessel inspection .

The staffing of the Angra-1 training centre consists of 9 instructors, 8 specialists for some other technical activities and 14 administrative support persons .

Managers from different areas of the plant regularly deliver lectures, in classroom or at the plant installations, about operational practices as well as other subjects such as safety culture and PSA. This practice has proved to be very effective in allowing field managers to be adequately involved in the training programmes and in enhancing information exchange between workers assigned to several job positions.

The Angra-2 training centre was built in 1985 and houses a full-scope training simulator whose design reference is the Angra-2 NPP. The training programs for Angra-2 personnel started in July 1996 and practical simulator training for such personnel is scheduled to start in June 1997.

Since 1985 an extensive scope of courses for operators, managers and other specialists from a total of eleven NPP's and other organizations in Germany, Spain, Argentina and Switzerland is being provided by FURNAS with the utilization of the simulator and the Angra-2 Training Centre staff.

The provision of such courses for NPP operators from other countries results in the acquisition, by the FURNAS instructors, of considerable experience in the area of training of NPP operation personnel. This experience will be extremely useful for the qualification of the Angra-2 operators .

The staffing of the Angra-2 training centre consists of 1 instructors, 6 specialists for the operation and maintenance of the simulator, 6 specialists for some other technical activities and 5 administrative support employees .

The Maintenance Training Centre was inaugurated in July 1996. It presently consists of classrooms, meeting rooms and offices for the staff. A maintenance workshop is currently under construction and will be part of the maintenance training centre. The training of the maintenance personnel is presently performed as on-the-job training at the Angra-1 plant .

Computers and audio-visual aids are available in all three centres.

The training department is responsible for the activities of the three training centres. The head of the training department reports to the thermonuclear generation superintendence (see attached diagram). The budget of the training department is about 5 million dollars per year, and the average salary of the instructors is about US$ 4000.00 per month .

The National Nuclear Energy Commission - CNEN, which is the Brazilian Regulatory Body, is subordinated to the Strategic Affairs Secretary-SAE of the Brazilian government .

There are two categories of nuclear power plant personnel which are regulated by CNEN: licensed personnel (senior reactor operators SRO and reactor operators - RO) and health physics supervisors. For these two categories, CNEN sets up norms and regulations which require approval of training programs and certification through independent written and oral examinations. All the training activities related to those personnel are reviewed by CNEN. The licensed operators are required biannual retraining courses and their licenses are renewed every two years, after the programs applied are evaluated and approved by CNEN . Their requalification training programs with the utilization of full-scope simulators, however, are performed every year, at training centres located in the USA and in Spain .

FURNAS continually exchanges information with international organizations such as IAEA, INPO, WANO and VGB, in the areas of operational experience and guidelines related to training activities.

2.3. TRAINING ORGANIZATIONS

Training Centre (TC) responses for the survey

Angara NPP Training Centre

Contact: Mr. Sergio Gonsalvés Mathias
Tel: 55 243 623201
Fax: 55 243 623010

Training practices which could be recommended for application in other training organizations:

Practical training of NPP operation personnel using a full scope training simulator.

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

2.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
• Is there a plant or operating organization training policy document?	1	
• Does plant management routinely monitor training?	1	
• Is training audited by a non-regulatory organization external to training department?	1	
• Is plant management directly involved in establishing training needs?	1	
• Is management and supervisory skills training provided?	1	
• Is general safety training provided?	1	
• Is emergency preparedness training provided?	1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Budget

Three per cent of the total operating budget is spent on training, based on 1 surveys/answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions.

2.5. TRAINING PROGRAMS

2.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE	GE	TS	TS	GE/TS	GE/TS
Prerequisite years of experience for this program	3	3	3	-	-	-

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE/TS	GE/TS	GE/TS	GE/TS	GE	GE
Prerequisite years of experience for this program	-	-	-	-	-	-

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

2.5.2.Training methodology

Job Position **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic approach to training (SAT) is used		1		1		1		1		1		1
Job analysis is used to determine training needs		1		1		1		1		1		1
Training needs are used to design measurable training/learning objectives	1		1		1		1		1		1	
Training materials are based on training/learning objectives	1		1		1		1		1		1	
Training implementation involves assessment of whether training/learning objectives are achieved	1		1		1		1		1		1	
Evaluation is based on training goals. Feedback of needed improvements takes place	1		1		1		1		1		1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

2.5.2. Training methodology cont.

Job Position **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic approach to training (SAT) is used		1		1		1		1		1		1
Job analysis is used to determine training needs		1		1		1		1		1		1
Training needs are used to design measurable training/learning objectives	1		1		1		1		1		1	
Training materials are based on training/learning objectives	1		1		1		1		1		1	
Training implementation involves assessment of whether training/learning objectives are achieved	1		1		1		1		1		1	
Evaluation is based on training goals. Feedback of needed improvements takes place	1		1		1		1		1		1	

*Numbers indicate the numbers of plants and training centres responding as indicated

2.5.3. Initial training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	1700	1700	1600	500	1014	1262
Lab/workshop	60	60	60			
Process or control room simulator	60	60	60			
Self-study	1500	1500	1500	400		
Formal on-the-job training	1050	1050	1050	1050		
Total initial training	4370	4270	4370	1950	1014	1262

2.5.3. Initial training programs - settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	972	64	564	370	40	160
Lab/workshop						
Process or control room simulator						
Self-study						
Formal on-the-job training			160	72	184	
Total initial training	972	64	724	442	224	160

2.5.4. Continuing training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	120	120	120	40	24	24
Lab/workshop						
Process or control room simulator	60	60	60			
Self-study	70	70	70	70		
Formal on-the-job training				40		
Total continuing training	250	250	250	150	24	24

2.5.4. Continuing training programs - settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	24	24	24	24	24	24
Lab/workshop						
Process or control room simulator					36	
Self-study						
Formal on-the-job training						
Total initial training	24	24	24	24	60	24

2.5.5. Total number of personnel trained by training centres

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	1	2	2	25	22	15
Average annual number of persons who participate in continuing training 1991–1995	8	7	28	90	45	30

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	15	11	18	17	3	5
Average annual number of persons who participate in continuing training 1991–1995	35	18	22	17	20	10

2.6. TRAINING FACILITIES

2.6.1. Physical facilities

Training Centre

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1		14
Maintenance workshops	1		2
Radiation protection/chemistry labs	1		1
Other Labs/workshops	1		2
Simulator(s)	1		1
Self-study rooms	1		2
Library(ies)	1		1
Dedicated instructor offices/work space	1		15
Technical and training documentation area	1		3
Training material preparation Area	1		3
Large lecture room	1		1
Dining facilities	1		2
Student housing facilities	1		3

*Numbers indicate the numbers of plants and training centres responding as indicated.

2.6.2.Training department staffing

Training Centre

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	14	0	0
Maintenance	1	6	2
Radiation Protection	0	4	1
Chemistry	0	2	1
Other Instructors	0	0	0
Management and Support Staff			
Management	1	0	0
Simulator Support	1	2	1
Maintenance Support	0	4	1
Training Material Development	3	4	1
Education Specialist	1	0	0
Others	0	0	0

2.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Fullscope	Angra II		Trillo (Spain) Goesgen (Switzerland) Atucha (Argentina)	536

2.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel	N	N
	Reactor vessel head	N	N
	Reactor internals	N	N
	Control rod drive mechanism	N	N
Steam generator	Complete	N	N
	Primary side channel head	N	N
	Tube examination equipment	N	N
	Steam generator inspection manipulator	N	N
	Handling tools of manhole	N	N
Reactor coolant pump (or primary loop recirculation pump)	Internal part	N	N
	Pump shaft seal	N	N
	Pump body	N	N
Main gate valve	Internal part	N	N
	Body	N	N
Fuel manipulator equipment	Manipulator crane	N	N
	Dummy fuel	N	N
	Fuel-handling tools	N	N
	Fuel-loading simulator	N	N
Pumps		N	N
Valves		N	N
Supporting structures		N	N
Welding-practice equipment		N	N
Compressor	Instrumentation air compressor	N	N
Laser alignment		N	N
Other		N	N

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		N	N
Reactor coolant pump motor		N	N
Control-rod drive mechanism control system		N	N
Control boards at electrical control room	Rod position indicator	N	N
	Reactor control and protection rack	N	N
	Protective relay system	N	N
	Ex-core nuclear instruments	N	N
	In-core nuclear instruments	N	N
	Generator automatic voltage regulator	N	N
	Constant voltage constant frequency power source	N	N
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	N	N
	Radiation measurement equipment	N	N
	Controller	N	N
	Other	N	N
Measurement system for motor-operated valves		N	N
Digital control device		N	N
Other		N	N
Common			
Non-destructive testing equipment		N	N
Transparent power plant	See-through	N	N
	Functional	N	N
Other		N	N

*Numbers correspond to the NPP or TC listed in Part II.

2.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training		1
Interactive video		1
Establishing and maintaining training database	1	
Generating examinations		1
Keeping student records	1	
Production of training materials	1	

Visual aids available at facility

	Yes*	No*
Whiteboards	1	
Overhead Projectors	1	
Slide projectors (such as 35mm)	1	
Flip charts	1	
Video equipment	1	
Computer liquid crystal display panel or computer projector		1
Video conferencing		1

*Numbers indicate the numbers of plants and training centres responding as indicated.

3. BULGARIA

3.1. SURVEY SUMMARY AND CONCLUSIONS

Training organization

The possibility to provide training for NPP personnel from organizations in other countries exists at NPP.

Unique training facilities: none were noted in answers.

Among the training practices which could be recommended for use in other organizations: CBT for maintenance personnel.

Average training budget was not included in the response.

Plant management is directly involved in directing and monitoring training.

The salary of trainers is the same or lower than the plant position salary.

Training programs

Systematic approach to training is used for training programs for job positions but job analysis is not used to determine training needs.

Training programs are based on a GE on TS degree entry level.

Simulator training is conducted in other countries.

The total average annual number of persons in initial and continuing training were only provided for control room operators.

Training facilities

Physical facilities are exist on NPP as indicated. Quantity of staff in TC is equal to 56 including 17 instructors.

Full scope simulator and multifunctional simulator are now under construction.

A laboratory for maintenance training are under development.

Computers and audio visual aids are used for training process and are available at facilities.

Conclusion

The upgrading of NPP personnel training is now progressing. In 1997–98 the construction of WWER-1000 full scope simulator and WWER-440 multifunctional simulator will be completed.

3.2. OVERVIEW OF NPP PERSONNEL TRAINING SYSTEM

3.2.1. Organizations

Utilities and ownership

There is one NPP in Bulgaria, located in Kozloduy. 6 WWER units are situated at Kozloduy NPP (4 units WWER-440, 2 units WWER-1000). The owner of the NPP is National Electric Company (NEC), which is shareholders' company and 100% of shares are owned by the State. The owner's control over the NEC is exercised by the Government through the Ministry of Energy.

Organizations involved in training

Two departments in NPP are involved in training and qualification — Department of Personnel and Training Center.

Department of Personnel is responsible for:

- recruitment of new staff
- maintaining service and training records of staff
- control over the qualification
- evaluating qualification
- evaluating training needs
- periodic internal examinations of personnel
- preparing documents for licensing from regulatory body for several positions

Head of department reports to the plant manager

Training Center is responsible for:

- initial training of new recruited staff
- initial training of subcontractors' staff
- training and retraining of all personnel

Initial training is obligatory for all people working on site. Other types of training and retraining are provided upon request of Department of Personnel or Regulatory Body. Director of Training Center reports to the Plant Manager.

3.2.2. Role or regulator

Legal aspects

The state control on adherence to criteria and requirements for training, qualification and certification of personnel working at nuclear facilities is exercised by the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) through the Inspectorate on the Safe Use of Atomic Energy. The rules of that control are described in:

(1) Law on the Use of Atomic Energy for Peaceful Purposes
(2) Regulations for the Enforcement of the Law
(3) Order No. 6 issued by the Committee on the Use of Atomic Energy for Peaceful Purposes.

Regulatory Body

The Regulatory Body is CUAEPP. There is a special inspector responsible for state control over the qualification. The inspectors have a power to check training and qualification of NPP personnel. Training programs and courses must be approved by Regulatory Body. The State Qualification Commission is appointed by the chairman of CUAEPP and includes members from following organizations:

- Regulatory Body
- Bulgarian Academy of Sciences
- Ministry of Health
- Ministry of Energy
- Sofia University
- Technical University

- National Electric company
- Kozloduy NPP

Secretary of the State Qualification Commission is responsible for maintaining examination records, issuing licenses, all documentation of the commission, etc. The Secretary is a member of the Commission, and usually he/she is inspector responsible for training and qualification.

Main principles of the state control

- The job descriptions for the personnel at NPP must be approved by CUAEPP.

- Education programs at the universities, high schools and training centers are under the supervision of CUAEPP.

- The program for training of operating personnel at NPP shall include training on full-scope simulators.

- License for work in nuclear energy field is issued by CUAEPP upon passing examination by State Qualification Commission for the following operating personnel:

  - reactor operator
  - plant shift supervisor and unit shift supervisor
  - shift supervisor in reactor department, I & C department, reactor control and protection systems department, radiation protection department
  - supervisor physicist.

For all other positions license is issued by the NPP, upon passing examination by NPP Qualification Commission

- Control over the qualification is exercised by CUAEPP through the site inspectors and inspector responsible for of training and qualification.

3.2.3. Training system overview

Basic education.

There are 4 levels of education in Bulgaria:

- primary school — 7 years
- secondary school (basic or technical) — 4–5 years
- technical high school — 2–3 years after secondary school
- university — 3–4 years for B.Sc. degree and 5–6 years for M.Sc. degree.

Graduating from secondary school is required for continuing education in technical high school or university.

Three educational organizations in Bulgaria are involved in basic education of NPP staff:

- Technical High School for Nuclear Engineering, based in town Kozloduy. Most of middle level operating personnel is coming from that school.

- Technical University of Sofia, Department of Nuclear Engineering.

- Sofia University “St. Kliment Okhridski”, Department of Nuclear Physics and Nuclear Engineering.

Most of high level management and operating personnel is coming from those universities or from equivalent ones in former Soviet Union.

Special education

There is only one special organization — Kozloduy Training Center, which is a part of NPP. This Center provides initial and specialized training and retraining for all NPP personnel. Initial training and retraining on full scope simulators for control room personnel is realizing in Russia (Novovoronege TC) and Ukraine (Zaporozhye NPP). Full-scope simulator for WWER-1000 reactors is under development in Kozloduy.

3.2.4. Training of maintenance personnel in Kozloduy NPP

Initial training of Kozloduy NPP maintenance personnel starts with computer-based training in safety, provided by Kozloduy TC. After knowledge testing, a maintenance person obtains a document giving permission for access to the working place.

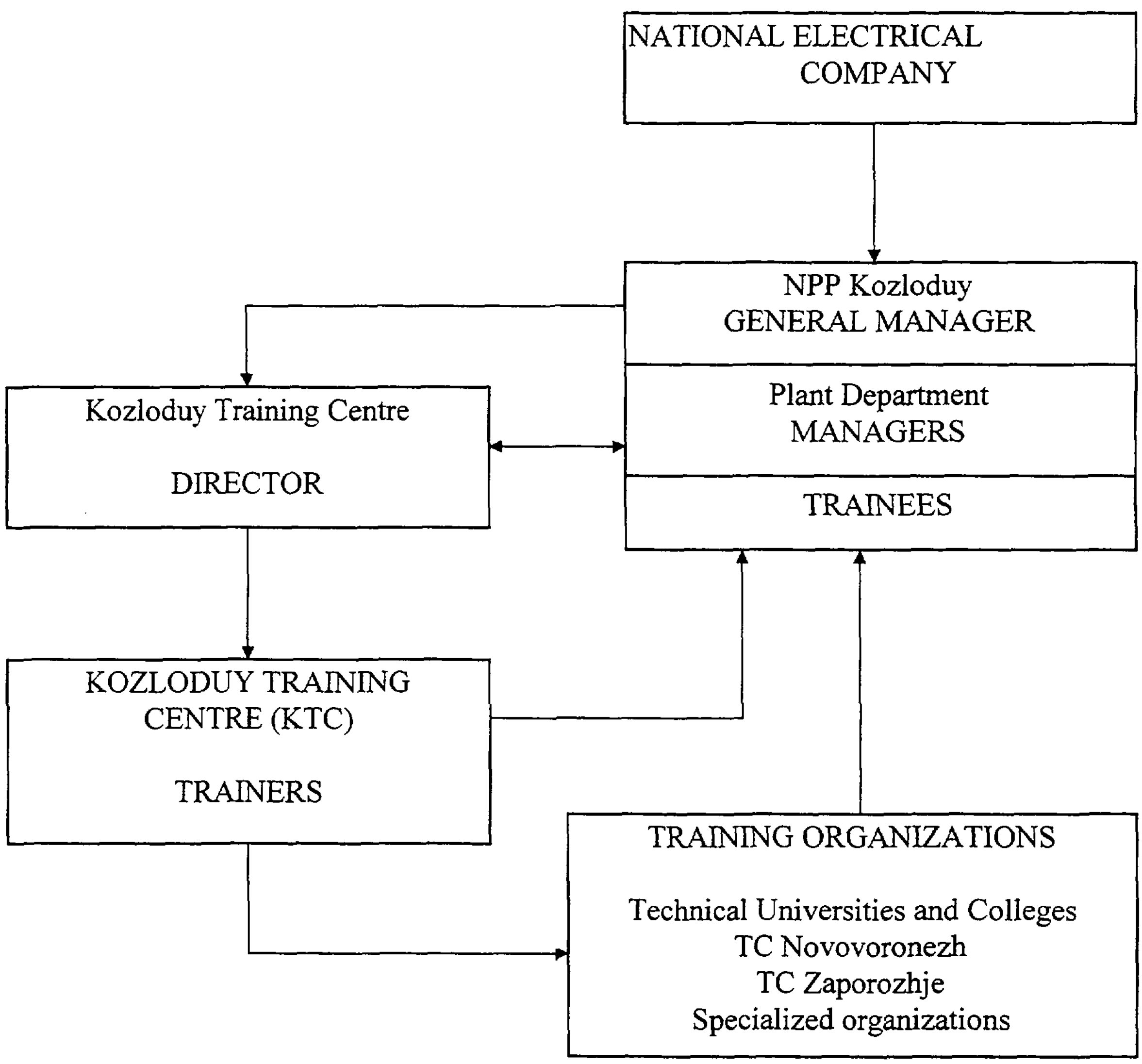


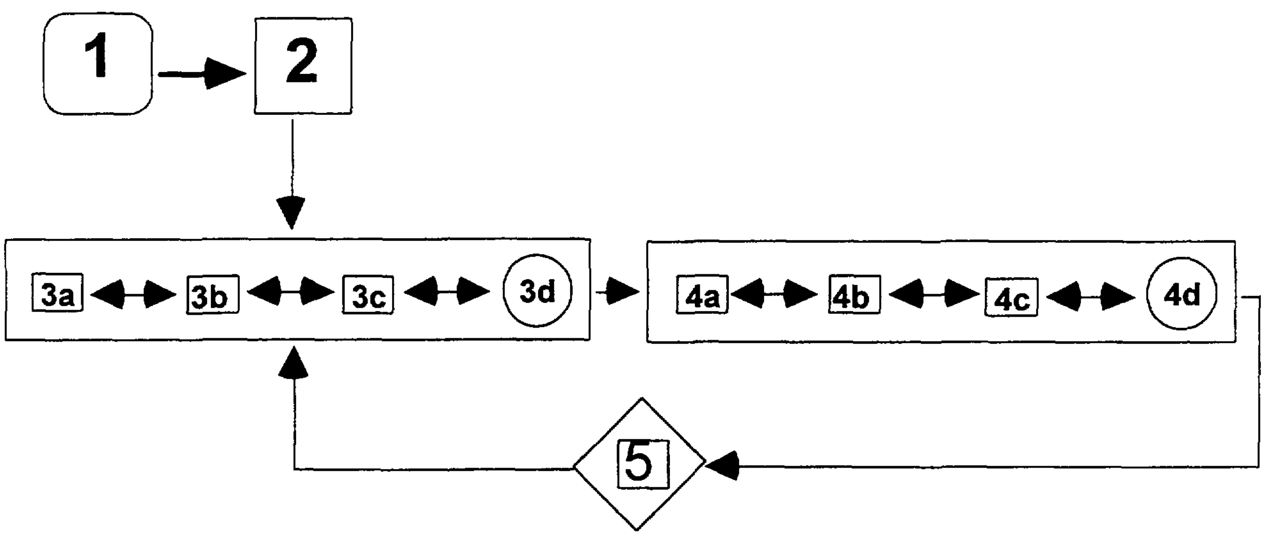
FIG. 3.2. NPP personnel training organization.

At the working place an on-the-job training is provided by experienced specialist assigned by top Management. Also, trainee passes self-study period including, if applicable, training on mock-ups and CBT. In KzTC are available two specialized CB courses for maintenance personnel, namely disassembling and assembling of the main shut-off valve and disassembling and assembling of the feed water pump. There is also a number of mock-ups which are to be used in support of classroom training and self-study. Presently two laboratories – for I & C and Mechanical maintenance personnel training are under construction in KzTC.

Initial training ends with examination by Utility Qualification Commission, giving a license for independent work.

Continuing training of maintenance personnel includes periodical training and knowledge testing in Radiation Protection, Industrial and Fire Safety, Regulations in force, as well as annual (20 hours per year) training within the frames of the so-called technical training year. The latter encompasses classroom training in important technical topics requested by the maintenance department and approved by the plant manager.

Kozloduy NPP personnel training system can be schematically represented as follows:



1 Selection and acceptance of the candidate; medical & psychophysiological examination
Entry training in safety for access to the plant site
2 Introductory training in Radiation Protection, Industrial and Fire Safety
Examinations for access to the working place
3 Initial training :
a. Classroom training and knowledge check-up
b. On-the-job training
c. Technical aids based training incl. simulators, mock-ups, etc. and testing of the acquired skills
d. Examination by the corresponding qualification commission and licensing
4 Continuing training :
a. Courses in safety and periodical knowledge testing in regulations
b. Courses in operational problems and knowledge testing
c. Technical aids based training, incl. simulators, mock-ups, etc. and skill testing
d. Examination by the licensing commission and re-licensing
5 Making a decision for training in order to move to a new position

FIG. 3.3. NPP personnel training model.

3.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Centre Responses for the Survey

1. **Kozloduy NPP**

Contact:
Mr E. Vapirev, Director of Kozloduy Training Center
Tel: (+359973) 7 3391
Fax: (+359973) 7 3670

Training practices which could be recommended for application in other training organizations:
CB - training for maintenance personnel

Availability of Training for Personnel from Organizations in Other Countries
NPP Personnel: Yes
Training Personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities
none noted in survey

3.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
• Is there a plant or operating organization training policy document?	1	0
• Does plant management routinely monitor training?	1	0
• Is training audited by a non-regulatory organization external to training department?	1	0
• Is plant management directly involved in establishing training needs?	1	0
• Is management and supervisory skills training provided?	1	0
• Is general safety training provided?	1	0
• Is emergency preparedness training provided?	1	0

Budget

Between N/A and N/A per cent of the total operating budget is spent on training, based on 1 survey answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions.
_____ *higher than the plant position salary
___1__ *the same as the plant position salary
___1__ *lower than the plant position salary

*Numbers indicate the numbers of plants and training centers responding as indicated

3.5. TRAINING PROGRAMS

3.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator**	Mechanical Maintenance**	Electrical Maintenance**
Education or certification prerequisite(s) for this program*	GE	GE	GE	TS	TS	TS
Prerequisite years of experience for this program	1 as Unit Supervisor	2 as Control Room Operator	2	2	-	-

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE or TS	GE	TS	TS	GE	GE
Prerequisite years of experience for this program	-	-	-	-	-	-

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma, SS = secondary school diploma].
**Program under development , certain courses prepared and conducted.

3.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1	0	1	0	1	0	1	0	1	0	1	0
Job analysis is used to determine training needs.	0	1	0	1	0	1	0	1	0	1	0	1
Training needs are used to design measurable training/learning objectives.	1	0	1	0	1	0	1	0	1	0	1	0
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training implementation involves assessment of whether training/learning objectives are achieved.	1	0	1	0	1	0	1	0	1	0	1	0
Evaluation is based on training goals. Feedback of needed improvements takes place.	1	0	1	0	1	0	1	0	1	0	1	0

* Numbers indicate the numbers of plants and training centers responding as indicated.

3.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1	0	1	0	1	0	1	0	1	0	1	0
Job analysis is used to determine training needs.	0	1	0	1	0	1	0	1	0	1	0	1
Training needs are used to design measurable training/learning objectives.	1	0	1	0	1	0	1	0	1	0	1	0
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training implementation involves assessment of whether training/learning objectives are achieved.	1	0	1	0	1	0	1	0	1	0	1	0
Evaluation is based on training goals. Feedback of needed improvements takes place.	1	0	1	0	1	0	1	0	1	0	1	0

3.5.3. Initial and continuing training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator*		Mechanical Maintenance*		Electrical Maintenance*	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	0	0–0	75	18–132	156	132–181						
Lab/Workshop	0	0–0	0	0–0	0	0–0						
Process or Control Room Simulator**	80	80–80	80	80–80	80	80–80						
Self–Study	922	922–922	1250	1082–1428	1503	1238–1769						
Formal On-the-Job Training	100	100–100	100		715	700–730						
Total Initial Training	1102	1102–1102	1505		2454	2150–2760						

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	40	40–40	40	40–40	40	40–40			20	20–20	40	40–40
Lab/Workshop	0	0–0	0	0–0	0	0–0			0	0–0	0	0–0
Process or Control Room Simulator	80	80–80	80	80–80	80	80–80			0	0–0	0	0–0
Self-Study	0	0–0	0	0–0	0	0–0			0	0–0	0	0–0
Formal On-the-Job Training	24	24–24	24	24–24	24	24–24			0	0–0	24	24–24
Total Continuing Training	144	144–144	144	144–144	1441	144–144			20	20–20	64	64–64

*Training program under development. ** Simulator training is realized: for units 1–4(WWER-440) in Russia (Novovoronezh TC);for units 5–6 (WWER-1000) in Ukraine (Zaporozhye NPP).

3.5.4. Total number of personnel trained by nuclear power plant training departments

Training Program / **Job position**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator*	Mechanical Maintenance*	Electrical Maintenance*
Average annual number of persons completing program 1991–1995	26	62	88			
Average annual number of persons who participate in continuing training 1991–1995	13	50	66			

Training Program / **Job Position**	Instrumentation & Control*	Quality Assurance /Quality Control*	Radiation Protection*	Chemistry *	Instructor Teaching Skills Training*	Simulator Instructor Skills Training*
Average annual number of persons completing program 1991–1995						

* Training program under development.

3.6. TRAINING FACILITIES

3.6.1. Physical Facilities

Nuclear Power Plant Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	11
Maintenance Workshops	0	1	0
Radiation Protection/Chemistry Labs	0	1	0
Other Labs/Workshops	0	1	0
Simulator(s)	1	0	2
Self Study Rooms	1	0	2
Library(ies)	1	0	1
Dedicated Instructor Offices/Work Space	1	0	7
Technical and Training Documentation Area	1	0	1
Training Material Preparation Area	1	0	2
Large Lecture Room	1	0	2
Dining Facilities	1	0	2
Student Housing Facilities	1	0	1

*Numbers indicate the numbers of plants and training centers responding as indicated.

3.6.2. NPP Training centre staffing

Nuclear Power Plant Training Centre

Numbers are the **average** for reporting facilities

	Number of Full Time Positions		Part Time Positions		
			Number	Full Time Equivalent	
Instructors					
Operations	5				
Maintenance	3				
Radiation Protection	2				
Chemistry	1				
Other Instructors	6				
Management and Support Staff					
Management	7				
Simulator Support	3				
Maintenance Support	7				
Training Material Development	5				
Education Specialist	1				
Others	16				

3.6.3. Control Room Simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full scope	unit 6 (1)	1	units 5,6 (1)	under construction
Analytical	unit 6 (1)	1	units 5,6 (1)	under construction
Basic Principles	unit 6 (1)	1	units 5,6 (1)	under construction
Multifunctional	unit 3 (1)	1	units 1–4 (1)	under construction

3.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		1
	Reactor vessel head		1
	Reactor internals		1
	Control rod drive mechanism		
Steam generator	Complete		1
	Primary side channel head		
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		
Reactor coolant pump (or primary loop recirculation pump	Internal part		1
	Pump shaft seal		
	Pump body		1
Main gate valve	Internal part		1
	Body		1
Fuel manipulator equipment	Manipulator crane		
	Dummy fuel		1
	fuel-handling tools		
	Fuel-loading simulator		
Pumps			1
Valves			1
Supporting structures			
Welding-practice equipment			
Compressor	Instrumentation air compressor		
Laser alignment			
Other			

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Switchgear equipment			
Reactor coolant pump motor			1
Control-rod drive mechanism control system			
Control boards at electrical control room	Rod position indicator system		
	Reactor control and protection rack		
	Protective relay system		
	Ex-core nuclear instruments		
	In-core nuclear instruments		
	Generator automatic voltage regulator		
	Constant voltage constant frequency power source		
Instruments	Transmitter (water level, pressure, flow, volume, etc.)		
	Radiation measurement equipment	1	
	Controller		
	Other		
Measurement system for motor-operated valves			
Digital control device			
Other	posters		1
Common			
Non-destructive testing equipment			
Transparent power plant	See-through		1
	Functional		
Other			

* Numbers correspond to the NPP or TC listed in Part II.

** Laboratory under development.

3.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer based training	1	0
Interactive video	1	0
Establishing and maintaining your training database	1	0
Generating examinations	1	0
Keeping student records	1	0
Production of training materials	1	0

*Numbers indicate the numbers of plants and training centers responding as indicated.

Visual aids available at facility

	Yes*	No*
White boards	1	0
Overhead projectors	1	0
Slide projectors(such as 35mm)	1	0
Flip charts	1	0
Video equipment	1	0
Computer Liquid Crystal Display panel or computer projector	1	0
Video conferencing	0	1

*Numbers indicate the numbers of plants and training centers responding as indicated.

4. CANADA

4.1. SURVEY SUMMARY AND CONCLUSIONS

Training organization

- NPP and TCs answering the questionnaire have the capability of providing training for NPP personnel from organization from other countries.
- Management is fully engaged in area such as training policy, training monitoring and safety training.
- Between 3 and 4% of the total budget is spent on training. Salary of trainers seems to be slightly higher than the same non-shift plant position.

Training programs

- Globally SAT methodology is used in training programs but not completely.
- High level of education is a pre requisite for training programs as well as experience.
- A large effort is provided on initial training for maintenance personnel.

Training facilities

- Plenty of facilities are provided in the training centres (mostly on maintenance).
- A large range of instructors is provided so the training is very diversified.
- Each training centre has a full scope simulator for each version of unit served by that facility.
- A wide range of mock-ups as well as real equipment is available for training.
- Training is also provided for computer applications.
- CBT is utilized for radiation protection continuing training.
- Fire fighting practice facilities are available.
- Supervisor training is provided.

4.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

4.2.1. Overall description of training system

4.2.1.1. Organizations and responsibilities

In Canada it is common practice to hire nuclear generating station (NGS) personnel directly from high schools, technical colleges and universities and to provide them with the training required to develop the unique and specialized knowledge and skills they need at utility training centres. A typical training organization at a multi unit NGS is shown in the flowchart attached.

Owner utility

Utility management is responsible for:

- establishing training policies

- ensuring that NGS staff are trained and qualified for their positions.

Training department or centres

Training department (or centre) responsibilities include:

- to assist NGS in determining their training needs,
- to design and develop the required training programs,
- to prepare course reference material,
- to organize training required by the NGS,
- to deliver programs to develop in trainees the knowledge and skills required for their assigned work in the plant,
- to evaluate training effectiveness and to report to NGS management

Ontario Hydro (OH) which has the largest nuclear power program in Canada, has an extensive, centralized organization responsible for developing and administering training. Utilities with a smaller nuclear program have, within their nuclear divisions, a training centre with essentially the same responsibilities.

An example of a training centre organization is shown on Fig.3.5.

Plant (Training department)

Line management in the plant is responsible for:

- ensuring that all staff have the required qualification to perform their assigned tasks,
- defining job performance expectations,
- preparing station specific course reference material,
- defining and approving the objectives of the various training programs,
- assessing the adequacy of the training programs,
- co-ordinating with the training centre or department delivery of on-the-job training.

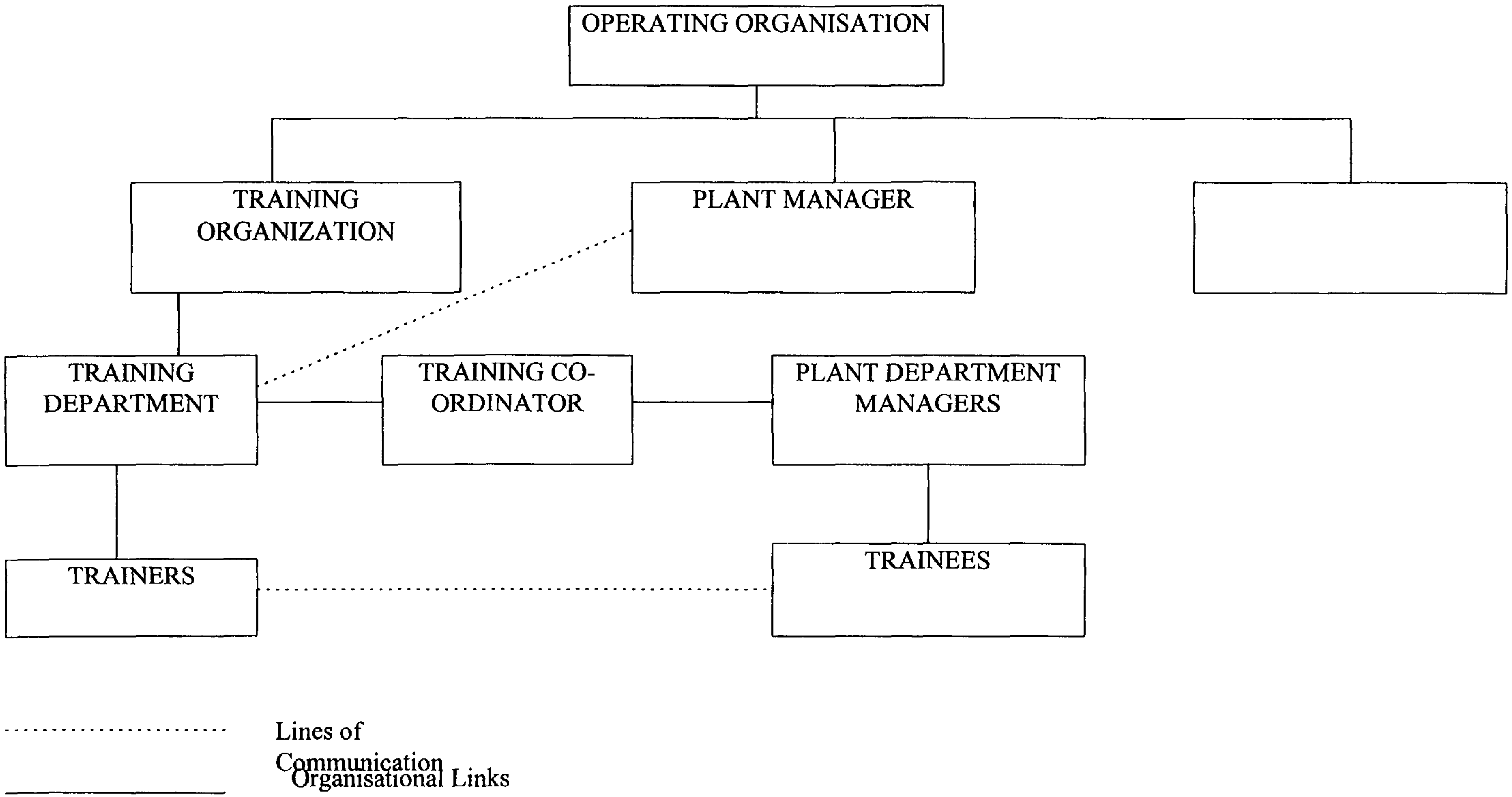


FIG.3.4. Organizational arrangement at multi-unit stations

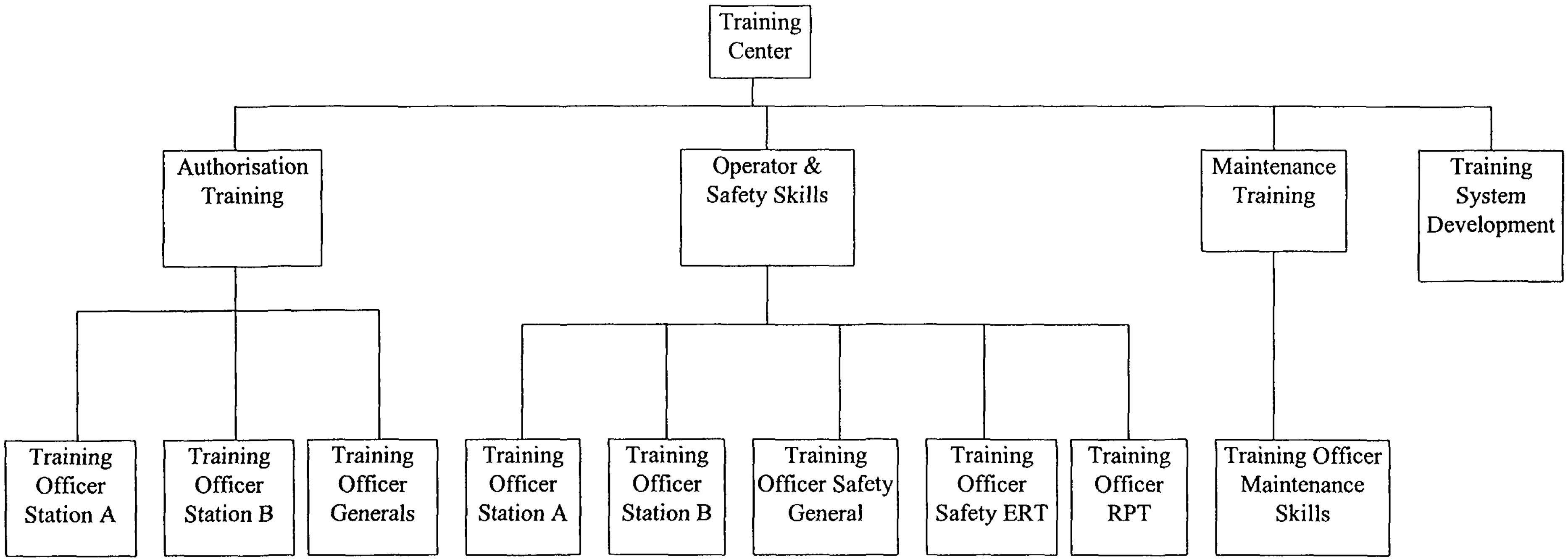


FIG.3.5. An example of a training centre organization.

Contractors

Use of contractor for training is not predominant. However, some utilities rely on local colleagues and universities to provide training in science fundamentals and equipment principles. Point Lepreau uses contract training for technical and maintenance staff and for instructor training.

4.2.1.2. Training methodology

Canadian nuclear utilities have accepted SAT as the best method to develop training programs for operations personnel at their NGS. Because of the resources needed to perform a formal job and task analysis, job requirements are often identified using what is referred to in the literature as "Job competencies analysis" and by referring to existing catalogues of knowledge, skills and attitudes required by operations personnel.

4.2.2. Role of the regulator in training

Since the introduction of nuclear power in Canada in the 1960s, the Atomic Energy Control Board (AECB) has been seeking assurance that senior control room staff candidates, namely shift supervisors (SSs) and control room operators (CROs) are initially well trained and adequately competent to perform their duties through an operator certification program. In addition to authorizing candidates to the SS and CRO positions, the AECB approves NGS staff organization and, specifically, the incumbents to the following positions:

- station manager,
- production manager,
- senior health physicist
- operation superintendent

4.2.2.1. Organization of regulatory body with respect to training

Within the AECB, the Operator Certification Division (OCD) has the specific responsibility of obtaining and documenting assurance that NGS operations personnel are initially well trained and adequately competent to perform their duties and that through continuing training and requalification their competence is maintained. The Division now comprises three sections, Examination, Training Program Evaluation and the Methodology and Standards sections, each having distinct functional responsibilities.

The Examination Section conducts regulatory examinations for the initial authorization of SS and CRO candidates at specific NGSs and participates in the audit of NGS administered requalification examinations.

The Training Program Evaluation Section conducts regulatory evaluations of initial and continuing training programs for NGS operations personnel, including audits of NGS administered written examinations for SS and CROP candidates.

The Methodology and Standards Section is responsible for defining and documenting COD methods for the assessment of the competence of authorized personnel and for the evaluation of operations personnel training programs. It is also responsible for defining the ACE requirements concerning knowledge and skills, training program contents and qualifications for NAGS operations personnel. It also reviews the adequacy of utility and NAGS policies and standards regarding training, examinations and qualification of operations personnel.

4.2.2.2. Functions

Certification

To acquire an initial SS or CRO authorization at a specific NGS, candidates to these positions must successfully complete a training program which meets standards acceptable to the AECB. They are also required to obtain passing grades in the written and simulator-based regulatory examinations held by the AECB.

Written Examinations:

SS and CRO candidates are required to take a common, comprehensive written regulatory examination covering topics relevant to both positions in science fundamentals and equipment principles, in design and operation of station-specific systems and in radiation protection. Furthermore, SS candidates are required to take an additional, written regulatory examination addressing knowledge unique to the SS position. The written regulatory examinations are based on documented curricula and training objectives acceptable to the AECB and defined in NGS training documentation.

At Point Lepreau, the regulator does not set on examination for Radiation Protection, but rather monitors the program quality.

To maintain their authorization SS and CRO incumbents are required to:

- successfully complete a continuing training program;
- successfully complete periodic formal requalification examinations conducted by the NGS.

Review of Training Activities

- Initial and continuing training programs for SS and CRO candidates and for selected NGS positions (including shift crew members other than SSs and CROs) are subject to scheduled regulatory evaluations.
- Examinations which are prepared and graded by a NGS to verify the competency of SS and CRO candidates are subject to periodic regulatory audits.
- Requalification examinations are periodically audited.

4.2.3. Specific positions for which training is available

Typically, the following training is provided at a NGS:

- Authorization training i.e.: the training required by CROs and SSs.
- Non authorized nuclear operator training.
- Maintenance trades skills training e.g. training for electrical, instrumentation & control technicians, mechanical maintainers, and civil maintenance.
- Chemical technician training.
- Engineering support personnel training (e.g.: system engineers, analysts, designers, project engineers, etc.)
- Radiation technician training,
- Conventional safety and radiation protection training. (This training is often the responsibility of the station Health Physics Department).
- General employee training.

- Emergency response training.
- Computer training
- Training for supervisors
- Safety culture training

4.2.4. Co-operation inside country

Between training organizations in providing different training modules or training material

Canadian utilities have always co-operated in producing and revising non station specific training material. Informal exchange of station specific training material also occurs from time to time.

Exchange of trainers/trainees

Very limited exchange of trainers and trainees has occurred, essentially in relation to topics not directly related to plant operation such as training on SAT.

Exchange of information (Operational experience feedback, training activities)

A standing Inter-Utility/Regulatory Working Group (SIU/RWG) formed in 1991, provides a voluntary forum for the Canadian nuclear utilities and the regulatory body to discuss and possibly resolve items of mutual interest and concern related to the establishment and verification of competence of nuclear generating stations. This group was instrumental in co-ordinating the preparation of a set of station system training objectives defining CRO knowledge requirements in this area, in providing input for the development of the AECB simulator-based examinations and, more recently, in co-ordinating the revision of non station specific training material.

In Canada, a licence to operate is contingent on providing to the AECB assurance that the NGS is operating in accordance with the licence's term and conditions. As a consequence each NGS is required to report to the AECB any event or operating condition which is a violation of the reactor operating licence in the form of a Significant Event Report. There exists, within the AECB, a group dedicated to analyzing these reports and to communicate these analyses to all NGS. Also each NGS maintains an Operating Experience (OE) group typically in the Reactor safety division. this group analyzes significant event reports from NGSs and foreign plants to identify their potential impact on the station operation. finally all plants using CANDU reactors are part of the CANDU operating utilities. Reports of significant events at any one CANDU site are distributed to other CANDU sites so that they can take advantage of the lesson learned. The COG network is linked to other networks and provides for an exchange of operating experience between CANDU operators and other NPP operators worldwide.

All Significant event reports are reviewed by the training organization for potential training impact.

One utility has established standing "training program review committees" for each job position. These committees are made up of individuals from the NGS and Training. They monitor the quality and effectiveness of the training program, and recommend changes as necessary.

Additional Information

Typically, all new staff with maintenance or technical support functions commence by attending courses at the utility's nuclear training centres. These courses covers variety of subjects within the areas of science fundamentals, equipment and system principles, work safety and radiation protection. These courses ensure that each trainee can perform work at the station in a safe manner and has the basic knowledge required for future specialized training. There are different versions of these courses addressing the specific needs of maintainers, technicians and engineers and last up to four months.

Subsequently trainees follow programs to qualify for specific positions such as:

- Mechanical maintainers
- Electrical, instrumentation and control technician
- Chemical technician
- Radiation technician
- Technical supervisor;
  - reactor physics and fuel management
  - nuclear systems
  - conventional systems
  - control and instrumentation systems
  - fuel handling systems
  - chemistry.

The program for each position involves periods of on-the-job training alternating with periods at the training centre. Typically several qualification levels are defined for each category. The trainee must complete all the requirements for one level before advancing to the next level in the program, the trainee's progress both at the training centre and at the station is evaluated at regular intervals by means of written tests and practical check-outs.

One utility has in place a supervisory and leadership program for senior nuclear plant management which is modeled after INPO.

4.3. TRAINING ORGANIZATIONS

4.3.1. Nuclear Power Plant (NPP) Training Department Responses for the Survey

Point Lepreau (NPP Name)

Contact:
J.J. McCarthy
Tel: 1-506-659-2220
Fax: 1-506-659-2107

Training practices which could be recommended for application in other training organizations:

Training improvement proposal. A process where any individual can recommend or suggest a change which they believe will improve training program.

Availability of Training for Personnel from Organizations in Other Countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

4.3.2. Training Centre (TC) Responses for the Survey

<u>Western Nuclear Training Department (TC Name)</u>

Contact:
D. McKenzie
Tel: 1 519-361-4401
Fax: 1 519 361 5706

Training practices which could be recommended for application in other training organizations:

Training Information Management System (TIMS). This computerized system maintains training records, manages continuing training requirements and is used for scheduling and billing of training. It is used by NGS and Training Staff.
Requalification testing of authorized station Control Room Staff.

Availability of Training for Personnel from Organizations in Other Countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

Unique Training Facilities

- Process loop for demonstrating process control concepts
- Mechanical Seals//Lapping Area
- Low emission fine training facility

<u>Eastern Nuclear Training Department (TC Name)</u>

Contact:
B. Berndt
Tel: 1 905-839-1151
Fax: 1 905-839-1177

Training practices which could be recommended for application in other training organizations:

Training management control of overheads and maintaining costs.

Availability of Training for Personnel from Organizations in Other Countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

Unique Training Facilities

Rigging mock up.

4.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	3	
Does plant management routinely monitor training?	3	
Is training audited by a non-regulatory organization external to training department?	3	
Is plant management directly involved in establishing training needs?	3	
Is management and supervisory skills training provided?	3	
Is general safety training provided?	3	
Is emergency preparedness training provided?	3	

Budget

Between 4 and 5 per cent of the total operating budget is spent on training, based on 3 surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

2 * higher than the plant position salary

1 * the same as the plant position salary

* lower than the plant position salary

*Numbers indicate the numbers of plants and training centres responding as indicated.

4.5. TRAINING PROGRAMS

4.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*[2]	GE or CRO	E or TS or CRO	TS or SS	SS	TS or SS	TS or SS
Prerequisite years of experience for this program	6–8	6–8	6–8	3–6	varies	varies

** depends on backgrounds.

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	TS–SS	**	TS or SS	TS or SS	TS or SS	TS or SS or CRO status
Prerequisite years of experience for this program	varies	-	6	varies	6–8	6–9

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

4.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*[3]	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	2, 1	3	2, 3		2, 1, 3		2, 1, 3		1, 3, 2		1, 3, 2	
Job analysis is used to determine training needs	2	1, 3	2, 3		2, 3	1`	2, 3	1	3, 2		3, 2 **	2, 1
Training needs are used to design measurable training/learning objectives	2, 1	3	2, 3		2, 1, 3		2, 1, 3		1, 3	2	1, 3, 2	
Training materials are based on training/learning objectives	2, 1	3	2, 3		2, 1, 3		2, 1, 3		2, 1, 3		2, 1, 3	
Training implementation involves assessment of whether training/learning objectives are achieved	2, 1	3	2, 3		2, 1, 3		2, 1, 3		2, 1, 3		2, 1, 3	
Evaluation is based on training goals. Feedback of needed improvements takes place	2, 1	3	2, 3		2, 1, 3		2, 1, 3		2, 1, 3		2, 1, 3	

1 is Point Leprau NPP, 2 is Western Nuclear TC; 3 is Eastern Nuclear TC.
** Job and Task Analysis is being finalized.

[3] *Numbers indicate the numbers of plants and training centres responding as indicated.

4.5.2. Training methodology cont.

Job Position **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*[4]	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1, 3, 2**				1, 2, 3		1, 2, 3		1, 3, 2**		1, 2, 3	
Job analysis is used to determine training needs		1, 2, 3			2	1, 3	2	1, 3		1, 2, 3	2	1, 3
Training needs are used to design measurable training/learning objectives	1, 3	2			1, 2,3		1, 2, 3		1, 3, 2		1, 2	3
Training materials are based on training/learning objectives	1, 2, 3				1, 2, 3		1, 2, 3		1, 2, 3		1, 2, 3	
Training implementation involves assessment of whether training/learning objectives are achieved	1, 2, 3				1, 2, 3		1, 2, 3		1, 2, 3		1, 2, 3	
Evaluation is based on training goals. Feedback of needed improvements takes place	1, 2, 3				1, 2, 3		1, 2, 3		1, 2, 3		1, 2, 3	

** Job and Task analysis is being finalized.

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[4]*Numbers indicate the numbers of plants and training centres responding as indicated.

4.5.3. Initial training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	*Plant or Station Shift Supervisor*	*Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	***Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	1350	40	1350	1000	360	380
Lab/Workshop				500	1250	1250
Process or Control Room Simulator	500	12	600			
Self-Study	1500	20	1600	1200		200
**Formal On-the-Job Training	930	200	930	60	20	20
Total Initial Training	3280	272	4480	3900	1670	1630

* The Control Room Operator (CRO) is the unit supervisor. the CRO also manipulates the controls in the Control Room. some facilities have a Shift Operating Supervisor (SOS) position which is typically a CRO with some additional training. The SOS supervises all Operators on a shift crew, but does not operate controls. The SOS is reported here as the Control Room Supervisor.

** Initiatives are in progress to significantly increase OJT in programs for Maintenance Staff.

*** Instrumentation and Control and Electrical Maintenance are classified under one job description "Control Technician"

4.5.3. Initial training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control***	Quality Assurance Quality Control**	Radiation Protection*	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	380		670	390	90	215
Lab/Workshop	1150		360		70	
Process or Control Room Simulator						7
Self-Study	200				6	50
Formal On-the-Job Training	20		280	500	6	50
Total Initial Training	1850		1310	890	109	322

* Numbers are reported for Radiation Safety Technicians at Ontario Hydro. This position does not routinely assume RP functions for workers. Workers receive extensive RP training to enable them to be responsible for their own RP. This training involves about 250 hours of initial training.

** There is no defined program.

*** Instrumentation and Control and Electrical Maintenance are classified under one job description "Control Technician".

4.5.4. Continuing training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	*Unit or Control Room Supervisor	*Control Room Operator	Field Operator	Mechanical Maintenance	***Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	80	40	90	40	20	22
Lab/Workshop						
Process or Control Room Simulator	55	55	55			
Self-Study	40	40				
Formal On-the-Job Training						
Total Continuing Training	175	135	135	95	20	22

Note: Pickering did not answer for Continuing Training for F.O./Mec/Elec/QA/RP/Cmy and Inst.; Point Lepreau unit 1 answered only for OPS and Instructors; Point Lepreau and Pickering answered NA for CRS.

* The Control Room Operator (CRO) is the unit supervisor. the CRO also manipulates the controls in the Control Room. some facilities have a Shift Operating Supervisor (SOS) position which is typically a CRO with some additional training. The SOS supervises all Operators on a shift crew, but does not operate controls. The SOS is reported here as the Control Room Supervisor.

** Initiatives are in progress to significantly increase OJT in programs for Maintenance Staff.

*** Instrumentation and Control and Electrical Maintenance are classified under one job description "Control Technician"

4.5.4. Continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control**	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	22		8	24	36	32
Lab/Workshop			8			
Process or Control Room Simulator						80
Self-Study						
Formal On-the-Job Training			40	16		
Total Initial Training	22		56	40	36	112

** There is no defined program.

4.5.5. Total number of personnel trained by nuclear power plant training departments

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	1	NA	1	-	-	-
Average annual number of persons who participate in continuing training 1991–1995	8	NA	8	-	-	-

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	-		-	-	-	
Average annual number of persons who participate in continuing training 1991–1995	-		-	-	-	

Note: Point Lepreau did not answer for FO/MC/ELec/IC/QA/RP/CMY/Instructor; answered NA for CRS.
Instructors responses only for Eastern Nuclear Training (Pickering). This table applies to Point Lepreau only.

4.5.6. Total number of personnel trained by training centres

Job Position / Training Program	Plant or Station Shift Supervisor	*Unit or Control Room Operator	*Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	10	3	18	90	25	15
Average annual number of persons who participate in continuing training 1991–1995	40	15	200	1060	725	500

Job Position / Training Program	Instrumentation & Control	**Quality Assurance/ Quality Control	**Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	15		5	4	2	1
Average annual number of persons who participate in continuing training 1991–1995	400		45	110	80	5

* The Control Room Operator (CRO) is the unit supervisor. the CRO also manipulates the controls in the Control Room. some facilities have a Shift Operating Supervisor (SOS) position which is typically a CRO with some additional training. The SOS supervises all Operators on a shift crew, but does not operate controls. The SOS is reported here as the Control Room Supervisor.

** There is no defined program.

** There is no defined program. Most operations staff qualified in RP to yellow or green level. (6000 persons) spend 40 hours every 2 years in continuing training.

4.6. TRAINING FACILITIES

4.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1		6
Maintenance Workshops	1		1
Radiation Protection/Chemistry Labs		x	
Other Labs/Workshops	1		1
Simulator(s)	1		1
Self-Study Rooms	1		1
Library(ies)	1		2
Dedicated Instructor Offices/Work Space	1		individual
Technical and Training Documentation Area	1		library
Training Material Preparation Area		1	
Large Lecture Room	1		1
Dining Facilities	1		1
Student Housing Facilities		1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities**
Classrooms	2		20
Maintenance Workshops	2		9
Radiation Protection/Chemistry Labs	2		7
Other Labs/Workshops	2		4
Simulator(s)	2		2
Self-Study Rooms	2		3
Library(ies)	2		1
Dedicated Instructor Offices/Work Space	2		15
Technical and Training Documentation Area	2		2
Training Material Preparation Area	-	-	
Large Lecture Room	2		1
Dining Facilities		2	
Student Housing Facilities		1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

**Answer valid only for Western Nuclear Training Department.

4.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	7		
Maintenance			
Radiation Protection			
Chemistry		1	1
Other Instructors			
Management and Support Staff			
Management	1		
Simulator Support	5		
Maintenance Support			
Training Material Development			
Education Specialist			
Others	4		

Training centres

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions**	
		Number	Full-time Equivalent
Operations	2.5		
Maintenance	9.5	6	4
Radiation Protection	7	2	2
Chemistry	1		
Other Instructors	19.5	1	1
Management and Support Staff			
Management	11.5		
Simulator Support	24.5		
Maintenance Support			
Training Material Development	7	2	2
Education Specialist	1		
Others	11		

** Only for Western Nuclear Training Department.

4.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Fullscope	Point Lepreau Unit 1	NPP	Point Lepreau Unit 1	900 +
Fullscope	Bruce A unit 1–4	TC	Bruce A unit 1–4	2000
Fullscope	Bruce B unit 5–8	TC	Bruce B unit 5–8	2000
Fullscope	Pickering unit 2	TC	Pickering A	2000
Fullscope	Pickering Unit 6	TC	Pickering B	2000
Fullscope	Pickering unit 2	TC	Darlington	2000

4.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		
	Reactor vessel head		1
	Reactor internals		1
	Control rod drive mechanism	1	1
Steam Generator	Complete		
	Primary side channel head		1
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		1
Reactor coolant pump (or primary loop recirculation pump)	Internal part		
	Pump shaft seal	3, 2	3
	Pump body	3	3
Main gate valve	Internal part	1, 3	3
	Body	1, 3	3
Fuel manipulator equipment	Manipulator crane	3	3
	Dummy fuel	1, 3, 2	3
	Fuel-handling tools	3	3
	Fuel-loading simulator	3	3
Pumps		1, 2, 3	2, 3
Valves		1, 2, 3	1, 2, 3
Supporting structures		2, 3	2, 3
Welding-practice equipment		1, 2, 3	2, 3
Compressor	Instrumentation air compressor	2, 3	2, 3
Laser alignment		2, 3	2, 3
Other		2*, 3**	3**

* Mech. SGALS/LAPPING area; ** Rigging Mock up.

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		1, 2, 3	1, 2, 3
Reactor coolant pump motor			
Control-rod drive mechanism control system		1	
Control boards at electrical control room	Rod position indicator	1	1
	Reactor control and protection rack		
	Protective relay system	2	2, 3
	Ex-core nuclear instruments		3
	In-core nuclear instruments		3
	Generator automatic voltage regulator	3	3
	Constant voltage constant frequency power source	1, 2, 3	2
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1, 2, 3	1, 2
	Radiation measurement equipment	1, 2	1
	Controller	1, 2, 3	2
	Other	2 (*), 3 (**)	2 (**)
Measurement system for motor-operated valves		1, 3	1
Digital control device			
Other		1*	1
Common			
Non-destructive testing equipment			
Transparent power plant	See-through		
	Functional		
Other			

* Recorder; ** Process Control Loops.

Numbers correspond to the NPP or TC listed in Part II.

4.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	3	1
Interactive video	1	
Establishing and maintaining training database	3	
Generating examinations	2	1
Keeping student records	3	
Production of training materials	3	

Other significant uses

For Point Lepreau NPP
- Scheduling
- E–mail
- Electronic Storage of Training Materials
- Accessing Station Logs
- Accessing Historical Real Plant Parameter data and other station data bases

For Western Nuclear Training Department
- Used with Programmable Logic Controller Training
- Scheduling Training
- E-mail, Training Records, Storage of Training Materials

For Eastern Nuclear Training Department
- Communicating with clients through network.
- Scheduling Training
- E-mail, Training Records, Storage of Training Materials

Visual aids available at facility

	YES	NO
Whiteboards	3	
Overhead projectors	3	
Slide projectors (such as 35mm)	3	
Flip charts	3	
Video equipment	3	
Computer liquid crystal display panel or computer projector	3	
Video conferencing	2	1

*Numbers indicate the numbers of plants and training centres responding as indicated.

5. CHINA

5.1. SURVEY SUMMARY AND CONCLUSIONS

Training organizations

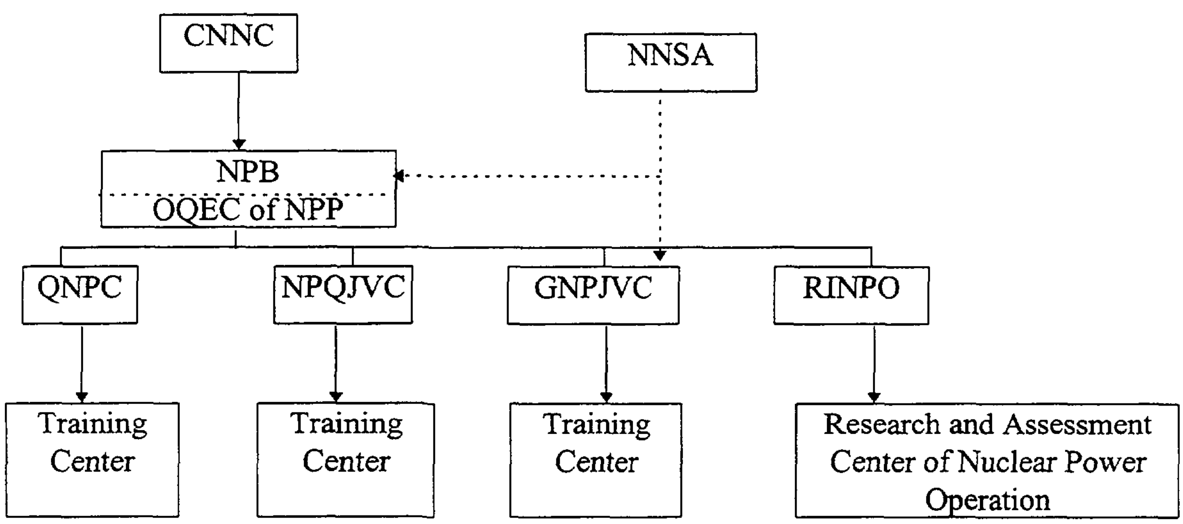
- Training centres responding to the survey are able to provide training for their personnel as well as for personnel of organizations from other countries. Management is completely involved in all parts of training.

Training programs

- SAT methodology is used in all the phases of training approach.
- Entry requirements in all job positions are at a good level.
- Initial and continuing training is fully provided for all the jobs positions except for shift supervisors.

Training facilities

- Staffing and physical facilities are in relationship with the training activity described above.
- Simulators are used for operation training and some mock-ups are provided for maintenance training as well as some real components for I & C and HP job positions.
- Computers are used for training this kind of training could be improved in the future



CNNC	China National Nuclear Corporation
NNSA	National Nuclear Safety Administration
NPB	Nuclear Power Bureau
NPP	Nuclear Power Plant
OQEC	Operators Qualification Examination Committee
QNPC	Qinshang Nuclear Power Company
NPQJVC	Nuclear Power Qinshang Joint Venture Co. Ltd.
GNPJVC	Guandong Nuclear Power Joint Venture Co. Ltd.
RINPO	Research Institute of Nuclear Power Operation

FIG. 3.6. Organizational arrangement for the training of NPP personnel in China.

5.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

5.2.1. Overall description of training system

The China National Nuclear Corporation (CNNC) has responsibility for all industry and research activities in the nuclear field in China (see Fig. 3.6.) SAT methodology is used as a basis of training system.

The National Nuclear Safety Administration is the regulatory authority. The function of NNSA is to review and supervise the safety of civil nuclear facilities according to nuclear statute, laws and regulations of the country.

5.2.2. Role of regulator in training

CNNC is the higher authority of nuclear plants. There is a OQEC of NPP. It is responsible for assurance of training programs and arranging the examination to ensure the qualification and competence of NPP personnel.

NNSA is responsible for inspecting licensing activities, and especially for reviewing and issuing licenses of reactor operator and senior reactor operators.

NPP is responsible for training the candidates of NPP's operators according to the standard and for implementation of licensing examinations of NPP's operators.

Training centre is responsible for:

- Co-ordinating all training for NPP personnel.
- Leading the development of training programs.
- Procuring and maintaining all training tools, equipment materials and including simulators and mock-ups.
- Maintaining records on the training and qualification of all NPP personnel.

5.2.3. Specific positions for which training is available

(1) Operations
(2) Maintenance (electrical, mechanical, I&C)
(3) Technical support (engineering, radiation protection, chemistry)
(4) Management.

5.2.4. Co-operation inside country

(1) Between training organizations in providing different training modules or training materials.
(2) Exchange of trainers/trainees.
(3) Exchange of information (Operational experience, feedback, training activities).

5.3. TRAINING ORGANIZATIONS

Training Centre (TC) Responses for the Survey

1 Daya Bay (TC Name)

Contact: Mr. Liu Gexin
Tel: 0755-3366566-39302
Fax: 0755-3365513

Training practices which could be recommended for application in other training organizations:

Fire fighting training
Safety culture training

Availability of Training for Personnel from Organizations in Other Countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

Unique Training Facilities

Transparent power plant

2 Qinshan (TC Name)

Contact: Mr. Tian Pei Liang
Tel: 0753-6023491-33741
Fax: 0753-6023491 33224

Availability of Training for Personnel from Organizations in Other Countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: N
Fee for Services: Y

5.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	2	
Does plant management routinely monitor training?	2	
Is training audited by a non-regulatory organization external to training department?	2	
Is plant management directly involved in establishing training needs?	2	
Is management and supervisory skills training provided?	2	
Is general safety training provided?	2	
Is emergency preparedness training provided?	2	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Budget

2 per cent of the total operating budget is spent on training, based on 2 survey answering this question. (Qinsham T.C.)

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

	* higher than the plant position salary
2	* the same as the plant position salary
	* lower than the plant position salary

5.5. TRAINING PROGRAMS

5.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance **	Electrical Maintenance **
Education or certification prerequisite(s) for this program*	GE	GE or E	E	E or TS	GE/E/TS	GE-E-TS
Prerequisite years of experience for this program	6 ~ 8	4–6	4	2	2–4	2–4

Job Position / **Training Program**	Instrumentation & Control **	Quality Assurance Quality Control **	Radiation Protection **	Chemistry **	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE/E/TS	GE or E	GE/E/TS	GE/E/TS	GE	GE
Prerequisite years of experience for this program	2	2	1	2	1–2	2

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma; SS = secondary school diploma].
** Depends on responsibility level in the job position.

5.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Job analysis is used to determine training needs	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Training needs are used to design measurable training/learning objectives	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Training materials are based on training/learning objectives	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Training implementation involves assessment of whether training/learning objectives are achieved	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Evaluation is based on training goals. Feedback of needed improvements takes place	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	

*Numbers indicate the numbers of plants and training centres responding as indicated.

5.5.2. Training Methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Job analysis is used to determine training needs	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Training needs are used to design measurable training/learning objectives	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Training materials are based on training/learning objectives	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Training implementation involves assessment of whether training/learning objectives are achieved	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	
Evaluation is based on training goals. Feedback of needed improvements takes place	1, 2		1, 2		1, 2		1, 2		1, 2		1, 2	

*Numbers indicate the numbers of plants and training centres responding as indicated

5.5.3. Initial training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom		180	900	280	620	560
Lab/Workshop		20	20	20	70	
Process or Control Room Simulator		105	280			
Self-Study						
Formal On-the-Job Training		1000	1200	1000	1000	1000
Total Initial Training		1305	2400	1300	1690	1560

These values are only valid for Daya Bay TC

5.5.3. Initial training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	890	525	525	420	700	900
Lab/Workshop	70			70		
Process or Control Room Simulator	70				70	400
Self-Study	6					
Formal On-the-Job Training	1000	800	800	750	800	1500
Total Initial Training	2100	1325	1325	1240	1570	2800

These values are only valid for Daya Bay TC.

5.5.4. Continuing training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom		70	70	50	35	35
Lab/Workshop		20	20	20	10	10
Process or Control Room Simulator		70				
Self-Study						
Formal On-the-Job Training		100	100	100	70	70
Total Continuing Training		260	260	170	115	115

These values are only valid for Daya Bay TC

5.5.4. Continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	70	35	35	35	70	70
Lab/Workshop	10					
Process or Control Room Simulator					70	
Self-Study						
Formal On-the-Job Training	70	35	35	35	100	200
Total Initial Training	150	70	70	70	170	340

These values are only valid for Daya Bay TC

5.5.5. Total number of personnel trained by training centres

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	8		11	15	30	20
Average annual number of persons who participate in continuing training 1991–1995	35		32	62	100	60

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	20	8	8	5	3	3
Average annual number of persons who participate in continuing training 1991–1995	60	25	30	20	10	6

2 did not answer on Continuing Training

Instructor Teaching and Simulator Values are only valid for Daya Bay TC

5.6. TRAINING FACILITIES

5.6.1. Physical facilities
Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	2		8
Maintenance Workshops	2		3
Radiation Protection/Chemistry Labs	2		1
Other Labs/Workshops	1	1	-
Simulator(s)	2		2
Self-Study Rooms	2		3
Library(ies)	-	2	-
Dedicated Instructor Offices/Work Space	2		3
Technical and Training Documentation Area	2		2
Training Material Preparation Area	2		2
Large Lecture Room	2		2
Dining Facilities	2		1
Student Housing Facilities	2		1

*Numbers indicate the numbers of plants and training centres responding as indicated.

- Industrial Safety & Fire Fighting Training Facilities under Construction for Daya Bay TC
- 2 Classrooms (1997) and fullscope simulator (1999) under Construction for Qinsham TC

Training Centres*

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	9	4	
Maintenance		10	
Radiation Protection		2	
Chemistry		2	
Other Instructors	1	5	
Management and Support Staff			
Management	6		
Simulator Support	4		
Maintenance Support	2		
Training Material Development	1		
Education Specialist			
Others	18		

*Only valid for Daya Bay TC

5.6.2. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Basic principle simulator	Daya Bay NPP Unit 1	Daya Bay TC	GNPS - LINAO unit 1, 2 Qinshan phase 2	140
Basic principle simulator	Qinshan 300 MW Unit	Qinshan TC	Qinshan phase 1 Chasima NPP	
Fullscope	Daya Bay NPP Unit 1	Daya Bay TC	GNPS.SINAD Unit 1,2 Qinshn Phase 2	1500
Fullscope	300 MW unit Qinshan	Qinshan TC	Qinshan phase 1 Chasima NPP	

5.6.3. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		2
	Reactor vessel head		
	Reactor internals		
	Control rod drive mechanism		1, 2
Steam Generator	Complete		
	Primary side channel head		1, 2
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		2
Reactor coolant pump (or primary loop recirculation pump)	Internal part		1
	Pump shaft seal		1, 2
	Pump body		
Main gate valve	Internal part		
	Body		
Fuel manipulator equipment	Manipulator crane		
	Dummy fuel		
	Fuel-handling tools		
	Fuel-loading simulator		
Pumps			2
Valves			1, 2
Supporting structures			1
Welding-practice equipment			2
Compressor	Instrumentation air compressor	1	
Laser alignment			
Other			

*Numbers correspond to the NPP or TC listed in Part II.

5.6.3. Maintenance training equipment cont.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment			
Reactor coolant pump motor			
Control-rod drive mechanism control system		2	
Control boards at electrical control room	Rod position indicator		
	Reactor control and protection rack		
	Protective relay system		
	Ex-core nuclear instruments		
	In-core nuclear instruments		
	Generator automatic voltage regulator		
	Constant voltage constant frequency power source	1, 2	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1, 2	
	Radiation measurement equipment	1	
	Controller	1	
	Other		1
Measurement system for motor-operated valves			
Digital control device			
Other			1
Common			
Non-destructive testing equipment			
Transparent power plant	See-through		1
	Functional		
Other			

*Numbers correspond to the NPP or TC listed in Part II.

5.6.4. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-Based Training	1	1
Interactive Video		2
Establishing and maintaining training database	2	0
Generating examinations	1	1
Keeping student records	2	0
Production of training materials	2	0

Visual aids available at facility

	Yes*	No*
Whiteboards	2	
Overhead Projectors	2	
Slide projectors (such as 35mm)	2	
Flip charts	2	
Video equipment	2	
Computer Liquid Crystal Display panel or computer projector	2	
Video conferencing	2	

*Numbers indicate the numbers of plants and training centres responding as indicated.

6. CZECH REPUBLIC

6.1. SURVEY SUMMARY AND CONCLUSIONS

The possibility to provide training for NPP personnel from organizations in other countries exists in the country.

Unique training facilities: The PC training simulator WWER 440 system 213.

Training practice which could be recommended for using in other places: module training scheme, PC- simulators.

Plant management is directly involved in training.

Average training budget is between 0.5–1.5% of the total operating budget.

The salary of trainers is the same as the plant position salary.

Training programs

Systematic approach to training is used for training programs for control room operators.

Training Programs are based on a GE or TS degree entry requirement.

The total average annual number of persons in initial and continuing training, which were indicated in answers is near of 2375 (400 per unit). This number corresponds with the higher number of employees which is normally indicated at WWER type reactor plants.

Training facilities

Physical facilities at the NPP and at the TC are shown in the Country Summary Tables.

Amount of staff in TC is 34 including 20 instructors; in the Training Department the average number of staff is about 27.

Mock-ups are used for maintenance personnel training.

Computers and audio visual aids are used for training process and are available at facilities.

Conclusion

The upgrading of NPP personnel training is progressing.

6.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

The nuclear power programme in the Czech Republic is based on commercial use of WWER type reactors:

NPP Dukovany: 4 units, PWR, 4 x 440 MWel, type 213, in commercial operation

NPP Temelin: 2 units, PWR, 2 x 1000 MWel, type 320, under construction, start-up of the 1st unit is planned in 1998.

There are 3 research reactors and other nuclear facilities in operation in the Czech Republic (dry interim spent fuel storage, low level waste repository, regional waste disposal facility and uranium industry).

Reorganization is taking place in many areas of NPP operation and Czech Power Company (Utility) in a well-organized and step-by-step manner. Present trends in NPP personnel training system are to improve the level of qualification and competence of all managers and workers in various post in the field of nuclear power technology use by a better and more individually tailored training system. The management of training is enhanced by the adoption of a systematic approach to training (SAT). The NPP personnel training and qualification requirements are stipulated in regulations of two government and Czech Power Company levels.

In the area of training, the change in the reporting lines of Nuclear Education and Training Centre (NTC) was completed and organizational scheme is now realized in the following way, shown in Fig. 3.7.

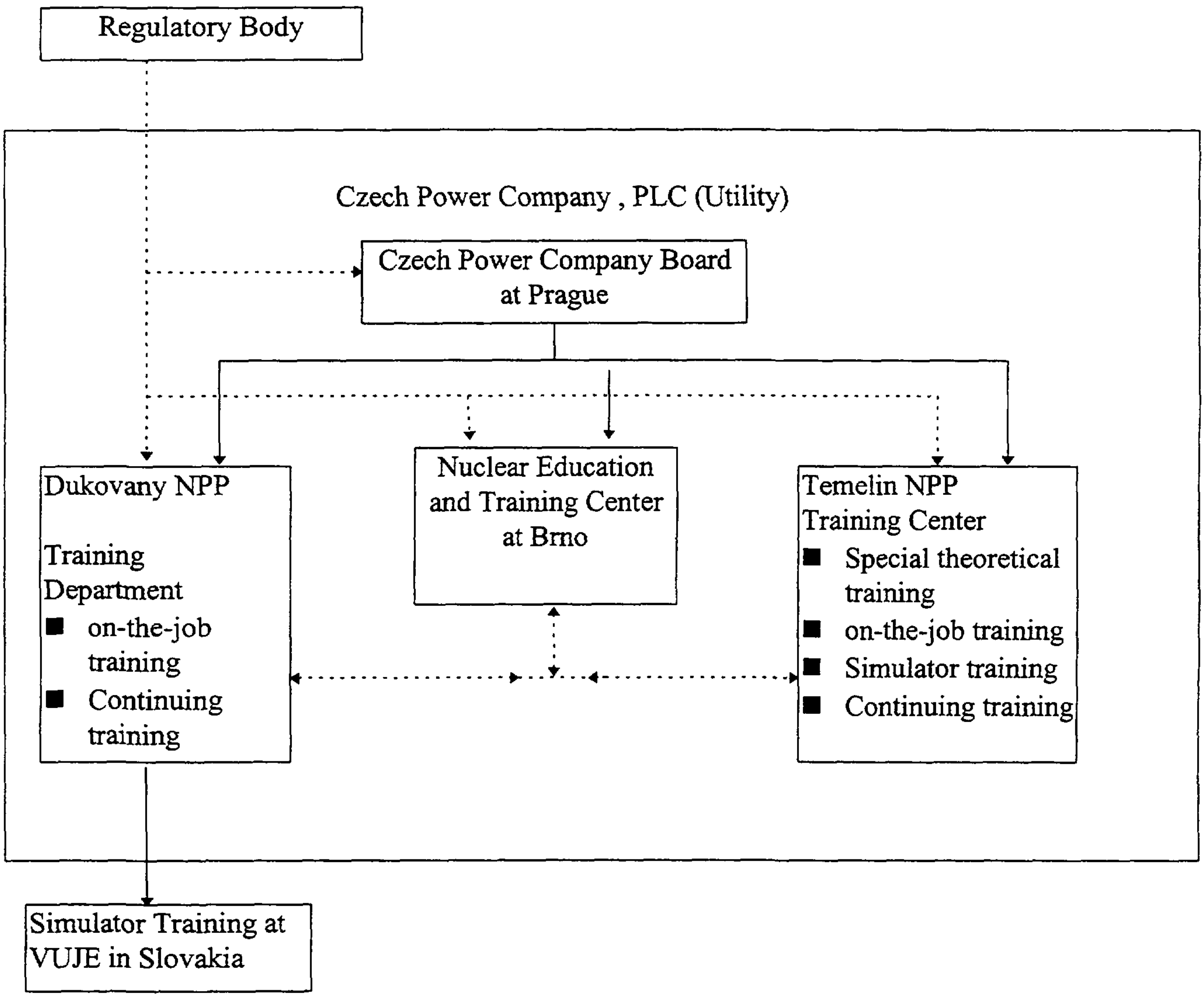


FIG. 3.7. Organizational Arrangement for the training of NPP Personnel in the Czech Republic.

The NTC categories is a special training and research facility providing the further education for all categories of NPPs personnel belonging to the Czech Power Company and preparation of the staff for nuclear energy. The process of NPP personnel training is divided into the following main parts:

- training for required qualification
- maintaining of the qualification
- verifying of the qualification.

There are several categories of NPP personnel in the *initial system*:

- *Selected (licensed) personnel with direct impact on nuclear safety*; control room operators, units supervisors, shift engineers, start-up physicist. A technical university education is required for most jobs.

- *Technical personnel in operating, technical and maintenance sections*; technical university or secondary school education is required.

- *Servicing shift and operating personnel of the technological equipment*; secondary or apprentice school education is required.

- *Maintenance personnel*; apprentice or secondary school education is required.

Each above mentioned category is divided into further professional groups: primary circuit, secondary circuit, instrumentation and control systems, electrical systems, chemistry, radioactive waste management; mechanical maintenance, electrical maintenance, I+C maintenance, health physics, in-servicė inspection, transport of spent fuel etc.

The NPP personnel training system in the Czech Republic was developed at the NTC at BRNO after requirements of SAT in very close co-operation with NPP Dukovany and NPP Temelin. The main idea of this concept was to improve the overall quality of the courses through better theoretical training, complementing practical on-the-job training and training on the full-scope simulator.

The training according to this concept is divided into several modules (for control room operators it is 10 modules). Each module consists of 3–5 weeks of theoretical training and 1-3 weeks of practical on-the-job training session directly at the NPP.

The duration of the training of control room operators including the final examinations for the "certificate" (about completed training course) is 66 weeks. Further training for "licence" is required (maximum 32 weeks mainly on-the-job).

Written examination in each subject takes place within each module. Each three modules are followed by an examination period, which lasts 1–2 weeks. during that period the trainees sit for oral examinations for the whole subject's contents. Each theoretical part of a module is completed by an interview. The purpose is to evaluate previous theoretical training problems which will be dealt with in future.

Continuing training of NPP personnel is organized and provided by training operational departments of each NPP. The content of continuing training is focused on:

- revision of required knowledge and skills from initial training
- modifications and changes of NPPs and procedures
- lessons learned from incidents and events, etc.

Continuing training is organized for all NPP personnel categories. This training is obligatory and compulsory. For NPP operational shifts is provided by so called "training days" – 1 day (8 hours) per each month.

Basic maintenance training

There are two topics which have to be specially considered in the training of NPP maintenance personnel in the Czech Republic:

- the organizational changes within Dukovany NPP leading to the transformation of various maintenance sections into private and independent companies
- the different status of the Temelin NPP which is still under construction and the fact that it will be equipped with Westinghouse I&C systems.

There are three categories of maintenance personnel who achieve qualification and competence through training:

- maintenance personnel (technicians, workers, shift leaders and foremen)
- technical shift and operating personnel (senior technicians and technicians)
- management maintenance personnel (technical and financial personnel with university degree or secondary school education.

Currently the mechanical, electrical and I&C maintenance departments at Dukovany and Temelin NPPs have already been transferred into private companies which work for Dukovany and Temelin NPPs as subcontractors. This new arrangement mainly affects the above mentioned category of maintenance personnel (technicians, workers, shift leaders, foremen). In some cases it is not yet clear how training will be provided for them, to what extent it will be provided and who will pay for it.

Generally the maintenance personnel must complete theoretical and practical training. Whereas the theoretical training is provided by NTC at Brno, the practical on-the-job training is organized and undertaken by the on-site NPP training departments. Since 1993 the NTC has developed a new modular training system in close co-operation with NPP Dukovany which enables it also to provide theoretical training for shift servicing and operating personnel. This training system also applies to Temelin NPP maintenance personnel.

The theoretical maintenance training is performed by experienced instructors and is accompanied by written training materials. The fact that he modular training system is newly elaborated and tailored to each category of personnel and also to every technical subgroups and job within each category, indicates that the maintenance training program can be effective. However, it was recommended that the integration of SAT would help to further improving of the whole modular maintenance training programme, its quality and its effectiveness.

Training for maintenance personnel of external subcontractors

Training for all people of external subcontractors is organized by NPP Dukovany site training department. This training is called "Entrance Training" and its content is created as following:

- actual status of work on NPP equipment
- fire protection
- safety of work
- work on open primary circuit
- emergency preparedness/radioactive waste management.

Above mentioned training is scheduled for one whole day from 7 a.m. to 1 p.m. In the afternoon is organized approximately 1.5 hour written examination test.

Simulator training

NPP simulator training in the Czech Republic is required only for selected staff, it means for category which is called "selected personnel" (control room operators, unit supervisors, shift supervisors, start-up physicists etc.)

Simulator training for NPP Dukovany selected personnel is provided by full-scope WWER440/213 type simulator which is located at Research Institute for Nuclear Power Plant Training Centre in Trnava, Slovakia. The content of simulator Training in Slovakia is created in close co-operation with NPP Dukovany operational staff and with the respect of current status of NPP Dukovany technological equipment modifications. Simulator training is provided on the base of contract between Czech and Slovak organizations.

Initial simulator training

is scheduled for 5 weeks and it is divided into two parts:

- 3 weeks of training of normal operational modes resp. procedures. The training is scheduled after completion of training module No. 8 and after 1 week of special training session

- 2 weeks of training of emergency operational modes res. procedures. This training is scheduled after completion of training module No. 9 and after 2 weeks of special training session.

Simulator retraining

Simulator training on the full-scope simulator is scheduled for selected personnel for one week training twice per year.

The VAR. 440/213 simulator at Trnavna was designed about 15 years ago and its equipment is now obsolete leading to problems associated with servicing and spares. The new full-scope simulator located directly at NPP Dukovany site is under consideration.

Full-scope simulator VAR 1000 for NPP Temelin personnel

NPP Temelin full scope simulator WAR 1000 is now under construction in the Czech Republic, simultaneously with construction of both nuclear electricity production units. the Czech Company ORGREZ, SC Brno is the main supplier of this training facility. There is strict requirement of the Regulatory Body: all VAR 1000 simulator training. Without such training, they will not be allowed by examinations by the State Examination Commission and will not receive the job license. The full-scope NPP Temelin simulator will be located directly at NTC at the Temelin site.

6.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Dukovany

Contact: Stanislav Valenta, Head of Training Department
Tel: +420509 60 55 90
Fax: +420 509 92 24 18

Training practices which could be recommended for application in other training organizations:

NO

Availability of training for personnel from organizations in other countries:
NPP Personnel: Y
Training Personnel: N

Loan personnel to other countries: N
Fee for services: NA

2. Temelin

Contact: Mr. Ivan Tichy, Head of Temelin NPP Training Centre
Tel: +420 334 4222 931
Fax: +420 334 4222 505

Training practices which could be recommended for application in other training organizations:

NO

Availability of training for personnel from organizations in other countries:

NO

Unique training facilities

NO

Training centre (tc) responses for the survey

NTC Brno

Contact: Mr. Roman Hájek, Director of NTC
Tel: +420 5 4522 2517 or +42 6012 22039
Fax: +420 5 4522 2068

Training practices which could be recommended for application in other training organizations:

1. Module Training Scheme

2. PC-Simulator

Availability of training for personnel from organizations in other countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

Unique training facilities

NO

6.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	3	0
Does plant management routinely monitor training?	3	0
Is training audited by a non-regulatory organization external to training department?	1	2
Is plant management directly involved in establishing training needs?	3	0
Is management and supervisory skills training provided?	3	0
Is general safety training provided?	3	0
Is emergency preparedness training provided?	3	0

Budget

Between 0.5 and 1.5 per cent of the total operating budget is spent on training, based on 1 survey answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

* higher than the plant position salary

* the same as the plant position salary

* lower than the plant position salary

*Numbers indicate the numbers of plants and training centres responding as indicated.

6.5. TRAINING PROGRAMS

6.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE	GE	GE	GE, E, TS, AC	TS, AC	TS, AC
Prerequisite years of experience for this program	9–6	6–4	4–2	2	2	2

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	TS	GE, TS	TS	TS, AC	GE, E, PS	GE, E, PS
Prerequisite years of experience for this program	2	1 ÷ 3	1	2	3	3

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma; SS = secondary school diploma], AC= apprentice centre, PS = University pedagogical study.

6.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	2	0	2	0	2	0	1	1		1		1
Job analysis is used to determine training needs	2	0	2	0	2	0	1	1		1		1
Training needs are used to design measurable training/learning objectives	2	0	2	0	1	1		1		1		
Training materials are based on training/learning objectives	2	0	2	0	1	1		1		1		
Training implementation involves assessment of whether training/learning objectives are achieved	2	0	2	0	1	1		1		1		
Evaluation is based on training goals. Feedback of needed improvements takes place	2	0	2	0	1	1		1		1		

*Numbers indicate the numbers of plants and training centres responding as indicated.

6.5.2. Training methodology cont.

Training Program	Instrumentation & Control		Quality Assurance/ Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1	1	1	1	1	1	1	1	-	-	-	1
Job analysis is used to determine training needs	1	1	1	1	1	1	1	1	-	-	-	1
Training needs are used to design measurable training/learning objectives	1	1	1	1	1	1	1	1	-	-	1	-
Training materials are based on training/learning objectives	1	1	1	1	1	1	1	1	-	-	1	-
Training implementation involves assessment of whether training/learning objectives are achieved												
Evaluation is based on training goals. Feedback of needed improvements takes place	1	1	1	1	1	1	1	1	-	-	1	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

6.5.3. Initial training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	1200	1180	1160	350–420	210	210
Lab/Workshop	35	35	35	0–200	-	-
Process or Control Room Simulator	248	228	188	-	-	--
Self-Study	108	98	88	35	35	35
Formal On-the-Job Training	2065	1765	1165–1515	288–422	175	175
Total Initial Training	3654	3306	2636–2986	673–1077	420	420

6.5.3. Initial training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	420	620	420	385–420	680	1079
Lab/Workshop	-	-	-	-	-	35
Process or Control Room Simulator	-	-	-	-	-	175
Self-Study	35	35	35	35	35	76
Formal On-the-Job Training	422–522	272	272	322–422	300	630
Total Initial Training	877–977	927	727	742–877	1015	1995

6.5.4. Continuing training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	100	100	100	45	NA	NA
Lab/Workshop	-	-	-	-	NA	NA
Process or Control Room Simulator	80	80	80	-	NA	NA
Self-Study	60	60	60	17	NA	NA
Formal On-the-Job Training	20	20	20	3	NA	NA
Total Continuing Training	260	260	260	65	NA	NA

6.5.4. Continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	40	40	20	40	20	-
Lab/Workshop	10	-	-	-	-	-
Process or Control Room Simulator	-	-	-	-	-	-
Self-Study	20	-	-	15	80	-
Formal On-the-Job Training	-	-	-	-	80	-
Total Initial Training	70	40	20	55	180	-

6.5.5. Total number of personnel trained by nuclear power plant training departments

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	1	4	25	40	-	-
Average annual number of persons who participate in continuing training 1991–1995	9	28	60	280	-	-

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	12	2	8	3	-	-
Average annual number of persons who participate in continuing training 1991–1995	70	30	35	60	-	-

6.5.6. Total number of personnel trained by training centres

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	0	4	105	356	137	84
Average annual number of persons who participate in continuing training 1991–1995	0	4	100	347	130	80

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	75	30	37	46	-	3
Average annual number of persons who participate in continuing training 1991–1995	73	30	35	44	-	3

6.6. TRAINING FACILITIES

6.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	2	0	6
Maintenance Workshops	0	2	0
Radiation Protection/Chemistry Labs	0	2	0
Other Labs/Workshops	0	2	0
Simulator(s)	0	2	0
Self-Study Rooms	0	2	0
Library(ies)	1	1	1
Dedicated Instructor Offices/Work Space	1	1	3
Technical and Training Documentation Area	1	1	1
Training Material Preparation Area	0	2	0
Large Lecture Room	0	2	0
Dining Facilities	1	1	2
Student Housing Facilities	1	1	1

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	8
Maintenance Workshops	0	1	0
Radiation Protection/Chemistry Labs	0	1	0
Other Labs/Workshops	0	1	0
Simulator(s)	1	0	1
Self-Study Rooms	1	0	1
Library(ies)	1	0	1
Dedicated Instructor Offices/Work Space	1	0	9
Technical and Training Documentation Area	1	0	1
Training Material Preparation Area	1	0	3
Large Lecture Room	1	0	1
Dining Facilities	0	1	0
Student Housing Facilities	1	0	52

*Numbers indicate the numbers of plants and training centres responding as indicated.

6.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	0	78	10
Maintenance	0	8	2
Radiation Protection	0	11	1.6
Chemistry	1	8	1.1
Other Instructors	2	52	6.1
Management and Support Staff			
Management	1	0	0
Simulator Support	1	3	0.1
Maintenance Support	1	3	0.1
Training Material Development	0	5	0.1
Education Specialist	0	0	0
Others	0	0	0

Training Centres

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	4	5	0.75
Maintenance	1	0	0
Radiation Protection	2	2	0.1
Chemistry	1	1	0.3
Other Instructors	12	12	4.2
Management and Support Staff			
Management	1	-	-
Simulator Support	0	2	2
Maintenance Support	2	0	0
Training Material Development	1	0	0
Education Specialist	0	0	0
Others	10		

6.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Basic Principles PC simulator	PWR 440	NTC Brno _ez	PWR 440 PWR 1000	100

6.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		3
	Reactor vessel head		3
	Reactor internals		
	Control rod drive mechanism		
Steam Generator	Complete		3
	Primary side channel head		
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		
Reactor coolant pump (or primary loop recirculation pump)	Internal part		
	Pump shaft seal		
	Pump body		
Main gate valve	Internal part		
	Body		
Fuel manipulator equipment	Manipulator crane		
	Dummy fuel		
	Fuel-handling tools		
	Fuel-loading simulator		
Pumps			
Valves			
Supporting structures			
Welding-practice equipment			
Compressor	Instrumentation air compressor		
Laser alignment			
Other			3

*Numbers correspond to the NPP or TC listed in section 6.3.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment			
Reactor coolant pump motor			
Control-rod drive mechanism control system			
Control boards at electrical control room	Rod position indicator		
	Reactor control and protection rack		
	Protective relay system		
	Ex-core nuclear instruments		
	In-core nuclear instruments		
	Generator automatic voltage regulator		
	Constant voltage constant frequency power source		
Instruments	Transmitter (water level, pressure, flow, volume, etc.)		
	Radiation measurement equipment		
	Controller		
	Other		
Measurement system for motor-operated valves			
Digital control device			
Other			
Common			
Non-destructive testing equipment			
Transparent power plant	See-through		3
	Functional		
Other			

*Numbers correspond to the NPP or TC listed in section 6.3.

6.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	2	1
Interactive video	1	2
Establishing and maintaining training database	3	0
Generating examinations	3	0
Keeping student records	3	0
Production of training materials	3	0

Visual aids available at facility

	Yes*	No*
Whiteboards	3	0
Overhead projectors	3	0
Slide projectors (such as 35mm)	2	1
Flip charts	3	0
Video equipment	3	0
Computer liquid crystal display panel or computer projector	3	0
Video conferencing	1	2

*Numbers indicate the numbers of plants and training centres responding as indicated.

7. FINLAND

7.1. SURVEY SUMMARY AND CONCLUSIONS

In Finland there are two NPP sites: Imatran Voima OY (VO) operates two electrical 465 MW WWER PWR units in Loviisa. They have a training centre on site with a plant-specific full-size training simulator since 1980. The simulator was upgraded and provided with new computers in 1988.

Teollisuunden Voima OY (TVO) operates in Olkiluoto two identical 710 MW net BWR units built by ABB. TVO had its control room crew trained at KSU Sweden up to 1989. TVO's training centre at the Olkiluoto site was put into operation 1987 and training on its full-scope plant-specific simulator started early 1990.

Both training centres have the possibility of training NPP personnel from organizations in other countries.

The initial education and training of the personnel was accomplished during the project phase where utility personnel intensively participated. An especially intensive period for training was connected with the commissioning of units. The knowledge and skills acquired by both the operations and technical personnel during this time have been sustained until today. This is particularly true as the turnover of personnel in both utilities has been very low.

With the aid of annual training and participation in plant modifications and projects the original skills are continuously refreshed and deepened. For new personnel, the company's initial training programs have been revised, and thorough OJT training was adopted.

Systematic approach to training is the principle in the development of training activities. A valuable tool in implementing SAT is the Training Manual that was established for TVO in 1990.

A description of TVO's training system follows.

7.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM (TVO)

The training centre with its training simulator is for the sole purpose of training the personnel of the two identical units and the other personnel.

For the yearly overhaul activities specialized vendors are hired who were engaged even in the design and/or erection/commissioning of both units.

The personnel were engaged as far as reasonable in early project stage, which means that initial training was very efficiently achieved as "on the job" training.

Quite a few of the main suppliers' project people were later hired by the company when the suppliers closed down their project organizations. Thus, the company got very competent 'part time teachers' in its other technical offices.

The training office with its training centre belongs to the technical department, so organizational boundaries do not prevent people from easily getting various experts as part time teachers whenever needed. That has enabled the number of training centre personnel to be kept reasonably low.

Turnover of personnel has been reasonably low, so the need for initial training has been extremely low during recent years.

Our interpretation of the systematic approach of training is based on the following hierarchy of responsibilities:

- Management of the company defines principles and goals for personnel training *and creates* prerequisites for achieving the goals and overseas training activities.

- Training committee is management's tool for this purpose. It represents the crucial target groups and expertise of training and development. It is responsible for the long term-planning and follow-up of training activities. It meets 2–3 times a year and:

  - Charts the needs for personnel development
  - Creates guidelines for necessary measures for development
  - Follows the realization and results of development activities.

- Training office (training centre):

  - Arranges all general training (standard courses) including simulator training
  - Co-ordinates, supervises and records training activities
  - Prepares the company's training plan and budget for next year
  - Establishes and develops training material
  - Utilizes two co-operation committees as tools, namely the *operational training group* with participants from operation and *maintenance training group* with participants from maintenance department.

- Training contact persons:

  - Total number 32
  - From all organization units and specialties
  - To co-ordinate the training arranged by their own organization
  - To find out training needs of their own organization
  - To prepare the proposals for training plan and budget for next year
  - To provide information to both training and line organizations

- Each supervisor has the responsibility that his personnel always must have the skills necessary to perform their jobs. That responsibility extends downwards to the level of foremen. In practice the original job competence requirements/training recommendations have been worked out systematically as teamwork between training office and the respective organization unit. The detailed responsibility to select the necessary additional training has been assigned to supervisors. The training centre of course assists them.

- More than 50% of training costs results from participating in various special external training occasions as well as various internal/international exhibitions/ conferences.

Training has an important role in maintaining high safety and availability of NPPs. As evaluating and anticipating effects of aging in NPP components is of importance, the same concerns apply to human resources. SAT is a valuable tool utilized for development of training in Finland.

Finland has no plant or shift supervisor position in its plants. Both are plants with two identical units.

Each operation shift includes a control room supervisor. This supervisor reports to an operations supervisor who works on the day shift. During other times there is an on-duty engineer with control room supervisor background. They are reachable by phone day and night.

7.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Teollisuuden Voima OY (TVO 1–2)

Contact: Altti Lucander
Tel: 358-38-8381 3500
Fax: 358-38-8381 3509

Availability of training for personnel from organizations in other countries:
NPP personnel: Y
Training personnel: Y
Loan personnel to other countries: Y
Fee for services: Y

Staff may be limited.

2. Imatran Voima OY (Louiisa 1–2)

Contact: Jussi Vaurio
Tel: 358 19 5504700
Fax: 358 19 55 04435

Availability as above

7.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	2	
Does plant management routinely monitor training?	2	
Is training audited by a non-regulatory organization external to training department?	2	
Is plant management directly involved in establishing training needs?	2	
Is management and supervisory skills training provided?	2	
Is general safety training provided?	2	
Is emergency preparedness training provided?	2	

Budget

Between 2 and 3 per cent of the total operating budget is spent on training, based on 2 surveys answering this question.

*Numbers indicate the numbers of plants and training centres responding as indicated.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

* higher than the plant position salary

* the same as the plant position salary

* lower than the plant position salary

7.5. TRAINING PROGRAMS

7.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	*Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*		E	TS	SS	E, TS, SS	E, TS, SS
Prerequisite years of experience for this program	N/A	3 – 3½	2 – 1	½	3....1	3...1

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE/E, TS, SS	GE, E, TS	GE, E, TS	GE	GE/E, TS	E, TS
Prerequisite years of experience for this program	1	3.....1	3....1	3......1	3	3

*This position does not exist in Finland. Instead there are on duty engineers with control room shift supervisor background reached by phone.

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma; SS = secondary school diploma].

7.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic approach to training (SAT) is used [1]	2	0	2	0	2	0	2	0	2	0	2	0
Job analysis is used to determine training needs [2]	2	–	2	–	2	–	2	–	2	–	2	–
Training needs are used to design measurable training/learning objectives	2	0	2	0	2	0	2	0	2	0	2	0
Training materials are based on training/learning objectives	2	0	2	0	2	0	2	0	2	0	2	0
Training implementation involves assessment of whether training/learning objectives are achieved	2	0	2	0	2	0	2	0	2	0	2	0
Evaluation is based on training goals. Feedback of needed improvements takes place	2	0	2	0	2	0	2	0	2	0	2	0

According to specific competence requirements/training recommendations.
The most orthodox procedures are not applied here.

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*Numbers indicate the numbers of plants and training centres responding as indicated.

7.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic approach to training (SAT) is used [1]	2	0	2	0	2	0	2	0	2	0	2	0
Job analysis is used to determine training needs [2]	2	–	2	–	2	–	2	–	2	–	2	–
Training needs are used to design measurable training/learning objectives	2	0	2	0	2	0	2	0	2	0	2	0
Training materials are based on training/learning objectives	2	0	2	0	2	0	2	0	2	0	2	0
Training implementation involves assessment of whether training/learning objectives are achieved	2		2		2		2		2		2	
Evaluation is based on training goals. Feedback of needed improvements takes place	2	0	2	0	2	0	2	0	2	0	2	0

According to specific competence requirements/training recommendations.
The most orthodox procedures are not applied here.

*Numbers indicate the numbers of plants and training centres responding as indicated.

7.5.3. Initial training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	–	1064	1064	500	250	300
Lab/Workshop	–	–	–	–	50	200
Process or Control Room Simulator	–	360	360	25	–	–
Self-Study	–	–	–	–	100	100
Formal On-the-Job Training	–	1000	1000	700	800	800
Total Initial Training	–	2424	2424	1275	1200	1400

7.5.3. Initial training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	300	300	300	300	100	120
Lab/Workshop	20	-	–	–	–	–
Process or Control Room Simulator	–	–	–	–	–	200
Self-Study	100	100	100	100	–	–
Formal On-the-Job Training	800	300	800	700	300	300
Total Initial Training	1220	700	1200	1100	400	620

7.5.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	–	73	68	40	56	56
Lab/Workshop	–	–	–	–	–	16
Process or Control Room Simulator	–	60	60	6	–	–
Self-Study	-	40	40	20	–	–
Formal On-the-Job Training	–	10	10	–	8	8
Total Continuing Training	–	183	178	66	80	80

7.5.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	60	80	80	80	80	80
Lab/Workshop	20	–	–	–	–	–
Process or Control Room Simulator	–	–	–	–	–	–
Self-Study	–	–	–	–	–	–
Formal On-the-Job Training	–	–	–	–	20	20
Total Initial Training	80	80	80	80	100	100

7.5.5. Total number of personnel trained by nuclear power plant training departments

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average number of persons completing program 1991–1995		4	4	5	10	6
Average number of persons who participate in continuing training 1991–1995		28	69	86	115	80

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average number of persons completing program 1991–1995	2	2	3	2	4	3
Average number of persons who participate in continuing training 1991–1995	54	18	26	26	9	9

7.6. TRAINING FACILITIES

7.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	2	0	5
Maintenance Workshops	1	1	2
Radiation Protection/Chemistry Labs	0	2	
Other Labs/Workshops	0	2	
Simulator(s)	2	0	2
Self-Study Rooms	2	–	
Library(ies)	2	0	1
Dedicated Instructor Offices/Work Space	2	0	1 per person
Technical and Training Documentation Area	2	0	several
Training Material Preparation Area	1	1	1
1arge Lecture Room	2	0	1
Dining Facilities	2	0	
Student Housing Facilities	NA	NA	

*Numbers indicate the numbers of plants and training centres responding as indicated.

7.6.2. Training department staffing

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	4		
Maintenance	3		
Radiation Protection		2	1
Chemistry		4	0,2
Other Instructors		60	2
Management and Support Staff			
Management	1		
Simulator Support	1		
Maintenance Support		1	0,1
Training Material Development	1		
Education Specialist	–	–	
Others	1		

7.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full Scope	Olkiluoto 1–2	Olkiluoto	Olkiluoto 1–2	1200
PC-based simulator for severe accident training	Olkiluoto 1–2	Olkiluoto	Olkiluoto 1–2	100
Full Scope	Loviisa 1–2	Loviisa	Loviisa 1–2	900

7.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel	–	–
	Reactor vessel head	–	–
	Reactor internals	–	–
	Control rod drive mechanism	–	–
Steam Generator N/A	Complete		
	Primary side channel head		
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		
Reactor coolant pump (or primary loop recirculation pump)	Internal part	–	–
	Pump shaft seal	–	–
	Pump body	–	–
Main gate valve	Internal part	–	–
	Body	–	–
Fuel manipulator equipment	Manipulator crane	–	–
	Dummy fuel	–	–
	Fuel-handling tools	–	–
	Fuel-loading simulator	–	–
Pumps		–	–
Valves		–	–
Supporting structures		–	–
Welding-practice equipment		–	–
Compressor	Instrumentation air compressor	–	–
Laser alignment		–	–
Other		–	–

'*Numbers correspond to the NPP or TC listed in Part II.

Electrical and instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		1	–
Reactor coolant pump motor		1	–
Control-rod drive mechanism control system		1	–
Control boards at electrical control room	Rod position indicator	1	–
	Reactor control and protection rack	–	–
	Protective relay system	–	–
	Ex-core nuclear instruments	1	–
	In-core nuclear instruments	1	–
	Generator automatic voltage regulator	–	–
	Constant voltage constant frequency power source	1	–
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1	–
	Radiation measurement equipment	1	–
	Controller	1	–
	Other	1	–
Measurement system for motor-operated valves		1	–
Digital control device		1	–
Other		–	–
Common			
Non-destructive testing equipment		1	–
Transparent power plant	See-through	1	–
	Functional	–	–
Other		1	–

*Numbers correspond to the NPP or TC listed in Part II.

7.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	1	1
Interactive Video	1	1
Establishing and maintaining training database	1	1
Generating examination	1	
Keeping student records	2	
Production of training materials	2	

Visual aids available at facility

	Yes*	No*
Whiteboards	2	
Overhead projectors	2	
Slide projectors (such as 35mm)	2	
Flip charts	2	
Video equipment	2	
Computer liquid crystal display panel or computer projector	2	
Video conferencing		1

*Numbers indicate the numbers of plants and training centres responding as indicated.

8. FRANCE

8.1. SURVEY SUMMARY AND CONCLUSIONS

Training organizations

- EDF training centres have the capability for training people from other countries. A large range of training facilities are available both for operation and maintenance (facilities for primary circuit maintenance).
- Annual meeting is organized between instructors of each nuclear operations training centres to compare training experience and resolve pedagogical problems.
- EDF management is completely involved in training.
- Salary of instructors is the same as the plant position salary.
- Percentage of the total NPP operations payroll spent in training is around 17%.

Training programs

- A SAT methodology is used to complement training programs.
- Entry requirements education and experience are at a high level and are on a way of improvement.
- Duration the both initial and continuing programs is at a good level for all job positions.

Training facilities

- Physical facilities as well as staffing are fully provided to fulfill training programs.
- Control room simulators are spread over the country in a sufficient number.
- Maintenance training is provided in three training centres using a large range of training equipment.
- Computers are used for computer based training, student records and production of training materials.
- Audiovisual aids are widely used for training.

8.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

8.2.1. Overall description of EDF's training system — organizations and responsibilities

In order to optimize and to take profit from a standardized nuclear generation capacity, the Corporate Resources Department (Moyens Centraux du Parc or MCP) is available to the NPP operations. The MCP is in charge of defining the initial training programs, of the ensuing structured retraining required to maintain competencies, as well as the actions resulting from the generic experience feedback.

NPPs are in charge of competence development based on skills and knowledge acquired through initial training programs NPP's are also responsible for establishing the training programs to maintain competence level.

According to site organization and required qualifications, the site management assumes the responsibility for managing the NPP personnel competence. The site management therefore relies on orientations and prescriptions defined at MCP level and decided by the nuclear power plant operation management. There is no training organization example forced upon all the NPPs and the chart below shows the current organization principles.

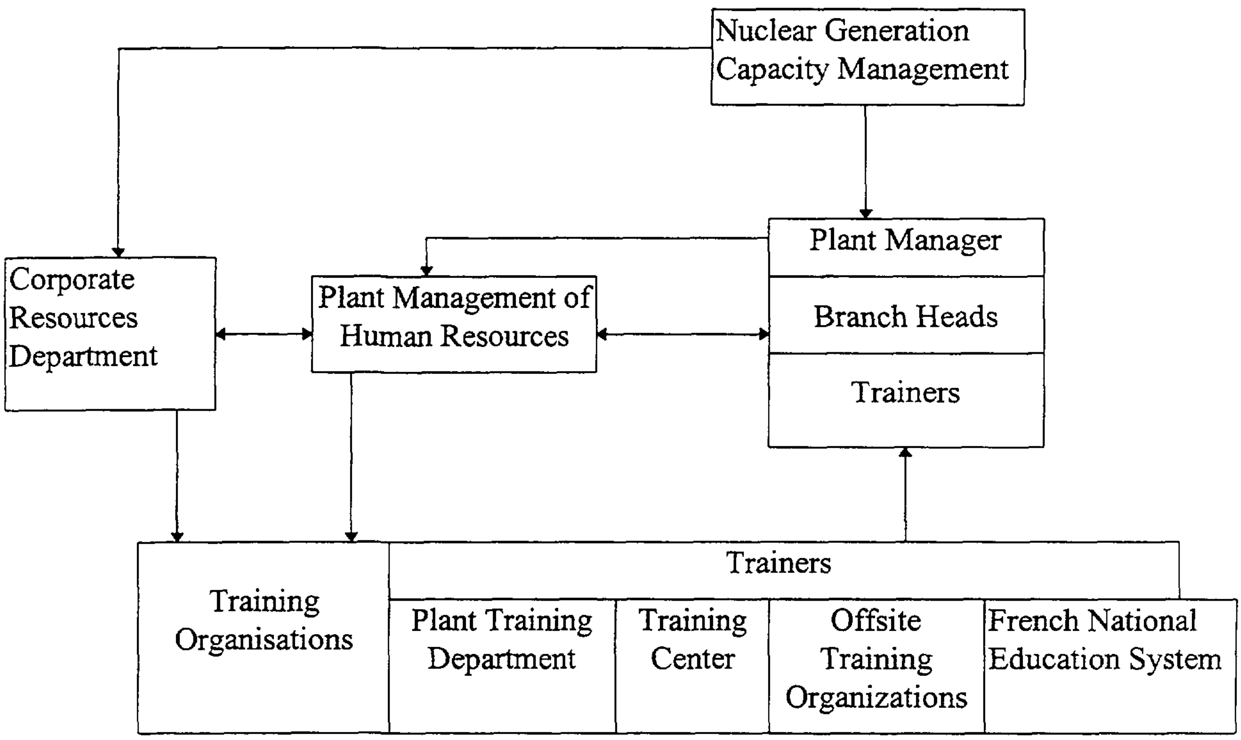

FIG.3.8. Organization Chart of Training in the EDF NPPs.

Training centres

The Professional Training Department (SFP) is responsible for operating several training centres for all the EDF personnel. Corporate means are available in several fields, amongst which training methods and techniques, the development of EDF jobs and the relationship with the French national educational system.

Four training entities are available for NPP personnel training. Each training entity overseeing one or several training centres. Two entities are dedicated to operations personnel training (Lyon-Est entity and Normandie Entity), two to maintenance personnel (Loyon-Ouest Entity and Paris-Est Entity). the entities are fitted with heavy training facilities. The maintenance training centres are thus divided into departments according to the field taught (I and C, Electrotechnics, mechanics etc...). The operations training centres are divided into departments according to simulator training (simulator training department) and class-room training (technical training department).

Maintenance training entities

The activities are broken down among the maintenance training centres according to the training facilities available. there is therefore no overlapping of the activities carried out by the two maintenance training centres.

The Lyon-Ouest Entity (La Pérolliére, PWR Nuclear Steam Supply System Maintenance Techniques Validation and Testing Centre (CETIC) are in charge of training the maintenance personnel working in the following fields:

- Boiler making, welding, non-destructive examinations, electrical rotating machines, vibrations, special tooling, machining and assembly, fuel handling.

The Paris-Est Entity (Gurcy le Chatel) is in charge of training the maintenance personnel working in the following fields.

- Valves, electronics, electro technics, I & C, corrosion chemistry, health and physics, process computerized system, diesel generator sets, controls.

Operation training entities

The distribution of activities among the operations training entities are achieved according to geographical criteria and to the standardized NPP series. There is therefore an overlapping of the activities carried out by the two operations training entities. Each operation training entity being divided into several training centres.

The Lyon-Est Entity, more particularly in charge of the 900 MW and 1400 MW standardized plant series, includes the training centres of Bugey, Cattenom and soon Fessenheim and Chooz.

The Normandie training entity, which is more particularly in charge of the 1300 MW standardized plant series, includes the training centres of Paluel, Caen and Gravelines.

Methodology applied to training

The methodology applied by EDF as concerns training is based upon the SAT and is used to a certain degree of accuracy and details according to jobs and their importance for safety.

Due to EDF training organization, SAT design, SAT development and SAT implement phases are mainly entrusted to the training centres. The other phases (analysis and evaluation) are carried out by the NPP Operation. as far as the analysis phases is concerned, EDF establishes the referential of competencies required for the jobs. The referential is achieved by working groups made up of job representatives, managers, experts and training professionals.

Subcontractors

The subcontractors are responsible for the training and the qualification of their personnel. For the technical or professional competencies, the subcontractors implement or use training devices or actions. EDF checks the quality of the training devices and actions.

As concerns the fields specific to the NPPs, such as safety, quality assurance, knowledge of the plant, risks prevention and health and physics, training devices have been set up jointly with EDF and compulsory training sessions are set up. EDF regularly audit the training to check the high quality level and to check that the training professionals themselves are trained accordingly to the technical and teaching abilities.

The subcontractors personnel have identical minimum qualifications and abilities in the mentioned fields as the NPP personnel carrying out the same tasks. The activities entrusted to the subcontracting personnel are thus carried out in total confidence, therefore establishing a sound relationship between subcontracting personnel and plant personnel.

- **General comments:**

Instructors

Instructors come from operations or university. If they come from operations they only need a pedagogical training (160 hours). If they come from university they must follow a two-year training programme, then the 160 hour pedagogical training.

Self-study for continuing training for the instructors represents a minimum required by the training department of EDF to spend in an NPP as refresher training.

In the training centers, instructors do both training and development of the training materials.

Control room supervisor (CRS)

CRS come from reactor operator position so they do not have special technical training.

A training programme for CRS including management, communication, safety etc. started to be implemented this year.

Initial training

For the following job position: electrical, mechanical, I & C and chemistry technicians, a three-year initial continuing training is provided. During this period they are trained in a training centre and in the NPP and they also participate in the department with a workload as a normal worker.

SAT methodology in EDF

A systematic approach to training is performed in EDF based on job competence analysis and a group of experts from the EDF training department and the EDF production department is working on the comparison between the EDF methodology and the IAEA Guidebook recommending SAT (TRS-380). A manual explaining these differences will be issued at the end of this working group process.

Self-study

Self-study in EDF is included in the total initial training programme for all job positions.

8.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. **ALL**

Contact: Mr. J. C. Hazet
Tel: 0033 2 3557 8656
Fax: 0033 2 3557 8605

Training practices which could be recommended for application in other training organizations:

N/A

Availability of training for personnel from organizations in other countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: N
Fee for Services:N

Unique training facilities

All training facilities are mostly in the Training centers.

Training Center (TC) Responses for the Survey

All

Contact: Mr. J.C. Hazet
Tel: 33 2 3557 8656
Fax: 33 2 3557 8605

Training practices which could be recommended for application in other training organizations:

- Annual meeting between instructors
- Use, during simulator sessions, of the total OPS crew SS/RO/POP to improve communication and relations between members of the crew.

Availability of training for personnel from organizations in other countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

Unique training facilities

In Paluel TC and Gurcy Le Chatel Nuclear Power plant functional mock-up (mini NPP) for RP, OPS, Mechanical, Electrical, I & C people training. This unique facility is located in the Normandie Training Entity in Paluel training centre and Gurcy Le Chatel and is called "MINI POWER PLANT". It consists in a primary circuit with a reactor (using electrical heaters for production of energy), a pressurizer, reactor cooling pump and a steam generator. The secondary side consists in a turbine with a generator linked to the electrical grid. In this "mini power plant" you can find heaters, condenser, pumps, valves all of usual size.

This "mini power plant" can be used to train HP, operations, mechanical, I & C. personnel in such subjects as operations, tag-out, control systems, radio protection workshop.... But the main use for the moment is for operations.

CETIC (GFLO)

Contact: Mr. J.C. Hazet
Tel: 33 2 3557 8656
Fax: 33 2 3557 8605

Training practices which could be recommended for application in other training organizations:

The main EDF maintenance facilities are located in the CETIC (Lyon-Ouest Training Entity). In this training centre can be found: real equipment for fuel-handling (dummy fuel, crane.), steam generator (for inspection and manipulation), reactor coolant pump for study and maintenance training. This equipment is used for EDF maintenance personnel but also for contractors' maintenance personnel.

Availability of Training for Personnel from Organizations in Other Countries:

NPP Personnel: Y
Training Personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

8.4. MANAGEMENT ROLE AND RESPONSIBILITIES

For all EDF	Yes	No
Is there a plant or operating organization training policy document?	x	
Does plant management routinely monitor training?	x	
Is training audited by a non-regulatory organization external to training department?	x	
Is plant management directly involved in establishing training needs?	x	
Is management and supervisory skills training provided?	x	
Is general safety training provided?	x	
Is emergency preparedness training provided?	x	

Budget

Between 16 and 18 per cent of the total Nuclear Production Department (EPN) payroll of EDF is spent on training.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

| | * higher than the plant position salary
| x | * the same as the plant position salary (all TC)
| | * lower than the plant position salary

8.5. TRAINING PROGRAMS

8.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE	E	E or TS	TS or SS	GE or TS	GE - E - TS
Prerequisite years of experience for this program	4	8	4 – 6	^{3} 7	6 – 10	6 – 10

Job Position **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE – E or TS	GE	E or TS	E or TS	GE (or operating experience)	GE (or operating experience)
Prerequisite years of experience for this program	3 mini to 10	NA	NA	> 2	> 4 years	>4 years

(Prerequisite years of experience) and Education prerequisite depend on the responsibility level in each job position.

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

8.5.2. Training methodology

Job Position **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	Y		Y		Y		Y		Y		Y	
Job analysis is used to determine training needs	Y		Y		Y		Y		Y		Y	
Training needs are used to design measurable training/learning objectives	Y		Y		Y		Y		Y		Y	
Training materials are based on training/learning objectives	Y		Y		Y		Y		Y		Y	
Training implementation involves assessment of whether training/learning objectives are achieved	Y		Y		Y		Y		Y		Y	
Evaluation is based on training goals. Feedback of needed improvements takes place	Y		Y		Y		Y		Y		Y	

EDF uses SAT in all its training programs.

*Numbers indicate the numbers of plants and training centres responding as indicated.

8.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	Y		Y		Y		Y		Y		Y	
Job analysis is used to determine training needs	Y		Y		Y		Y		Y		Y	
Training needs are used to design measurable training/learning objectives	Y		Y		Y		Y		Y		Y	
Training materials are based on training/learning objectives	Y		Y		Y		Y		Y		Y	
Training implementation involves assessment of whether training/learning objectives are achieved	Y		Y		Y		Y		Y		Y	
Evaluation is based on training goals. Feedback of needed improvements takes place	Y		Y		Y		Y		Y		Y	

EDF uses SAT in all its training programs.

*Numbers indicate the numbers of plants and training centres responding as indicated.

8.5.3. Initial training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	*Mechanical Maintenance	*Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	840	NA	720	950	380	530
Lab/Workshop	-	NA		NA	3 years** but no simulator training	4 years** but no simulator training
Process or Control Room Simulator	40	NA	420	NA	3 years** but no simulator training	4 years** but no simulator training
Self-Study	680	NA	2100	950	3 years** but no simulator training	4 years** but no simulator training
Formal On-the-Job Training	NA	NA	NA	NA	3 years** but no simulator training	4 years** but no simulator training
Total Initial Training	1560					

* This information is valid for a technician.
** To be a fully accredited technician.

8.5.3. Initial training programs - settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	*Instrumentation & Control	*Quality Assurance Quality Control	*Radiation Protection	*Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	800	NA	NA	530	150	150
Lab/Workshop	180	NA	NA		NA	NA
Process or Control Room Simulator	25	****	****	2660 For lab/workshop and self-study but no simulator.	***	***
Self-Study	around** 300	NA	NA	NA	NA	NA
Formal On-the-Job Training	~4000	NA	NA	3190	NA	NA
Total Initial Training						

* This information is valid for a Technician.
** To be a fully accredited Technician.
*** + 2 years of operation training if instructor comes directly from a University.
**** Depends on background.

8.5.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	NA	160	160	160	75	75
Lab/Workshop	NA	NA	NA	NA	NA	NA
Process or Control Room Simulator	80	80	80	NA	-	-
Self-Study	NA	NA	NA	NA	NA	NA
Formal On-the-Job Training	NA	NA	NA	Na	NA	NA
Total Continuing Training	80	240	240	160	75	75

8.5.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	NA	NA	50	-	75	75
Lab/Workshop	190	NA	NA	75		
Process or Control Room Simulator	-	NA	-	-	-	-
Self-Study	NA	NA	NA	NA	75	75
Formal On-the-Job Training	NA	NA	NA	NA	NA	NA
Total Initial Training	190	NA	50	75		

8.6. TRAINING FACILITIES

8.6.1. Physical facilities

A, B and C are for Operation training centres of Bugey, Caen and Paluel. D and E are valid for EDF.

Nuclear Power Training Departments — N/A

A. Training Centers

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	3		14
Maintenance Workshops	3		2
Radiation Protection/Chemistry Labs	3		0
Other Labs/Workshops	3		2
Simulator(s)	3		5
Self-Study Rooms	2		2
Library(ies)	2		1
Dedicated Instructor Offices/Work Space	3		28
Technical and Training Documentation Area	3		2
Training Material Preparation Area	1		1
Large Lecture Room	3		1
Dining Facilities	3		1
Student Housing Facilities	2		1

Numbers indicate the numbers of plants and training centers responding as indicated.

8.6.2. Training department staffing

Nuclear Power Plant Training Department — N/A

B. Training Centres

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	41		
Maintenance	3		
Radiation Protection	NA		
Chemistry	1		
Other Instructors	18*		
Management and Support Staff			
Management	6		
Simulator Support	11		
Maintenance Support			
Training Material Development	**		
Education Specialist	1		
Others			

*2 Computer specialists + 16 Technical instructors.
** Instructors to both teaching and development.

8.6.3. Control room simulators

Total Part Task including PT simulators in NPP is 12.

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
2 x 1300 Fullscope	Paluel, 2, 3, 4, Flauvanille 1, 2	Paluel TC	Paluel (4 units) Penly (2 units) Belleville (2 Units) Flammanvanille (2 units)	2400h/smu
900 MW Fullscope	Craveline 1, 2, 3, 4, 5, 6 Dampierre 1, 2, 3, 4 Tricastin 1, 2, 3, 4	Paluel TC	Dampierre (4 units) Blayais (2 units)	2250
CVCS Part Task	900 MW	Paluel TC	Personnel from 900 & 1300 MW	350h
Turbine Part Task	900 MW	Paluel TC	Personnel from 900 & 1300 MW	350h
Reactor operations Part Task	900 MW	Paluel TC	Personnel from 900 & 1300 MW	570h
Full Scope 900 PWR	900 MW St. Laurent	Caen TC	St. Laurent Chinon Dampierre Cruas	3500h
Full Scope 900 MW	Bugey 2	Bugey TC	Bugey 2, 3, 4, 5, Fessenheim 1, 2	2280h
900 MW Full Scope	Craveline 1	Bugey TC	Tricastin 1, 2, 3, 4 Blayais s.2	2280h
900MW Full Scope	St. Laurent B1	Bugey TC	Cruas 1, 2, 3, 4 St. Laurent 1, 2	2100h
1300MW Full Scope	Paluel 1	Bugey TC	Golfech 1, 2 St. Alban 1, 2	2100h
1300MW Full Scope	Paluel 1	Cattenom	Cattenom 1, 2, 3, 4 Nogeu 1, 2	2160h
1400MW Full Scope	Chooz 1/ Paluel	Bugey	Chooz 1 Civaux 1	2280h
CVCS, Turbine, Reactor Operating 900 MW 3 Part Task Simulators	900MW	Bugey	Personnel from 900 and 1300 MW units	800h
900MW Full Scope — Started in April 1995	Craveline 1	Cravaline	Cravaline 1, 2, 3, 4, 5, 6	1275h

8.6.4. Maintenance training equipment

Mechanical (This data is for all EDF Companies)

Plant Component	Training Equipment	Real & Dedicated for Training	Mock-up
Reactor	Reactor pressure vessel	Y	Y
	Reactor vessel head	Y	Y
	Reactor internals	Y	Y
	Control rod drive mechanism	Y	Y
Steam Generator	Complete	Y	Y
	Primary side channel head	Y	
	Tube examinationination equipment	Vendor	
	Steam generator inspection manipulator	Y	
	Handling tools of manhole	Y	
Reactor coolant pump (or primary loop recirculation pump)	Internal part	Y	Y
	Pump shaft seal	Y	Y
	Pump body	Y	Y
Main gate valve	Internal part	NA	NA
	Body	NA	NA
Fuel manipulator equipment	Manipulator crane	Y	
	Dummy fuel	Y	
	Fuel-handling tools	Y	
	Fuel-loading simulator	Y	
Pumps		Y	Y
Valves		Y	Y
Supporting structures		Y	
Welding-practice equipment		Y	
Compressor	Instrumentation air compressor	Y	
Laser alignment		NO	NO
Other			

Most of these components are available in the maintenance training center entities GFLO or GFPE (see country pages).

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training	Mock-up
Switchgear equipment		Y	
Reactor coolant pump motor		Vendor	
Control-rod drive mechanism control system		Y	
Control boards at electrical control room	Rod position indicator	Y	
	Reactor control and protection rack	Y	
	Protective relay system	Y	
	Ex-core nuclear instruments	Y	
	In-core nuclear instruments	Y	
	Generator automatic voltage regulator	Y	
	Constant voltage constant frequency power source	Y	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	Y	
	Radiation measurement equipment	Y	
	Controller	Y	
	Other		
Measurement system for motor-operated valves		Y	
Digital control device		Y	
Other			
Common			
Non-destructive testing equipment		Y	
Transparent power plant	See-through	N	
	Functional	N	
Other	Transparent PWR Loop		Y
	Transparent Deaerator		Y
	Transparent Evaporator		Y
	Hydraulic loop		Y
	NPP functional mock-up		Y

8.6.5. Use of computers and visual aids

Computers are used for

	Yes	No
Computer-based training	Y	
Interactive video	Y	
Establishing and maintaining training database	Y	
Generating examinations	N	
Keeping student records	Y	
Production of training materials	Y	

Visual aids available at facility

	Yes	No
Whiteboards	Y	
Overhead projectors	Y	
Slide projectors (such as 35mm)	Y	
Flip charts	Y	
Video equipment	Y	
Computer liquid crystal display panel or computer projector	Y	
Video conferencing	Y	

9. GERMANY

9.1. SURVEY SUMMARY AND CONCLUSIONS

Training organizations

- Eleven NPPs completed and returned the questionnaire, which represents 13 reactors out of 19 to which the survey questionnaire was sent.
- All TCs to which the survey questionnaire was sent completed and returned the questionnaire.
- The NPP is solely responsible for the training of its personnel and acts on its own discretion within the scope of the guidelines issued by the authorities.
- The supervisory authority is widely involved in training procedures. It establishes guidelines, supervises the implementation of the requirements, licenses training facilities for basic nuclear courses, and is directly involved in the licensing of the responsible shift personnel.
- The cost of training can be estimated at 2% of the total NPP costs.
- The instructors' salaries are comparable to those paid to personnel holding similar plant positions.
- Three NPPs and most TCs provide training for NPP personal from other countries.

Training programs

- All NPP personnel receive training, specified by guidelines of the authority.
- Training programs for responsible shift personnel are very strictly defined.
- SAT methodology is fully established for the training of responsible shift personnel training.
- All skills and abilities required from maintenance personnel are already imparted during vocational training. Therefore, training of maintenance personnel at the NPP is not necessary. Moreover, most maintenance work is performed by the suppliers and vendors.
- At different NPPs, many job positions largely regarding assignment and responsibility, thus influencing the scope and content of the training. For this reason, no information is given about these training programs.

Training facilities

- Full-scope simulators are available for all reactors with only two exceptions.
- In addition, multifunctional and compact simulators are in use.
- There exists a unique simulating facility. A 1:10 scale model of a PWR largely made from glass enables trainees to see exactly the most significant thermohydraulic phenomena inside the system during normal operation and accident conditions.
- CBT is widely used for initial and continuos training.

9.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

9.2.1. Overall description of the training system

The training of nuclear power plant personnel is the owner's obligation. He is exclusively responsible for training his personnel, for keeping them optimally qualified and for adjusting this qualification to any change in the state of science and technology. He is the only one capable of transforming the regulatory requirements into operation-oriented training objectives which take into account the needs and constraints of the actual tasks to be accomplished.

The training of NPP personnel is performed as theoretical training and on-the-job training at the NPP, as theoretical training in external training centres and as simulator training in the simulator centre in Essen (there are two exceptions, where the simulator is at the plant itself).

Article 7 of the German Atomic Energy Act – the legal basis for the licensing of construction and operation of all nuclear installations – states that a license to operate a nuclear installation may be granted only if, among other prerequisites such as safe plant design, technical safety features, security measures, the following requirements are met:

- No facts shall be known that give rise to any doubt as to the reliability of the personnel responsible for the management and control of the operation of the installation (responsible operations personnel), and these personnel shall have the requisite competence.

- It is assured that the personnel otherwise engaged in the operation of the installation (subordinate operations personnel) have the necessary knowledge concerning safe operation of the installation, possible risks, and safety measures to be applied.

These legally binding licensing requirements clearly distinguish between ***responsible operations personnel***, for which the legal qualification requirements cover reliability and requisite competence subject to very strict guidelines, and ***subordinate operations personnel*** for which only a clearly defined level of knowledge, concerning plant safety and safety of the personnel, related to their respective tasks and working places, is required. Although there are no stringent guidelines set up for training these subordinate operations personnel, the owner of the nuclear installation has to establish a training programme.

Even though the plant owner is not obliged to provide vocational training for skilled workers in the NPP, nearly all plants carry out these training activities. The training for mechanics and electricians is performed in vocational schools and in (training) workshops in the facility.

The German educational system for skilled workers and master craftsmen minimizes the need for full-scope maintenance training programs within the organization. Therefore only special courses for specific components have to be provided to the maintenance personnel.

Detailed requirements regarding the qualification of operations personnel have been specified by the licensing authorities.

9.2.2. The role of the regulatory body with respect to training

The licensing requirements of article 7 of the Atomic Energy Act concerning the qualification and training of personnel have been further specified for nuclear power plants in guidelines on:

- The proof of the requisite competence of responsible operations personnel
- The contents of the examination of responsible shift personnel
- The requirements for requalification programmes for responsible shift personnel

- The assurance of the necessary knowledge of subordinate operations personnel
- The proof of the competence of radiation protection technicians
- Requirements regarding physical protection personnel and security guards.

The plant owner has to prove to the authorities that each member of the category of responsible operations personnel of his plant has the requisite competence by submitting appropriate documentation (for instance certificates from training centres, diplomas from universities or other training institutions, evidence on practical experience and professional history with other installations, statements by the plant management regarding in-plant training and personal abilities and characteristics).

Shift supervisors, their deputies and control room operators have to take written and oral examinations on nuclear fundamentals taught in special courses at nuclear training centres as well as at their own plant before getting licensed. The training centres providing nuclear fundamentals have been accredited by the authorities following an independent experts' assessment. The oral examinations are taken in the presence of a board of examiners in which the regulatory body is represented. The examinations are to be taken only once, i.e. when the candidate is licensed for the respective plant and the respective function for the first time. No regular repetition is required. If responsible shift personnel change from one power plant to another, the plant specific part of the training is to be repeated.

Requalification programmes have to be submitted to the competent authority, updated every three years.

Subordinate operations personnel receive instruction concerning safety-related knowledge in areas such as fire protection, radiation protection, industrial safety and knowledge of the plant. The authority will assess the training programme and the list of trainees submitted by the plant owner and will – to the extent necessary – suggest modifications. These documents and additional information on the methods and the duration of the training activities are the basis for assuring the necessary safety-related knowledge of subordinate operations personnel.

9.2.3. Specific positions for which training is available

The safety-related nuclear fundamentals are taught to shift supervisors and control room operators-to-be in special courses of about twelve weeks' duration at nuclear training centres which qualify them to take final examinations. The main subjects covered by these courses and checked by the written and the oral examinations are: nuclear physics, reactor physics and technology, thermohydraulics and energy release, reactor safety including unexpected events, radiation protection, industrial safety, fire protection, nuclear legislation.

The plant-specific part of the training for shift supervisors and control room operators-to-be consists of classroom and in-plant technical training. Each candidate has to pass a written and an oral examination. The oral examination is taken individually and consists of a plant walk-through to demonstrate the candidate's knowledge of locations and functions of important systems and components, and of an experts' discussion between the candidate and the board of examiners in the control room.

Responsible shift personnel have to undergo full-scope simulator training of at least 8 weeks (PWR) or 7 weeks (BWR), respectively. No examination is required at the simulator. However, the simulator training personnel have to evaluate, to document and to testify on the training success for each trainee, including possible weaknesses or deficiencies in knowledge or abilities.

Subordinate operations personnel receive instruction concerning safety-related knowledge in areas such as fire protection, radiation protection, industrial safety and knowledge of the plant.

For training personnel special pedagogical training is provided.

Requalification training covers theoretical and practical subjects. Each member of the category of the responsible shift personnel shall participate in regular retraining activities for at least 100 hours per year. In addition, 20 days of full-scope simulator retraining is required for PWR shift personnel (15 days for BWR) within three years. These programmes have to be established by the respective training officer, who will be responsible for their execution as well.

Subordinate operations personnel regularly receive refresher courses to update their safety-related knowledge.

In Germany, the job positions

Instrumentation and control technician
QA/QC inspector
Radiation protection technician
Chemistry technician Instructor

are characterized by different tasks and responsibilities, which vary from one NPP to another. Since the relevant guidelines for training are individually specified for each plant, they are not contained in this country report for the survey.

9.2.4. The role of the regulatory body with respect to training

Representatives of nuclear power plants responsible for the realization of training programmes of plant personnel form a working panel and meet regularly for the exchange of information and experience about plant operation, training activities and trends in the national and international development of training systems and requirements. This working panel also keeps close contact with training centres and regulatory authorities in order to assure that operational requirements, training programmes and regulatory conditions fit together in an optimized manner. To achieve this goal, the working panel is involved in the elaboration of training guidelines and programmes.

9.3. TRAINING ORGANIZATIONS

A. Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. RWE Energie AG
Nuclear Power Plant Biblis

Contact:

Herrn Dipl.-Ing. Ralph Reuhl
Tel: +49 6245 21 4152
Fax: +49 6245 21 3180

Training practices which could be recommended for application in other training organizations:

- Instructors for operations personnel all hold a current shift supervisor license
- Biblis radiation protection group prepares own employees and personnel of other NPP for examinations at the Chamber of Industry and Commerce

Availability of training for personnel from organizations in other countries *

NPP personnel: yes, with reservations
Training personnel: yes, with reservations
Loan personnel to other countries: yes, with reservations
Fee for services: yes

Unique training facilities

Training at the PWR Glas Model (Scale 1:10, 60 kW thermal power)
Direct contact: NIS Engineering Company
Herrn H. Rehn
Tel: +49 6181 10 9440
Fax: +49 9181 12 0033

2. **HEW**
Kernkraftwerk Brunsbüttel GmbH

Contact:
Herrn Dipl.-Ing. Manfred Sickert
Tel: +49 4852 89 2270
Fax: +49 4852 89 2209

No information to these subjects are given.

3. **PreussenElektra**
Gemeinschaftskernkraftwerk Grohnde GmbH

Contact:
Herrn H. Bohr
Tel: +49 5155 67 2312
Fax: +49 5155 67 2380

Availability of training for personnel from organizations in other countries

NPP personnel: Yes (training on the job)
Training personnel: No
Loan personnel to other countries: No
Fee for services: No

Unique Training Facilities

- Compact-plant-analyser simulator on the site

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*Regarding the „Availability of Training for personnel from Organizations in Other Countries" it should additionally be mentioned that there are 16 German NPPs having established a partnership with NPPs in Middle and East Europe. These partnerships are not considered in the answers given by the NPPs.
Their co-operation focuses on:

- the exchange of experience in the form of mutual visits of the operations teams
- the familiarization of the foreign NPP personnel with the work flow in German NPPs in the form of on-the-job training and
- special seminars for the foreign partners on topics such as Operations Management, Quality Assurance, Training of personnel, etc.

4. **Kernkraftwerk Isar 1**

Contact:
Herrn Robert Graf
Tel: +49 8702 99 2214
Fax: +49 8702 99 2461

Training practices which could be recommended for application in other training organizations:

- Information exchange between personnel of different departments

5. **Kernkraftwerk Obrigheim GmbH**

Contact:
Herrn Dipl.-Ing. F. Wensing
Tel: +49 6261 65 501
Fax: +49 6261 65 390

Training practices which could be recommended for application in other training organizations:

- All shift personnel is yearly trained at the Biblis Glas Model

6. **Kernkraftwerk Philippsburg GmbH**
   Unit 1

Contact:
Herrn Dipl.-Ing. Heiko Tabbat
Tel: +49 7265 95 2299
Fax: +49 7256 95 2029

Training practices which could be recommended for application in other training organizations:

- Stress-Seminar for reactor operators and shift supervisors

7. **Kernkraftwerk Philippsburg GmbH**
   Unit 2

Contact:
Herrn Dipl.-Ing. Martin Leverenz
Tel: +49 7256 95 4554
Fax: +49 7256 95 2029

Training practices which could be recommended for application in other training organizations:

- Stress-Seminar for reactor operators and shift supervisors

8. **PreussenElektra**
   Kernkraftwerk Unterweser

Contact:
Herrn Dipl.-Ing. Bernd Spindler
Tel: +49 4732 80 2577
Fax: +49 4732 8661

Training practices which could be recommended for application in other training organizations:

- Training: „Rules of communication for plant operation"

9. PreussenElektra
Kernkraftwerk Brokdorf

Contact:
Herrn Rietz
Tel: +49 4829 75 2427
Fax: +49 4829 1666

Training practices which could be recommended for application in other training organizations:

- Computer based training

10. Kernkraftwerke Gundremmingen Betriebsgesellschaft mbH
KRB II, Unit B and Unit C

Contact:
Herrn Dipl.-Ing. Alfred Leinauer
Tel: +49 8224 78 2150
Fax: +49 8224 78 2900

Training practices which could be recommended for application in other training organizations:

- Continuous computer-based self-examination
- Self-instruction of student-groups under supervision of an experienced instructor

Availability of training for personnel from organizations in other countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Yes

11. Kernkraftwerk Krümmel

Contact:
Herrn Thurm
Tel: +49 4152 15 2272
Fax: +49 4152 15 2099

No information to these subjects are given.

B. Training Centre (TC) Responses for the Survey

12. KSG Kraftwerks–Simulatorgesellschaft mbH /
GfS Gesellschaft für Simulatorschulung mbH

Contact:
Herrn Dr.-Ing. Eberhard Hoffman
Tel: +49 201 4862 108
Fax: +49 201 4862 290

Training practices which could be recommended for application in other training organizations:

- Instructors training
- Trainee assessment

Availability of training for personnel from organizations in other countries

NPP personnel: No
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Yes

Unique training facilities

- Simulator training

13. Siemens AG
KWU-Training Centre Karlstein

Contact:
Herrn Dipl.-Phys. D. Gronau
Tel: +49 6188 780 750
Fax: +49 6188 780 803

Availability of training for personnel from organizations in other countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique training facilities

- Theoretical training
- Simulator training
- Computer-based-training
- I&C training

14. CAG Technologie Management Consultants Greifwald GmbH

Contact:
Herrn Dipl.-Ing. Peter Reibert
Tel: +49 3834 803 219
Fax: +49 3834 803 213

Availability of training for personnel from organizations in other countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique training facilities

- Simulator training for VVER-440

15. Forschungszentrum Karlsruhe
Fortbildungszentrum für Technik und Umwelt

Contact:

Herrn Dipl.-Ing. Dieter Schrammel
Tel: +49 7247 82 3252
Fax: +49 7247 82 4857

Availability of training for personnel from organizations in other countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique training facilities

- Providing the requisite safety-related fundamental knowledge for shift supervisor- and control room operator-candidates
- Providing radiation protection training to all NPP personnel

16. Kraftwerksschule E.V.

Contact:

Herrn Dipl.-Ing. Uwe Möller
Tel: +49 201 8489 150
Fax: +49 201 8489 102

Unique training facilities

- Providing the requisite safety-related fundamental knowledge for shift supervisor- and control room operator-candidates

17. Fachhochschule Ulm

Contact:

Herrn Dipl.-Ing. Dietrich Ade
Tel: +49 731 502 8214
Fax: +49 731 27649

Unique training facilities

- Providing the requisite safety-related fundamental knowledge for shift supervisor- and control room operator-candidates

9.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	16	
Does plant management routinely monitor training?	16	
Is training audited by a non-regulatory organization external to training department?	12	4
Is plant management directly involved in establishing training needs?	12	4
Is management and supervisory skills training provided?	13	3
Is general safety training provided?	14	2
Is emergency preparedness training provided?	13	3

Budget

Between 0.3 and 2 percent of the total operating budget is spent on training, based on 6 surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions.

7 *the same as the plant position salary

* Numbers indicate the numbers of plants and training centres responding as indicated.

9.5. TRAINING PROGRAMS

9.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor[3)]	Control Room Operator[3)]	Field Operator[3)]	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	N/A	GE/E/TS [1)]	TS [1)] /SS [2)]	TS [1)] /SS [2)]	N/A	N/A
Prerequisite years of experience for this program		0–5/0–4/3–5	0–4/4–5	2–3/0–2		

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	N/A	N/A	N/A	N/A	N/A	GE
Prerequisite years of experience for this program						2–3

*(GE = graduate engineer or dipl. engineer degree (4–6 years university study); E=engineering degree (2–3 years university study); TS=technical school diploma, SS=secondary school diploma).

[1)] also skilled worker with master degree of his profession, for shift supervisor working as deputy only.

[2)] skilled worker with certificated apprenticeship.

[3)] as presented in the summary, training is performed for the entire NPP personnel. For all NPPs personnel training is regulated by a training manual or an internal training guideline. These specify the initial training as well as the repetition of the subject matter and the pertaining training goals in the scope of a three years training programme. Regarding the training of responsible personnel the contents is regulated in detail by the pertaining official guidelines. The training of subordinate operations personnel is also regulated by guidelines the scope of which depends on the type of working place and the extent of responsibility assumed while the job is performed, thus permitting a larger scope for training, since it depends among others on the reactor type, on whether the plant has one or more units, on the management organization and also on the responsible supervisory authority (federal system).

Only in the case of shift supervisors, reactor operators and field operators this type of training can be directly compared between different German NPPs. But even the training of field operators differs from one NPP to another because they are subordinate operations personnel. The term „field operator" includes mechanics, electricians and local control operators who work on shift. These persons are required to have detailed knowledge of the plant technology and in many NPP's they form the potential for future reactor operators.

It should again be emphasized that the vocational training system in Germany, i.e. a thorough basic education of young people in school and at the place of employment and the passing of an examination at the Chamber of Industry and Commerce – is designed to impart many skills to the trainee which are required for the work in NPPs. Thus, these skills need not be achieved in specialized training at the NPP itself once again. Maintenance tasks are generally not performed by NPP personnel but by expert personnel of the manufacturer or vendor.

9.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used			11		11		11					
Job analysis is used to determine training needs.			11		11		11					
Training needs are used to design measurable training/learning objectives.			11		11		11					
Training materials are based on training/learning objectives			11		11		11					
Training implementation involves assessment of whether training/learning objectives are achieved.			11		11		11					
Evaluation is based on training goals. Feedback of needed improvements takes place.			11		11		11					

*Numbers indicate the numbers of plants and training centres responding as indicated.

9.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used											2	
Job analysis is used to determine training needs.											3	
Training needs are used to design measurable training/learning objectives.											3	
Training materials are based on training/learning objectives											3	
Training implementation involves assessment of whether training/learning objectives are achieved.											3	
Evaluation is based on training goals. Feedback of needed improvements takes place.											3	

9.5.3. Initial and continuing training programs – settings and duration

(Hours listed are the number of hours for an exemplary NPP)*

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Program Setting						
Classroom		2700	2700	900		
Lab/Workshop		750	750	300		
Process or Control Room Simulator		300	300			
Self-Study		450	450	600		
Formal On-the-Job Training		600	600	3000		
Total Initial Training		4800	4800	4800		

Continuing Training Program	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Program Setting						
Classroom		160	160	150		
Lab/Workshop						
Process or Control Room Simulator		40	40			
Self-Study		40	40	40		
Formal On-the-Job Training						
Total Continuing Training		240	240	190		

* The average duration and the range of training has not been mentioned, since they are bindingly regulated for shift supervisors and reactor operators by the pertaining guideline. Field operators undergo training of varying durations, since this personnel carries out different tasks and assumes different responsibilities. Therefore, data of an examination plary NPP are given. Slightly different data hold for other NPPs, which does of course not mean that there are deficiencies in the quality of training.

9.5.3. Initial and continuing training programs – settings and duration cont.

(Hours listed are the number of hours for an exemplary simulator TC)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Program Setting						
Classroom						1840
Lab/Workshop						320
Process or Control Room Simulator						1280
Self-Study						640
Formal On-the-Job Training						1040 in NPP
Total Initial Training						5120

Continuing Training Program	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Program Setting						
Classroom						40
Lab/Workshop						
Process or Control Room Simulator						
Self-Study						40
Formal On-the-Job Training						80 in NPP
Total Continuing Training						160

9.5.4. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments (values are given for personnel of 13 reactors)

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995		29	19	30		
Average annual number of persons who participate in continuing training 1991–1995		236	239	419		

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995						
Average annual number of persons who participate in continuing training 1991–1995						

Total number of personnel trained by training centres

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995		99	346			
Average annual number of persons who participate in continuing training 1991–1995		130	376			

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995						94
Average annual number of persons who participate in continuing training 1991–1995						55

9.6. TRAINING FACILITIES

9.6.1. Physical facilities

1. Nuclear Power Plant Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Range for reporting facilities
Classrooms	11		2–9
Maintenance Workshops	7	4	1–3
Radiation Protection/Chemistry Labs	7	4	1–7
Other Labs/Workshops	5	6	1
Simulator(s)	1		1
Self Study Rooms	6	5	1–10
Library(ies)	5	6	1–3
Dedicated Instructor Offices/Work Space	9	2	1–3
Technical and Training Documentation Area	10	1	1–2
Training Material Preparation Area	5	6	1
Large Lecture Room	7	4	1–8
Dining Facilities	9	2	1–2
Student Housing Facilities		11	

*Numbers indicate the numbers of plants responding as indicated.

2. Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Range for reporting facilities
Classrooms	6		2–13
Maintenance Workshops	1	5	2
Radiation Protection/Chemistry Labs	3	3	1–4
Other Labs/Workshops	3	3	1–6
Simulator(s)	3	3	1–5 (9)**
Self Study Rooms	4	2	1–2
Library(ies)	5	1	1
Dedicated Instructor Offices/Work Space	6		1–4
Technical and Training Documentation Area	6		1–2
Training Material Preparation Area	6		1–2
Large Lecture Room	4	2	1–2
Dining Facilities	5	1	1
Student Housing Facilities	1	5	1

* Numbers indicate the numbers training centres responding as indicated.
** Will be in operation in the next years.

9.6.2. Training department staffing

1. Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

	Number of Full Time Equivalent Positions
Instructors	
Operations	1–7.5
Maintenance	0–5
Radiation Protection	0–0.5
Chemistry	0–0.1
Other Instructors	0–2
Management and Support Staff	
Management	1
Simulator Support	0–2
Maintenance Support	
Training Material Development	0–2
Education Specialist	0–1
Others	0–2

2. Training Centres

Numbers are the **average** for reporting facilities

	Number of Full Time Equivalent Positions
Instructors	
Operations	2–57
Maintenance	0–2
Radiation Protection	0–6
Chemistry	0–2
Other Instructors	0–1
Management and Support Staff	
Management	1–5
Simulator Support	0–52
Maintenance Support	0–0.5
Training Material Development	1–16
Education Specialist	
Others	0–25

9.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of simulator*	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Glas model		1	several, even foreign	480
Multifunctional		11	Krümmel, Isar-1, Brunsbüttel, Philippsburg-1	480
Multifunctional		3	Grohnde	320
Compact		13	Emsland, Isar-2, Neckarwestheim	1500
Full Scope	Greifswald Unit 5	14	Ravno, Kola, Armenia	1280
Full Scope	Biblis Unit B	12	Biblis, Stade, Gösgen	2860
Full Scope	Mülheim-Kärlich	12	Mülheim-Kärlich	760
Full Scope	Grafenrheinfeld	12	Grafenrheinfeld, Grohnde	2440
Full Scope	Brunsbüttel	12	Brunsbüttel, Krümmel, Würgassen	1580
Full Scope	Gundremmingen	12	Gundremmingen	960
Full Scope	Emsland	12	Emsland, Isar-2, Neckarwestheim	under construction
Full Scope	Philippsburg 2	12	will be used only for unit its replica	
Full Scope	Brokdorf	12		
Full Scope	Unterweser	12		
Full Scope	Neckarwestheim 1	12		
Full Scope	Obrigheim	12		
Full Scope	Isar 1	12		
Full Scope	Philippsburg 1	12		
Full Scope	Borssele	12		
Full Scope	Krümmel	11		

*Numbers correspond to the NPP or TC listed in Part III.

9.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel	1	4
	Reactor vessel head	1	
	Reactor internals	11	2
	Control rod drive mechanism	11,16	4
Steam generator	Complete		
	Primary side channel head	3, 8	3
	Tube examination equipment		
	Steam generator inspection manipulator	8	
	Handling tools of manhole	1, 8	
Reactor coolant pump (or primary loop Recirculation pump	Internal part	1, 11	
	Pump shaft seal	11	
	Pump body	11	
Main gate valve	Internal part	1, 11	
	Body	1, 11	
Fuel manipulator equipment	Manipulator crane	1, 11	
	Dummy fuel	1, 2, 9, 11	10
	fuel-handling tools	1, 2, 11	10
	Fuel-loading simulator	11	
Pumps		1, 11, 13, 16	
Valves		1, 11, 13, 16	10,11
Supporting structures		11	
Welding-practice equipment		1, 2, 11	11
Compressor	Instrumentation air compressor	1	
Laser alignment			
Other			

*Numbers correspond to the NPP or TC listed in Part III.

Electrical and Instrumentation

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Switchgear equipment		1, 3, 11	3
Reactor coolant pump motor		11	
Control-rod drive mechanism control system		11	
Control boards at electrical control room	Rod position indicator system	11	
	Reactor control and protection rack	11	
	Protective relay system	1, 11	
	Ex-core nuclear instruments	11	
	In-core nuclear instruments	11	
	Generator automatic voltage regulator	1, 11, 16	
	Constant voltage constant frequency power source	11, 16	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1, 11, 16	10
	Radiation measurement equipment	1, 11, 16	
	Controller	11, 16	
	Other	16	
Measurement system for motor-operated valves		1, 3, 4, 11	
Digital control device		1, 3, 4, 11	
Other		3, 9, 13	1, 3, 9
Common			
Non-destructive testing equipment		11, 16	11
Transparent power plant	See-through	2, 3, 4, 9	3, 9, 10, 11
	Functional		
Other			

*Numbers correspond to the NPP or TC listed in Part III.

9.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer based training	14	3
Interactive video	4	11
Establishing and maintaining your training database	14	2
Generating examinations	10	7
Keeping student records	12	4
Production of training materials	17	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Visual aids available at facility

	Yes*	No*
White bards	17	
Overhead projectors	17	
Slide projectors(such as 35mm)	16	1
Flip charts	16	1
Video equipment	17	
Computer liquid crystal display panel or computer projector	13	4
Video conferencing		16

*Numbers indicate the numbers of plants and training centres responding as indicated.

10. HUNGARY

10.1. SURVEY SUMMARY AND CONCLUSIONS

Training Organizations

- Paks NPP training department is an integral part of the plant structure, constituting three main sections: training section, simulator centre and maintenance centre.

- The cost of training can be estimated at 2–3% of the total operating NPP costs.

Training Programs

- Entry-level requirements:

  GE/E for plant and unit supervisors and for all instructors
  TS for all other positions
  6 years required for plant supervisors
  5 years required for unit supervisors and all instructors
  4 years required for control room operators
  2 years required for QA
  1 year required for field operators, I/C, mechanical and electrical maintenance
  0.5 year required for radiation protection and chemistry

- Training methodology:

  SAT-based training for all positions except for electrical maintenance, radiation protection, chemistry and instructor.

Training Facilities

- Full-scope, compact and basic principle simulators are available for all units.

- The maintenance training centre was completed in early 1997.

- Staffing

  Eight full-time instructors reported for operations. For other types of training no full-time instructors are reported but a large number (2–100) of part-time instructors.

  Management and support personnel involve full-time positions as follows:

  Management: 6
  Simulator support: 8
  Maintenance support: 2
  Training material development: 5
  Education specialist: 1
  Others: 15

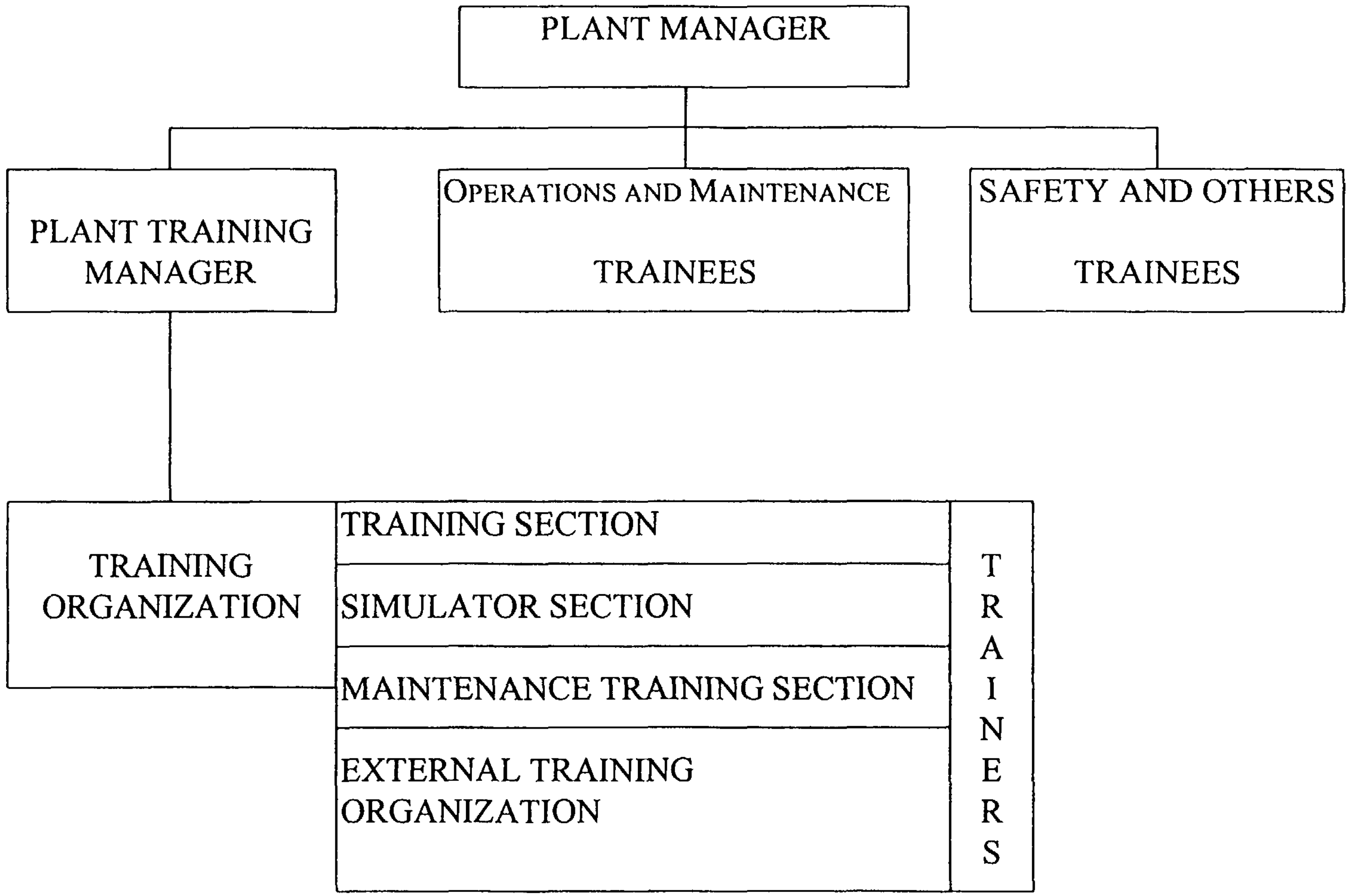

FIG. 3.9. Paks NPP training system Organization.

10.2. OVERVIEW OF NUCLEAR POWER PLANTS PERSONNEL TRAINING SYSTEM

10.2.1. National characteristics

Paks Nuclear Power Plant is the sole nuclear installation of Hungary. Its four units (460 MWe total output each) generate electricity, corresponding to nearly half of the of the domestic production.

Training of NPP personnel is governed by national laws and regulations, in addition to plant-level procedures and codes.

For training at the plant, the training development is in charge. The training development is an integral part of the plant organization, constituting three main sections: training section, simulator centre and maintenance training centre.

At the plant, only those employees may be assigned to individual work or can perform the duties individually who fully fulfill qualification and examination requirements as set and approved for his position plus medical, psychological fitness.

General qualification and examination requirements relevant to specific job position groups are included in the Plant training codes. Independent appendices to these training codes contain general procedures, rules relevant to examination and individual training programs. Training is covered with a quality-assured documentation and data recording system that allows monitoring of actual status of accomplishment of qualification and examination requirements. For fulfilling job-specific qualification and examination requirements the competent manager together with the job-incumbent are responsible.

Practical (initial) training is a must for all employees working in plant operation, maintenance or technical support. Practical (initial) training can only be received if the employee has previously passed his job-specific theoretical knowledge examination in addition to sitting for and passing examinations required by regulations (health physics, industrial safety, fire protection. etc.). For individual job performance one needs to fulfill requirements of in-house and regulatory licensing examinations. Regulatory licensing is in all cases preceded by a so called "area examination". Before the first regulatory licensing examination control room operators must take a five-week initial course on the simulator.

Regulatory licenses are issued by the Nuclear Safety Control Board of the Hungarian Atomic Energy Commission. (NSCB). Licensed job positions are: plant and unit shift supervisors, reactor operator, control room operator, secondary side shift leader, turbine senior field engineer, turbine operator, electric shift leader, electric foreman, senior electrician, I&C shift leader, I&C foreman, radiation protection shift leader, primary side senior field operator, primary side shift leader.

Regulator license validity is 2 years; before expiration a renewal examination must be taken in the presence of an NSCB representative. Condition for passing this examination is the renewal of the medical and psychological aptitude and fitness tests.

In 1996 the plant had 272 licensed employees.

Upon passing in-house licensing examinations one is authorized for individual job performance for a period of 3 years. Authorization must be renewed before expiration. Conditions for renewal thereof are participation in refresher and, continuing training, passing the examinations and medical, psychological aptitude and fitness tests.

Continuing training is obligatory for all employees bearing regulatory or in-house licenses. Job positions with in-house license obligation are: primary side field operator, refueling machine operator, turbine field operator, off-site technology shift leader, off-site technology senior field operator, off-site technology field operator, electrician I&C field operator, plant process computer operator on duty, dosimetrist, chemistry shift leader, protection instrument mechanic, control rod drive mechanic, nuclear surveillance system mechanic, precision mechanic, control rod drive fitter, reactor in-core measurement mechanic, mechanical maintenance leader, reactor maintainer, instrument maintainer, pump maintainer, turbine maintainer, armature maintainer, diesel- and machinery maintainer, ventilation maintainer, crane maintainer.

Continuing training for operations personnel involves central (unit-level) and section-level training (64 hours/year).

Above that, licensed control room operators must take continuing simulator training (2 times 5 days per year) in complete shift teams.

For maintenance job positions a 32 day/year central and section-level training is prescribed. For training of operations personnel a properly equipped training centre has been available since 1986. This centre has the Paks plant-specific full-scope simulator, made in the framework of a Finnish-Hungarian co-operation and finished in 1988. Basis for acceptance tests was the US standard; no simulator with similar quality parameters can be found within WWER operator countries, except Finland.

With a support from the International Atomic Energy Agency, the Hungarian model project on training has been completed (1994–1997). The objective of this project was upgrading of the training system through the application of SAT -systematic approach to training, establishment of a maintenance training centre and enhancement of safety culture.

10.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Paks Nuclear Power Plant

Contacts: Kálmán Babos, Head of maintenance training centre,
István Kiss, Paks, NPP training department
Tel: +36 75 317 628
Fax: +36 155 1332

Training practices which could be recommended for application in other training organizations:

Training on full scope simulator.

Availability of Training for Personnel from Organizations in Other Countries:
NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for Services: Yes

Unique Training Facilities

Well equipped maintenance training centre
Video-studio (Sony U-Matic)

10.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
• Is there a plant or operating organization training policy *document*?	1	0
• Does plant management routinely monitor training?	1	0
• Is training audited by a non-regulatory organization external to training department?	1	0
• Is plant management directly involved in establishing training needs?	1	0
• Is management and supervisory skills training provided?	1	0
• Is general safety training provided?	1	0
• Is emergency preparedness training provided?	1	0

Budget

Between 2 and 3 per cent of the total operating budget is spent on training, based on surveys answering this question.

*Numbers indicate the numbers of plants and training centres responding as indicated.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

0 * higher than the plant position salary

1 * the same as the plant position salary

0 * lower than the plant position salary

10.5. TRAINING PROGRAMS

10.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE/E	GE/E	GE/E	TS/S	TS	TS
Prerequisite years of experience for this program	6	5	4	1	1	1

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	TS	TS	TS	TS	GE/E	E/TS
Prerequisite years of experience for this program	1	2	0.5	0.5	5	5

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma; SS = secondary school diploma].

10.5.2. Training methodology

Job Position / Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic approach to Training (SAT) is used	1	0	1	0	1	0	1	0	1	0	0	1
Job analysis is used to determine training needs	1	0	1	0	1	0	1	0	1	0	0	1
Training needs are used to design measurable training/learning objectives	1	0	1	0	1	0	1	0	1	0	0	1
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	1	0	0	1
Training implementation involves assessment of whether training/learning objectives are achieved	1	0	1	0	1	0	1	0	1	0	0	1
Evaluation is based on training goals. Feedback of needed improvements takes place	1	0	1	0	1	0	1	0	1	0	0	1

*Numbers indicate the numbers of plants and training centres responding as indicated.

10.5.2. Training methodology cont.

Job Position **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic approach to training (SAT) is used	1	0	1	0	0	1	0	1	-	-	-	-
Job analysis is used to determine training needs	1	0	1	0	0	1	0	1	-	-	-	-
Training needs are used to design measurable training/learning objectives	1	0	1	0	0	1	0	1	-	-	-	-
Training materials are based on training/learning objectives	1	0	1	0	0	1	0	1	-	-	-	-
Training implementation involves assessment of whether training/learning objectives are achieved	1	0	1	0	0	1	0	1	-	-	-	-
Evaluation is based on training goals. Feedback of needed improvements takes place	1	0	1	0	0	1	0	1	-	-	-	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

10.5.3. Initial training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	-	400	600	400	200	200
Lab/Workshop	-	-	80	40	-	-
Process or Control Room Simulator	-	200	200	-	-	-
Self-Study	480	960	640	200	160	160
Formal On-the-Job Training	960	960	960	960	?	?
Total Initial Training	1440	2520	2480	1600	360	360

10.5.3. Initial training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	200	200	450	300	40	40
Lab/Workshop	-	320	40	300	160	160
Process or Control Room Simulator	-	-	-	-	-	200
Self-Study	-	160	160	160	160	160
Formal On-the-Job Training	?	320	960	640	480	480
Total Initial Training	200	1000	1680	1400	840	1040

10.5.4. Continuing training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	80	80	80	80	80	80
Lab/Workshop	-	-	-	-	-	-
Process or Control Room Simulator	80	80	80	-	-	-
Self-Study	80	80	80	80	80	80
Formal On-the-Job Training	40	40	40	40	40	40
Total Continuing Training	280	280	280	200	200	200

10.5.4. Continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	80	16	80	80	16	16
Lab/Workshop	-	-	-	-	8	8
Process or Control Room Simulator	-	-	-	-	-	-
Self-Study	80	40	80	80	100	100
Formal On-the-Job Training	40	-	40	40	-	-
Total Initial Training	200	56	200	200	124	124

10.5.5. Number of persons in initial and continuing training

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	3	1	8	12	-	-
Average annual number of persons who participate in continuing training 1991–1995	31	14	76	146	-	-

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	-	-	-	-	-	-
Average annual number of persons who participate in continuing training 1991–1995	-	-	-	-	-	

10.6. TRAINING FACILITIES

10.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	4
Maintenance Workshops	0	1	-
Radiation Protection/Chemistry Labs	0	1	-
Other Labs/Workshops	1	0	1
Simulator(s)	1	0	2
Self-Study Rooms	1	0	2
Library(ies)	1	0	5
Dedicated Instructor Offices/Work Space	1	0	6
Technical and Training Documentation Area	1	0	4
Training Material Preparation Area	1	0	5
Large Lecture Room	1	0	3
Dining Facilities	1	0	-
Student Housing Facilities	0	1	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

10.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	8	100	?
Maintenance	-	20	?
Radiation Protection	-	5	?
Chemistry	-	2	?
Other Instructors	-	50	?
Management and Support Staff			
Management	6		
Simulator Support	8		
Maintenance Support	2		
Training Material Development	5		
Education Specialist	1		
Others	15		

10.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full scope	Paks 1–4	Paks	Paks 1–4	4600
Compact	NA	Paks	Public (College Students)	40
Basic Principle	Paks 1–4	-	-	

10.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel	1	-
	Reactor vessel head		1
	Reactor internals	1	-
	Control rod drive mechanism	1	-
Steam Generator	Complete	1	-
	Primary side channel head	NA	-
	Tube examination equipment	1	-
	Steam generator inspection manipulator	1	-
	Handling tools of manhole	-	-
Reactor coolant pump (or primary loop recirculation pump)	Internal part	1	-
	Pump shaft seal	1	-
	Pump body	1	-
Main gate valve	Internal part	1	-
	Body	1	-
Fuel manipulator equipment	Manipulator crane	NA	-
	Dummy fuel	1	-
	Fuel-handling tools	1	-
	Fuel-loading simulator	NA	-
Pumps		1	-
Valves		1	-
Supporting structures		-	-
Welding-practice equipment		-	-
Compressor	Instrumentation air compressor	-	-
Laser alignment		1	-
Other		1	-

Electrical and Instrumentation

*Numbers correspond to the NPP or TC listed in Part II.

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		-	-
Reactor coolant pump motor		-	-
Control-rod drive mechanism control system			
Control boards at electrical control room	Rod position indicator	1	-
	Reactor control and protection rack	-	-
	Protective relay system	-	-
	Ex-core nuclear instruments	-	-
	In-core nuclear instruments	1	-
	Generator automatic voltage regulator	-	-
	Constant voltage constant frequency power source	-	-
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	-	-
	Radiation measurement equipment	1	-
	Controller	-	-
	Other	-	-
Measurement system for motor-operated valves		1	-
Digital control device		-	-
Other		-	-
Common			
Non-destructive testing equipment		1	-
Transparent power plant	See-through	1	-
	Functional	1	-
Other		-	-

*Numbers correspond to the NPP or TC listed in Part II.

10.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	1	0
Interactive video	1	0
Establishing and maintaining training database	1	0
Generating examinations	1	0
Keeping student records	1	0
Production of training materials	1	0

Visual aids available at facility

	Yes*	No*
Whiteboards	1	0
Overhead projectors	1	0
Slide projectors (such as 35mm)	1	0
Flip charts	1	0
Video equipment	1	0
Computer liquid crystal display panel or computer projector	1	0
Video conferencing	-	-

11. JAPAN

11.1. SURVEY SUMMARY AND CONCLUSIONS

Training Organizations

- **Availability of training for NPP personnel from organizations in other countries:**
  Information not available.

- **Unique training facilities:**
  Maintenance training centre.

- **Recommended training practices:**
  Team training.
  Self directed training.

Management

- **Management role and responsibilities:**
  Generally involved. 60% involved in establishing training needs.

- **Training Budget:**
  No response provided.

- **Salary of trainers:**
  Same as plant position salary.

Training Programs:

- **Entry-level requirements:**
  Secondary School Diploma
  20 years experience for shift Supervisor
  15 years experience for Control Room Supervisor
  6–8 years experience for Control Room Operator
  1–2 years experience for Field Operator
  1–3 years experience for all other positions.

- **Training methodology:**
  SAT generally used.

- **Duration and settings of initial and continuing training:**
  See the Country Summary Tables.

- **Numbers of persons in initial and continuing training:**
  See the Country Summary Tables.

11.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

11.2.1. Operation training

In our country, education and training of nuclear power plant (NPP) personnel is carried out by each utility, e.g. by sending operators to the operation training centres and offering them in-house education, to enhance their competence as an operator.

At present, there are two operation training centres available: BTC (boiling water training centre) for BWR plants operators and NTC (nuclear power training centre) for PWR plant operators. BTC and NTC, established by the investment of utilities and nuclear power plant manufacturers, have been providing the operators with basic education and practical training using simulators since 1974.

These two operation training centres have offered variety of courses such as the initial training course, the re-training course and the shift team training course, in accordance with the operators" ability. By the end of 1994, 13,436 employees and 3,705 teams in total had completed the training.

In addition, each utility has its own training facility for operators, where the following education and training programs are provided:

- To enable operators to understand the plant-specific principles, functions and accompanied behaviour, knowledge-based education is provided, using simulators, concerning plant-specific behaviour under the normal and abnormal conditions which operators always have to cope with.

- To enhance the operators' comprehensive ability such as correct judgment of situations during anomalies and ability to respond to operational problems, accident-simulating training based on examples at home and abroad as well as discussions on various accidents are carried out.

The government involvement in the training of operators can be seen in the following situations: The operation supervisor who is to direct operators in the main control room of the NPP must be qualified by the national qualification system as a person responsible for operation. The eligible applicants are given the practical test on operation, lectures and an oral quiz, whose comprehensive results determine whether they should be qualified or not. The practical test on operations is conducted using simulators at BTC or NTC by the practical examiner previously designated by the qualification agency. The qualification expires after 3 years from the date of issue of the certificate. For the renewal of qualification, another test must be passed. By the end of 1994, 386 people had been qualified as the operation supervisor.

The Thermal and Nuclear Power Engineering Society of Japan has been designated by the government as the qualification agency.

11.2.2. Maintenance training

In Japan, each utility has a maintenance training centre where employees of utilities and relevant companies are given practical training by using the facilities which simulate the actual plant, for the purpose of maintaining and enhancing knowledge, skills and work-management ability of the personnel. Concerning the qualification of maintenance personnel, there is no qualification system specified by the government. Instead, each utility has its own qualification system.

11.2.3. Others

The foregoing is about the operation and maintenance training centres. There are no other training divisions in any utilities.

Japan's utilities hold meetings periodically to exchange information on operating experience, training curriculum and so forth. However, training modules and training materials are developed independently by each utility. A number of instructors are sent from the utilities to BTC and NTC, but there are few examples of exchanges of personnel among training centres.

11.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Hokkaido Electric Power Co. Tomari - 1-2 (NPP Name)

Contact: Mr. Toshihaki Kudo, General Manager
Tel: 0135 75 3331, 4330
Fax: 0135 75 3069

Training practices which could be recommended for application in other training organizations:

- Switchgear maintenance course
- Study of plant operation by compact simulator
  Study of maintenance skills by the mechanical, electrical, I & C facilities
- Shift–team training (BTC family training)
- Family training conducted by shift supervisor
- Voluntary training of maintenance personnel without instructors
  Training of subsidiary personnel
- Shift team training
- Practice and training of recovery for emergency pump trouble
- Study of plant operation by compact simulator
- Voluntary training and solution-finding without instructors
- Stress special action contributing to operational error prevention.

Unique Training Facility a

2. Tohoku Electric Power Co. – Onagawa 1–2 (NPP Name)

Contact: Mr. Junji Yamaki, Manager
Tel: 0222 225 2792
Fax: 022 217 3567

Unique Training Facility b

3. Tokyo Electric Power Co. – Fukushima Daiichi 1–6 (NPP name)

Contact: Mr. Takayoshi Tone, Manager
Tel: 03 3501 8111
Fax: 03 3596 8538

Unique Training Facility c

4. Chubu Electric Power Company – Hamaoka 1–2 (NPP Name)

Contact: Mr. Yukio Ogura, Training Manager
Tel: 0537 86 3481
Fax: 0537 85 4985

Unique Training Facility d

5. Hokuriku Electric Power Company – Shika – 1 (NPP Name)

Contact: Mr. Hideo Tabata, Manager
Tel: 0764 33 9431
Fax: 0764 33 9963

Unique Training Facility e

6. Kansai Electric Power Co. Mihama 1–3, Takahama 1–3, Ohi 1–4 (NPP name)

Contact: Mr. Hidekazu Shirasaki, Asst. Manager
Tel: 06 441 8821
Fax: 06 443 2659

Unique Training Facility f

7. Chugoku Electric Power Co. Shimane 1–2 (NPP Name)

Contact: Mr. Susumu Kugatani, Manager
Tel: 082 242 6641
Fax: 082 244 1741

Unique Training Facility g

8. Shikolu Electric Power Co. – Ikata 1–3 (NPP Name)

Contact: Mr. Yasuhiro Saijo, Manager
Tel: 0878 21 5061
Fax: 0878 25 3012

Unique Training Facility h

9. Kyusho Electric Power Co. – Genkai – 1–3 (NPP Name)

Contact: Mr. Takashi Saski, Manager
Tel: 092 761 3031
Fax: 092 761 4622

Unique Training Facility i

10. Japan Atomic Power Company – Tsuruga 1–2 (NPP Name)

Contact: Mr. Fukuji Isbizaki, Manager
Tel: 029 287 0111
Fax: 029 287 00112

Unique Training Facility j

Training Centre (TC) Responses for the Survey

NTC

Contact: Mr.Teiichi Yoshikawa, Managing Director
Tel: 0770 23 5531
Fax: 0770 22 5662

Unique Training Facilities k

BTC

Contact: Mr.Akira Kobayashi, Manager
Tel: 0240 32 2795
Fax: 0240 31 0005

Unique Training Facilities l

11.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	10	
Does plant management routinely monitor training?	5	
Is training audited by a non-regulatory organization external to training department?	9	1
Is plant management directly involved in establishing training needs?	6	4
Is management and supervisory skills training provided?	8	2
Is general safety training provided?	10	
Is emergency preparedness training provided?		

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

* higher than the plant position salary

9 * the same as the plant position salary

* lower than the plant position salary

*Numbers indicate the numbers of plants and training centres responding as indicated.

11.5. TRAINING PROGRAMS

11.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	SS/over SS	SS/over SS	SS/over SS	SS/over SS	SS/over SS	SS/over SS
Prerequisite years of experience for this program	(7)–20	~ 15	6–8	1–2	1–3	1–3

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	SS/over SS	SS/over SS	SS/over SS	SS/over SS	SS/over SS	
Prerequisite years of experience for this program	1–3	1*	1–3	1–3	–	–

* only one answer.

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

11.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	5	2	5	2	6	2	5	2	5	3	5	3
Job analysis is used to determine training needs	7		7		8		7		7	1	7	1
Training needs are used to design measurable training/learning objectives	9		9		10		9		10		10	
Training materials are based on training/learning objectives	9		9		10		9		10		10	
Training implementation involves assessment of whether training/learning objectives are achieved	5	3	5	3	6	3	5	3	6	3	6	3
Evaluation is based on training goals. Feedback of needed improvements takes place	8		8		9		8		9		9	

*Numbers indicate the numbers of plants and training centres responding as indicated.

11.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	5	3	2	1	5	2	4	2	2	4	2	4
Job analysis is used to determine training needs	7	1	3		7		6		3	4	3	3
Training needs are used to design measurable training/learning objectives.	10		4		8	1	8	1	5	3	4	3
Training materials are based on training/learning objectives	10		4		8	1	8	1	5	3	5	3
Training implementation involves assessment of whether training/learning objectives are achieved	6	3	2	2	6	2	6	2	3	5	3	5
Evaluation is based on training goals. Feedback of needed improvements takes place	9		3		8		8		4	3	3	3

*Numbers indicate the numbers of plants and training centres responding as indicated.

11.5.3. Initial training programs — settings and duration

(Hours listed are the **average** and range number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	3–35	4–35	4–576	4–776	6–88	6–80
Lab/Workshop	NA	NA	15–60	16–225	3–128	3–128
Process or Control Room Simulator	5–48	20–48	16–344	20–254	0–24	0–24
Self-Study	NA	na	0–200	0–400	NA	NA
Formal On-the-Job Training	NA	NA	0–1440	0–1440	0–600	0–600
Total Initial Training	8–82	20–82	215–2376	88–1512	40–712	40–712

11.5.3. Initial training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control*	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	8–208	2–7	8–208	16–88	20–100	15–20
Lab/Workshop	3–128	NA	—49	0–16	20–256	0–50
Process or Control Room Simulator	0–24	NA	NA	NA	36–100	44–160
Self-Study	NA	NA	NA	NA	0–80	0–50
Formal On-the-Job Training	0–600	NA	0–600	0–600	0–10	0–10
Total Initial Training	40–832	2–42	8–808	30–688	19–260	64–220

* Only from 2 facilities we got answers.

11.5.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	4–112	4–112	0–130	4–112	8–16	8–17
Lab/Workshop	0–42	0–24	0–14	0–8	10–24	6–24
Process or Control Room Simulator	20–56	20–57	20–96	7–60	0–24	0–24
Self-Study	NA	NA	NA	NA	NA	NA
Formal On-the-Job Training	NA	NA	0–800	0–600	0–600	0–600
Total Continuing Training	48–112	48–112	65–925	52–623	37–632	33–632

11.5.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program / **Program Setting**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	8–16	5	8–24	7–16	10–30	0–20
Lab/Workshop	7–24	NA	4–24	3–16	0–10	0–15
Process or Control Room Simulator	0–24	NA	NA	NA	NA	0–56
Self-Study	NA	NA	NA	NA	10–40	0–40
Formal On-the-Job Training	0–600	NA	0–600	0–600	NA	NA
Total Initial Training	35–632	5	13–608	10–608	40–60	10–126

11.5.5. Number of persons in initial and continuing training

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	139	180	289	250	691	363
Average annual number of persons who participate in continuing training 1991–1995	149	206	463	332	436	132

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	239	51	122	41	9	2
Average annual number of persons who participate in continuing training 1991–1995	189	56	109	70	5	9

11.6. TRAINING FACILITIES

11.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	9	1	2–15
Maintenance Workshops	9	1	2–7
Radiation Protection/Chemistry Labs	3	5	1–2
Other Labs/Workshops	2	6	1–2
Simulator(s)	9	1	1–3
Self-Study Rooms	3	5	1–3
Library(ies)	5	2	1
Dedicated Instructor Offices/Work Space	6	2	1–2
Technical and Training Documentation Area	5	3	1–2
Training Material Preparation Area	3	5	1–2
Large Lecture Room	7	3	1–2
Dining Facilities	4	3	1–2
Student Housing Facilities	3	4	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	2		7–14
Maintenance Workshops		2	
Radiation Protection/Chemistry Labs		2	
Other Labs/Workshops		2	
Simulator(s)	2		3–5
Self-Study Rooms	1	1	1
Library(ies)	2		1–2
Dedicated Instructor Offices/Work Space	2		1–2
Technical and Training Documentation Area	2		1–2
Training Material Preparation Area	2		1–2
Large Lecture Room	2		2
Dining Facilities	2		1–2
Student Housing Facilities	2		

*Numbers indicate the numbers of plants and training centres responding as indicated.

11.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	1–5		
Maintenance	1–5	0–2	
Radiation Protection	1–4		
Chemistry	1		
Other Instructors	1–2		
Management and Support Staff			
Management	1–5		
Simulator Support	0–3		
Maintenance Support	0–6		
Training Material Development			
Education Specialist			
Others	0–2		

Training Centres

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	25–43		
Maintenance			
Radiation Protection			
Chemistry			
Other Instructors			
Management and Support Staff	2–4		
Management	0–3		
Simulator Support	0–4		
Maintenance Support	0–1		
Training Material Development			
Education Specialist			
Others	0–9		

11.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full Scope	Zion	K	PWR	2640
Full Scope	T-3	K	PWR	3104
Full Scope	0-3	K	PWR	1736
Full Scope	IF-3	L	BWR-3, 4	2800
Full Scope	IF-4	L	BWR-3,4	2800
Full Scope	2F-3	L	BWR-5	2500
Full Scope	K-4	L	BWR-5	3700
Full Scope	K-6	L	ABWR	2000
Full Scope	H-3	D	H-3,4	1840
Full Scope	S-2	G	S-1, 2	1300
Full Scope	I-3	H	I-1-3	1300
Compact		B	0-1,2	864
Compact		C	K-1-5	?
Compact		C	IF-1-6	700
Compact		C	2F-1-4	413
Compact		D	H-1, 2	400
Compact		D	H-3, 4	208
Compact		I	G-1-3 S-1-2	480
Compact		J	T-1, 2, T2	1600
Compact		F	M-1-3	647
Compact		F	T-1-4	682
Compact		F	O-1-4	1125
Compact	T-1, 2?	A	T-1, 2,	1000

11.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vesseld	d	b, h
	Reactor vessel head	f, h	h
	Reactor internals	d, f	h
	Control rod drive mechanism	b, d, c, f, g, h, j	c, h, j
Steam Generator	Complete		f, h
	Primary side channel head	a, f, h	h, i
	Tube examination equipment	a, f, h	
	Steam generator inspection manipulator	a, f, h	
	Handling tools of manhole	a, f	
Reactor coolant pump (or primary loop recirculation pump)	Internal part	j	j
	Pump shaft seal	a, b, c, d,e, f, g, h, j	c, h, c, j
	Pump body		
Main gate valve	Internal part	c, d, g, j	a, j
	Body	c, d, j	a, j
Fuel manipulator equipment	Manipulator crane	f, h	
	Dummy fuel	d, f, h, j	g, h, j
	Fuel-handling tools	d, f, g, h	
	Fuel-loading simulator	f, h	
Pumps		a, b, c, d, e, f, g, h, i, j	a, c, g, h, j
Valves		a, b, c, d, e, f, g, h, i, j	a, c, g, h, j
Supporting structures		a, d, f, h	c, h
Welding-practice equipment		a, c, d, g, h, i, j	
Compressor	Instrumentation air compressor	c, h, j	
Laser alignment		a	
Other			

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		a,b, c, d, e, f, g, h, j	c, h
Reactor coolant pump motor		a, f	
Control-rod drive mechanism control system		a, b, c, d, g, h, j	f, g, j
Control boards at electrical control room	Rod position indicator	a, f, h, j	
	Reactor control and protection rack	a, f, h, j	
	Protective relay system	a, d, e, f, g, h, j	
	Ex-core nuclear instruments	a, f, h, j	
	In-core nuclear instruments	c, d, e, g, h, j	
	Generator automatic voltage regulator	a, f, h, j	
	Constant voltage constant frequency power source	a, c, f, h, j	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	a, b, c, d, e, f, g, h, j	h
	Radiation measurement equipment	a, c, d, g, h, j	
	Controller	a, b, c, d, e, f, g, h, j	
	Other	c, j	
Measurement system for motor-operated valves		a, c, f, j	
Digital control device		b, c, d, e, f, g, j	
Other		j	
Common			
Non-destructive testing equipment		a, b, c, d, e, f, g, i, j	
Transparent power plant	See-through	f, h	c
	Functional	f	c
Other		f	

*Numbers correspond to the NPP or TC listed in Part II.

11.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	10	2
Interactive video	3	9
Establishing and maintaining training database	4	8
Generating examinations	8	4
Keeping student records	6	6
Production of training materials	8	4

Visual aids available at facility

	Yes*	No*
Whiteboards	12	
Overhead projectors	12	
Slide projectors (such as 35mm)	9	3
Flip charts		12
Video equipment	12	
Computer Liquid Crystal Display panel or computer projector	3	9
Video conferencing	3	9

*Numbers indicate the numbers of plants and training centres responding as indicated.

12. KAZAKHSTAN

12.1. SURVEY SUMMARY AND CONCLUSIONS

BN-350 unit: fast breeder reactor with 600 MW power

BN-350 unit is situated at Mangyshlak NPP (MAEC).

Training Organization

There is no of possibility to provide training for NPP personnel from organizations in other countries at MAEC.
No unique training facilities were noted in answers.
No training practice which could be recommended for use in other places was noted.
NPP personnel are trained with direct involvement of plant management .
Average training budget was not indicated.
The salary of trainers is the same as the plant position salary.

Training Programs

Systematic approach to training is used for training programs for field operators, for chemistry and for radiation protection technicians but not for other job positions.
Training programs are based on a high level of basic education (entry requirements).
Duration and setting of training do not include simulator training.
The total average annual number of persons in initial and continuing training, as indicated in the responses, is about 152 (152 per unit).

Training Facilities

Physical facilities were not indicated in answers.
Quantity of staff were not indicated in answers.
Training equipment for maintenance personnel is not indicated in answers..
Computers are only used for the generation of examinations.
Some visual aids are available at the facility.

Conclusion

The upgrading of NPP personnel training is needed in the country.

12.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

There is no special training organization to provide training to NPP personnel in Kazakhstan. There is no training centre in Kazakhstan.

Training of the operating personnel includes the following stages:
- getting basic education;
- checking suitability for a job (medical examination, aptitude tests);
- self-study (learning of technical documentation and details concerning specific plant);
- examining on each type of equipment;
- final examination (process technology, emergency measures, etc.);
- on-the-job training;
- independent work.

Operating personnel pass annual examinations. In the case of a hard violation of rules, the person must be re-examined.

There is a special department which hires and trains professionals at MAEC. There is also a system of preparing high level management at the MAEC. The external organization at which the upgrading of qualifications takes place is the Central Institute of Upgrading Qualification in Obninsk (CIPKS) Russia. Chief engineer of the MAEC is a person who is responsible for training and re-training of NPP personnel.

There is no information regarding training budget.

The salary of high level specialists who provide training depends on the number of hours of training.

Personnel qualification requirements including basic education and work experience, as indicated for each position. Initial and Continuing Training is used for training programs for field operators, chemistry and radiation protection. For other job position training uses the program of learning safety rules, instructions and specifications.

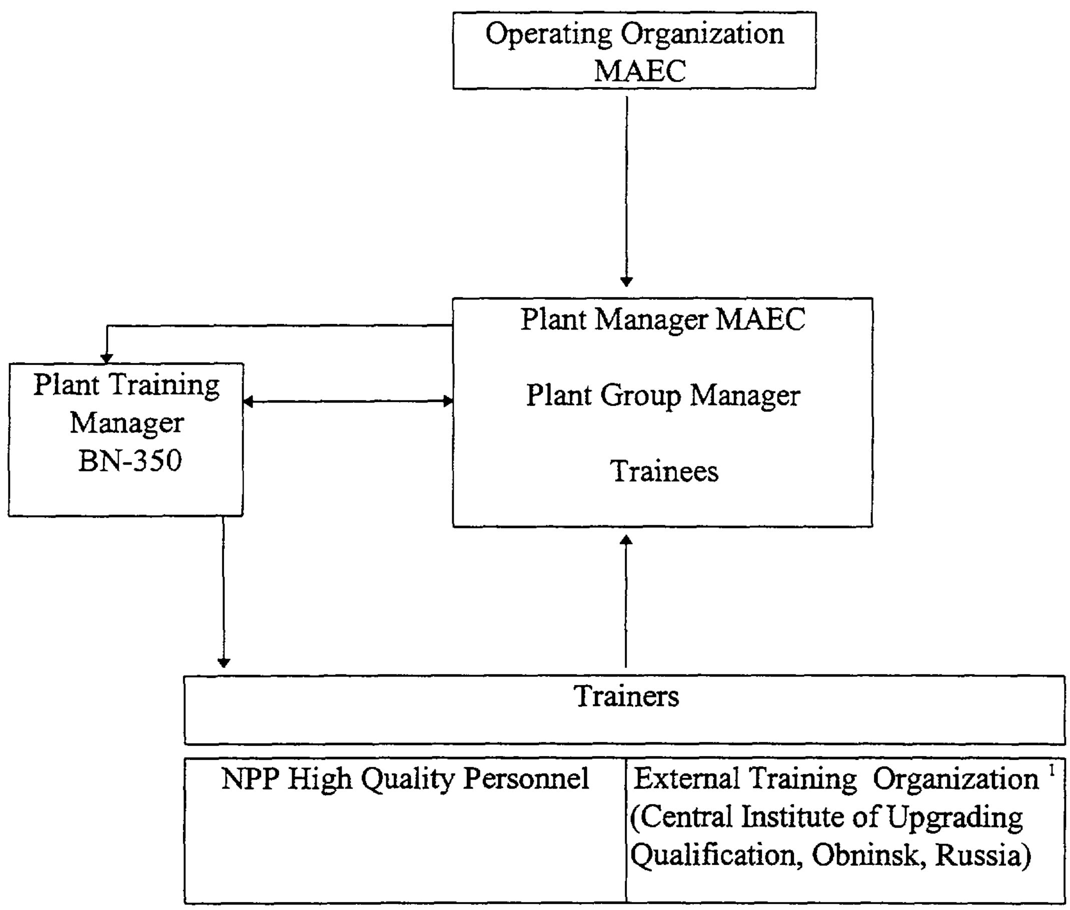

FIG. 3.10. General scheme of NPP personnel training in Kazakhstan.

Recruitment and training for NPP personnel are indicated in the following documents:

- Guide of recruitment, training and qualification of personnel during the operation of NPP.
- Rules of work organization with personnel in organizations of Minatomenergo USSR (PORP-89).

12.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Mangyshlak (NPP Name)

Contact: Mr. Sergey Krechetov
Tel: (007) 3272 639 364; Fax: (007) 3272 633 356

Training practices which could be recommended for application in other training organizations: No

Availability of Training for Personnel from Organizations in Other Countries: No

Unique Training Facilities

No

12.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	1	
Does plant management routinely monitor training?	1	
Is training audited by a non-regulatory organization external to training department?	1	
Is plant management directly involved in establishing training needs?	1	
Is management and supervisory skills training provided?	1	
Is general safety training provided?	1	
Is emergency preparedness training provided?	1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

0	* higher than the plant position salary
1	* the same as the plant position salary
0	* lower than the plant position salary

12.5. TRAINING PROGRAMS

12.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE	GE	GE	SS	GE	GE
Prerequisite years of experience for this program	5	3	0	0	0	0

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE	GE	TS	SS	-	-
Prerequisite years of experience for this program	0	0	0	0	-	-

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

12.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	0	1	0	1	-	1	1	0	0	1	0	1
Job analysis is used to determine training needs	-	-	-	-	-	-	1	0	-	-	-	-
Training needs are used to design measurable training/learning objectives	-	-	-	-	-	-	1	0	-	-	-	-
Training materials are based on training/learning objectives	-	-	-	-	-	-	1	0	-	-	-	-
Training implementation involves assessment of whether training/learning objectives are achieved												
Evaluation is based on training goals. Feedback of needed improvements takes place	-	-	-	-	-	-	1	0	-	-	-	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

12.5.2. Training methodology cont.

Job Position / Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	0	1	0	1	1	0	1	0	-	-	-	-
Job analysis is used to determine training needs	-	-	-	-	1	0	1	0	-	-	-	-
Training needs are used to design measurable training/learning objectives	-	-	-	-	1	0	1	0	-	-	-	-
Training materials are based on training/learning objectives	-	-	-	-	1	0	1	0	-	-	-	-
Training implementation involves assessment of whether training/learning objectives are achieved												
Evaluation is based on training goals. Feedback of needed improvements takes place	-	-	-	-	1	0	1	0	-	-	-	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

12.5.3. Initial training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	0	0	0	60	0	0
Lab/Workshop	0	0	0	0	0	0
Process or Control Room Simulator	0	0	0	0	0	0
Self-Study	600	600	600	60	60	60
Formal On-the-Job Training	144	144	144	144	144	144
Total Initial Training	744	744	744	264	204	204

12.5.3. Initial training programs - settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	-	-	102	60	-	-
Lab/Workshop	0	0	300	300	-	-
Process or Control Room Simulator	0	0		0	-	-
Self-Study	60	60	60	60	-	-
Formal On-the-Job Training	144	144	144	144	-	-
Total Initial Training	204	204	606	564	-	-

12.5.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	0	0	0	60	0	0
Lab/Workshop	0	0	0	0	0	0
0Process or Control Room Simulator	0	0	0	0	0	0
Self-Study	60	60	60	60	60	60
Formal On-the-Job Training	24	24	24	24	24	24
Total Continuing Training	84	84	84	144	84	84

12.5.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumen tation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	0	0	0	0	-	-
Lab/Workshop	0	0	0	0	-	-
Process or Control Room Simulator	0	0	0	0	-	-
60Self-Study	60	60	60	60	-	-
Formal On-the-Job Training	24	24	24	24	-	-
Total Initial Training	84	84	84	84	-	-

12.5.5. Number of persons in initial and continuing training

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	6	6	10	15	7	7
Average annual number of persons who participate in continuing training 1991–1995	6	6	10	15	7	7

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	5	4	10	6	-	-
Average annual number of persons who participate in continuing training 1991–1995	5	4	10	6	-	-

12.5.6. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	0	1
Interactive video	0	1
Establishing and maintaining training database	0	1
Generating examinations	1	0
Keeping student records	0	1
Production of training materials	0	1

Visual aids available at facility

	Yes*	No*
Whiteboards	1	0
Overhead projectors	1	0
Slide projectors (such as 35mm)	1	0
Flip charts	1	0
Video equipment	0	1
Computer liquid crystal display panel or computer projector	0	1
Video conferencing	0	1

*Numbers indicate the numbers of plants and training centres responding as indicated.

13. REPUBLIC OF KOREA

13.1. SURVEY SUMMARY AND CONCLUSIONS

Training Organization

- **Availability of training for NPP personnel from organizations in other countries:**
  Yes for a fee.

- **Unique training facilities:**
  Workshops and laboratories for maintenance training.

Recommended training practices:
I & C training using an I & C simulator.

Management

- **Management role and responsibilities:**
  Limited management involvement.

- **Training Budget:**
  0.5–1.0%

- **Salary of trainers:**
  0.5–1.0%

Training Programs

- **Entry-level requirements:**
  GE/E for supervisors and instructors.
  E/TS for all other positions.
  10 years experience for Shift Supervisor
  5–7 years experience for Control Room Supervisor
  3–5 years experience for Control Room Operator
  1–2 years experience for all other

13.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

13.2.1. Training organizations

There are two major organizations involved in nuclear training in Korea: one is Korea Atomic Energy Research Institute (KAERI), which is a nuclear R&D organization sponsored by the Government, that has its training unit, the Nuclear Training Centre (NTC); the other is Korea Electric Power Corporation (KEPCO), which has under its framework Kori Nuclear Training Centre (KNTC).

The Nuclear Training Centre of KAERI was founded in 1967 in an attempt to carry out open-door nuclear training for domestic personnel from utility, regulatory body, manufacturers, radioisotope users, universities, and other nuclear-related organizations by means of offering various kinds of training fields such as nuclear power and safety, nuclear fuel technology, radioisotope utilization, non-destructive testing, research reactor experimentals, and retraining for nuclear-related license holders and qualified engineers. In addition to the above-mentioned training fields, the centre has offered IAEA regional training courses on nuclear power and safety annually for developing countries under the framework of the IAEA/RCA program since 1988. The Government is trying to expand the role of the centre through the establishment of the international training centre by the financial assistance of the Government so that the centre could offer necessary regional or interregional training courses as well as fellowship training and scientific visit programs for the staff of the developing countries.

The Korea Electric Power Corporation is the sole utility in Korea responsible for electric power generation, transmission and distribution. The head office of KEPCO has primary responsibility for establishing training policy, ensuring training programs and budgeting plant personnel training. The main nuclear training venue for nuclear power plant personnel in KEPCO is the Nuclear Training Centre (KNTC) located at the Kori site. The centre is operated as an in-house training centre for reactor operators and maintenance crew as well as engineering staff of nuclear power plants. The centre has established three plant training branches at Yonggwang, Wolsong, Ulchin site, respectively, for the effective implementation of training courses including on-the-job training for plant personnel. The centre could provide nuclear power-related training courses not only for national non-KEPCO personnel but also for developing countries. Recommended training practices in the centre for application in other training organizations are simulator training courses for nuclear power plant operational personnel and a special I & C training course using I & C simulator.

The Korea Power Plant Service Company (KPS), a subsidiary company of KEPCO, is in charge of all kinds of plant maintenance services. KPS established the nuclear maintenance training centre in 1990 as part of the KNTC for the purpose of cultivating and training the maintenance crew of nuclear power plants. The centre is directly connected with the nuclear training centre of KEPCO for the training of nuclear power plant maintenance personnel.

13.2.2. Training methodology

It is essential that training courses and facilities be continuously improved to cultivate qualified nuclear power plant personnel. The KEPCO Nuclear training centre is also applying the method of systematic approach to training (SAT), which was recommended by the IAEA and INPO to member countries' nuclear power utilities, to training program development. These recommendations involve training needs analysis, the evaluation and modification of training programs, etc. which are modified in accordance with the situation of KNTC. The centre has three training phases for new recruits and plant personnel according to their qualifications and managerial levels; an initial training program (basic courses for 39 weeks) and a continuing training program consisting of advanced courses (2–4 weeks) and specialized courses (2–4 weeks). In general, each training course consists of lectures (52%), discussions (11%), practical exercises (17%), audio-visual lectures (3%), site tours (3%), moral culture (0.5%), evaluations (4.5%), and others (9%). The centre offers more than 100 training courses to their employees, and course contents vary depending upon the employees' technical and managerial levels. The maintenance training centre has offered about 25 maintenance training courses in the field of mechanical and electrical maintenance as well as component maintenance including refueling, welding, NDE, etc.

The training programs for national nuclear personnel at the NTC/KAERI are divided into 6 categories: IAEA/RCA training courses on nuclear power and safety for developing countries, nuclear power and nuclear fuel technology courses, radioisotope utilization and radiation protection courses, non-destructive testing courses for national nuclear personnel, retraining courses for national nuclear license holders and qualified engineers, reactor experiments for university students.

13.2.3. Training facilities

The KNTC has several buildings including buildings of the maintenance training centre of the KPS with total floor space of 24 000 m^3 at site area of 251 200 m^2. The maintenance training centre including all maintenance training equipment and facilities is at the KNTC site. These buildings contain 19 classrooms, 14 maintenance workshop rooms, 2 full-scope simulator rooms, auditorium, 2 radiation protection and chemical laboratories, CAI room and audio-video control room, language laboratory and library, 2 dining facilities and 150 student house facilities, etc. There are a total of 53 full-time instructors and 139 management and staff in the KNTC including the 18 instructors and 39 management support staff of the three branch plant training centres. The centre is equipped with various training facilities including two PWR full-scope simulators and a number of equipment mock-ups such as refueling handling equipment, RCP seals, electrical and I&C simulator, control rod drive mechanism, steam generator, etc. Ulchin plant training centre has a full-scope simulator and the other plant training centres simulators are under construction. There are 14 instructors and 15 management and support staff in the maintenance training centre of KPS. Physical facilities and maintenance training equipment and facilities of the maintenance training centre of KPS are the properties of the Korea Electric Power Corporation. The KPS maintains the training centre and train its employees as a contractor.

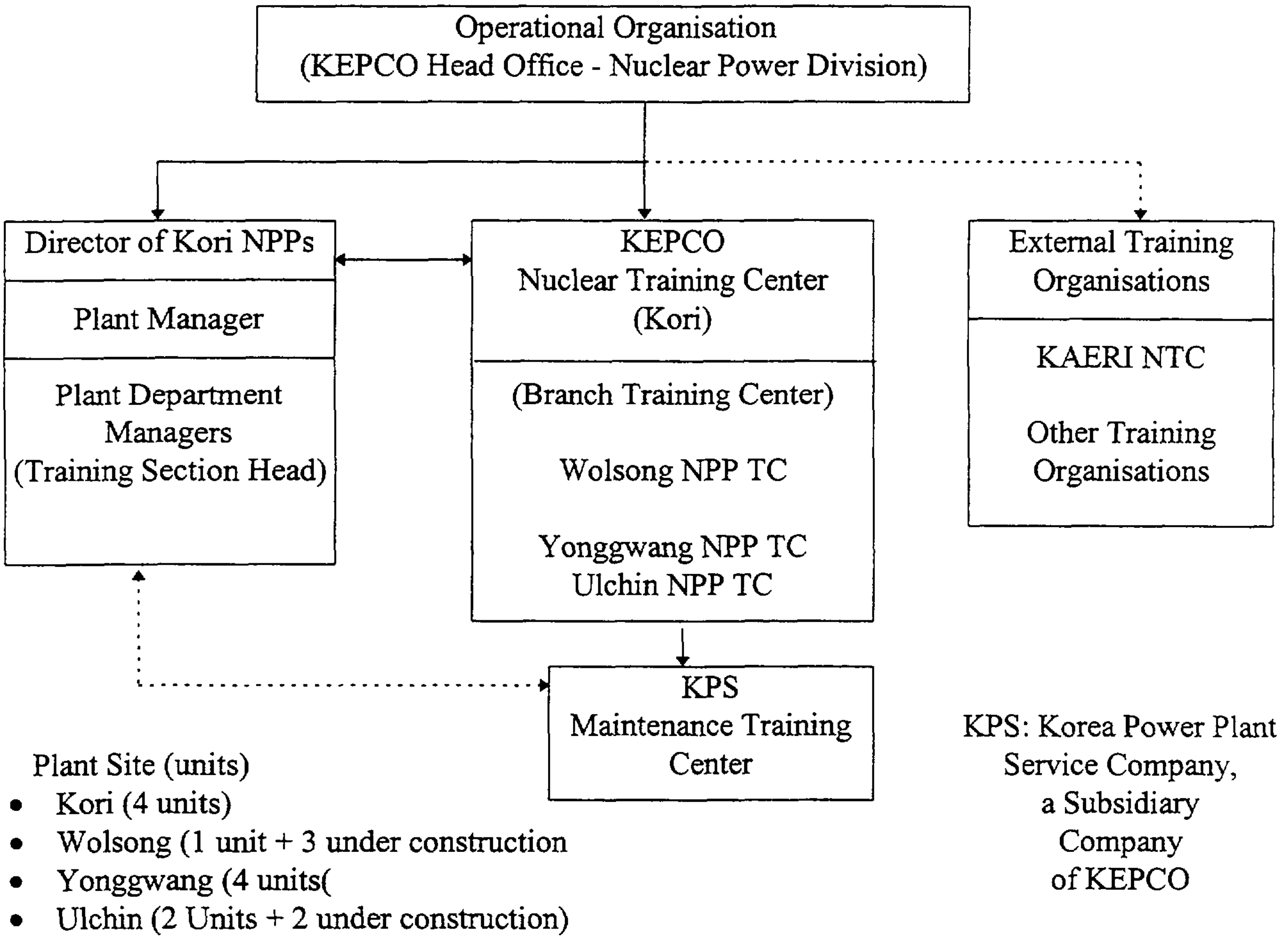

FIG. 3. 11. Organizational arrangements for training of NPP personnel in the Republic of Korea.

13.3. TRAINING ORGANIZATIONS

Training centre (TC) Responses for the Survey

1. Korea Atomic Energy Research Institute (KAERI) (TC Name)

Contact:

Mr. In-Suk SUH, Vice President for Nuclear Training
Tel: 82 42 868 2670
Fax: 82 42 861 5018/1395

Training practices which could be recommended for application in other training organizations:

Offers regional courses on nuclear power and safety for developing countries under the framework of the IAEA/RCA program

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

Compact nuclear power plant simulator.

2. Korea Electric Power Corporation (KEPCO) (TC Name)

Contact:

Mr. Kang-Dong, Manager Training Development and Planning
Tel: 82 51 726 6310
Fax: 82 51 726 6214

Training practices which could be recommended for application in other training organizations:

Simulator used for NPP operational personnel, special I & C training using I & C simulator.

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

Well equipped workshops .

3. Korea Power Plant Service Co. Ltd., Nuclear Maintenance Training Center (TC Name)

Contact:
Mr. Jin-Hwan Koh, Manager Education and Training
Tel: (02) 2500-421
Fax: (02) 2500-408

Availability of Training for Personnel from Organizations in Other Countries:
NPP personnel: No
Training personnel: No
Loan personnel to other countries: No

Unique Training Facilities

Well equipped workshops for maintenance training.

13.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	3	0
Does plant management routinely monitor training?	1	2
Is training audited by a non-regulatory organization external to training department?	1	2
Is plant management directly involved in establishing training needs?	1	2
Is management and supervisory skills training provided?	3	0
Is general safety training provided?	3	0
Is emergency preparedness training provided?	2	1

Budget

Between 0.5 and 1 per cent of the total operating budget is spent on training, based on surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

* higher than the plant position salary

2 * the same as the plant position salary

* lower than the plant position salary

*Numbers indicate the numbers of plants and training centres responding as indicated.

13.5. Training Programs

13.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE/E (1)	E/TS (1)	E/TS (1)	E/TS (1)	E/TS (1)	E/TS (1)
Prerequisite years of experience for this program	10	5–7	3–5	1–2	1–2	1–2

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	E/TS (1)	E/TS (1)	E/TS (1)	E/TS (1)	GE/E (1)	GE/E (1)
Prerequisite years of experience for this program	1–2	1–2	1–2	1–2	1–2	1–2

13.5.2. Training methodology

Job Position **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1 (a)	0	1 (a)	0	1 (a)	0	1 (a)	0	2 (a)	0	2 (a)	0
Job analysis is used to determine training needs	1	0	1	0	1	0	1	0	2	0	2	0
Training needs are used to design measurable training/learning objectives	1	0	1	0	1	0	1	0	2	0	2	0
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	2	0	2	0
Training implementation involves assessment of whether training/learning objectives are achieved	1	0	1	0	1	0	1	0	2	0	2	0
Evaluation is based on training goals. Feedback of needed improvements takes place	1	0	1	0	1	0	1	0	2	0	2	0

(a) Modified and simplified method in accordance with the situation of KNTC.

*Numbers indicate the numbers of plants and training centres responding as indicated.

13.5.2. Training methodology cont.

Job Position / Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1 (a)	0	1 (a)	0	1 (a)	0	1 (a)	0	1 (a)	0	1 (a)	0
Job analysis is used to determine training needs	1	0	1	0	1	0	1	0	1	0	1	0
Training needs are used to design measurable training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training implementation involves assessment of whether training/learning objectives are achieved	1	0	1	0	1	0	1	0	1	0	1	0
Evaluation is based on training goals. Feedback of needed improvements takes place	1	0	1	0	1	0	1	0	1	0	1	0

*Numbers indicate the numbers of plants and training centres responding as indicated.

13.5.3. Initial training programs — settings and duration

(Hours listed are the **average** and range number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	14	109	146	585	480	475
Lab/Workshop	5	2	7	7	36	41
Process or Control Room Simulator	4	24	190	-	-	-
Self-Study	-	20	50	100	100	100
Formal On-the-Job Training	-	-	-	528	424	424
Total Initial Training	23	155	393	1220	1040	1040

13.5.3. Initial training programs — settings and duration cont.

(Hours listed are the **average** and range number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	585	47 (a)	585	585	22	22
Lab/Workshop	7	10 (a)	7	7	11	11
Process or Control Room Simulator	-	-	-	-	-	-
Self-Study	100	-	100	100	5	5
Formal On-the-Job Training	528	-	528	528	450	450
Total Initial Training	1220	57 (a)	1220	1220	488	488

(a) Applied to Seoul Training Center of KEPCO.

For mechanical and Electrical maintenance initial and continuing training, the figures are average of figures reported from TC2 and 3.

13.5.4. Continuing training programs — settings and duration

(Hours listed are the **average** and range number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	68	136	136	160	22	20
Lab/Workshop	17	34	34	34	10	11
Process or Control Room Simulator	49	98	98	74	-	-
Self-Study	20	40	40	40	5	5
Formal On-the-Job Training	-	-	12	12	16	16
Total Continuing Training	154	308	320	320	43	26

13.5.4. **Continuing training programs — settings and duration cont.**

(Hours listed are the **average** and range number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	20	7 (a)	20	20	7	7
Lab/Workshop	13	4 (a)	13	13	3	3
Process or Control Room Simulator	-	-	-	-	-	-
Self-Study	5	-	5	5	1	1
Formal On-the-Job Training	12	12	12	12	12	12
Total Initial Training	50	23	50	50	23	23

(a) Applied to Seoul Training Center of KEPCO.

13.5.5. Total number of personnel trained by training centres

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	5	10	60	250	50	30
Average annual number of persons who participate in continuing training 1991–1995	10	95	240	360	200	65

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	35	20	35	30	5	5
Average annual number of persons who participate in continuing training 1991–1995	460	30	80	90	10	10

Answer valid only for KEPCO Nuclear TC.

13.6. TRAINING FACILITIES

13.6.1. Physical facilities

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	3		9
Maintenance Workshops	2	1	9
Radiation Protection/Chemistry Labs	2	1	2
Other Labs/Workshops	2	1	3
Simulator(s)	2	1	1
Self-Study Rooms	3		6
Library(ies)	3		1
Dedicated Instructor Offices/Work Space	3		8
Technical and Training Documentation Area	3		1
Training Material Preparation Area	3		1
Large Lecture Room	3		1
Dining Facilities	3		0.5
Student Housing Facilities	2	1	65

*Numbers indicate the numbers of plants and training centres responding as indicated.

13.6.2. Training centre staffing

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	9	170	25
Maintenance	11.5	43	21
Radiation Protection	3	35	5
Chemistry	1	20	2
Other Instructors	4	100	20
Management and Support Staff			
Management	2.5		
Simulator Support	5		
Maintenance Support	5		
Training Material Development	3		
Education Specialist	6		
Others	24		

13.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Compact	Kori 3–4	KAERI NTC	NSSS Design Personnel	560
Fullscope	Surry 2	KEPCO NTC	Kori 1–2	681
Fullscope	Youggwang	11	Kori 1–2 Younggwang 1–2	1928
Fullscope	Ulchin 1–2	Ulchin Plant TC	Ulchin 1–2	1402

13.6.4. Maintenance training equipment

Mechanical equipment

Plant Component**	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		2, 3
	Reactor vessel head		2, 3
	Reactor internals		2, 3
	Control rod drive mechanism		
Steam Generator	Complete		
	Primary side channel head		2, 3
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		2, 3
Reactor coolant pump (or primary loop recirculation pump)	Internal part		
	Pump shaft sea		2, 3
	Pump body		
Main gate valve	Internal part		2, 3
	Body		2, 3
Fuel manipulator equipment	Manipulator crane		2, 3
	Dummy fuel		2, 3
	Fuel-handling tools		2, 3
	Fuel-loading simulator	2	2, 3
Pumps		2	2, 3
Valves			
Supporting structures			
Welding-practice equipment		2, 3	
Compressor	Instrumentation air compressor	2. 3	2, 3
Laser alignment			
Other			

** Korea Atomic Energy Research Institute does not have any equipment.

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and instrumentation equipment

Plant Component**	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		2, 3	
Reactor coolant pump motor			
Control-rod drive mechanism control system			2
Control boards at electrical control room	Rod position indicator	2	
	Reactor control and protection rack	2	
	Protective relay system	2	
	Ex-core nuclear instruments	2	
	In-core nuclear instruments	2	
	Generator automatic voltage regulator		2, 3
	Constant voltage constant frequency power source	2	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	2	
	Radiation measurement equipment		
	Controller	2	
	Other	2	
Measurement system for motor-operated valves			
Digital control device		2	
Other		2	
Common			
Non-destructive testing equipment		2, 3	
Transparent power plant	See-through		
	Functional		
Other			

** See note on previous page.

*Numbers correspond to the NPP or TC listed in Part II.

13.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	1	2
Interactive video	2	1
Establishing and maintaining training database	3	
Generating examinations	1	2
Keeping student records	3	
Production of training materials	3	

Visual aids available at facility

	Yes*	No*
Whiteboards	3	
Overhead projectors	3	
Slide projectors (such as 35mm)	3	
Flip charts	2	1
Video equipment	3	
Computer liquid crystal display panel or computer projector	2	1
Video conferencing		3

*Numbers indicate the numbers of plants and training centres responding as indicated.

14. LITHUANIA

14.1. SURVEY SUMMARY AND CONCLUSIONS

Two RBMK unit with 1500 MW power each.
These units are situated at Ignalina NPP.

Training Organization

Unique training facilities: none noted in answers.
Training practice which could be recommended for use in other places is: none.
On-the-job training is spent on shift during second half of an initial training course.
The salary of trainers is lower than the plant position salary.

Training Programs

Training programs are oriented to a high level of basic education.
Duration and setting of training is as indicated.
The total average annual number of persons in initial and continuing training, which were indicated in answers, is near 207 (100 per unit).

Training Facilities

Physical facilities are as indicated in answers.
Training base for maintenance personnel consists of real equipment and mock-ups.
Computers are used for generation of examinations, CBT, database and training material production.
Some visual aids are available at facility except video equipment, computer LCD panel and video conferencing.

Conclusion

The upgrading of NPP personnel training system is needed for the country.

14.2. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

Ignalina NPP

Contact: Mr. Nikolay Trefilov, Head of Training Department
Tel: (007) 37066 60396, 28806
Fax: (007) 37066 60396, 34106

Training practices which could be recommended for application in other training organizations:

On job training is spent at shift department, during second half of an initial training course.

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Y

Training personnel: Y

Loan personnel to other countries: Y

Fee for Services: Y

Unique Training Facilities

NO

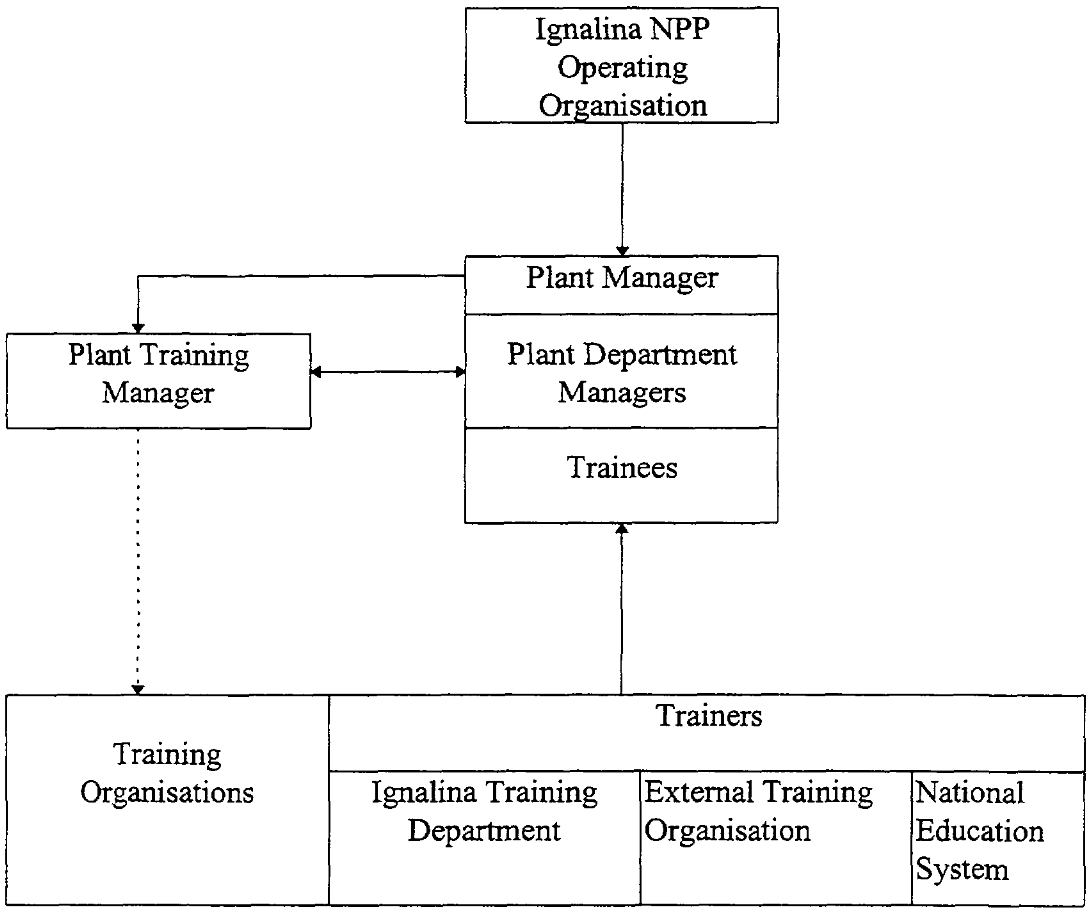

FIG.3.12. Lithuanian organizational arrangements for the training of NPP personnel.

14.3. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	1	0
Does plant management routinely monitor training?	1	0
Is training audited by a non-regulatory organization external to training department?	1	0
Is plant management directly involved in establishing training needs?	1	0
Is management and supervisory skills training provided?	1	0
Is general safety training provided?	1	0
Is emergency preparedness training provided?	1	0

Budget

Between 0.1 and 0.15 per cent of the total operating budget is spent on training, based on surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

0 * higher than the plant position salary

0 * the same as the plant position salary

1 * lower than the plant position salary

*Numbers indicate the numbers of plants and training centres responding as indicated.

14.4. TRAINING PROGRAMS

14.4.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE	GE	GE	E, TS, SS	GE, E, TS, SS	GE, E, TS
Prerequisite years of experience for this program	>3	>2	>2	0 , 2	0 , 2	0 , 2

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE, E, TS	GE, E, TS	GE, E, TS	GE, E	GE, E	GE
Prerequisite years of experience for this program	0 , 2	0 , 1	0 , 2	0 , 2	>2	>2

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

14.4.2. Training methodology

Job Position / Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used		1		1		1		1		1		1
Job analysis is used to determine training needs	1		1		1		1		1		1	
Training needs are used to design measurable training/learning objectives	1		1		1		1		1		1	
Training materials are based on training/learning objectives	1		1		1		1		1		1	
Training implementation involves assessment of whether training/learning objectives are achieved	1		1		1		1		1		1	
Evaluation is based on training goals. Feedback of needed improvements takes place	1		1		1		1		1		1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

14.4.2. Training methodology cont.

Job Position / Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*'	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to training (SAT) is used		1		1		1		1		1	-	-
Job analysis is used to determine training needs	1		1		1		1		1		-	-
Training needs are used to design measurable training/learning objectives	1		1		1		1		1		-	-
Training materials are based on training/learning objectives	1		1		1		1		1		-	-
Training implementation involves assessment of whether training/learning objectives are achieved	1		1		1		1		1		-	-
Evaluation is based on training goals. Feedback of needed improvements takes place	1		1		1		1		1		-	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

14.4.3. Initial training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	0	0	600–1200	160	80	80
Lab/Workshop	0	0	0	0	40	0
Process or Control Room Simulator	80	80	80	0	0	0
Self-Study	400	800 ÷1600	240 ÷ 280	350 ÷ 550	30 ÷ 180	70 ÷180
Formal On-the-Job Training	536	1236 ÷ 2972	280 ÷ 640	450 ÷ 650	50 ÷ 100	100 ÷ 170
Total Initial Training	2016	2616 ÷ 4652	1200 ÷ 2198	960 ÷ 1360	200–400	250 ÷ 420

14.4.3. Initial training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	144	0	143	140	140	0
Lab/Workshop	322	0	0	0	0	0
Process or Control Room Simulator	0	0	0	0	0	0
Self-Study	424	0	800	420	120	0
Formal On-the-Job Training	432	0	700	260	160	0
Total Initial Training	1323	0	1643	820	420	0

14.4.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	20	20	20	20	-	-
Lab/Workshop	0	0	0	0	-	-
Process or Control Room Simulator	40	40	40	40	-	-
Self-Study	20	20	20	20	-	-
Formal On-the-Job Training	0	0	0	0	-	-
Total Continuing Training	80	80	80	80	-	-

14.4.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program / **Program Setting**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	-	-	-	40	80	-
Lab/Workshop	-	-	-	0	0	0
Process or Control Room Simulator	-	-	-	0	20	0
Self-Study	-	-	-	40	80	0
Formal On-the-Job Training	-	-	-	0	1140	0
Total Initial Training	-	-	-	80	320	0

14.4.5. Total number of personnel trained by nuclear power plant training departments

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	1	2	10	40	20	-
Average annual number of persons who participate in continuing training 1991–1995	2	4	10	30	80	-

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	1	-	1	1	1	0
Average annual number of persons who participate in continuing training 1991–1995	-	-	-	1	3	0

14.5. TRAINING FACILITIES

14.5.1. Physical facilities

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	5
Maintenance Workshops	1	0	2
Radiation Protection/Chemistry Labs	0	1	0
Other Labs/Workshops	1	0	1
Simulator(s)	1	0	1
Self-Study Rooms	1	0	5
Library(ies)	1	0	1
Dedicated Instructor Offices/Work Space	1	0	5/10
Technical and Training Documentation Area	1	0	1
Training Material Preparation Area	1	0	1
Large Lecture Room	0	1	0
Dining Facilities	1	0	1
Student Housing Facilities	0	1	0

*Numbers indicate the numbers of plants and training centres responding as indicated.

14.5.2. Training department staffing

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	4	0	0
Maintenance	1	5	0.5
Radiation Protection	0	0	0
Chemistry	1	0	0
Other Instructors	0	0	0
Management and Support Staff			
Management	1	0	0
Simulator Support	1	0	0
Maintenance Support	0	0	0
Training Material Development	1	0	0
Education Specialist	0	0	0
Others	4	0	0

14.5.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Basic Principles	Units 1, 2	Ignalina NPP	Units 1, 2	250
Full Scope	Unit 1,2	Ignalina NPP	Units 1,2	n/a

14.5.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		
	Reactor vessel head		
	Reactor internals		
	Control rod drive mechanism		
Steam Generator	Complete		
	Primary side channel head		
	Tube examination equipment		
	Steam generator inspection manipulator	1	1
	Handling tools of manhole		
Reactor coolant pump (or primary loop recirculation pump)	Internal part	1	
	Pump shaft seal		
	Pump body		
Main gate valve	Internal part	1	
	Body	1	
Fuel manipulator equipment	Manipulator crane		
	Dummy fuel	1	1
	Fuel-handling tools		
	Fuel-loading simulator	1	
Pumps			1
Valves		1	1
Supporting structures		1	
Welding-practice equipment		1	
Compressor	Instrumentation air compressor		
Laser alignment			
Other			

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment			
Reactor coolant pump motor			
Control-rod drive mechanism control system		1	1
Control boards at electrical control room	Rod position indicator		
	Reactor control and protection rack		
	Protective relay system		1
	Ex-core nuclear instruments		1
	In-core nuclear instruments		
	Generator automatic voltage regulator		
	Constant voltage constant frequency power source		
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1	1
	Radiation measurement equipment	1	1
	Controller		1
	Other		
Measurement system for motor-operated valves		1	1
Digital control device		1	1
Other			
Common			
Non-destructive testing equipment		1	
Transparent power plant	See-through		
	Functional		
Other			

*Numbers correspond to the NPP or TC listed in Part II.

14.5.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	1	
Interactive video		1
Establishing and maintaining training database	1	
Generating examinations	1	
Keeping student records		1
Production of training materials	1	

Visual aids available at facility

	Yes*	No*
Whiteboards	1	
Overhead projectors	1	
Slide projectors (such as 35mm)		1
Flip charts		1
Video equipment		1
Computer liquid crystal display panel or computer projector		1
Video conferencing		1

*Numbers indicate the numbers of plants and training centres responding as indicated.

15. MEXICO

15.1. SURVEY SUMMARY AND CONCLUSIONS

Training Organizations

- The extent of management involvement in the training process was not included in the survey response.

Training Programs

- Good entry level requirements are asked for NPP personnel.
-
- Big efforts have been realized on initial training for operations and maintenance personnel but maintenance continuing training needs improvements.

Training Facilities

- Physical facilities are fully provided for the trainees as well as for the trainers.
-
- Number of trainers for operations training is quite enough but needs improvement in maintenance training.
-
- Computers are used for training.

15.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

At present at the Laguna Verde NPP the training and qualification priorities are:

– Maintaining personnel qualification

– Application of the systematic approach to training

– Introducing the safety culture philosophy to NPP personnel

15.2.1. Maintaining personnel qualification

To maintain the qualification of the Laguna Verde personnel, the training centre has a qualification program for the following groups: licensed operators, non-licensed operators, mechanical maintenance, electrical maintenance, i & c, health physics, quality control, chemistry, and engineering support.

Simulators and mockups are used in the programs to maintain personnel qualification. There is a unit one full-scope simulator in use since 1991 for the initial training and retraining of licensed operators. The simulator has also been used for training managers on emergency situations, and for validation of procedures before their implementation in the plant. Once a year the entire crew participates in the emergency simulator scenarios. Some part-task simulators are used for I & C technicians.

Important features of the operations and maintenance training involve the emphasis on human-factor-related competencies such as: human relations, communication, team work, management and supervisory skills, root cause analysis techniques and maintenance good practices.

It is important to note the positive impact in training effectiveness when the management of a department increased its ownership of their training programs.

15.2.2. Application of the Systematic Approach to Training

At Laguna Verde the application of SAT methodology for training is under way.

For the Analysis step, the method selected is a combination of the job and task analysis (JTA) and the job competencies analysis (JCA). The departure point is the revision of the job orders executed in the plant. There are approximately 86 000 job orders for analysis; the standards were set by training and the revision is made by a contractor. On the first step started in September 1996 and completed in early 1997, 40 000 job orders were selected.

The outputs expected from the analysis of the work orders are:

- The tasks which are more frequently executed
- The competencies required to perform these tasks.

The documented work orders will allow identification of the person who performed the task and consequently the competencies the personnel already have and do not need training on, as well as identification of the competencies that require training. On this basis, the SAT process will be used to produce training objectives.

The person who, according to the work executed, has certain specific competencies, will be interviewed by his/her supervisor to confirm the knowledge required for that competency; if that person has this knowledge, he/she will be certified on that specific competence. In addition, as of mid-1996, for important and/or critical activities an on-field verification is made and documented, those responsible for the verification being an instructor and the worker's supervisor.

In the case where the person does not have the knowledge or skills needed, then a training objective is developed, to be able to certify the person in that task.

In parallel, the maintenance training programs as of 1996 were designed using SAT. The whole process is expected to be completed in three years. The source of the definition of training objectives was a self-assessment made by the maintenance and training departments on the performance of the maintenance department personnel since 1993.

Some of the outputs of this self-assessment were:

- The equipment failures which are frequently experienced.
- The type of work orders more frequently executed
- The amount and type of reworks which are frequently done
- Concerning all of the above, those which were caused by human error, lack of training and/or inadequate design.

In the short time since introducing SAT-based training for maintenance personnel, the following advantages have been found:

- Training has been given on realistic needs for day-to-day activities

- An increase in training attendance has been noted, which means that personnel find the training is useful.

In connection with maintenance personnel training, the following is pointed out:

- In some cases a shortening of the unavailability time of a component or system has been observed. Unavailability was longer in the past because of the lack of certain specific knowledge which was not covered in training.

- A reduction in time necessary to do the job, and on reworks has also been observed.

15.2.3. Role of the Mexican Regulatory Body with respect to the training, qualification and competence of NPP personnel

The Mexican regulatory body, COMISION NACIONAL DE SEGURIDAD NUCLEAR Y SALVAGUARDIAS (CNSNS) has a department in charge of operations verification. One branch of this department has the responsibility for training certification. At this branch they are organized to verify:

- Licensed personnel
- Non-licensed personnel
- Requalification programs

The regulatory body in 1995 required Laguna Verde to implement SAT methodology for the training of maintenance personnel (mechanical, electrical and I& C). They certify and review the training according to the US regulations stated in: 10CFR 50.55, Regulatory Guide 1.8 and ANSI/ANS 3.1-1993.

The cost of application of SAT at Laguna Verde for the positions required by the regulatory body is expected to be on the order of one million US dollars, or about 0.66% of the overall operating budget.

15. 3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Laguna Verde NPP Units 1 and 2

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15.4. TRAINING PROGRAMS

15.4.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	E	E	E	TS	TS	TS
Prerequisite years of experience for this program						

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	TS	TS	TS	TS	E	E
Prerequisite years of experience for this program						

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma.

15.4.2. Initial training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	3000		2500	254	96	96
Lab/Workshop						
Process or Control Room Simulator	900		400			
Self-Study						
Formal On-the-Job Training	1200		1100	2000	1000	1000
Total Initial Training	5100		4000	2254	1096	1096

15.4.2. Initial training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	264	264	264	604	300/1500	1120
Lab/Workshop				80		
Process or Control Room Simulator						
Self-Study						
Formal On-the-Job Training	1000	1000	1000	1000		
Total Initial Training	1264	1264	1264	1684	300/1500	

15.4.3. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom						
Lab/Workshop						
Process or Control Room Simulator						
Self-Study						
Formal On-the-Job Training						
Total Continuing Training	130		130	130	36	22

15.4.3. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom						
Lab/Workshop						
Process or Control Room Simulator						
Self-Study						
Formal On-the-Job Training						
Total Initial Training	22	24	70	76		

15.4.4. Total number of personnel trained by nuclear power plant training departments

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	3		7	17		
Average annual number of persons who participate in continuing training 1991–1995	33		24	81	90	38

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995						
Average annual number of persons who participate in continuing training 1991–1995	45	23	52	31	35	15

15.5. TRAINING FACILITIES

15.5.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	x		12
Maintenance Workshops	x		3
Radiation Protection/Chemistry Labs	x		1
Other Labs/Workshops		x	
Simulator(s)	x		1
Self-Study Rooms		x	
Library(ies)		x	
Dedicated Instructor Offices/Work Space	x		25
Technical and Training Documentation Area	x		2
Training Material Preparation Area	x		1
Large Lecture Room	x		1
Dining Facilities		x	
Student Housing Facilities		x	

*Numbers indicate the numbers of plants and training centres responding as indicated.

15.5.2. Training department staffing

1. Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	10	2	
Maintenance	3	3	
Radiation Protection	1	1	
Chemistry	0	1	
Other Instructors		1	
Management and Support Staff			
Management			
Simulator Support			
Maintenance Support			
Training Material Development			
Education Specialist			
Others			

15.5.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full Scope	Laguna Verde	Plant	Laguna Verde	3200

15.5.4. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training		
Interactive video		
Establishing and maintaining training database	X	
Generating examinations	X	
Keeping student records	X	
Production of training materials	X	

*Numbers indicate the numbers of plants and training centres responding as indicated.

16. ROMANIA

16.1. SURVEY SUMMARY AND CONCLUSIONS

Training Organization

There is a possibility of training for personnel from organizations in other countries.
Unique training facilities: none noted in answers.
Training practices which could be recommended for use in other places: SAT application, performance discrepancy analysis, moving from "training" to performance improvement.
NPP personnel training is realized as indicated.
Average training budget is 1.7%.
The salary of trainers is the same as the plant position salary.

Training Programs

Systematic approach to training is used for training programs. Since Cernavoda NPP is a second generation design of the basic CANDU Reactor Plant and since several similar CANDU-600 are in operation world-wide, the analysis of the job functions associated with the operation and maintenance of CANDU NPP has already been undertaken.

As a result, the job-related training requirements are, to a considerable extent, pre-determined for Cernavoda. However, the analysis is done when:

(a) the adaptation of existing CANDU training programs is done, in order to ensure that specific differences in job function and/or plant design are taken into account; and

(b) a new program, specific for Cernavoda, is developed.

Training programs are oriented to a middle-level basic education.
Duration and setting of training as indicated.
The total average annual number of persons in initial and continuing training, which were indicated in the answers is about 761.

Training Facilities

Physical facilities are as indicated in answers.
Number of staff indicated as 43.
Training equipment for maintenance personnel are as indicated in answers..
Computers are used for CBT and Interactive Video.
Some Visual Aids are available at the facility.

Conclusion

NPP personnel training is well organized.

16.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

16.2.1. Romanian nuclear program status

Cernavoda Nuclear Power Project comprises five nuclear power units with a net output of 633 MW each, located in southeast Romania, on the Danube river, close to Cernavoda town, 166 km far away from Bucharest the capital, and 60 km from the Black Sea.

Each unit is based on the standard CANDU 600 design, which is similar to the Nuclear Power Plants Gentilly II and Point Lepreau in Canada, Wolsung II in South Korea and Embalse in Argentina. Since each unit is essentially a "stand alone" CANDU 600, the units can be operated in an autonomous way.

Type of reactor: PHWR CANDU-600 (natural uranium, heavy water as moderator, heavy water under pressure as cooling agent, 380 horizontal fuel channels).

Unit 1: connected to the Grid in July 1996 and went commercial at the end of November 1996.
Units 2-5: after 2000

Romanian nuclear development program is complemented by a nuclear fuel manufacturing plant, heavy water production plant and major organizations for engineering, manufacturing and erection for systems and components.

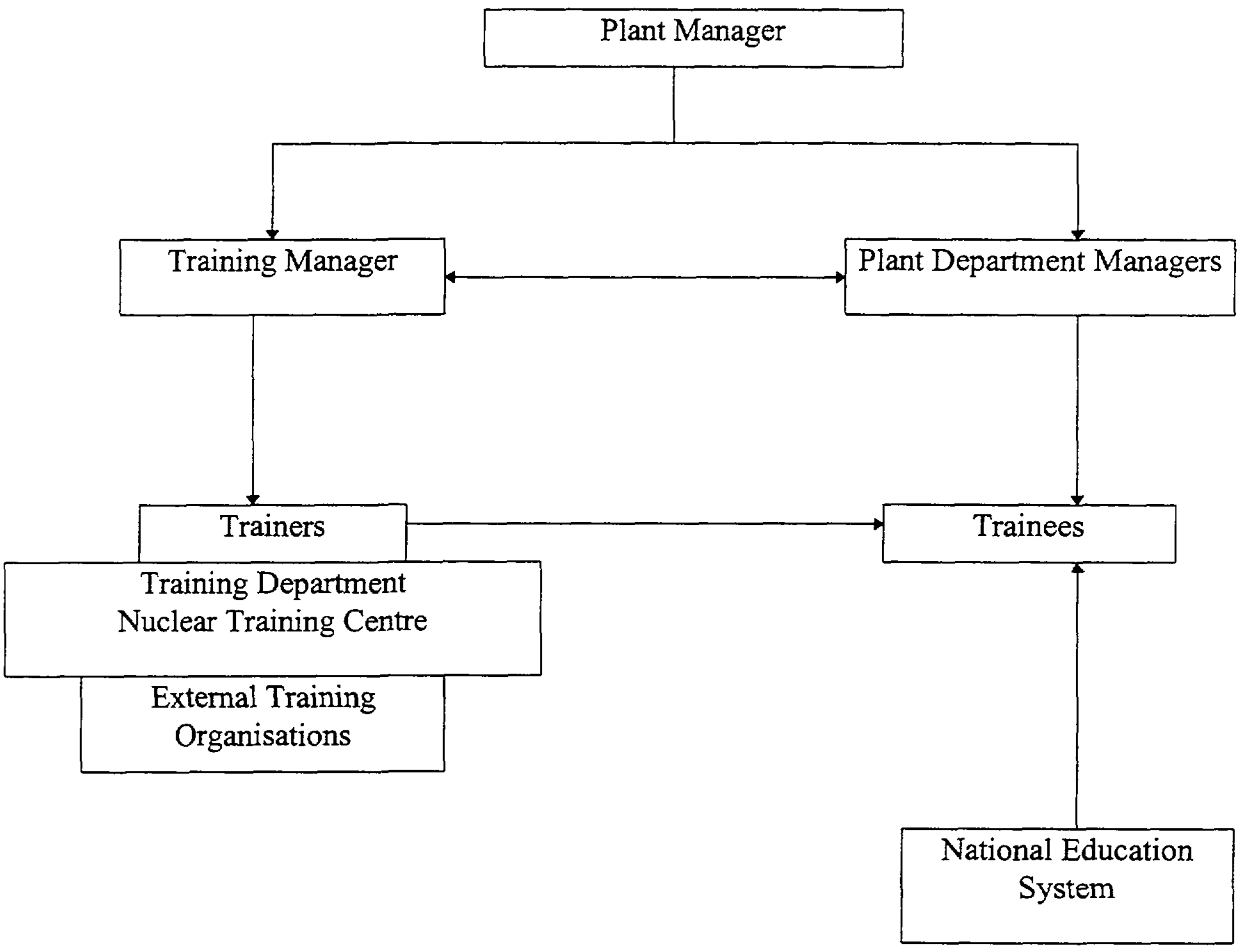

FIG. 3.13. Organizational arrangements for training of Cernavoda NPP personnel.

16.2.2. Project organization

The Station is the property of the Romanian Government and the Romanian Electricity Authority/Regia Autonoma Nationala de Electricitate (RENEL) is the state organization responsible for its construction and operation.

Nuclear Power Group/Grupul de Energetica Nucleara (GEN) is the department of RENEL in charge of nuclear program development.

The basic organizational scheme of Cernavoda Project is shown in Fig. 3.13.

The Cernavoda Project was run under direction of several Ministries from its initial stages, from 1979 until 1990 when RENEL was created under the direction of Ministry of Industry.

In August 1991 RENEL signed a contract with a Consortium (AAC) formed by AECL Canada and ANSALDO Italy. The main scope of this contract is the provision of all resources, services, equipment, tools, materials and supplies required for completion of Unit 1, the management and control of all work associated with Unit 1, including operating unit for a period of 18 months.

The actual management of the Cernavoda Project is carried out by a project management team (PMT) composed by expatriate personnel from Canada (AECL) and Italy (ANSALDO) having a wide background of international project management and nuclear experience, and Romanian staff which covers the positions of "deputy" for supervisory functions, operative technical positions, administrative, secretarial and auxiliary positions.

The senior Romanian personnel in the supervisory functions and the technical personnel attached to the Project follow intensive on-the-job training through exposure to project activities. The operations for the first 18 months following criticality will be the responsibility of AAC organization, all managers and supervisors including shift supervisors, control room and field senior operators are expatriates with extensive nuclear plant experience. Each of them has a Romanian deputy (or counterpart), so that the development process will be continuous. The transfer from the commissioning phase to the operating phase will result in an organization as shown in the figure 1.

The National Commission for Nuclear Activities Control (CNCAN) is the governmental regulatory body, responsible for full surveillance and control in all areas relevant to nuclear safety and environmental protection in the siting, construction, commissioning, operations of nuclear plants, research reactors and other nuclear facilities in Romania. With respect to NPP personnel training, CNCAN performs licensing of the shift supervisors, control room operators and managers of the Cernavoda NPP, review and evaluation of the training activities developed by training department of Cernavoda NPP.

16.2.3. Overall description of training system

16.2.3.1. Training concept

For the first nuclear plant in a country, which is the case of Romania, the establishment of one's own training concept must take into consideration the educational system and the industrial development stage of the country, and also must be based on experience of the countries with developed nuclear power programs.

For the Cernavoda NPP, the training concept is based mainly on the training systems established in the other CANDU utilities. This permits an easy integration of the off-shore training opportunities with the domestic program.

General international guidance that has been developed and published by the IAEA on the subject area of the training and qualification and technical assistance (in the form of experts missions, training courses, scientific visits) have been also very useful in establishing the approach to training and qualification of the Cernavoda NPP personnel.

16.2.3.2. Training organization

The training activities for the NPP personnel in Romania are achieved under responsibility of the training department of Cernavoda NPP. Figure 1 gives the organization chart of the training department in the station organization chart.

The training policy at the utility level is established by the Operations Division of RENEL's Nuclear Power Group. The training department receives directives and orientations from the division mentioned above.

General training, theoretical specific training, basic skills training and simulator training is delivered at the Cernavoda Nuclear Training Centre, part of the training department, located very close to the plant.

Cernavoda Nuclear Training Centre is a new and modern one, put into service at the end of 1995. General dimensions: 88.5. x 45m; 2 floors, provided with classrooms (450 sq. m.), workshops (720 sq. m.), laboratories (546 sq. m.), full-scope simulator (540 sq. m.), video and techniques (100 sq. m.), library (420 sq. m.), management offices (220 sq. m.), instructors office (100 sq. m.), conference room (324 sq. m.), cafeteria (216 sq. m.), exhibition (140 sq. m.).

The simulator is full replica of Cernavoda Unit 1 main control room put into service since April 1995 in phase 1 (Cernavoda control room panels driven by NPP Point Lepreau simulator software). In phase 2, after commissioning of unit 1, the simulator will be updated based on operating data.

The specific training (on-the-job training consisting of field check-outs, work assignments, commissioning participation, co-piloting, specific skills) is delivered in the plant under co-ordination of the plant departments' training co-ordinators.

The training co-ordinators maintain training records and send these records to the training department for the centralized training record system.

The main work groups for which training is available are: operation (shift supervisors, control room operators, senior field operators, nuclear operators, assistant nuclear operators); maintenance (mechanical, electrical, I&C); fuel handling (operation/maintenance); technical support (system engineering, radiation protection, chemistry); general services; administration.

The training department organization chart is shown in Figure 1.

16.2.3.3. Training Methodology

The requirements for the delivery of planned training are based upon the job related training requirements (JRTRS) for each job position. Department managers/group superintendents assess an incumbent's requirements for training based upon consideration of followings: education, training and experience, on-the-job skills assessment and individual training records.

Considering the definition of training needs, program implementation activities include:

- Definition of the required programs;
- Development of the required course objectives and subject material through a systematic approach to training;

- Definition of the required programs;

- Development of the required course objectives and subject material through a systematic approach to training;

- Establishment of the methods to evaluate trainee performance;

- Development of training program delivery schedules consistent with station priorities to cover all areas of activity, including operator licensing, operations, maintenance and technical areas;

- Provision of feedback to responsible supervisors/superintendents/managers on the progress of training to meet JRTR's.

Training programs are classified as either departmental (D) or topical (T) where the former refers to training of a specific nature and the latter refers to training of a generic nature applicable to several departments.

16.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Cernavoda NPP

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Training practices which could be recommended for application in other training organizations:

1. SAT application;
2. Performance discrepancy analysis;
3. Moving from "training" to performance improvement.

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Y
Training personnel: Y
Loan personnel to other countries: Y
Fee for services: Y

16.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	1	0
Does plant management routinely monitor training?	1	0
Is training audited by a non-regulatory organization external to training department?	1	0
Is plant management directly involved in establishing training needs?	1	0
Is management and supervisory skills training provided?	1	0
Is general safety training provided?	1	0
Is emergency preparedness training provided?	1	0

Budget

Between 1.6 and 2 per cent of the total operating budget is spent on training, based on survey answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

* higher than the plant position salary

* the same as the plant position salary

* lower than the plant position salary

*Numbers indicate the numbers of plants and training centres responding as indicated.

16.5. TRAINING PROGRAMS

16.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position **Training Program**	Plant or Station Shift Supervisor	*Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE	TS/SS	N/A	SS	SS	SS
Prerequisite years of experience for this program	NA	NA	NA	NA	NA	NA

Job Position **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	SS	TS	SS	SS	GE	TS/SS
Prerequisite years of experience for this program	NA	NA	NA	NA	NA	NA

*The position is called "control room operator".

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

16.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1	0	1	0	1	0	1	0	1	0	1	0
Job analysis is used to determine training needs	1	0	1	0	1	0	1	0	1	0	1	0
Training needs are used to design measurable training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training implementation involves assessment of whether training/learning objectives are achieved	1	0	1	0	1	0	1	0	1	0	1	0
Evaluation is based on training goals. Feedback of needed improvements takes place	1	0	1	0	1	0	1	0	1	0	1	0

* Since Cernavoda NPP is a second generation design of the basic CANDU Reactor plant and since several similar CANDU-600 are in operation worldwide, the analysis of the job functions associated with the operation and maintenance of CANDU NPP has already been undertaken. As a result, the job related training requirements are, to a considerable extent, pre-determined for Cernavoda. However, the analysis is done when: a) the adaptation of existing CANDU training programs is done, in order to ensure that specific differences in job function and/or plant design are taken into account; b) a new program, specific for Cernavoda, is developed.

*Numbers indicate the numbers of plants and training centres responding as indicated.

16.5.2. Training methodology cont.

Job Position **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1	0	1	0	1	0	1	0	1	0	1	0
Job analysis is used to determine training needs	1	0	1	0	1	0	1	0	1	0	1	0
Training needs are used to design measurable training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	1	0	1	0
Training implementation involves assessment of whether training/learning objectives are achieved	1	0	1	0	1	0	1	0	1	0	1	0
Evaluation is based on training goals. Feedback of needed improvements takes place	1	0	1	0	1	0	1	0	1	0	1	0

* Since Cernavoda NPP is a second generation design of the basic CANDU Reactor plant and since several similar CANDU-600 are in operation worldwide, the analysis of the job functions associated with the operation and maintenance of CANDU NPP has already been undertaken. As a result, the job related training requirements are, to a considerable extent, pre-determined for Cernavoda. However, the analysis is done when: a) the adaptation of existing CANDU training programs is done, in order to ensure that specific differences in job function and/or plant design are taken into account; b) a new program, specific for Cernavoda, is developed.

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*Numbers indicate the numbers of plants and training centres responding as indicated.

16.5.3. Initial training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	*Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	1080	1080	N/A	736	736	736
Lab/Workshop	0	0	N/A	0	0	0
Process or Control Room Simulator	120	120	N/A	0	0	0
Self-Study	300	300	N/A	324	324	0
Formal On-the-Job Training	700	700	N/A	756	756	756
Total Initial Training	2200	2200	N/A	1816	1816	1816

* The position is called "control room operator".

16.5.3. Initial training programs - settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	*Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	736	180	248	160	128	176
Lab/Workshop	0	0	40	0	40	0
Process or Control Room Simulator	0	0	0	0	0	40
Self-Study	324	54	0	0	40	40
Formal On-the-Job Training	756	126	368	540	12	40
Total Initial Training	1816	360	656	700	220	296

*Typically holds a shift supervisor or control room operator licence.

16.5.4. Continuing training programs - settings and duration(**)

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	*Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	80	80	N/A	80	80	80
Lab/Workshop	0	0	N/A	0	0	0
Process or Control Room Simulator	80	80	N/A	0	0	0
Self-Study	40	40	N/A	54	54	54
Formal On-the-Job Training	0	0	N/A	126	126	126
Total Continuing Training	200	200	N/A	260	260	260

* The position is called "control room operator".
** Estimated data at this time.

16.5.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program / **Program Setting**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	80	40	40	40	16	8
Lab/Workshop	0	0	40	24	0	0
Process or Control Room Simulator	0	0	0	0	0	0
Self-Study	54	0	0	0	0	0
Formal On-the-Job Training	126	0	0	0	40	200
Total Initial Training	260	40	80	64	56	208

16.5.5. Number of persons in initial and continuing training

Job Position **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991-1995	9	9	N/A	140/20	55	30
Average annual number of persons who participate in continuing training 1991-1995	0	0	N/A	160	70	40

Job Position **Training Program**	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991-1995	30	10	20	25	2	3
Average annual number of persons who participate in continuing training 1991-1995	50	8	30	30	10	0

16.6. TRAINING FACILITIES

16.6.1. Physical facilities

Nuclear power training departments

Existing facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	8
Maintenance Workshops	0	1	0
Radiation Protection/Chemistry Labs	1	0	1
Other Labs/Workshops	1	0	3
Simulator(s)	1	0	1
Self-Study Rooms	1	0	1
Library(ies)	1	0	1
Dedicated Instructor Offices/Work Space	1	0	3
Technical and Training Documentation Area	1	0	1
Training Material Preparation Area	1	0	1
Large Lecture Room	1	0	1
Dining Facilities	1	0	-
Student Housing Facilities	1	0	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

16.6.2. Training department staffing

Nuclear power plant training department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	9	6	3
Maintenance	5	3	1.5
Radiation Protection	1	5	2.5
Chemistry	1	1	0.5
Other Instructors	5		
Management and Support Staff			
Management	1		
Simulator Support	9		
Maintenance Support	0	4	2
Training Material Development	9		
Education Specialist	0		
Others	0		

16.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full Scope	Cernavoda Unit-1	Cernavoda NPP	Unit 1 of Cernavoda NPP	900

16.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		
	Reactor vessel head		
	Reactor internals		
	Control rod drive mechanism		
Steam Generator	Complete		1
	Primary side channel head		1
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		
Reactor coolant pump (or primary loop recirculation pump)	Internal part		
	Pump shaft seal		
	Pump body		
Main gate valve	Internal part		
	Body		
Fuel manipulator equipment	Manipulator crane	1	
	Dummy fuel	1	
	Fuel-handling tools	1	
	Fuel-loading simulator		
Pumps		1	
Valves		1	
Supporting structures		1	
Welding-practice equipment		1	
Compressor	Instrumentation air compressor	1	
Laser alignment			
Other			

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		1	
Reactor coolant pump motor			1
Control-rod drive mechanism control system			
Control boards at electrical control room	Rod position indicator		
	Reactor control and protection rack		
	Protective relay system	1	
	Ex-core nuclear instruments		
	In-core nuclear instruments		
	Generator automatic voltage regulator	1	
	Constant voltage constant frequency power source	1	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1	
	Radiation measurement equipment	1	
	Controller	1	
	Other	1	
Measurement system for motor-operated valves			
Digital control device			
Other		1	
Common			
Non-destructive testing equipment			
Transparent power plant	See-through		2
	Functional		
Other			

*Numbers correspond to the NPP or TC listed in Part II.

16.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	0	1
Interactive video	0	1
Establishing and maintaining training database	1	0
Generating examinations	1	0
Keeping student records	1	0
Production of training materials	1	0

E-mail

Scheduling

Electronic storage of training documents

Access to station logs

Access to station hazard information system

Visual aids available at facility

	Yes*	No*
Whiteboards	1	0
Overhead projectors	1	0
Slide projectors (such as 35mm)	1	0
Flip charts	1	0
Video equipment	1	0
Computer liquid crystal display panel or computer projector	1	0
Video conferencing	0	1

*Numbers indicate the numbers of plants and training centres responding as indicated.

17. RUSSIAN FEDERATION

17.1. SUMMARY AND CONCLUSIONS

Training Organization

At present in The Russian Federation NPP personnel training is organized as shown in Fig. 3.14.

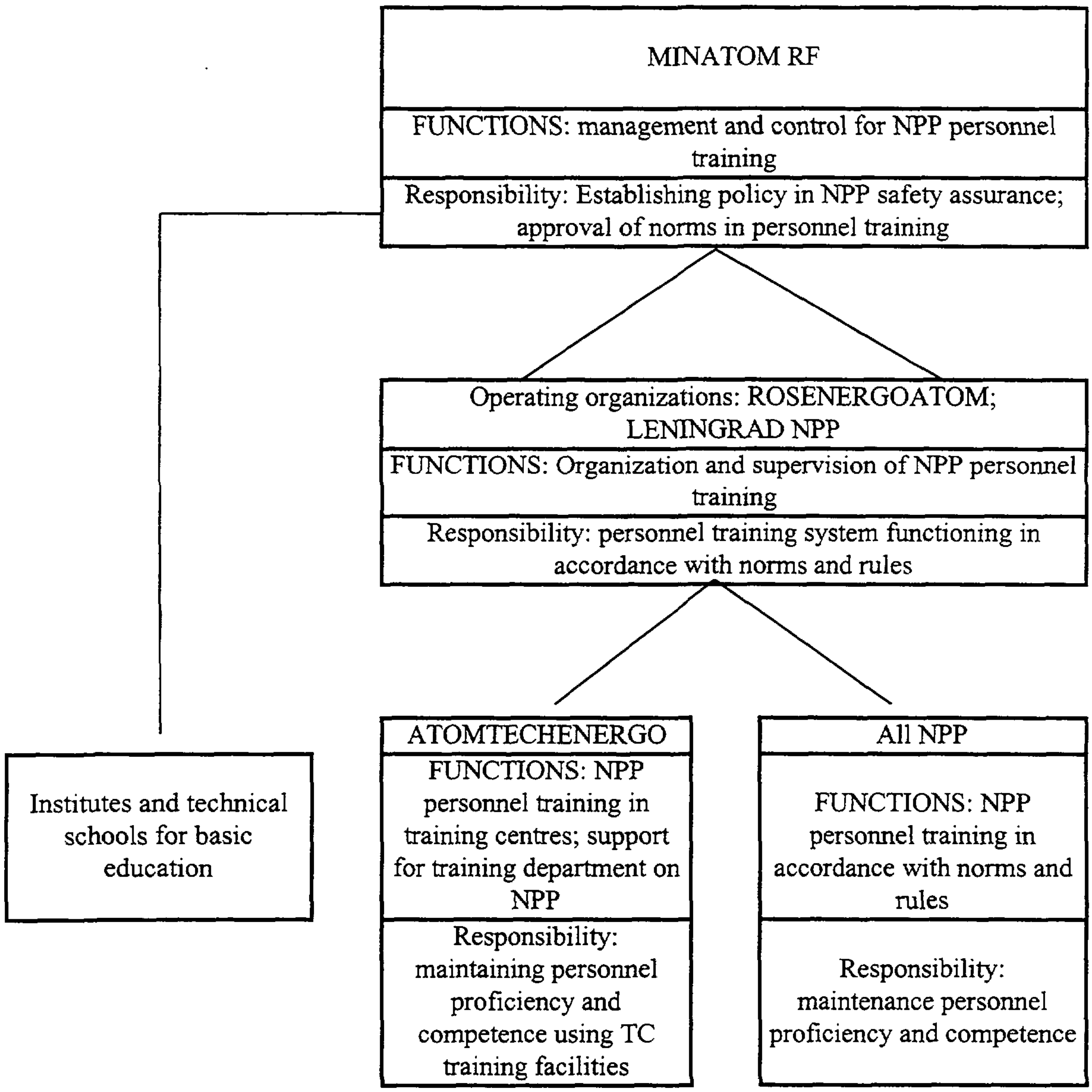

Fig. 3.14. Organizational structure, functions and responsibility of different organizations for NPP personnel system in the Russian Federation.

In general, all Russian training organizations are able to provide training for NPP personnel from organizations in other countries (for SU design units).

Unique Training facilities: none noted in answers of Russian NPP and TC.

Among the training practices which could be recommended for use in other places are: the results of SAT implementation, approaches for organization of training and maintenance training (SAT based).

NPP personnel training is centralized with direct involvement of plant management under supervision of regulatory and operation organizations.

Average training budget is near of 2% of total operating budget. The salary of trainers is lower than the plant position salary.

Training Programs

Training methodology which is used have features of SAT methodology and is under modernization on the basis of SAT ideas.

Training Programs as usual are oriented on high level basic education.

Duration and setting of training have a great range due to different design of units and to differences in training facilities which are available at different NPPs.

The total average annual number of persons in initial and continuing training is near to 90 per unit and is determined now mainly by training facilities which exist. This number approximately is divided half and half between training centres and NPP training departments (TDs).

Training Facilities

Physical facilities are under construction at NPPs and there now exists more of them at TCs than at NPPs.

The largest group of instructors are those for the training of operators. The number staff at TCs is on average twice that at NPP training departments.

Full-scope simulators are now concentrated at TCs but the tendency is to provide all NPP TDs with these simulators (5 full-scope simulators for NPP TDs are under construction).

Maintenance training equipment is represented mainly by mock-ups. Historically it was acquired without a clear understanding of training needs for maintenance personnel training. Now the development of a more systematized training base for maintenance is under way.

Computers and audio visual aids are widely used for training, CBT training is popular and has a priority in comparison with audio-visual aids for training.

Conclusion

The modernization of NPP personnel training is now in under way in the country.

17.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

Two main type of units are used now in The Russian Federation: first type, the WWER pressurized water reactor (units of this type exist with 440 and 1000 MW); second type, the RBMK boiling water reactor (units of this type exist with 1000 MW).

WWER units are situated at Balakovo NPP (4 units WWER-1000), at Kola NPP (4 units WWER-440), at Kalinin NPP (2 units WWER-1000), and at Novovoronezh NPP (1 unit WWER-1000, 2 units WWER-440).

RBMK units are situated at Kursk NPP (5 units RBMK-1000), at Leningrad NPP (4 units RBMK-1000), and at Smolensk NPP (3 units RBMK-1000).

A 600 MW fast breeder reactor is in operation at Beloyarsk NPP.

Four units of special design are in operation at Bilibino NPP. These units each have 40 MW power and also produce industrial heat.

17.2.1. Overall description of training system

The organizational structure for the management and implementation of personnel training involves a number of organizations. These organizations are the following:

- Ministry of the Russian Federation for Atomic Energy (MINATOM)
- Rosenergoatom
- Leningrad nuclear power plant
- Atomtechenergo together with its Novovoronezh Training Centre and Smolensk Training Centre
- Research Institute for nuclear power plant operation (VNIIAES)
- Training departments (so-called Points) at nuclear power plants

In addition, the regulation of training activities is governed by the regulatory organization GOSATOMNADZOR.

Among the above-mentioned organizations the following distribution of roles and responsibilities exists:

MINATOM

The role of MINATOM is to establish the national policy in NPP safety assurance and to manage activities carried out for implementation of this policy, including NPP personnel training. MINATOM provides for the personnel training organizations the approval of normative documents on personnel training, training plans, plans for development of training facilities and materials, and follow-up for observing the above-mentioned documents. These functions are carried out by Headquarters of Staff and Educational Institutions of MINATOM.

ROSENERGOATOM, LENINGRAD NPP

Technical supervision and practical implementation of the Ministry training policy are provided by Rosenergoatom and Leningrad NPP as operating organizations. Rosenergoatom (for all Russian NPP except Leningrad NPP) and Leningrad NPP (for itself only) are assigned the responsibility for the overall operations of NPP's and, as such, have a role in management, co-ordination, and supervising implementation of training including funding resources for training. These organizations also have responsibility for the development and issuance of codes and standards referred to as normative documents.

Rosenergoatom and Leningrad NPP realize in practice the functioning of the personnel training system using manpower and capabilities of Atomtechenergo, VNIIAES, NPPs training departments and with the following allocation of tasks and responsibilities among organizations.

ATOMTECHENERGO

Atomtechenergo and its two training centres (one of them for personnel from NPP's with WWER-type units and the other one for personnel from NPP's with RBMK-type units) use their own training facilities to: provide NPP personnel training in compliance with the requirements of normative documentation; develop the training and methodological materials programs and guides required for implementation of initial training and retraining programs; develop and approve, upon the ministry and operation organization's request, the guiding documents on training management and implementation.

VNIIAES

VNIIAES provides the development of full-scope simulators and other technical training facilities for NPP training departments and also executes scientific supervision of the development of training documentation for their simulators.

VNIIAES is responsible for the development of full-scope simulators for NPP personnel training and for scientific supervision of training process.

NPP TRAINING DEPARTMENTS

NPPs training department ensure the maintaining of personnel proficiency and competence by conducting current training of NPP personnel. For this purpose the NPPs use both their own training facilities and facilities of the training centres of Atomtechenergo. As a rule NPP training facilities are used for continuing training and for personnel emergency training (when possible). Atomtechenergo training centres facilities usually are used for initial training, for periodic retraining of operating NPP personnel and also for instructor training.

training departments of NPPs are responsible for organization and practical realization of training for plant personnel, that is, for planning, scheduling, and conducting of training using facilities of the NPP, Training Centers, and other contractors.

On the whole, NPPs and their training departments bear responsibility for meeting the requirements of the Ministry and operating organization-level documents on personnel training.

Traditionally, training methodology used by the above-mentioned structure for NPP personnel training included the elements of the SAT approach. During the last few years SAT methodology has been used as a basis for modernization of NPP personnel training.

17.2.2. Role of regulator in training

Gosatomnadzor is the regulatory body with respect to training of NPP personnel.
Its basic functions are:

- examination and co-ordination of documents governing the initial and continuing training of NPP personnel;
- issuing licenses to the training centers and NPPs training departments for the right to conduct training of NPP personnel;
- supervision of NPP personnel training;
- testing managers and specialists of operating organizations and NPPs for their knowledge of safety rules and standards.

In practice these functions are realized by regional branches of Gosatomnadsor which are situated at almost each NPP together with training centres and NPP training departments.

17.2.3. Specific positions for which training is available

In principle, for all job positions at Russian NPPs training is required by normative documents, and should be done in accordance with training programs for each position. These training programs must provide the necessary level of knowledge and qualification as determined by the norms for each job position at the NPP.

Practical realization of training programs includes two main parts :

(1) On-the-job training at work places at the NPP.

(2) Special training in training centres or sometimes in NPP training departments when the necessary number of courses and training equipment are available for the positions.

At present the main part of training for operators consists of special training. Additional on-the-job training for these position is in the form of duplicating. For the main positions of maintenance and technical support personnel special training is also available, but the full number of courses and training equipment needed are not available. The up-grading of training for these positions is now under development. After its completion, special training for maintenance and technical support personnel will be available in training centres and in NPP training departments.

Instructor training usually includes training in the area of the job position for which the instructor will train personnel and also specialized pedagogical training in psychology and in the use of training tools. For specialized instructor pedagogical training etc. contractors from other organizations are usually used. The instructor training in job positions is provided in the manner mentioned above for other personnel.

For other job positions, in addition to their on-the-job training some courses from training programs of the above-mentioned job positions are used. The content and number of courses in such cases are determined individually.

17.2.4. Co-operation inside the country

The content of co-operation among training organizations is determined by the following factors:

(1) The training system for personnel of Russian NPPs in accordance with normative documents is centralized. There exists a distribution of functions for the different components of the system. NPPs and their training departments are responsible for continuing training, for the adequate competence level of their staff and for organization of training for such purposes in all other facilities in addition to their own. training centres of Atomtechenergo are responsible for providing specialized initial training and continuing retraining for NPP personnel.

(2) The current modernization of the training process now underway at many NPPs and at the training centres of Atomtechenergo uses a SAT methodology and comprises almost all main categories of NPP personnel.

(3) The different NPPs have different degrees of progress in using the new training methods and training materials.

(4) In the future, taking into account the large volume of needed training activities, the training system will be more decentralized and each component of this system including NPP facilities and training centre facilities will be more specialized.

Under the action of these factors at present, in addition to traditional exchanges of trainees between NPP and TC and information exchange, co-operation inside the country has the following new features:

- trainers seminars for representatives of all organizations which are involved in NPP personnel training;
- intention to create a national database on NPP personnel training
- more exact specialization of different organizations in providing training for different categories of personnel, and common use of facilities of those specialized organizations.

17.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Balakovo NPP

Contact: Mr. S. Berdjugin, Deputy of NPP Chief engineer in personnel training
Tel: (007) 845 70 37542
Fax:(007) 845 70 32637

Training practices which could be recommended for application in other training organizations:

Periodical retraining of operators two times per year and after refueling;
Maintenance personnel training;
Production of norms and standards in NPP personnel training;
Training materials for WWER-1000 on the base of SAT methodology.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

2. Beloyarsk NPP

Contact: Mrs. L. Skryabina, Head of Training Department
Tel: (007) 343 77 36251
Fax:(007) 343 77 31070

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: No
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

3. Kalinin NPP

Contact: Mr. J. Kuchersky, Head of Training Department
Tel: (007) 082 55 68822
Fax:(007) 082 55 44591

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries: No

Unique Training Facilities
None noted in survey

4. Kola NPP

Contact: Mr. L. Kumkov, Head of Training Department
Tel: (007) 815 32 682220
Fax:(007) 815 32 68140

Training practices which could be recommended for application in other training organizations:

The using of business game methods for emergency preparedness training

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: No

Unique Training Facilities

None noted in survey

5. Kursk NPP

Contact: Mr. V. Galberg Deputy of NPP Chief engineer in personnel training
Tel: (007) 071 31 46643
Fax:(007) 071 31 40629

Training practices which could be recommended for application in other training organizations:

Training materials for mechanical maintenance on base of CBT, video and functional simulators

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: No
Loan personnel to other countries: No
Fee for services: Yes

Unique Training Facilities

None noted in survey

6. Leningrad NPP

Contact: Mr. M. Chudyakov Head of Human Factor Department
Tel: (007) 812 69 62429
Fax:(007) 812 69 62429

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

7. Novovoronege NPP

Contact: Mr. V. Gonchar Chief specialist of Training Department
Tel: (007) 073 64 73163
Fax:(007) 073 64 73302

Training practices which could be recommended for application in other training organizations:

Preparation of requirements for annual programs of continuing training for NPP

Availability of Training for Personnel from Organizations in Other Countries: No

Unique Training Facilities

None noted in survey

8. Smolensk NPP

Contact: Mr. A. Kaigorodov Head of Training Department
Tel: (007) 081 53 71580
Fax:(007) 081 53 71925

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries*

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

- Together with Smolensk Training Center

Unique Training Facilities

None noted in survey

Training Center (TC) Responses for the Survey

9. Novovoronege TC of Atomtechenergo

Contact: Mr. A. Ivanchenko, TC Chief Engineer
Tel: (007) 073 64 20701
Fax:(007) 095 564 8154

Training practices which could be recommended for application in other training organizations:

The results of SAT based job analysis for NPP job positions;
Safety course in NPP operation for managers;
Instructor training on the base of special course.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

10. Smolensk TC of Atomtechenergo

Contact: Mr. J. Trigub, TC Director
Tel: (007) 081 53 71507
Fax:(007) 081 53 71925

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes*
Training personnel: Yes*
Loan personnel to other countries: Yes
Fee for services: Yes
- For NPPs with RBMK reactors in Lithuania and Ukraine

Unique Training Facilities

None noted in survey

17.4. MANAGEMENT ROLE AND RESPONSIBILITY

	Yes*	No*
• Is there a plant or operating organization training policy document?	10	
• Does plant management routinely monitor training?	10	
• Is training audited by a non-regulatory organization external to training department?	10	
• Is plant management directly involved in establishing training needs?	8	2
• Is management and supervisory skills training provided?	10	
• Is general safety training provided?	10	
• Is emergency preparedness training provided?	10	

Budget

Between one and two and half percent of the total operating budget is spent on training, based on 8 surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions.

2 *the same as the plant position salary
8 *lower than the plant position salary

Numbers indicate the numbers of plants and training centers responding as indicated.

17.5. TRAINING PROGRAMS

17.5.1. Entry level requirements

(Numbers in braces indicate the numbers of plants and training centers responding as indicated)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance**	Electrical Maintenance**
Education or certification prerequisite(s) for this program*	GE(10) .	GE(10) .	GE(10) .	E(5), TS(3), E/TS(2)	GE(10)	GE(10)
Prerequisite years of experience for this program	Tree on the previous job position.	Tree on the previous job position	Two in the previous job position	One (10)	Tree on the previous job position	Tree on the previous job position

Job Position / **Training Program**	Instrumentation & Control**	Quality Assurance Quality Control	Radiation Protection**	Chemistry**	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE(10)	GE(10)	GE(10)	GE(10)	GE(10)	GE(10)
Prerequisite years of experience for this program	Two in the previous job position	NA(10)	Two in the previous job position	One or two in the previous job position	Tree on the previous job position	NA(10)

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma, SS = secondary school diploma].

**[education and certification prerequisites are given for highest job positions in shops. For the other positions in shops the requirement are lower.

17.5.2. Training methodology

Job Position / Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	5	5	5	5	5	5	4	6	4	6	4	6
Job analysis is used to determine training needs.	5	5	5	5	5	5	4	6	4	6	4	6
Training needs are used to design measurable training/learning objectives.	8	2	8	2	8	2	7	3	7	3	7	3
Training materials are based on training/learning objectives	7	3	7	3	7	3	6	4	6	4	6	4
Training implementation involves assessment of whether training/learning objectives are achieved.	7	3	7	3	7	3	6	4	6	4	6	4
Evaluation is based on training goals. Feedback of needed improvements takes place.	7	3	7	3	7	3	6	4	6	4	6	4

* Numbers indicate the numbers of plants and training centers responding as indicated.

17.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	3	7	2	8	3	7	3	7	5	5	5	5
Job analysis is used to determine training needs.	4	6	2	8	4	6	3	7	5	5	5	5
Training needs are used to design measurable training/learning objectives.	5	5	3	7	6	4	6	4	7	3	7	3
Training materials are based on training/learning objectives	6	4	4	6	5	5	5	5	7	3	7	3
Training implementation involves assessment of whether training/learning objectives are achieved.	6	4	4	6	5	5	5	5	7	3	7	3
Evaluation is based on training goals. Feedback of needed improvements takes place.	5	5	3	7	5	5	5	5	7	3	7	3

* Numbers indicate the numbers of plants and training centers responding as indicated.

17.5.3. Initial and continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TC)

Initial Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	404	160–793	134	30–250	207	116–494	152	54–494	126	0–146	137	125–240
Lab/Workshop	18	0–90	6	0–30	9	0–47	10	0–34	6	0–60	8	0–80
Process or Control Room Simulator	225	80–640	158	50–640	168	50–400	45	27–50	9	0–45	46	0–80
Self-Study	236	0–480	216	30–480	146	70–240	56	0–180	33	0–80	40	0–80
Formal On-the-Job Training	556	160–1137	368	160–616	293	160–420	690	160–1276	304	160–518	248	20–280
Total Initial Training	1439	640–2317	882	640–1600	820	640–1064	953	350–1612	478	350–664	479	350–801

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	45	18–64	45	13–64	45	18–64	32	13–60	69	0–104	64	0–104
Lab/Workshop	1	0–8	1	0–8	1	0–8	12	0–16	12	0–16	13	0–16
Process or Control Room Simulator	30	10–40	30	10–40	30	10–40	18	0–22	14	2–20	16	0–50
Self-Study	4	0–16	4	0–16	4	0–16	4	0–16	10	0–26	9	0–12
Formal On-the-Job Training	0	0–0	0	0–0	0	0–0	0	0–0	2	0–20	2	0–20
Total Continuing Training	80	48–116	80	43–95	80	48–98	66	30–80	107	56–120	93	56–120

17.5.3. Initial and continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TC)

Initial Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	270	125–900	140	100–210	116	12–240	182	8–604	131	54–160	36	0–48
Lab/Workshop	64	0–80	0	0–0	7	0–33	8	0–38	4	0–40	0	0–0
Process or Control Room Simulator	14	0–50	4	0–45	46	0–50	46	0–50	29	0–45	47	0–80
Self-Study	61	0–157	2	0–20	21	0–41	45	0–159	97	0–236	3	0–20
Formal On-the-Job Training	297	160–402	232	0–360	202	0–264	343	64–846	86	0–160	12	0–112
Total Initial Training	1003	350–1746	377	350–570	392	24–454	624	80–1158	347	108–440	98	0–160

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	49	20–64	49	0–60	30	4–80	43	10–64	52	25–64	27	15–60
Lab/Workshop	1	0–10	0	0–0	0	0–0	2	0–9	2	0–15	0	0–0
Process or Control Room Simulator	14	0–20	0	0–2	0	0–0	6	0–17	2	0–20	20	10–25
Self-Study	1	0–10	0	0–0	0	0–3	0	0–3	16	0–150	0	0–0
Formal On-the-Job Training	2	0–20	4	0–40	0	0–0	0	0–0	44	0–160	0	0–0
Total Continuing Training	67	40–80	53	0–100	30	7–80	51	27–80	116	60–360	47	30–80

17.5.4. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	4	11	47	81	23	22
Average annual number of persons who participate in continuing training 1991–1995	18	97	171	300	234	107

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	23	3	23	32	6	2
Average annual number of persons who participate in continuing training 1991–1995	66	0	252	102	7	2

Total number of personnel trained by training centers

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	2	2	42	42	0	0
Average annual number of persons who participate in continuing training 1991–1995	12	15	116	80	12	6

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	24	0	12	14	12	3
Average annual number of persons who participate in continuing training 1991–1995	21	0	13	49	26	11

17.6. TRAINING FACILITIES

17.6.1. Physical facilities

Nuclear Power Plant Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	6	2	9.5
Maintenance Workshops	3	5	1.7
Radiation Protection/Chemistry Labs	3	5	1
Other Labs/Workshops	2	6	1
Simulator(s)	5	3	1.4
Self Study Rooms	6	2	3.5
Library(ies)	6	2	1
Dedicated Instructor Offices/Work Space	7	1	4.5
Technical and Training Documentation Area	6	2	1.3
Training Material Preparation Area	4	4	1.4
Large Lecture Room	6	2	1.6
Dining Facilities	4	4	1
Student Housing Facilities	4	4	N/A

*Numbers indicate the numbers of plants and training centers responding as indicated

Training Centers

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	2	0	14
Maintenance Workshops	1	1	2
Radiation Protection/Chemistry Labs	0	2	0
Other Labs/Workshops	0	2	0
Simulator(s)	2	0	5
Self Study Rooms	2	0	3
Library(ies)	2	0	1
Dedicated Instructor Offices/Work Space	2	0	10/18
Technical and Training Documentation Area	2	0	1
Training Material Preparation Area	2	0	8
Large Lecture Room	2	0	1
Dining Facilities	2	0	1
Student Housing Facilities	2	0	80

*Numbers indicate the numbers of plants and training centers responding as indicated.

17.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

	Number of Full Time Positions	Part Time Positions			
		Number	Full Time Equivalent		
Instructors	Average	Range		Average	Range
Operations	7.25	0–15	7	2	0–10
Maintenance	4	0–8	12.8	1	0–4
Radiation Protection	1	0–1	1.5	0.2	0–1
Chemistry	0.5	0–1	1.5	0.1	0–1
Other Instructors	1.5	0–6	2.75	0.2	0–1
Management and Support Staff					
Management	2	0–4	0	0	0
Simulator Support	1.25	0–4	0.12	0.2	N/A–0.2
Maintenance Support	1.4	0–4	0	0	0
Training Material Development	1.4	0–8	3.5	1.1	0–6
Education Specialist	0.25	0–2	1	0.25	0–0.3
Others	2.6	0–15	0.9	0.3	0–2.4

Training Centers

Numbers are the **average** for reporting facilities

	Number of Full Time Positions	Part Time Positions			
		Number	Full Time Equivalent		
Instructors	Average	Range		Average	Range
Operations	18	16–20	9.5	1.5	1–2
Maintenance	6	0–12	0	0	
Radiation Protection	0.5	0–1	0.5	0.5	0–1
Chemistry	2.5	2–3	0	0	
Other Instructors	0		16	4	0–8
Management and Support Staff					
Management	5.5	5–6	0	0	
Simulator Support	5	2–8	0	0	
Maintenance Support	9	9–9	0	0	
Training Material Development	14	10–18	0	0	
Education Specialist	1	0–2	0	0	
Others	28	5–53	0	0	

17.6.3. Control room simulators

Numbers in brackets correspond to the NPP or TC listed in Part II.

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full scope WWER-440	Unit 3, (7)	(9)	Units 3,4 (7); Units 1,2 (4)	1750
Full scope WWER-1000	Unit 5, (7)	(9)	Units 5 (7); Units 1,2 (3)	715
Full scope WWER-1000	Unit 3, (1)	(9)	under construction	-
Full scope WWER-1000	Unit 4, (1)	(9)	under construction	-
4 part task simulators (for reactor, turbine, electrical part, chemistry)	Unit 5, (7)	(9)	Units 5 (7); Units 1,2 (3)	approx. 320 for each
Compact WWER-1000	for all WWER-1000 units	(9)	all WWER-1000 units	200
Multifunctional WWER-440	Unit 3, (7); Units 2,4 (4)	(9)	under construction	-
Full scope RBMK-1000	Unit 1 (8)	(10)	all RBMK units in The Russian Federation	1600
Part task simulators for main RBMK systems	N/A	(10)	all RBMK units in The Russian Federation	N/A
Full scope WWER-1000	Unit 3 Zaporogskaya NPP(Ukraine)	(1)	Units 1-4 (1)	2150
Full scope RBMK-1000	Unit 3, (7)	(10)	under commissioning	-
Compact WWER-440	Unit 3, (4)	(4)	Units 3,4 (4)	350
Part task (for reactor) WWER-440	Unit 2, (4)	(4)	Units 1,2 (4)	100
Basic Principle WWER-440	N/A	(7)	Units 3,4 (7)	50
Basic Principle BN-600	Unit 3 (2)	(2)	Unit 3 (2)	N/A
Part Task simulators for main WWER-1000 systems	N/A	(3)	Unit 1,2 (3)	N/A
Part Task simulators for main BN-600 systems	Unit 3 (2)	(2)	Unit 3 (2)	N/A

* 5 full scope simulators are now under construction for Kola, Kalinin 1, Kalinin 2, Kursk and Leningrad NPP's..

17.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		9
	Reactor vessel head		1,9
	Reactor internals		9
	Control rod drive mechanism	6,9	1
Steam generator	Complete		
	Primary side channel head		
	Tube examination equipment	3	
	Steam generator inspection manipulator		
	Handling tools of manhole	3	
Reactor coolant pump (or primary loop recirculation pump	Internal part	6	9,10
	Pump shaft seal	6	5,9,10
	Pump body	6	5,9,10
Main gate valve	Internal part		9
	Body		9
Fuel manipulator equipment	Manipulator crane		8,9,10
	Dummy fuel		1,6,9
	fuel-handling tools	6	1,6,9
	Fuel-loading simulator	6	5,6,9,10
Pumps		6	5,6
Valves		3,5,8	5,6
Supporting structures		6	5,6
Welding-practice equipment		3,5,6,8	6
Compressor	Instrumentation air compressor	1,3,6	6
Laser alignment		1	
Other		3,5,6,8	5,9,10

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Switchgear equipment		3,10	
Reactor coolant pump motor		6	5,10
Control-rod drive mechanism control system		1,6,9,10	
Control boards at electrical control room	Rod position indicator system	1,6,10	6
	Reactor control and protection rack	1,6,10	
	Protective relay system	1,6	
	Ex-core nuclear instruments	1,6,9	
	In-core nuclear instruments	1,6	
	Generator automatic voltage regulator		
	Constant voltage constant frequency power source	1,3	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1,6,9,10	
	Radiation measurement equipment	6,10	5
	Controller	3,6	5
	Other	9,10	5
Measurement system for motor-operated valves		1,3,6,10	
Digital control device		1,3,6,10	
Other		3,5,10	5
Common			
Non-destructive testing equipment		6	6
Transparent power plant	See-through		6,10
	Functional	5	6
Other		3	

*Numbers correspond to the NPP or TC listed in Part II.

17.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer based training	10	0
Interactive video	5	5
Establishing and maintaining your training database	10	0
Generating exams	6	4
Keeping student records	8	2
Production of training materials	10	0

*Numbers indicate the numbers of plants and training centers responding as indicated.

Visual aids available at facility

	Yes*	No*
White boards	10	0
Overhead projectors	7	3
Slide projectors(such as 35mm)	7	3
Flip charts	3	7
Video equipment	8	2
Computer liquid crystal display panel or computer projector	1	9
Video conferencing	3	7

*Numbers indicate the numbers of plants and training centers responding as indicated.

18. SLOVAKIA

18.1. SURVEY SUMMARY AND CONCLUSIONS

Training organization

Training of all NPP personnel in Slovakia is currently carried out at the nuclear training facility VUJE TC (class room training, simulator training) and on-the job training is performed at Bohunice NPP. Mochovce NPP, which is under the construction and will be commissioned in two years, has its own full-scope simulator. The training for control room personnel will be carried out on-site by Mochovce training personnel.

The unique training facilities which can be identified are: well-equipped classrooms with simultaneous translation in VUJE TC and a new full-scope simulator for WWER-440/213 at Mochovce.

A training practice which could be recommended for use in other places is CBT for maintenance personnel.

The utility organizational structure is currently being developed with great emphasis on NPP personnel training to better reflect training needs in all NPPs.

Training Programs

The IAEA Technical Cooperation project SLR/0/003 "Upgrading NPP Personnel Training Program" started in 1995 with the aim to implement SAT. Four jobs were selected for which the training programs are being developed according to SAT. The VUJE TC and NPP personnel are involved in this project. It is anticipated that after completion of the project other job position training manuals will be subject to review according to SAT methodology.

Greater involvement of regulatory body in NPP personnel training has been established. There are routine inspections to check performance, compliance with regulations and training programs at both the nuclear training centre and the NPP. A comprehensive review of existing standards and regulations is being done to verify compliance with current nuclear standards in the field of NPP personnel training. The new standards and regulations will be developed according to demand in order to strengthen the quality of the trainers, trainees and consequently training process itself.

Training Facilities

Simulator training has specific features in Slovakia. There are two different reactor types in operation (WWER-440/230 and 213 models) and another one (213) is under the construction at the Mochovce site. Although the Mochovce units are of a very similar design to the Bohunice 213 units, the control room is completely different (Siemens was the supplier of the I&C and main control room). The Mochovce full-scope simulator, which is a 100% replica of the main control room, is being tested prior to operator training, which will start soon. The simulator is located directly at the Mochovce site. Mochovce training staff will carry out the simulator training while the classroom training is performed by VUJE TC.

The Bohunice 213 full scope simulator has been partially upgraded, but a large amount of money must be spent for further improvements to meet the current criteria for simulator training. Moreover, the plant is developing symptom-oriented procedures and the simulator is going to be used for their final validation.

Simulator training for Bohunice 230 personnel is based on a PC simulator with limited simulation. Personnel can interfere in the process only through the PC keyboard, which is not sufficient to train operations skills of the control room personnel. Within the frame of the PHARE program a multifunctional simulator (MFS) is being developed. There are two software models, 230 and 213, included in that simulator and a user-friendly environment to operate it. The plant and VUJE TC personnel have been involved in different phases of the project. The MFS will significantly contribute to the quality improvement of the control room personnel training for 230 units. Delivery of the MFS on site is expected early in 1997.

A nuclear training centre for maintenance personnel is being established at the Bohunice site. It is going to be furnished with training equipment and mockups such as a reactor pressure vessel (already installed), steam generator parts, reactor coolant isolation valves, some parts of reactor coolant circulation pump and many other plant components. Entirely new training manuals for specific job positions are being developed using SAT methodology within the scope of the IAEA Technical Cooperation project. Bohunice and Mochovce maintenance personnel will be trained there. It is important to start such training particularly for Mochovce personnel because the plant will be ready to start in two years.

Conclusion

The upgrading of NPP personnel training in Slovakia is now in process. In 1997 the construction of the multifunctional simulator will be completed and the full-scope WWER-440/213 simulator will be upgraded. Further development and application of SAT is being done for as many jobs as practicably achievable.

18.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

Slovakia is currently operating four units of WWER-440 reactors at the Bohunice site. Two units are of the earlier WWER-440/230 design, and two units are of the advanced WWER-440/213 design.

Four WWER-440/213 units are under construction at the Mochovce site.

In accordance with the Slovak laws the NPP operator is responsible for the safe operation of the plant.

To ensure safe and reliable NPP operation, the availability of sufficient numbers of competent personnel is required. NPP personnel can obtain the required competence through the appropriate education and training.

Taking into account this fact two main legal documents concerning the qualification and training of NPP personnel have been issued:

- Act No. 28 from 1984 on the Authority of the State over Nuclear Safety of Nuclear Facilities,
- Regulation of the Czechoslovak commission for Atomic Energy on Criteria for Nuclear Power Enterprises personnel Training.

On the basis of these two legal documents Slovak Power Utilities (Slovenské elektrárne a.s.) has issued the Regulation No. 14 on the Rules for NPP personnel Training.

Slovak Power Utilities (Slovenské elektrárne a.s.) is a joint stock company (100% owned by the state) which owns the Slovak nuclear power plants. There are two sites — Bohunice (4 units in operation) and Mochovce (4 units under construction).

According to Regulation No. 14 of the Slovak Power Utilities the NPP is responsible for the training of its personnel.

Two main types of the NPP personnel training are established:

- initial training
- continuing training

Initial training is realized through the following phases:

- theoretical training
- on-site training
- simulator training
- preparation and examination for obtaining the "certificate"
- on-the-job training
- preparation and examination for obtaining "licence"
- examination for obtaining "commission".

The duration of each phase in weeks is shown below for 6 categories of NPP personnel:

- category I - Licensed personnel
- category II - Technical and Economics personnel and foreman
- category III - Shift and other operational personnel
- category IV - Maintenance personnel
- category V - Plant decommissioning personnel
- category VI - Other personnel

Initial Training of NPP Personnel

		Category					
Phase of the training		**I**	**II**	**III**	**IV**	**V**	**VI**
Theoretical training		23	13	6	6	8	x
On-site training		18	6	6	6	7	
Simulator training			5				
Exam for "certificate"		2	1.5	1	1	1	
On-the-job training		4	x	x	x	x	x
Exam for "license"		x					
Exam for "commission"	x	x	x	x	x	x	

All phases of the initial training for each category of personnel are realized according to the training programmes which determine the duration of the phase, learning objectives, content, training setting and how to assess whether the learning objectives have been met. In accordance with the Regulation of the Czechoslovak Commission for Atomic Energy on "Criteria for Nuclear Power Enterprises Personnel Training", training can be done only by those training facilities which are authorized for this activity by the Slovak Regulatory Authority.

Theoretical training and simulator training can be performed only by the NPP personnel training centre of the NPPs Research Institute Trnava Inc. (this training centre has the licence for these activities) and on-site training and on-the-job training can be performed by NPP. The NPP personnel training centre of the NPPs research institute Trnava Inc. is also an organization which is authorized to issue the "certificate" for all categories of personnel.

The "licence" for personnel of category I is issued by the Slovak Regulatory Authority on the basis of the licence exam. The "commission" is issued by the NPP Operator on the basis of an examination. If a person gains the "commission", he can fulfill his job duties without supervision.

Continuing training consists of two parts:

- general employee training (industrial safety, fire protection, health physics, response to plant emergencies,...)
-
- professional oriented training.

This part of the continuing training is formally defined only for shift personnel and consists of:

- revision of the required knowledge and skills from initial training
- modifications and changes of equipment and procedures
- lessons learned from incidents and events at the plant and similar plants
- simulator training (just for personnel from category I).

Number of persons in initial and continuing training (per training year):

•	number of persons in initial training	200
•	number of persons in initial simulator training	50
•	number of persons in continuing simulator training	450
	Total number of persons trained by the training centre	700

18.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. **Mochovce 1, 2 NPP**

Contact: Mr Stefan Sabik
Tel: (421) 813 363 582
Fax: (421)813 391 120

Training practices which could be recommended for application in other training organizations: No

Availability of Training for Personnel from Organizations in Other Countries: No

Unique Training Facilities: No

2. **Bohunice (NPP Name)**

Contact: Mr Jan Malovec
Tel: (421) 80521301ext. 2339
Fax: (421) 80524467

Training practices which could be recommended for application in other training organizations: No

Availability of Training for Personnel from Organizations in Other Countries: No

Unique Training Facilities: No

Training Centres (TC) Responses for the Survey

3. Training Centre of NPP Research Institute Trnava Inc.

Contact: Ms. Marta Ziakova
Tel: +421 805605614 or +421 80546578
Fax: +421 805605640 or 421 805501242

Training practices which could be recommended for application in other training organizations: No

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Y
Training personnel: Y
Loan personnel to other countries: Y
Fee for services: Y

Unique Training Facilities: No

18.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
• Is there a plant or operating organization training policy document?	2	0
• Does plant management routinely monitor training?	0	2
• Is training audited by a non-regulatory organization external to training department?	2	0
• Is plant management directly involved in establishing training needs?	0	2
• Is management and supervisory skills training provided?	2	0
• Is general safety training provided?	2	0
• Is emergency preparedness training provided?	2	0

Budget

Around 1 percent of the total operating budget is spent on training, based on 2 surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions.
__0__ *higher than the plant position salary
__0_ *the same as the plant position salary
__1_ *lower than the plant position salary

Numbers indicate the numbers of plants and training centres responding as indicated.

18.5. TRAINING PROGRAMS

18.5.1. Entry level requirements

Numbers indicate the numbers of plants and training centres responding as indicated

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator**	Mechanical Maintenance**	Electrical Maintenance**
Education or certification prerequisite(s) for this program*	GE	GE	GE	TS /SS	GE/TS/SS	GE/TS/SS
Prerequisite years of experience for this program	7,5 (2)	5,5 (2)	3,5/1,5 (2)	1 (2)	1 (2)	1 (2)

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE/TS/SS	GE/TS	GE/TS/SS	GE/TS/SS	GE/TS/SS	GE
Prerequisite years of experience for this program	1 (2)	1 (2)	1 (2)	1 (2)	1 (2)	6 (1), N/A(1)

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma, SS = secondary school diploma].

18.5.2. Training methodology

Job Position / Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	2**	0	2**	0	2**	0	-	-	-	-	-	-
Job analysis is used to determine training needs.	2**	0	2**	0	2**	0	0	2	2**	0	2**	0
Training needs are used to design measurable training/learning objectives.	2	0	2	0	2	0	2	0	2	0	2	0
Training materials are based on training/learning objectives	2	0	2	0	2	0	2	0	2	0	2	0
Training implementation involves assessment of whether training/learning objectives are achieved.	2	0	2	0	2	0	2	0	2	0	2	0
Evaluation is based on training goals. Feedback of needed improvements takes place.	2	0	2	0	2	0	2	0	2	0	2	0

* Numbers indicate the numbers of plants and training centres responding as indicated.

** See country pages.

18.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	2**	0	2**	0							1**	0
Job analysis is used to determine training needs.	0	2	0	2	0	2	0	2	0	2	1**	1
Training needs are used to design measurable training/learning objectives.	2	0	2	0	2	0	2	0	2	0	1	0
Training materials are based on training/learning objectives	2	0	2	0	2	0	2	0	2	0	1	0
Training implementation involves assessment of whether training/learning objectives are achieved.	2	0	2	0	2	0	2	0	2	0	1	0
Evaluation is based on training goals. Feedback of needed improvements takes place.	2	0	2	0	2	0	2	0	2	0	1	0

** See country pages.

18.5.3. Initial and continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator*		Mechanical Maintenance*		Electrical Maintenance*	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	55		55		920	880–960	240		240		240	
Lab/Workshop	-		-		0		0		0		0	
Process or Control Room Simulator**	25		25		150	100–200	0		0		0	
Self-Study	-		-		150		0		0		0	
Formal On-the-Job Training	80		120		920		400		400		400	
Total Initial Training	160		190		2140	1900–2230	640		640		640	

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	114		114		114		40		40		40	
Lab/Workshop	0		0		0		0		0		0	
Process or Control Room Simulator	50		50		50		0		0		0	
Self-Study	0		0		0		0		0		0	
Formal On-the-Job Training	36		36		36		16		16		16	
Total Continuing Training	200		200		200		56		56		56	

18.5.3. Initial and continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Instrumentation & Control*		Quality Assurance Quality Control*		Radiation Protection*		Chemistry*		Instructor Teaching Skills Training*		Simulator Instructor Skills Training*	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	960	
Lab/Workshop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	
Process or Control Room Simulator	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	200	
Self-Study	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	
Formal On-the-Job Training	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	920	
Total Initial Training	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2230	

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lab/Workshop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Process or Control Room Simulator	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Self-Study	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Formal On-the-Job Training	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Continuing Training	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

18.6. TRAINING FACILITIES

18.6.1. Physical facilities

Nuclear Power Plant Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	2	0	5
Maintenance Workshops	0	2	0
Radiation Protection/Chemistry Labs	0	2	0
Other Labs/Workshops	0	2	0
Simulator(s)	1	1	1
Self Study Rooms	0	2	0
Library(ies)	0	2	0
Dedicated Instructor Offices/Work Space	1	1	1
Technical and Training Documentation Area	1	0	1
Training Material Preparation Area	0	2	0
Large Lecture Room	2	0	N/A
Dining Facilities	2	0	2
Student Housing Facilities	1	1	N/A

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	8
Maintenance Workshops	0	1	0
Radiation Protection/Chemistry Labs	0	1	0
Other Labs/Workshops	0	1	0
Simulator(s)	1	0	1
Self Study Rooms	1	0	1
Library(ies)	1	0	1
Dedicated Instructor Offices/Work Space	1	0	12
Technical and Training Documentation Area	1	0	1
Training Material Preparation Area	1	0	1
Large Lecture Room	1	0	1
Dining Facilities	1	0	1
Student Housing Facilities			

*Numbers indicate the numbers of plants and training centres responding as indicated.

18.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

	Number of Full Time Positions		Part Time Positions		
			Number	Full Time Equivalent	
Instructors	Average	Range		Average	Range
Operations					
Maintenance					
Radiation Protection					
Chemistry					
Other Instructors					
Management and Support Staff					
Management	4	1–7			
Simulator Support	6	1–12			
Maintenance Support					
Training Material Development					
Education Specialist					
Others	3	0–6			

Training Centres

Numbers are the **average** for reporting facilities

	Number of Full Time Positions		Part Time Positions		
			Number	Full Time Equivalent	
Instructors	Average	Range		Average	Range
Operations	15				
Maintenance	3				
Radiation Protection	1				
Chemistry	1				
Other Instructors	0				
Management and Support Staff					
Management	4				
Simulator Support	8				
Maintenance Support	5				
Training Material Development					
Education Specialist					
Others					

18.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full scope non reference	unit 1,2 (2)	3	units 1,2 (2)	450
Full scope	unit 3 (2)	3	units 3,4 (2), Units 1–4 Dukovany NPP	4285
Basic Principles	-	3	units 1,2 (2)	300

18.6.4. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer based training	2	1
Interactive video	0	3
Establishing and maintaining your training database	3	0
Generating exams	0	3
Keeping student records	2	1
Production of training materials	1	2

*Numbers indicate the numbers of plants and training centres responding as indicated.

Visual aids available at facility

	Yes*	No*
White boards	3	0
Overhead projectors	3	0
Slide projectors(such as 35mm)	3	0
Flip charts	3	0
Video equipment	3	0
Computer liquid crystal display panel or computer projector	1	2
Video conferencing	0	3

*Numbers indicate the numbers of plants and training centres responding as indicated.

19. SLOVENIA

19.1. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

19.1.1. Overall description of training system

19.1.1.1. Organization and responsibilities

Owner/utility

NPP Krško is owned by two countries, Slovenia and Croatia. It is under jurisdiction of Slovenia. Plant management has full responsibility for operation of the facility. NPP Krško internal organization and training communication relationships are shown on attached charts. The Administration for Nuclear Safety of Republic of Slovenia is the responsible government agency to supervise safe operation of the plant.

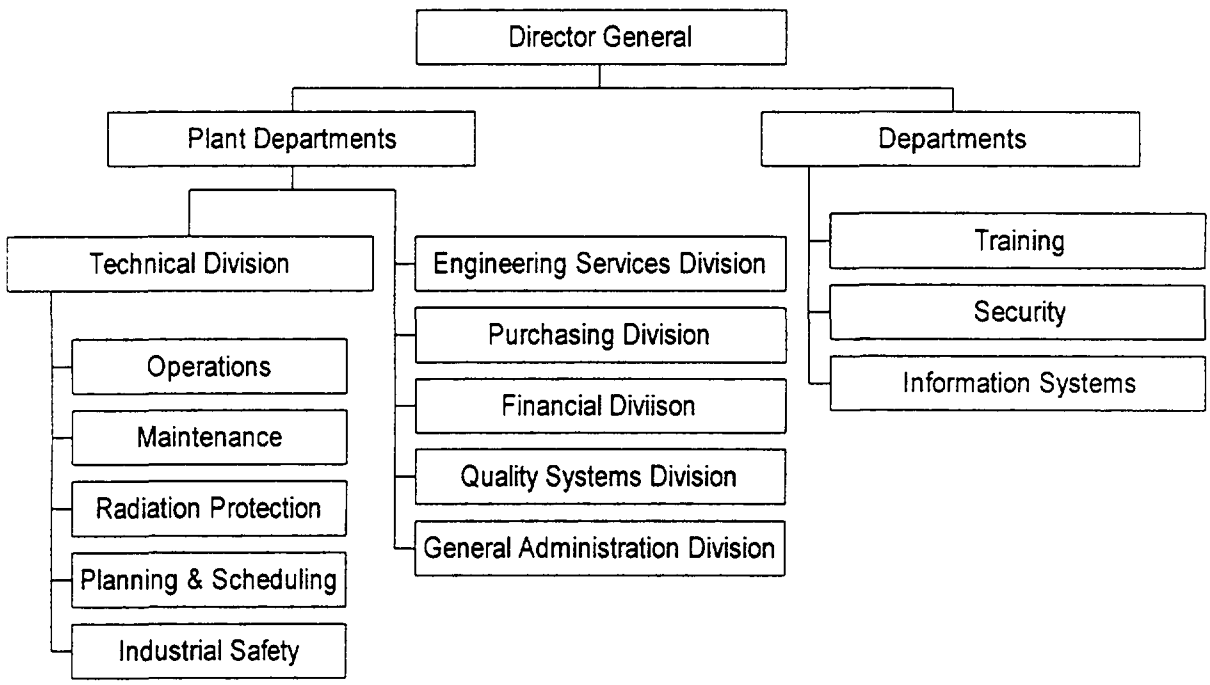

FIG. 3.15. NPP Krsko organization chart.

Training centre

NPP Krško currently has a training centre consisting of three classrooms, instructor offices, self–study room, archive and clerical support room. Training facilities include audiovisual aids like overhead projectors and audiovisual projectors, black and white boards, flip charts and personal computers.

NPP Krško conducts some training courses jointly with training Centre for Nuclear Technology (TCNT), located at Josef Stefan Institute in Ljubijana.

TCNT has six classrooms and complete audiovisual equipment necessary for training. In addition to NPP personnel the TCNT is offering training also to other persons working with radioactive materials. Four NPP Krško instructors are permanently working at TCNT and conducting training for the plant. A basic principle training simulator is being purchased by NPP Krško and is scheduled to be installed at TCNT in Ljubljana in February 1997.

A new training centre is planned to be built in next three years at NPP Krško site. It will house a full-scope replica simulator and training facilities for maintenance disciplines and other support functions.

A new full-scope simulator is scheduled to be ready for training in October 1999. The project will go in parallel with steam generator replacement project. The intent is to have the simulator available before installation of new steam generators. Start of the project is scheduled for January 1997. During the project it is also planned to increase the number of instructors with the aim to establish self sufficient training organization for conduction of initial and continuing training.

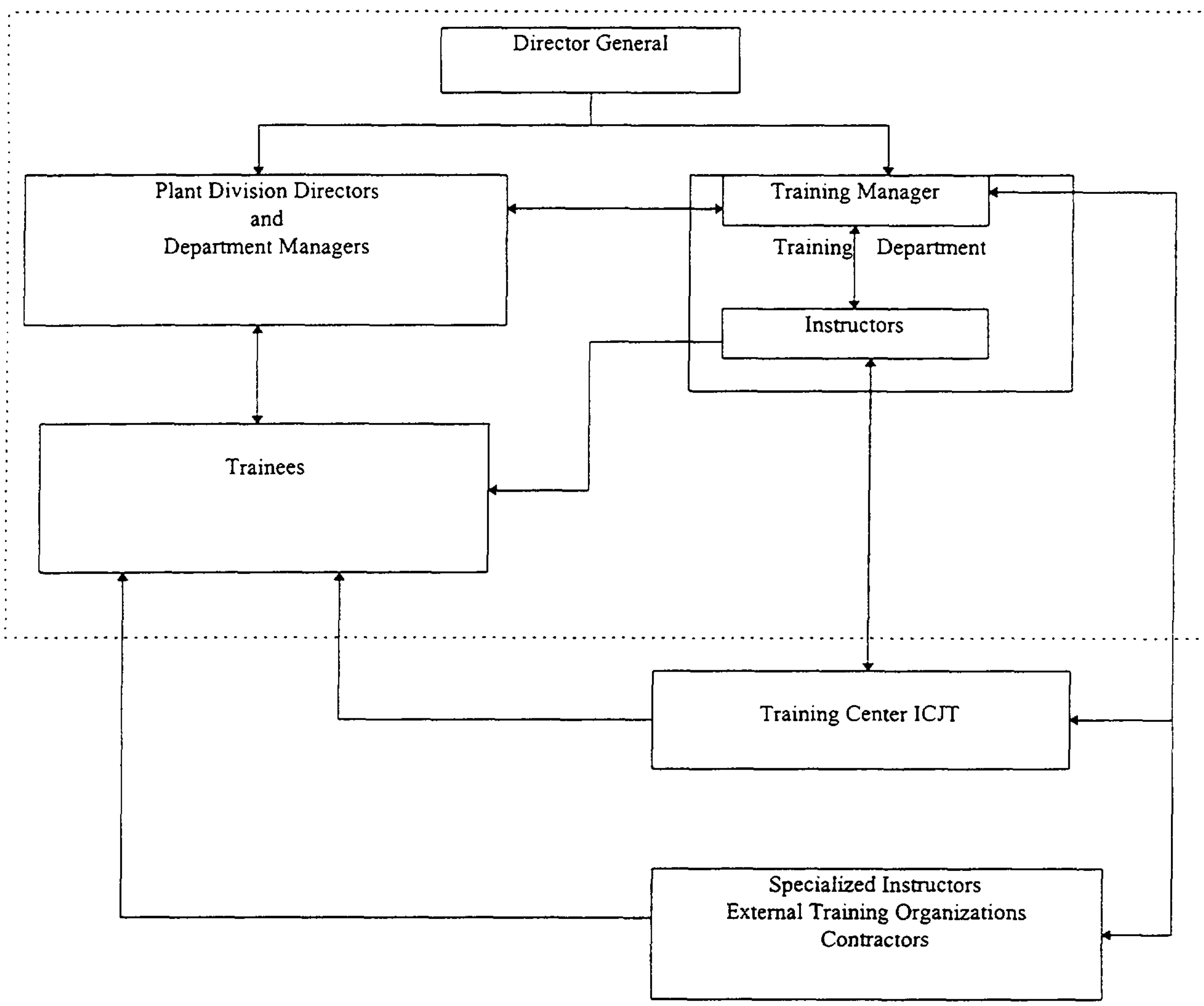

FIG. 3.16. NPP Krsko training communication chart.

In addition the new training centre will have dedicated training facilities for other departments. For example, this will enable the conducting of training for maintenance disciplines on site. The new training centre will mean also enhancement of training in engineering support training, general employee training, emergency preparedness and work safety.

Plant (training department)

The training department is responsible to deliver training and to co-ordinate and organize contracted training. Training department staff: training manager, secretary, co-ordinator and seven instructors. Training department is currently manned to cover the following:

a.	Operations	7 instructors
b.	Radiation protection and GET	1 instructor
c.	Chemistry	1 instructor
d.	Security	1 instructor

In addition subject matter experts are used to deliver specific training topics.

Contractor

Contracted training is used extensively to fulfill training needs of various departments. For some training programs NPP Krško has established long-term arrangements. For some specific training courses, arrangements are made with qualified training providers on a case by case basis. Such training is conducted by domestic and foreign specialized training organizations, authorized institutions (such as Welding Institute, Institute for Safety at work, etc.) and equipment vendors (such as Westinghouse).

19.1.1.2. Training methodology

Training of plant personnel is conducted in accordance with the requirements set in FSAR. Training department procedures cover specific training programs, training system development and training administration.

A combination of different training settings is implemented — classroom, simulator, self study, tutored on-the-job training. Co-operation with national education system introduces some industrial experience to students at various levels. Newly hired personnel receive basic plant training through initial introductory training and on-the-job training. Specialized training is given on a case-by-case basis in accordance with the needs of a specific department, which is generally obtained during the probation period or period during which a person is an assistant to a senior person.

It is also plant policy that a larger number of personnel receives training about nuclear technology at a higher level than that needed for a specific position as described below.

Nuclear technology course (NTC) is a 33 week course covering science fundamentals and systems and procedures. This course is a prerequisite for simulator initial training for licensed personnel. Additionally it is used for plant engineers from various departments to get good knowledge of plant operation.

Fundamentals of nuclear technology course (FNTC) is a 9 week course covering also science fundamentals and plant systems and procedures in shorter form. This course is aimed at local operators and technicians of various departments to get a good understanding of plant operations.

The above-mentioned courses are delivered by NPP Krško instructors and TCNT instructors jointly at TCNT in Ljubljana.

19.1.2. Role of regulator in training

Administration for Nuclear Safety of Republic of Slovenia controls plant training activities. Each year the annual training plan is submitted to the regulatory body for approval. Implementation of annual training is reported to the regulatory body for review. The regulatory body has a special commission of experts which is responsible to conduct periodic examinations for licensed operators. Occasionally, training activities on the simulator are audited.

A special commission of experts is appointed by regulatory body to conduct examinations of licensed personnel. The commission purposes the validity period of operators' licenses to the regulatory body. Licences are granted based on successful completion of examination.

The validity period for the licences can be from one to four years. When the licence is granted for the first time it is valid one year, in subsequent relicensing, licences can be granted for up to four years.

19.1.3. Specific positions for which training is available

19.1.3.1. Operations

Licensed Personnel Training

Initial Training

Initial training for operations personnel includes initial classroom training for licensed personnel (NTC program), initial simulator training and on-site training (guided self-study and on-the-job training). Formal training is concluded by a licensing examination, conducted by commission of experts appointed by the regulatory body. Currently, simulator initial training is contracted from Westinghouse Training and Operational Services in Pittsburgh, Pennsylvania, USA. The contractor is responsible to provide the training program, simulator, instructors, training material. In the last four years, 10 people attended initial simulator training. This year six people are scheduled for initial simulator training and next year an additional six. During this planned training we will introduce also our own instructors to work with the contractor as a part of instructors' on-the-job training.

Continuing Training

Continuing training for licensed personnel is conducted on-site (two weeks per year, classroom only) and off-site (simulator retraining, contracted, 7 working days per year). Continuing simulator training is currently contracted from General Physics Corporation, Columbia, Columbia, Maryland, USA. General Physics contracted the simulator from Rochester Gas and Electric, Ginna Power Station. 14 groups, 4 participants each are participating each year. This training is conducted for all shift crews and shift technical advisors. Shift technical advisors are given the same simulator retraining program as required by our regulations in order for them to hold an active SRO licence. The yearly training program is outlined jointly by the contractor and plant training department and then prepared and conducted by the contractor. Last year we begun introducing our instructors to work with the contractor's instructor on the simulator in order to prepare ourselves for future utilization of our own simulator.

Nonlicensed Operators

Initial training for nonlicensed operators includes initial classroom training (FNTC program), on-the-job training and regulation-driven training, conducted by the Association of Energy Workers.

Examination and periodic reexamination (five year cycle) is conducted by a commission appointed by the Republic Inspectorate for Energy.

19.1.3.2. Maintenance (Electrical, Mechanical, I&C)

The NTC program and FNTC program are used for training large numbers of maintenance engineers and technicians. Specific specialist training for maintenance personnel is conducted based on needs analysis performed by each maintenance discipline in accordance with particular department qualification matrix. This training is conducted at the facilities of equipment vendors or specialized institutions or at the Krško site, when possible.

19.1.3.3. Technical support (engineering, radiation protection, chemistry)

NTC program and FNTC program is used for training large numbers of engineers and technicians working in technical support. Specific specialist training for technical support personnel is conducted based on needs analysis performed by each organizational unit. This training is mainly conducted at the facilities of equipment vendors or specialized institutions.
When possible, training is organized at the Krško site.

19.1.3.4. Instructor

All instructors have good expert and working background in the areas of their responsibility. After assuming the instructor position, they receive specialized training on adult teaching and instructional skills. As a part of the preparation for our own future simulator utilization, a certain number of instructors already received basic training for simulator instructors and are periodically introduced to working with groups in simulator training sessions.

19.1.3.5. Others

Training is organized for some other areas also. Examples of such training are: general employee training, fire protection training and drills, emergency preparedness drills. Part of such training may be conducted by the training department (general employee training) or by special groups which are responsible for specific programs such as work safety, fire protection or emergency preparedness.

19.1.4. Co-operation inside country

NPP Krško conducts some training with co-operation with training Centre for Nuclear Technology, specifically, NTC and FNTC programs. At this training centre the courses organized through international organizations (IAEA) are also conducted. Occasionally joint training is organized for trainers (instructors) from NPP Krško and Training Centre for Nuclear Technology. Four NPP Krško trainers work permanently at TCNT. This kind of co-operation is established only with foreign organizations, as Slovenia has only one nuclear power plant. NPP Krško receives information from IAEA, INPO, WANO, WOG. A good working relationship has been established with the training centre of Ginna nuclear power plant in Rochester, USA.

19.2. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

Nuclear Power Plant KRŠKO (NPP Name)

Contact: Mr. Franc Pribozic, Training Manager
Tel: 386-608-22-410, 386-608-21 ext. 386
Fax: 386-608-21-528

Training practices which could be recommended for application for other training organizations:

Nuclear Technology course for licensed operators is delivered also to a large number of engineers in Engineering Divisions.

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for Services: NA

Training Centre (TC) Responses for the Survey

Josef Stefan Institute (TC Name)

Contact: Mr. Andrej Stritar, Head
Tel: +386 61 1885 363
Fax: +386 61 374 688

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for Services: Yes

19.3. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*[1]
Is there a plant or operating organization training policy document?	1	0
Does plant management routinely monitor training?	1	0
Is training audited by a non-regulatory organization external to training department?	0*Note	1
Is plant management directly involved in establishing training needs?	1	0
Is management and supervisory skills training provided?	1	0
Is general safety training provided?	1	0
Is emergency preparedness training provided?	1	0

Budget

Between 1 and 2 per cent of the total operating budget is spent on training, based on 1surveys answering this question.

[1]*Numbers indicate the numbers of plants and training centres responding as indicated.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

0 * higher than the plant position salary

1 * the same as the plant position salary

0 * lower than the plant position salary

*Note: The statement is true unless OSART mission and WANO peer review is also considered as external audit.

19.4. TRAINING PROGRAMS

19.4.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE, TS	GE, TS	GE, TS	TS	GE, TS	GE, TS
Prerequisite years of experience for this program	4	2	0	0	-	-

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE, TS	GE, TS	GE, TS	GE, TS	GE, TS	GE, TS
Prerequisite years of experience for this program	-	-	-	-	-	-

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

19.4.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	-	-	-	-	-	-	-	-	-	-	-	-
Job analysis is used to determine training needs	1(a)	0	1(a)	0	1(a)	0	1(a)	0	-	-	-	-
Training needs are used to design measurable training/learning objectives	1	0	1	0	1	0	1	0	-	-	-	-
Training materials are based on training/learning objectives	1	0	1	0	1	0	1	0	-	-	-	-
Training implementation involves assessment of whether training/learning objectives are achieved	1	0	1	0	1	0	1	0	-	-	-	-
Evaluation is based on training goals. Feedback of needed improvements takes place	1	0	1	0	1	0	1	0	-	-	-	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

19.4.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	-	-	-	-	-	-	-	-	-	-	-	-
Job analysis is used to determine training needs	-	-	-	-	-	-	-	-	-	-	-	-
Training needs are used to design measurable training/learning objectives	-	-	-	-	-	-	-	-	-	-	-	-
Training materials are based on training/learning objectives	-	-	-	-	-	-	-	-	-	-	-	-
Training implementation involves assessment of whether training/learning objectives are achieved	-	-	-	-	-	-	-	-	-	-	-	-
Evaluation is based on training goals. Feedback of needed improvements takes place	-	-	-	-	-	-	-	-	-	-	-	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

19.4.3. Initial training programs - settings and duration

(Hours listed are the **average** and range number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	905	-	825	320	-	-
Lab/Workshop	-	-	33	8	-	-
Process or Control Room Simulator	-	-	-	-	-	-
Self-Study	-	-	500	160	-	-
Formal On-the-Job Training	320	-	420	320	-	-
Total Initial Training	1225	-	1913	808	-	-

19.4.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	101	101	101	-	-	-
Lab/Workshop	-	-	-	-	-	-
Process or Control Room Simulator	28	28	28	-	-	-
Self-Study	-	-	-	-	-	-
Formal On-the-Job Training	-	-	-	-	-	-
Total Continuing Training	129	129	129	-	-	-

19.4.5. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	3	4	6	6	-	-
Average annual number of persons who participate in continuing training 1991–1995	7	6	12	-	-	-

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	-	-	-	-	-	-
Average annual number of persons who participate in continuing training 1991–1995	-	-	-	-	-	-

19.5. TRAINING FACILITIES

19.5.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	3
Maintenance Workshops	0	1	
Radiation Protection/Chemistry Labs	0	1	
Other Labs/Workshops	0	1	
Simulator(s)	0	1	
Self-Study Rooms	1	0	1
Library(ies)	0	1	
Dedicated Instructor Offices/Work Space	1	0	5
Technical and Training Documentation Area	1	0	2
Training Material Preparation Area	1	0	1
Large Lecture Room	0	1	
Dining Facilities	1	0	
Student Housing Facilities	0	1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	6
Maintenance Workshops	0	1	
Radiation Protection/Chemistry Labs	1	0	1
Other Labs/Workshop	1	0	-
Simulator(s)	0	1	
Self-Study Rooms	1	0	3
Library(ies)	1	0	1
Dedicated Instructor Offices/Work Space	1	0	10
Technical and Training Documentation Area	1	0	1
Training Material Preparation Area	1	0	1
Large Lecture Room	1	0	1
Dining Facilities	1	0	1
Student Housing Facilities	0	1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

19.5.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	3	1	0.2
Maintenance	-		
Radiation Protection	1		
Chemistry	1		
Other Instructors	1		
Management and Support Staff			
Management	1		
Simulator Support	-		
Maintenance Support	-		
Training Material Development	-		
Education Specialist	-		
Others	2		

Training Centres

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	6		
Maintenance	-		
Radiation Protection	1		
Chemistry	-		
Other Instructors	-		
Management and Support Staff			
Management	1		
Simulator Support	-		
Maintenance Support	-		
Training Material Development	2		
Education Specialist	-		
Others	1		

19.5.3. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		
	Reactor vessel head	a	
	Reactor internals		
	Control rod drive mechanism		
Steam Generator	Complete	-	-
	Primary side channel head	-	1
	Tube examination equipment	-	-
	Steam generator inspection manipulator	-	-
	Handling tools of manhole	-	-
Reactor coolant pump (or primary loop recirculation pump)	Internal part	-	-
	Pump shaft seal	-	-
	Pump body	-	-
Main gate valve	Internal part	-	-
	Body	-	-
Fuel manipulator equipment	Manipulator crane	-	-
	Dummy fuel	1	1
	Fuel-handling tools	-	-
	Fuel-loading simulator	-	-
Pumps		-	-
Valves		-	-
Supporting structures		-	-
Welding-practice equipment		-	-
Compressor	Instrumentation air compressor	-	-
Laser alignment		-	-
Other		-	-

Notes: a) complete research reactor in the Joseph Stefan Institute; b) In some cases real equipment (not dedicated for training only) is used for training purposes (example: fuel handling tools).

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		-	-
Reactor coolant pump motor		-	-
Control-rod drive mechanism control system		-	-
Control boards at electrical control room	Rod position indicator	-	-
	Reactor control and protection rack	-	-
	Protective relay system	-	-
	Ex-core nuclear instruments	-	-
	In-core nuclear instruments	-	-
	Generator automatic voltage regulator	-	-
	Constant voltage constant frequency power source	-	-
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	-	-
	Radiation measurement equipment	-	-
	Controller	-	-
	Other	-	-
Measurement system for motor-operated valves		-	-
Digital control device		-	-
Other		-	-
Common			
Non-destructive testing equipment		-	-
Transparent power plant	See-through	-	-
	Functional	-	-
Other	Control Room	-	1

*Numbers correspond to the NPP or TC listed in Part II.

19.5.4. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	0	2
Interactive video	0	2
Establishing and maintaining training database	2	0
Generating examinations	1	0
Keeping student records	1	0
Production of training materials	2	0

Visual aids available at facility

	Yes*	No*
Whiteboards	2	0
Overhead projectors	2	0
Slide projectors (such as 35mm)	2	0
Flip charts	1	1
Video equipment	2	0
Computer liquid crystal display panel or computer projector	2	0
Video conferencing	0	2

*Numbers indicate the numbers of plants and training centres responding as indicated.

20. SPAIN

20.1. SUMMARY AND CONCLUSIONS

Training Organizations

- Maintenance facilities such as steam generator inspection manipulator are available.
- Scale drawings of control room simulator is used in technology courses.
- Management both from NPP and training centre is involved in training.
- Salary of instructors is on average the same as the plant position salary in the NPP training department and lower in the training centre.
- Percentage of the total operating budget is around 3.5%.
- Training centre in Spain has the capability to provide training for NPP personnel from other countries, (including non destructive tests training).

Training Programs

- SAT methodology is being used to maintain and continually improve training in Spain.
- Entry requirements are at good level for all job positions.
- Duration of initial and continuing programs is sufficient for all the positions.

Training Facilities

- Physical facilities and staff are fully provided operations training but seem to need improvement for maintenance training.
- A large range of control room simulators and interactive graphic simulators is provided for all kinds of NPP.
- Maintenance training equipment is provided for mostly reactor coolant system.
- Computers are used for only records or training materials production.
- All range of visual and audio aids are used in NPPs as well as training centre.

20.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

20.2.1. Overall description of training system

20.2.1.1. Organization

The nuclear production system is composed of 9 units in seven different sites: 2 sites with 2 (PWR) units of 930 MW(e) each; 1 site with 1 (PWR) unit of 1067 MW(e); 1 site with 1 (PWR) unit of 1000 MW(e); 1 site with 1 (PWR) of 160 MW(e); 1 site with 1 (BWR) unit 994 MW(e); 1 site with 1 (BWR) unit of 460 MW(e).

The training organization is shown in Fig.3.17.

The NPP training departments have some training facilities such as classrooms, instructor's area, computers for training material development and training records of trainees.

External training organizations are training centres and other training services suppliers such as NSSS vendors or other equipment and services vendors.

Training Centres

Tecnatom training center, owned by a private company, supplies training services for operations personnel (licensed and not licensed) and other job positions of the plant.

Monticello Training Center (USA) rents its simulator for Santa Mª de Garoña NPP.

Angra Training Center (Brazil) supplies simulator courses for Trillo NPP licensed personnel.

CIEMAT (Spain) supplies courses in health physics and human factors for the plants.

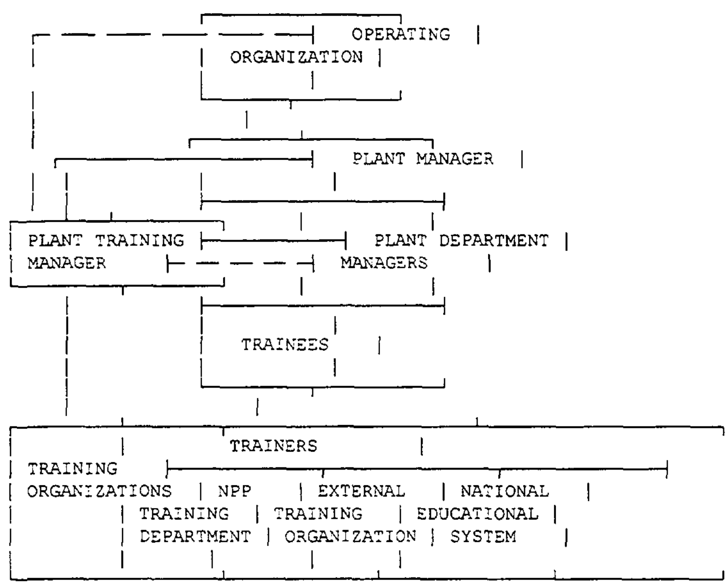

FIG. 3.17. The organization of training in Spain. (The most typical distribution is shown in solid lines. Other possibilities are: plant training manager reports to the operating organization or to the plant department managers as shown in the dotted lines.).

Other training services suppliers

Other training services suppliers are major NSSS or BOP vendors such as Siemens, Westinghouse, General Electric. They provide on the operation and maintenance of the main equipment they supply (nuclear instrumentation, main coolant pumps, fuel, turbines, generators, etc.).

Vendors of pumps, valves, motors, transformers, etc. supply training on maintenance of the components.

20.2.1.2. Responsibilities

Operating organization has defined the training policy and all responsibilities for the training of NPP personnel.

Plant manager is ultimately responsible for ensuring that all personnel is adequately trained. Plant department managers are directly responsible to define the training needs of their personnel and to get them trained. Plant training manager is responsible of supporting the plant department managers to define training program and to administer the training programs.

In most cases, in Spain, NPP training departments have a very reduced number of personnel. Their main function is to manage external training supplied by external training centres or other external organizations (e.g., NSSS vendors, equipment vendors, services vendors), although they also deliver some training specially for operating personnel. They are responsible for training administration but they rely on training services suppliers for most of the training activities.

Training centres are responsible for training material, instructors and training tools, with enough quality to reach high level standards. Most of the Spanish utilities use Tecnatom, SA. for training licensed and non licensed operating personnel, radiation, chemical and engineering personnel. For licensed personnel other training centres used are: Monticello NPP Training Centre (USA) and Angra Training Centre (Brazil).

20.2.1.3. Training methodology

Training is fully SAT-based for a specific PWR (Almaraz) plant for the following positions: licensed and non-licensed personnel for control room, field operations personnel, radiation protection personnel and chemistry personnel. As Tecnatom training centre uses Almaraz as reference plant for its PWR simulator, the training programs for operating personnel existing in the training centre are based on a specific SAT for the reference plant. The other PWR similar units use that training program as a generic training and then provide specific training for their licensed personnel. Licensed personnel for the BWR plants is trained by using a standard training program based on the needs defined by experienced personnel.

20.2.2. Role of regulator in training

20.2.2.1. Organization of regulatory body with respect to training

The regulatory body produces the rules to be applied basically to the licensed control room personnel (shift supervisor, control room supervisor, reactor operators) and for the supervisor of radiation protection section.

The regulatory body by means of a licence tribunal certifies licensed personnel. This tribunal also audits every specific training program followed by licence candidate.

20.2.2.2. Function

a) Certification for licensed personnel

For initial certification, the candidates are requested to pass a written, simulator and plant walk-through examinations.

If they pass they receive a license. This license is indefinite if they fulfill some conditions: They operate at least a minimum per year, perform annual requalification (not less than 20 simulator hours performing some defined operation and not less than 100 hours in reviewing some theoretical operating experience, plant modification, etc.) and have medical and psychological health according to the law.

b) Audit of training programs for each new license candidate

20.2.3. Specific positions for which training is available

(1) Operations: plant shift supervisor, control room shift supervisor, reactor operator, turbine operator, field operators for both PWR and BWR plants. Including human factors courses.

(2) Maintenance: electrical, mechanical and I&C.
Common: systems courses for maintenance personnel
Human factors courses
Specific components maintenance courses (valves, pumps, motors, etc.)

(3) Technical support
Radiation protection: for RP supervisor and monitor
Chemistry: for chemical analyst
Nuclear Engineering: for Nuclear Engineering Section

(4) Instructor
Licensed personnel instructor including instructional skill courses (theoretical and simulator).
SAT use
Instructional courses for matter experts

(5) Other
General employee training courses
Fire prevention courses

20.2.4. Co-operation inside the country

- The use of a common training centre provides a large economy of scale. SAT-based training program for licensed personnel for a specific PWR plant has been used as a generic program for similar plants.

- Basic training modules such as: basic nuclear physics, nuclear engineering, basic health physics, basic engineering (electrical, mechanical and I&C), basic equipment descriptions (valves, pumps, motors, heat exchangers, ...), human factor courses, are used to train students from all the plants

- The use of PWR full-scope simulator as a generic simulator for different plants

- Common courses are taught to students of different NPP's

- Operational experience feedback is provided through the instructors of the training centre who visit the plants

- Reportable incidents are automatically sent to the other plants

- Annual meetings are programmed to share the lessons learned from the most significant incidents

- A group composed of the training managers of all NPP's meets regularly in the frame of UNESA (once per quarter) to analyse specific issues and propose solutions to their plant managers.

20.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Central Nuclear de Almaraz (NPP Name)

Contact: Mr. José María Gómez de la Torre
Tel: 34 27 54 50 90 ext. 2048
Fax: 34 27 54 41 96

Availability of Training for Personnel from Organizations in Other Countries: No

2. C.N. José Cabrera (NPP Name)

Contact: Mr. Luis Jaime Serrano
Tel: 34 1 5212875
Fax: 34 1 521871

Availability of Training for Personnel from Organizations in Other Countries: No

3. ASCO (NPP Name)

Contact: Mr. José María Isach
Tel: 34 77 405000
Fax: 34 77 405 181

Training practices which could be recommended for application in other training organizations:

Interactive Graphic Simulator
Availability of Training for Personnel from Organizations in Other Countries: No

Unique Training Facilities

Manipulator Cranes
Fuel Handling Tools

5. Trillo 1 (NPP name)

Contact: Mr. Julio Benavides
Tel: 34 49 81 0000
Fax: 34 49 81 0726

Availability of Training for Personnel from Organizations in Other Countries: No

Training Centre (TC) Responses for the Survey

4. Tecnatom SA. (TC Name)

Contact: Mr. Francisco Martí Alarcó
Tel: 34-1-6516700
Fax: 34-1-6541531

Training practices which could be recommended for application in other training organizations:

Scale drawings of simulator C-R used in Technology Courses
Interactive graphic simulator for non licensed personnel

Availability of Training for Personnel from Organizations in Other Countries:
NPP personnel: Y
Training personnel: Y
Loan personnel to other countries: Y
Fee for Services: Y

20.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	4	
Does plant management routinely monitor training?	3	1
Is training audited by a non-regulatory organization external to training department?	4	
Is plant management directly involved in establishing training needs?	4	
Is management and supervisory skills training provided?	2	2
Is general safety training provided?	4	
Is emergency preparedness training provided?	4	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Budget

Between 3 and 3.5 per cent of the total operating budget is spent on training, based on 3 surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

1 * higher than the plant position salary

2 * the same as the plant position salary

1 * lower than the plant position salary

20.5. TRAINING PROGRAMS

20.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program* (*)	E	E	E	TS	GE or TS or SS	GE or TS or SS
Prerequisite years of experience for this program						

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program* (*)	GE or E or TS	GE or E or TS	GE or E or TS	GE or E or TS	GE or E (1)	GE or E (1)
Prerequisite years of experience for this program					(2)	(3)

(*) Depends on job activity; (1) Minimum; (2) For instructors for licensed personnel, they have received RO training program (at least 72 weeks course); (3) Three years of experience as instructor in lecture courses for operation personnel.

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma.

20.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1	2, 3, 5	1	2, 3, 5	1	2, 3, 5	1	2, 3, 5		2, 3, 5		2, 3, 5
Job analysis is used to determine training needs	1	2, 3, 5	1	2, 3, 5	1	2, 3, 5	1	2, 3, 5		1, 2, 3, 5		1, 2, 3, 5
Training needs are used to design measurable training/learning objectives	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	3	1, 2	3	1, 2
Training materials are based on training/learning objectives	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	3, 5	1, 2	3, 5	1, 2
Training implementation involves assessment of whether training/learning objectives are achieved	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	3, 5	1, 2	3, 5	1, 2
Evaluation is based on training goals. Feedback of needed improvements takes place	1, 5	2	1, 5	2	1, 5	2	1, 5	2	1, 5	2	1, 5	2

Note: 3 did not answer the last question.. So the "evaluation is based on training goals....." 4 answered NA for all job positions except instructor.

*Numbers indicate the numbers of plants and training centres responding as indicated.

20.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used		1, 2, 3, 5		1, 2, 3, 5	1	2, 3, 5	1	2, 3, 5		1, 2, 5		1, 2, 5
Job analysis is used to determine training needs		1, 2, 3, 5		1, 2, 3, 5	1	2, 3, 5	1	2, 3, 5		1, 2,5, 4**		1, 2, 5, 4**
Training needs are used to design measurable training/learning objectives	3, 5	1, 2	3, 5	1, 2	1, 3, 5	2	1, 3, 5	2	5	1, 2	5	1, 2
Training materials are based on training/learning objectives	5	1, 2	5	1, 2	1, 5	2	1, 5	2	5	1, 2	5	1, 2
Training implementation involves assessment of whether training/learning objectives are achieved	5	1, 2	5	1, 2	1, 5	2	1, 5	2	5	1, 2	5	1, 2
Evaluation is based on training goals. Feedback of needed improvements takes place	1, 5	2	1, 5	2	1, 5	2	1, 5	2	1, 5	2	1, 5	2

3 did not answer to the two last questions; 4 answered NA to all job positions except Instructor; ** Not specific for teaching skills, for instructor and simulator instructor. SAT methodology is used for RO/SRO courses.

*Numbers indicate the numbers of plants and training centres responding as indicated.

20.5.3. Initial training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person (*)	Hours of Training per person (*)	Hours of Training per person (*)	Hours of Training per person (*)	Hours of Training per person (*)	Hours of Training per person (*)
Classroom	360	280	1280	400	240	240
Lab/Workshop						
Process or Control Room Simulator	120	120	170			
Self-Study	500	500	360			
Formal On-the-Job Training	320	320	480	20	120	120
Total Initial Training	1220	1220	2290	420	360	360

* Only 2 answered. 5 answered that this question was not available in such format.
Note: 4 answered only for instructors.

20.5.3. Initial training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person (*)	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	400	No data	No data	No Data	120	40
Lab/Workshop		"	"	"	12	-
Process or Control Room Simulator		"	"	"	-	20
Self-Study		"	"	"	-	-
Formal On-the-Job Training	120	"	"	"	8	90
Total Initial Training	520	"	"	"	140	150

*Only 2 answered this question.

Note: 4 answered only for instructors, and answered NA for other job positions; 1 and 3 did not answer for initial training; 2 did not answer for QA, RP, chemistry and instructors on initial training.

20.5.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	110	110	110	35	35	35
Lab/Workshop						
Process or Control Room Simulator	20	25	25			
Self-Study						
Formal On-the-Job Training				70		
Total Continuing Training	130	135	135	105	35	35

20.5.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumen tation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom					20	40
Lab/Workshop						
Process or Control Room Simulator	70	25	35	35		
Self-Study						20
Formal On-the-Job Training						
Total Continuing Training	70	25	35	35	49 (**)	40 (**)

** + 2 more weeks of technical training.

20.5.5. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	-	7	9	25	0.25	0.25
Average annual number of persons who participate in continuing training 1991–1995	34	41	82	143	150	73

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	0.25	-	-	-	-	-
Average annual number of persons who participate in continuing training 1991–1995	87	25	84	74	6	

Note: 1 answered only for CRS and RO for initial training; 3 gave data for continuing training; 1, 2 5 did not give data for instructors; 2 did not answer for QA, RP, Chemistry, Instructor.

Total number of personnel trained by training centres

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995						
Average annual number of persons who participate in continuing training 1991–1995						

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995					2	2
Average annual number of persons who participate in continuing training 1991–1995					30	30

20.6. TRAINING FACILITIES

20.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	4		6
Maintenance Workshops	1	3	1
Radiation Protection/Chemistry Labs		4	-
Other Labs/Workshops		4	-
Simulator(s)	2	2	1
Self-Study Rooms	4		6
Library(ies)	4		1
Dedicated Instructor Offices/Work Space	4		4
Technical and Training Documentation Area	4		2
Training Material Preparation Area	4		
Large Lecture Room	2	2	1
Dining Facilities	1	3	-
Student Housing Facilities	1	3	-

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1		8
Maintenance Workshops		1	-
Radiation Protection/Chemistry Labs	1		1
Other Labs/Workshops		1	-
Simulator(s)	1		2
Self-Study Rooms	1		4
Library(ies)	1		1
Dedicated Instructor Offices/Work Space	1		1
Technical and Training Documentation Area	1		1
Training Material Preparation Area	1		1
Large Lecture Room	1		1
Dining Facilities	1		**
Student Housing Facilities	N		-

** in the surroundings.

*Numbers indicate the numbers of plants and training centres responding as indicated.

20.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	3		
Maintenance	1	1 to 5	6 months
Radiation Protection	1	2	3 months
Chemistry	-	1	1 month
Other Instructors	2		
Management and Support Staff			
Management	1		
Simulator Support			
Maintenance Support			
Training Material Development	1		
Education Specialist			
Others	2		

Training Centres

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	24	6	3
Maintenance	-	3	1.25
Radiation Protection	1	3	1.5
Chemistry	-	1	0.5
Other Instructors	-		
Management and Support Staff			
Management	3	2	1
Simulator Support	7	2	1
Maintenance Support	-		
Training Material Development	2	1	0.5
Education Specialist	3	-	-
Others (Clerk–Secretary)	3	-	-

20.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Interactive graphic simulator	(CN Jose Cabrera)	Plant	José Cabrera	140
Interactive graphic simulator	ASCO	Plant	Asio 1 and 2	280
Fullscope Cofrentes (BWR)	Cofrentes NPP	TC	1 unit Cofrentes	600
Fullscope almaraz	Almaraz 1	TC	6 units	1200
Fullscope interactive graphic simulator (Cofrentes)	Cofrentes	TC	1 unit	60
Interactive Graphic Simulator	José Cabrera	TC	1 unit	120

20.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		
	Reactor vessel head		1
	Reactor internals		3
	Control rod drive mechanism		
Steam Generator	Complete		
	Primary side channel head		
	Tube examination equipment		3, 1, 4
	Steam generator inspection manipulator	4	
	Handling tools of manhole	4	
Reactor coolant pump (or primary loop recirculation pump)	Internal part		
	Pump shaft seal		
	Pump body		
Main gate valve	Internal part		
	Body		
Fuel manipulator equipment	Manipulator crane	3	
	Dummy fuel		3, 1
	Fuel-handling tools	3	
	Fuel-loading simulator		
Pumps		4	
Valves		4	1
Supporting structures			
Welding-practice equipment			
Compressor	Instrumentation air compressor		
Laser alignment		3	
Other			

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment			
Reactor coolant pump motor			
Control-rod drive mechanism control system			
Control boards at electrical control room	Rod position indicator		
	Reactor control and protection rack		
	Protective relay system		
	Ex-core nuclear instruments		
	In-core nuclear instruments		
	Generator automatic voltage regulator		
	Constant voltage constant frequency power source		
Instruments	Transmitter (water level, pressure, flow, volume, etc.)		
	Radiation measurement equipment	4	
	Controller		
	Other		
Measurement system for motor-operated valves			
Digital control device			
Other			
Common			
Non-destructive testing equipment		4	
Transparent power plant	See-through		
	Functional		
Other			

*Numbers correspond to the NPP or TC listed in Part II.

20.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training		5
Interactive video	1	4
Establishing and maintaining training database	5	
Generating exams	3	2
Keeping student records	5	
Production of training materials	5	

Visual aids available at facility

	Yes*	No*
Whiteboards	5	
Overhead projectors	5	
Slide projectors (such as 35mm)	5	
Flip charts	1	
Video equipment	5	
Computer liquid crystal display panel or computer projector	3	2
Video conferencing		5

*Numbers indicate the numbers of plants and training centres responding as indicated.

21. SWEDEN

21. 1. SURVEY SUMMARY AND CONCLUSIONS

TRAINING ORGANIZATIONS

Unique training facilities

Full-scope, replica simulators for all units.

Recommended or good training practices

Training in "crew resource management" for shift supervisors.
Training of operators in "communication"
Field operators take part in simulator training for operators.

Training budget

The range is 2–8%

Salary of trainers

In general instructor salaries are the same or higher compared to similar plant positions.

Availability of training for NPP personnel from organizations in other countries.

In most cases the answer is "no". For a fee a few plants are prepared to loan personnel to other countries.

TRAINING PROGRAMS

Training methodology

For operators and radiation protection most plants report "Yes" to use SAT on all questions but for all the other positions almost all report "no" on all questions.

Entry-level requirements

With a few exceptions the following is reported:
Plant shift supervisor not applicable
"E" for unit supervisors and simulator instructors and "TS" for all other positions.

Duration and settings of initial and continuing training

Since all operators start as field operators the duration of the initial training is fairly similar for all operator positions, varying from 200 to 600 hours in each position.
Simulator training is offered to all operators including field operators.

Number of persons in initial and continuing training

Large variation in the numbers of persons trained for different positions at different plants, varying from 5 to 200.

TRAINING FACILITIES

Physical Facilities

Classrooms, instructor offices, documentation areas and large lecture rooms are available at all plants and other facilities are available in varying degree at different locations.

Staffing

For operations, 5 full-time instructors on average at NPPs and 42 at the training centre. For other departments, 1–2 full-time positions and 5–6 part-time instructors on average at NPPs and none at the training centre.
1–2 full-time management and support staff and 1–2 part-time positions on average at the NPPs and the following at the training centre:
Management: 3 full-time positions
Simulator support: 28 full-time positions
Maintenance support: 8 full-time positions
Training material development: 8 full-time positions
Education specialist: 2 full-time positions

Control room simulators

At the training centre there are 7 full-scope, replica simulators. This means that the staff from all the NPPs in the country are trained on simulators which are replicas of their plants.
Also, at some plants compact simulators are used for parts of the basic training.

Maintenance training equipment

With the exception of some pumps and valves there is very little training equipment available.

Computers and visual aids

No use of interactive video but at a majority of the plants computers are used in training. No use of video conferencing but almost all the other listed training aids are in use.

21.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

21.2.1. Overall description of training system

21.2.1.1. Organizations and responsibilities

Owner/utility

In Sweden there are four different companies who own and operate the total of 12 nuclear power plants.

The organizations at the NPPs differ from company to company. In general the units are matrix organized:

Typical example for a station:

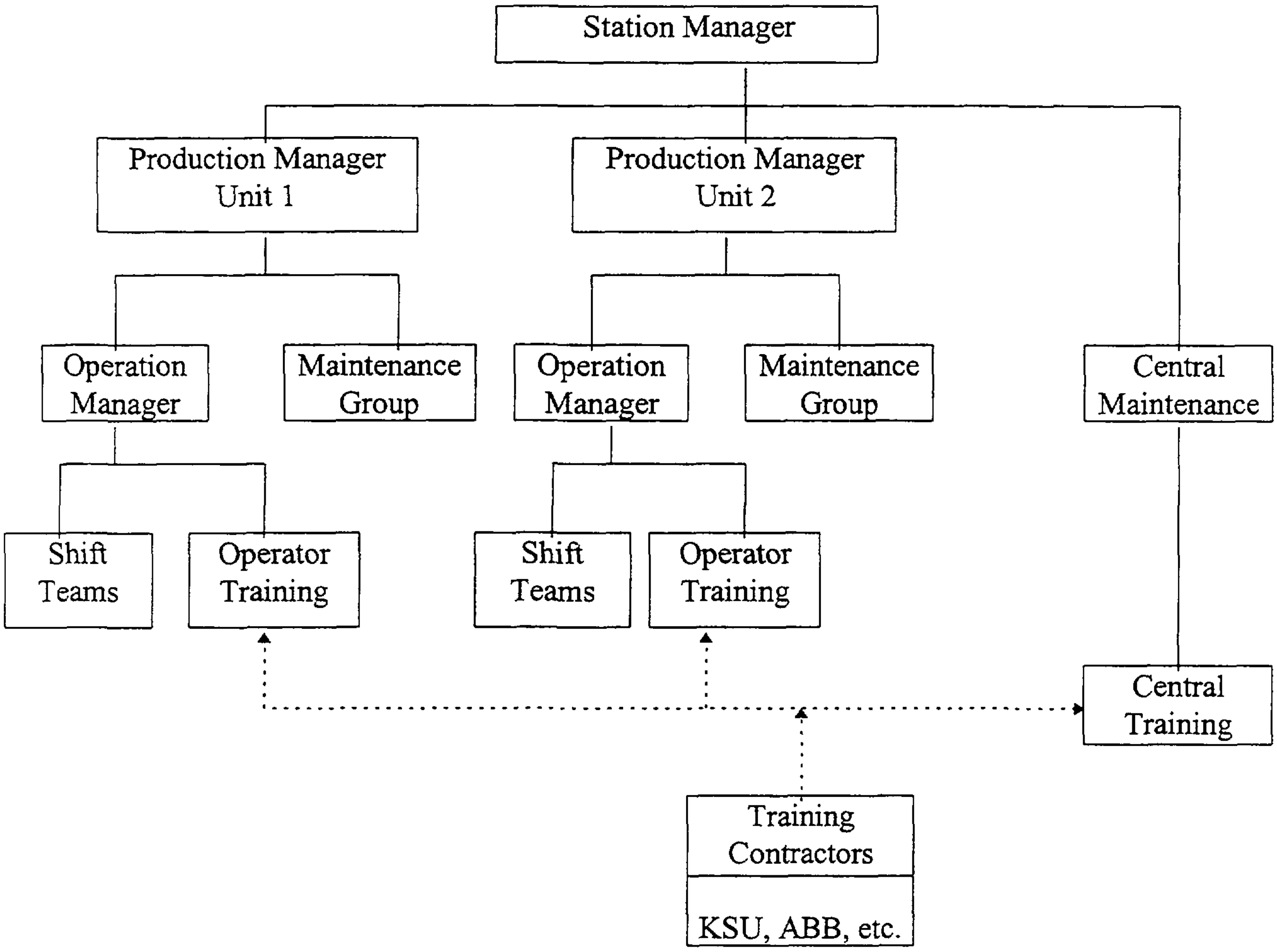

FIG. 3.18. Organization of training.

Each production manager is responsible for the operation of one unit. Reporting to the operation manager in each unit there are 1–2 instructors for operator training.

A central training department is responsible for all training at the station except the operator training. The training activities are also supported by external contractors.

Training centre

There are no specific training centres at the NPPs. Simulator training is centralized at KSU. KSU has 7 full-scope simulators. The vendor of the BWR reactors has a training centre for maintenance training in reactor-oriented systems.

21.2.1.2. Training methodology

Most of the training programs at the NPPs are historically developed the "conventional way" based on experience and training needs expressed by managers and trainees.

Now there are ongoing programs at every NPP to upgrade the training programs in accordance with SAT.

21.2.2. Role of regulator in training

The plant manager is fully responsible for the training and competence of the NPP personnel. There is no formal licensing of operators in Sweden.

The regulatory body approves/licenses the training programs for operators, managers, instructors and some specific maintenance personnel. If the trainee passes the program with approved tests he/she is "certified".

At the regulatory body, SKI, there is one inspector responsible for monitoring training activities at NPP.

21.2.3. Specific positions for which training is available

Operations

At every power plant the training programs, initial and continuing, for operations personnel must be approved by the authority. Special programs are set up for field operators, control room operators and shift supervisors. operators always start at and are trained for the lowest position. Upon promotion to Control Room operator, or shift supervisor they get additional training. The figures given for these positions include only this additional training.

Instructors should have the same technical competence as shift supervisors and control room operators, as a minimum. Instructors also undergo an initial pedagogical training program of 8 weeks and 1 week annual continuing training.

Others

Other categories (maintenance, technical support) have more individually developed training programs due to the specific categories' training needs.

21.2.4. Co-operation inside the country

Within each company the NPPs have similar/identical training programs. Between the companies there are some minor differences but the basic structure of the training programs are similar.

The exchange of trainers and trainees is limited. KSUs simulator instructors are mostly recruited from the power plants.

One of KSUs activities is to organize operational experience feedback, domestic and international. KSU, the centralized training centre, is also a place for exchanging experience in training activities. Annually the instructors from all NPPs meet for experience feedback and discussing the development of new programs.

21.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Barsebäck Kraft AB

Contact:
Eva Johansson, Training Manager
Tel: +46 72 40 00
Fax: +46 72 37 43

Availability of Training for Personnel from Organizations in Other Countries:

No

2 Forsmarks Kraftgrupp AB

Contact:
Stig Persson, Training Manager
Tel: +46 173 81 000
Fax: +46 173 55 116

Training practices which could be recommended for application in other training organizations:

Training in communication for control room staff.
Training in material and corrosion for technical staff.

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for Services: Yes

3. Oskarshamns Kraftgrupp AB

Contact:
Tomas Olofsson, Training Engineer
Tel: +46 491 86 792
Fax: +46 491 86 745

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: No
Training personnel: No
Loan personnel to other countries: Yes
Fee for Services: Yes

4. Vattenfall AB, Ringhals Unit 1

Contact: Per Gunmar Ceder, Operation Manager
Tel: +46 340 66 71 00
Fax: +46 340 66 80 00

Availability of Training for Personnel from Organizations in Other Countries:

No

5. Vattenfall AB Ringhals Unit 2

Contact: Lars Ottosson, Operation Manager
Tel: +46 340 66 72 00
Fax: +46 340 66 80 00

Availability of Training for Personnel from Organizations in Other Countries: No

6. Vattenfall AB Ringhals Unit 3-4

Contact: Bengt Ljunqguist, Training Manager
Tel: +46 340 66 74 92
Fax: +46 340 66 73 05

Availability of Training for Personnel from Organizations in Other Countries:
NPP personnel: No
Training personnel: No
Loan personnel to other countries: Yes
Fee for Services: Yes

Training Centre (TC) Responses for the Survey

Nuclear Training and Safety Centre

Contact: Lars Erikson, Manager, Marketing and Development
Tel: +46 155 26 35 00
Fax: +46 155 26 30 74

Availability of Training for Personnel from Organizations in Other Countries:

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for Services: Yes

21.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	2	1
Does plant management routinely monitor training?	5	1
Is training audited by a non-regulatory organization external to training department?	6	0
Is plant management directly involved in establishing training needs?	3	3
Is management and supervisory skills training provided?	6	0
Is general safety training provided?	6	0
Is emergency preparedness training provided?	6	0

Budget

Between 2 and 8 per cent of the total operating budget is spent on training, based on 3 surveys answering this question.

*Numbers indicate the numbers of plants and training centres responding as indicated.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

2	* higher than the plant position salary
3	* the same as the plant position salary
1	* lower than the plant position salary

21.5. TRAINING PROGRAMS

21.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	NA	E [a]	E [a]	TS [b]	TS [c]	TS [c]
Prerequisite years of experience for this program	NA	8–10	4–6	0–1	0	0

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	TS	TS	TS	TS	TS [d]	E
Prerequisite years of experience for this program	0	0)	3	3	6–10	4–8

a) Two responses TS; b) One response E; c) Two responses SS; d) Two responses E.

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma].

21.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	NA	NA	4	2	5	1	5	1	0	6	0	6
Job analysis is used to determine training needs	NA	NA	4	2	5	1	6	0	1	5	1	5
Training needs are used to design measurable training/learning objectives	NA	NA	3	3	4	1	5	1	1	5	1	5
Training materials are based on training/learning objectives	NA	NA	4	1	6	0	6	0	1	5	1	5
Training implementation involves assessment of whether training/learning objectives are achieved	NA	NA	4	1	6	0	6	0	1	5	1	5
Evaluation is based on training goals. Feedback of needed improvements takes place	NA	NA	4	1	6	0	6	0	1	5	1	5

In some responses notes like "partly" or "being implemented" have been added.

*Numbers indicate the numbers of plants and training centres responding as indicated.

21.5.2. Training methodology cont.

Job Position / Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	0	1	0	2	4	1	0	3	0	6	1	0
Job analysis is used to determine training needs	0	2	0	2	4	1	0	5	2	4	1	0
Training needs are used to design measurable training/learning objectives	1	0	1	1	4	1	4	1	1	5	1	0
Training materials are based on training/learning objectives	1	1	1	1	4	1	4	1	2	4	1	0
Training implementation involves assessment of whether training/learning objectives are achieved	2	1	2	0	5	0	5	0	3	3	1	0
Evaluation is based on training goals. Feedback of needed improvements takes place	2	0	2	0	5	0	2	3	3	3	1	0

In some responses notes like "partly" or "being implemented" have been added.

*Numbers indicate the numbers of plants and training centres responding as indicated.

21.5.3. Initial training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	N/A (N/A)*	216 (80–300)	368 (280–400)	404 (300–560)	70	70
Lab/Workshop	N/A (N/A)	0	0	10 (0–10)	10	10
Process or Control Room Simulator	N/A (N/A)	58 (40–70)	344 (280–520)	8 (0–40)	0	0
Self-Study	N/A (N/A)		72 (0–360)			
Formal On-the-Job Training	N/A (N/A)	548 (100–960)	804 (100–1120)	1844 (100–2160)		
Total Initial Training	N/A (N/A)	822 (220–1100)	1588 (1700–2240)	2144 (660–2680)	80	80

*Numbers in brackets are the range of hours of training per person.

21.5.3. Initial training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	70	70	107 (70–120)*	102 (50–120)	260 (240–320)	280
Lab/Workshop	10	10	25 (10–30)	27 (20–30)	0	0
Process or Control Room Simulator	0	0	0	0	0	240
Self-Study						
Formal On-the-Job Training						320
Total Initial Training	80	80	132 (80–150)	129 (70–150)	260 (240–320)	600

*Numbers in brackets are the range of hours of training per person.

21.5.4. Continuing training programs — settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	N/A (N/A)	94 (64–110)	89 (50–110)	65 (20–80	10	10
Lab/Workshop	N/A (N/A)	0	0	0	10	10
Process or Control Room Simulator	N/A (N/A)	62 (56–64)	62 (56–64)	0	0	0
Self-Study	N/A (N/A)					
Formal On-the-Job Training	N/A (N/A)					
Total Continuing Training	N/A (N/A)	155	151 (106–174)	65 (20–80)	20	20

*Numbers in brackets are the range of hours of training per person.

21.5.4. Continuing training programs — settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	20	30	18 (16–20)	18 (16–20)	35 (0–40)	40
Lab/Workshop	20	10	20	20	0	0
Process or Control Room Simulator	0	0	0	0	0	0
Self-Study						
Formal On-the-Job Training						
Total Initial Training	40	40	38 (16–40)	38 (16–40)	35 (40)	40

*Numbers in brackets are the range of hours of training per person.

21.5.5. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	NA	12	37	19	200	100
Average annual number of persons who participate in continuing training 1991–1995	NA	86	173	170	200	100

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	100	15	5	5	10	
Average annual number of persons who participate in continuing training 1991–1995	100	15	30	30	15	

Total number of personnel trained by training centres

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	N/A	-	40	10	-	-
Average annual number of persons who participate in continuing training 1991–1995	N/A	90	200	-	-	-

Job Position / Training Program	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	-	-	-	-	10	6
Average annual number of persons who participate in continuing training 1991–1995	-	-	-	-	15	42

21.6. TRAINING FACILITIES

21.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	6	0	9
Maintenance Workshops	1	5	1
Radiation Protection/Chemistry Labs	2	4	1
Other Labs/Workshops	4	2	1
Simulator(s)	3	3	1–3
Self-Study Rooms	2	4	5
Library(ies)	2	4	1
Dedicated Instructor Offices/Work Space	6	0	2–5
Technical and Training Documentation Area	6	0	1
Training Material Preparation Area	5	1	1
Large Lecture Room	6	0	1
Dining Facilities	1	1	1
Student Housing Facilities			

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	1	0	10
Maintenance Workshops	0	1	
Radiation Protection/Chemistry Labs	0	1	
Other Labs/Workshops	0	1	
Simulator(s)	1	0	7
Self-Study Rooms	1	0	5
Library(ies)	0	1	
Dedicated Instructor Offices/Work Space	1	0	42
Technical and Training Documentation Area	1	0	7
Training Material Preparation Area	1	0	10
Large Lecture Room	1	0	1
Dining Facilities	1	0	1
Student Housing Facilities	0	1	

*Numbers indicate the numbers of plants and training centres responding as indicated.

21.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	5 (3–6)*	12 (2)	2 (1–2)
Maintenance	0	5	0.2
Radiation Protection	1	6	0.2
Chemistry	0	3	0.2
Other Instructors	1	45	3.0
Management and Support Staff			
Management	1	-	
Simulator Support	-	-	
Maintenance Support	1	2	1.5
Training Material Development	1	-	
Education Specialist	1	2	1.0
Others	2	-	

*Numbers in brackets indicate average.

Training Centres

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	42		
Maintenance			
Radiation Protection			
Chemistry			
Other Instructors			
Management and Support Staff			
Management	3		
Simulator Support	28		
Maintenance Support	8		
Training Material Development	8		
Education Specialist	2		
Others			

21.6.3. Control room simulators

Type (Full-scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full-scope	Barsebäck 1–2	KSU	Barsebäck 1–2 Oskarshamn 2	1600
Full-scope	Oskarshamn 1	KSU	Oskarshamn 1	600
Full-scope	Forsmark 3 Oskarshamn 3	KSU	Forsmark 3 Oskarshamn 3	900
Full-scope	Forsmark 1–2	KSU	Forsmark 1–2	900
Full-scope	Ringhals 1	KSU	Ringhals 1	480
Full-scope	Ringhals 2	KSU	Ringhals 3	540
Full-scope	Ringhals 3	KSU	Ringhals 3–4	820
Compact	Ringhals 1	Ringhals	Ringhals 1–4	100
Compact	Forsmark 3	Forsmark	Forsmark	200
Compact	Forsmark 1–2	Forsmark	Forsmark 1–3	200

21.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel	0	1
	Reactor vessel head	0	0
	Reactor internals	1	0
	Control rod drive mechanism	1	0
Steam Generator	Complete	0	0
	Primary side channel head	0	0
	Tube examination equipment	0	0
	Steam generator inspection manipulator	0	0
	Handling tools of manhole	0	0
Reactor coolant pump (or primary loop recirculation pump)	Internal part	1	0
	Pump shaft seal	1	0
	Pump body	1	0
Main gate valve	Internal part	1	0
	Body	0	0
Fuel manipulator equipment	Manipulator crane	1	0
	Dummy fuel	1	0
	Fuel-handling tools	1	0
	Fuel-loading simulator	0	0
Pumps		2	1
Valves		1	1
Supporting structures		0	0
Welding-practice equipment		0	0
Compressor	Instrumentation air compressor	0	0
Laser alignment		1	1
Other		0	0

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		0	0
Reactor coolant pump motor		1	0
Control-rod drive mechanism control system		0	0
Control boards at electrical control room	Rod position indicator	0	0
	Reactor control and protection rack	0	0
	Protective relay system	0	0
	Ex-core nuclear instruments	0	0
	In-core nuclear instruments	0	0
	Generator automatic voltage regulator	0	0
	Constant voltage constant frequency power source	1	0
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	0	0
	Radiation measurement equipment	1	0
	Controller	0	0
	Other	0	0
Measurement system for motor-operated valves		0	0
Digital control device		0	0
Other		0	0
Common			
Non-destructive testing equipment		0	0
Transparent power plant	See-through	0	1
	Functional	0	0
Other		0	0

*Numbers correspond to the NPP or TC listed in Part II.

21.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	1	6
Interactive video	0	7
Establishing and maintaining training database	5	2
Generating examinations	3	4
Keeping student records	5	2
Production of training materials	6	1

Visual aids available at facility

	Yes*	No*
Whiteboards	7	0
Overhead projectors	7	0
Slide projectors (such as 35mm)	5	2
Flip charts	6	1
Video equipment	7	0
Computer liquid crystal display panel or computer projector	4	3
Video conferencing	0	7

*Numbers indicate the numbers of plants and training centres responding as indicated.

22. SWITZERLAND

22.1. SURVEY SUMMARY AND CONCLUSIONS

Training Organization

Availability for other countries

The training organizations within Switzerland are used by Swiss NPPs. Training is done in the German language only, so the availability to other countries is limited.

Management role and responsibilities

Managers of NPPs have the responsibility for the competence of the staff within their department. They identify together with their staff members training needs and they organize the necessary training courses, either within the NPP, or, if necessary, with external organizations.

All Swiss NPPs have a special training section within the department for operations, which organizes the training for the licensed personnel.

Training budget

Training is recognized as the most important contributor to a safe and reliable operation of NPPs. Adequate resources (time and budget) are devoted to training (maintenance and licensed personnel).

Salary of trainers

Only the department of operations has full-time trainers within their training department. The salary is based on the basic education (engineers) and on their experience. Their salary is comparable to other engineering personnel within the plant.

Training Programs

Licensed personnel

The training department for operations defines the yearly training programs for the licensed personnel based on operating experience, external events (nuclear and in some cases also non-nuclear), plant/procedure modifications and PSA findings. According to these programs the detailed training courses and the simulator training are organized.

Maintenance personnel

For maintenance personnel the retraining programs are defined by the special needs of the individual (mainly by external organizations).

Training Methodology

The training methodology depends on the different training goals and the training tools used. On-the-job training, classroom, self-study, simulators etc. are used.

Entry level requirements

The training for the staff of Swiss NPPs is strongly based on the Swiss national training system. For field operators, reactor operators and maintainers this includes an apprenticeship (4 years) in a technical profession which is completed by a theoretical and practical examination. The content of the training program and the requirements for the examinations are defined by the Swiss government for each profession.

Duration and settings of initial and continuing training

After the apprenticeship, the specific training within the NPP depends on the job assignment of the individuals.

Since maintainers are working on their original profession, only some specific additional training is necessary. This may be some weeks of training on-the-job (not very formal).

For licensed personnel training requirements and duration are clearly defined by a regulatory guideline (for initial and continuing training).

Training facilities

Adequate and state of the art methods and equipment are provided and substantial resources are devoted to training.

All Swiss NPPs have a special training section within the department of operations for the training of the licensed personnel. Adequate staffing is provided (trainers and maintenance personnel for the simulator).

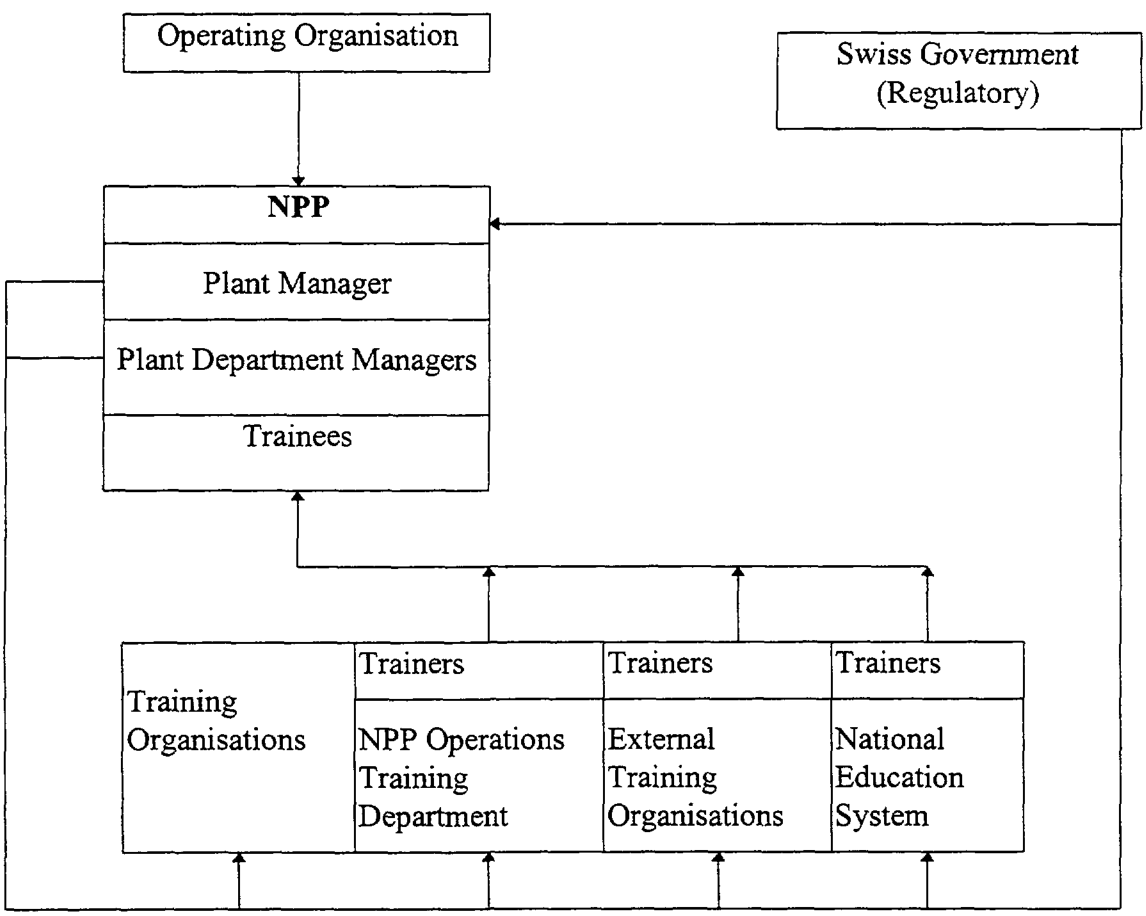

FIG. 3.19. Typical arrangement for the training of NPP personnel in Switzerland.

All four Swiss NPPs do simulator training on full-scope simulators. Two NPPs have full-scope replica simulators on site, one has a compact simulator with plant-specific models and one NPP has decided to obtain a full-scope replica simulator within the next few years.

In the maintenance department either real equipment or mockups are used for specific maintenance training. Photographs and additional visual aids are used for maintenance training purposes.

Computer-based training is used only in areas where the information base remains stable for a certain period of time (i.e. radiation protection). Other visual aids (photographs, video) are used for special training purposes.

Conclusion

Training of NPP personnel in Switzerland has a long tradition, strongly based on the national training system and the national apprenticeship program. At the very beginning of the nuclear industry the NPPs have recognized that training gives a substantial contribution to a safe and reliable operation of the plant and therefore adequate resources (personnel, equipment, budget and time) are devoted to training.

22.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

22.2.1. Swiss education systems

Switzerland (Confederatio Helveticae) consists of 26 cantons, each one with its own government, its own departments: e.g. justice, health, economy and of course education.

Additionally, due to the four different languages in the country (German, French, Italian, Raeto-roman) there are many different educational systems in Switzerland. This means that the structure of the systems, the content of the different educational programs, the content of schoolbooks and even the duration of the basic education (9-10 years) may differ.

Some educational features are standardized in the whole country, but they concern the education after the ordinary school. These characteristics of certain educational institutions (training program, final examinations, etc.) are regulated by the Swiss Office of Industry and Trade BIGA (Bundesamt für Industrie, Gewerbe und Arbeit).

Craftsmen

Most of the young Swiss people do an apprenticeship of 3–4 years after their ordinary school. This consists of a theoretical vocational training and training on-the-job. The content of the training programs are prescribed by the BIGA. The final examination of each profession is well defined and only people with a successful completion of this examination are allowed to bear the official title of their profession like electrician, mechanic, blacksmith, gardener etc. This implies that the level of competence of individuals within one certain profession after completion of the apprenticeship is standardized.

Technicians

A technical school (TS) requires a successfully completed apprenticeship and some years of professional experience. The courses at this type of school lasts about one year. The final examination for each type of technician is prescribed by the BIGA. Only persons with a successful final examination are allowed to bear the title “technician” (“Techniker TS”).

Engineers

a) Academic Engineers

The final examination of the High School is also regulated by the Swiss Government, i.e. the people starting their university studies have all about the same level of competence. The academic studies on engineering sciences may be done at one of the two Swiss Federal Institutes of Technology (academic engineers, physicists, chemists, etc.) or at one of the cantonal universities (physicists, chemists). The studies are completed by an examination leading to either a Master or a Ph.D. degree.

b) Graduates of an Engineering School

Switzerland has several cantonal engineering schools HTL (Höhere Technische Lehranstalt). Their training programs and examinations are also regulated by the BIGA. People with a completed apprenticeship and some years of experience in their profession may enter an Engineering School (an entrance examination is usual). They complete the education program for an engineer within at least 3 years. The successful examination allows them to bear the title "engineer" (Ingenieur HTL).

22.2.2. Requirements for NPP personnel

The minimum educational requirements for a position in Swiss NPPs are recommended in a guideline of the "Group of Swiss NPP Managers" (Gruppe der Schweizerischen Kernkraftwerks-Leiter, GSKL).

Requirements for licensed personnel are additionally defined by the Swiss Nuclear Safety Inspectorate (Hauptabteilung für die Sicherheit der Kernanlagen, HSK) in the guideline on Training R-27.

a) Management

For a position in the management usually a degree as Engineer (academic or HTL) is a prerequisite. Section leaders and group leaders may be either engineers (HTL) or technicians (TS).

b) Maintenance Personnel

All Swiss NPPs require a successfully completed apprenticeship for maintenance people. Since their education is regulated and the minimum professional knowledge and skills are well defined and proven by the completed examination, job descriptions and procedures may be written in a more general sense and some details may be omitted.

c) Licensed Personnel

Plant Operators

The Swiss NPPs require that candidates for plant operators have successfully completed an apprenticeship on a technical profession and have gained at least two years of professional experience.

During the two first years at the NPP they do an additional apprenticeship which is also completed by a BIGA approved examination to become a "NPP Operator".

The minimum time to become a Plant Operator is 2 years after joining the NPP.

Reactor Operators

For reactor operators the NPPs require 2 years experience as plant operator and the successful completion of the BIGA "NPP Operator" examination.

The theoretical education of Reactor Operator candidates is performed at the reactor school at the (federal) Paul Scherrer Institute. This 55 weeks full-time course is regulated by the BIGA and completes with an examination on the TS level which leads to a "reactor technician".

The HSK requires the successful completion of this course or an equivalent education (similar program and level) for reactor operator candidates. HSK experts take part at the final examination at the reactor school.

Theoretical and practical courses on systems and plant design and plant behavior are given in a systematic way at the NPP. A basic simulator training of several weeks gives the practical skills.

The licensing examination may be performed earliest four years after the operator has joined the NPP. It consists of an interview of about 1½ hours duration and a practical demonstration on certain systems in the control room and in the plant. This examination is performed by the training manager of the NPP, the manager of operations and his deputy. Usually the plant general manager is present as an observer. Experts of the HSK observe the whole examination and may ask additional questions. The decision on the success of the examination is done in a final meeting of the NPP's and the HSK's experts. In the case of any doubt the HSK takes the final decision.

Shift Supervisors

Qualified reactor operators with at least two years experience and additional training on systems behaviour, transients, emergencies and radiation protection complemented with a specific simulator training may be qualified as shift supervisors.

The licensing examination is done in a similar interview as for Reactor Operators (same participants and rules) but with emphasis on transients, emergencies and radiation protection.

The minimum time to become a shift supervisor is 6 years after joining the NPP.

Picket-engineers (Shift Technical Advisors)

Picket-engineers need a basic education as engineer on an academic or HTL level. They do the same career as shift supervisors (only the periods as plant operator and reactor operator may be shortened to some extent). Additional training, mainly self-study on emergencies and severe accidents as well as specific simulator training allow them to perform the licensing examination to become a picket engineer. The examination is similar to the one for shift supervisor with more emphasis on emergencies and severe accidents. Additionally they have to show their skill in the function of a picket engineer during an emergency exercise which is part of the licensing examination.

The minimum time to become a picket engineer is 6 years after joining the NPP.

22.2.3. Surveillance by the Swiss Federal Nuclear Safety Inspectorate HSK

The HSK is in close contact with the training managers of the NPPs, has insights into the training programs at the plant and HSK experts observe sporadically the simulator training of each plant. By this and the participation at the licensing examinations the HSK gains a good insight into the performance of the training performed at the NPPs and the performance of the licensed personnel.

22.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Mühleberg (NPP Name)

Contact:
Ulrich Ryf, Training Manager
Tel: 031 754 7111
Fax: 031 754 7120

2. Gösgen (NPP Name)

Contact:
Tel: 41 62 288 2001
Fax:

3. Leibstadt (NPP Name)

Contact:
Niklaus Hugentobler, Training Manager Operation
Tel: 056 267 71 11
Fax: 056 247 14 37

4. Beznan (NPP Name)

Contact:
Eberhard Wyrsch, Field Operator
Tel: 056 266 73 53
Fax: 056 266 77 01

22.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
Is there a plant or operating organization training policy document?	4	
Does plant management routinely monitor training?	3	1
Is training audited by a non-regulatory organization external to training department?	2	2
Is plant management directly involved in establishing training needs?	3	1
Is management and supervisory skills training provided?	4	
Is general safety training provided?	4	
Is emergency preparedness training provided?	4	

*Numbers indicate the numbers of plants and training centers responding as indicated.

A. Budget

Between 1and 5 per cent of the total operating budget is spent on training, based on 3 surveys answering this question.

B. Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions:

1	* higher than the plant position salary
3	* the same as the plant position salary
	* lower than the plant position salary

22.5. TRAINING PROGRAMS

22.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Training Program / Job Position	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE/E	TS	TS	SS	E/TS	E/TS
Prerequisite years of experience for this program	2–9,5	2–7,5	2–5,5	1–3	3.4	3–4

Training Program / Job Position	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE/TS/SS	GE/E/TS	GE/TS	E/TS	E/TS	E
Prerequisite years of experience for this program	3–4	2–3	1–3	0–3	4–10	6–10

*[GE = graduate engineer or dipl. engineer degree (4-6 years university study); E = engineering degree (2-3 years university study); TS = technical school diploma; SS = secondary school diploma.

22.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1	1	1	2	1	2	1	2		1		
Job analysis is used to determine training needs	2		2	2	2	2	2	2	2		1	
Training needs are used to design measurable training/learning objectives	3		4		4		4		2		1	
Training materials are based on training/learning objectives	3		4		4		4		2		1	
Training implementation involves assessment of whether training/learning objectives are achieved	3		4		4		4		2		1	
Evaluation is based on training goals. Feedback of needed improvements takes place	3		4		4		4		2		1	

*Numbers indicate the numbers of plants and training centers responding as indicated.

22.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	1		1		1	1	1	1		2		2
Job analysis is used to determine training needs	2		1	1	1	2	1	1		2	1	2
Training needs are used to design measurable training/learning objectives	1	1	2		3		2		1	1	3	
Training materials are based on training/learning objectives	2		2		3		2		1	1	3	
Training implementation involves assessment of whether training/learning objectives are achieved	2		2		2	1	2			2	2	1
Evaluation is based on training goals. Feedback of needed improvements takes place	2		1		2	1	1	1	1	1	3	

*Numbers indicate the numbers of plants and training centers responding as indicated

22.5.3. Initial training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	160–1500	160–3000	400–2900	160–520	5–30	60–100
Lab/Workshop	0–620	0–620	0–620	0–20	12–15	60–500
Process or Control Room Simulator	40–640	40–560	92–320	0–10	NA	NA
Self-Study	0–1000	0–1000	0–600	0–300	0–20	100–150
Formal On-the-Job Training	0–1000	0–900	0–500	0–700	50–400	100–3000
Total Initial Training	200–4600	200–5700	492–4700	200–1150	90–442	320–3750

22.5.3. Initial training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Program Setting	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person	Hours of Training per person
Classroom	60–100	24–410	300–800	0–80		80–1600
Lab/Workshop	60–600	24–300	0–300	0–40		0–560
Process or Control Room Simulator	NA	NA	NA	NA		20–270
Self-Study	50–100	0–200	0–100	0–100		0–1200
Formal On-the-Job Training	100–2000	10–1000	200–2000	100–2300		0–1100
Total Initial Training	320–2750	260–1500	100–2600	200–2300		100–4840

22.5.4. Continuing training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Program Setting	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	65–144	60–180	60–180	25–144	0–8	48–50
Lab/Workshop	0–10	0–10	NA	0–10	12–15	0–60
Process or Control Room Simulator	20–44	20–50	0–50	0–5	NA	NA
Self-Study	20–150	0–150	0–100	0–50	0–15	20–100
Formal On-the-Job Training	0–100	0–100	0–100	0–50	40–50	0–400
Total Continuing Training	115–360	90–400	90–360	30–150	60	68–550

22.5.4. Continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Continuing Training Program / **Program Setting**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person	Annual average number of training hours per person
Classroom	48–50	0–80	50–300	20–100		20–90
Lab/Workshop	NA	10–80	0–100	0–100		NA
Process or Control Room Simulator	NA	NA	NA	NA		20–60
Self-Study	50–80	0–200	0–50	0–30		0–200
Formal On-the-Job Training	80–500	0–10	0–100	0–50		0–200
Total Initial Training	750–600	160–220	100–370	50–250		40–550

22.5.5. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Operator	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	3 [1]	9 [1]	13 [1]	13 [1]	11 [1]	5
Average annual number of persons who participate in continuing training 1991–1995	28	58	103	89	80	78

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance/ Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	4	4	4	8	1	5
Average annual number of persons who participate in continuing training 1991–1995	37	14	31	26	2	18

[1] Data from Beznan could not be used. Valid for personnel belonging to 5 reactors.

22.6. TRAINING FACILITIES

22.6.1. Physical facilities

Nuclear Power Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	4		2–10
Maintenance Workshops	4		1
Radiation Protection/Chemistry Labs	3	1	1–3
Other Labs/Workshops	2	2	1–8
Simulator(s)	3	1	1
Self–Study Rooms	4		1–3
Library(ies)	4		1
Dedicated Instructor Offices/Work Space	3	1	1–4
Technical and Training Documentation Area	4		1–2
Training Material Preparation Area	4		1
Large Lecture Room	3	1	1–2
Dining Facilities	3	1	1
Student Housing Facilities		4	

*Numbers indicate the numbers of plants and training centers responding as indicated.

22.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

Instructors	Number of Full-time Positions	Part-time Positions	
		Number	Full-time Equivalent
Operations	2-3		0.5
Maintenance	-		2.5
Radiation Protection	-		0.5
Chemistry	-		0.2
Other Instructors	-		1
Management and Support Staff			
Management	1		0.5
Simulator Support	5		
Maintenance Support	1		1.2
Training Material Development	1		1.5
Education Specialist	1		0.25
Others	-		

22.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifuntional)	For what unit(s) is this a replica simulator?	Location of Simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Fullscope	Leibstadt (3)	(3)	(3)	500*
Reduced Replica	Mühleberg (1)	(1)	(1)	**
Compact		(4)	(4) I + II	-

* Simulator ready for training since June '95.

** Start 1996.

22.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		1
	Reactor vessel head	1	1
	Reactor internals	1	1
	Control rod drive mechanism	1, 3	
Steam Generator	Complete		
	Primary side channel head		4
	Tube examination equipment	4	
	Steam generator inspection manipulator	4	
	Handling tools of manhole	4	4
Reactor coolant pump (or primary loop recirculation pump)	Internal part	1	
	Pump shaft seal	1, 3	4
	Pump body	1	
Main gate valve	Internal part	1	3
	Body	1	
Fuel manipulator equipment	Manipulator crane	1	
	Dummy fuel	1, 3	4
	Fuel-handling tools	1, 4	
	Fuel-loading simulator		
Pumps		1, 3, 4	
Valves		1, 3	
Supporting structures			1
Welding-practice equipment		1, 3, 4	
Compressor	Instrumentation air compressor	1	
Laser alignment		4	
Other		4	

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real & Dedicated for Training*	Mock-up*
Switchgear equipment		1, 3, 4	4
Reactor coolant pump motor		1	
Control-rod drive mechanism control system		1	
Control boards at electrical control room	Rod position indicator		4
	Reactor control and protection rack	1	4
	Protective relay system	1, 3	
	Ex-core nuclear instruments		
	In-core nuclear instruments	1	
	Generator automatic voltage regulator		
	Constant voltage constant frequency power source	1	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	1, 3	4
	Radiation measurement equipment	1,3	4
	Controller	3, 4	
	Other	4	4
Measurement system for motor-operated valves		1, 3, 4	4
Digital control device		1	4
Other			
Common		4	4
Non-destructive testing equipment		4	
Transparent power plant	See-through	4	1
	Functional	4	
Other		4	

*Numbers correspond to the NPP or TC listed in Part II.

22.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer-based training	2	2
Interactive video		4
Establishing and maintaining training database	3	1
Generating examinations	2	2
Keeping student records	1	3
Production of training materials	4	

Visual aids available at facility

	Yes*	No*
Whiteboards	4	
Overhead projectors4	4	
Slide projectors (such as 35mm)	4	
Flip charts	3	1
Video equipment	4	
Computer liquid crystal display panel or computer projector	3	1
Video conferencing		4

*Numbers indicate the numbers of plants and training centers responding as indicated.

23. UKRAINE

23.1. SUMMARY AND CONCLUSIONS

Two main type of units are used now in Ukraine:

The first type is the WWER pressurized water reactor (the units of this type are 440 and 1000 MW);

The second type is the RBMK boiling water reactor (the units of this type are 1000 MW).

WWER units are situated at Khmelnitsky NPP (1 unit WWER-1000), at Zaporozhye NPP (5 units WWER-1000), at South-Ukraine NPP (3 units WWER-1000), and at Rovno NPP (1 unit WWER-1000, 2 units WWER-440).

RBMK units are situated at Chernobyl NPP (2 units RBMK-1000)

Training Organization

In general there is the possibility to provide training for NPP personnel from organizations in other countries (for SU design units).
Unique training facilities: none noted in answers of Ukraine NPPs and TCs.

Among training practices which could be recommended for use in other places were noted : training system upgrade conceptual document, CBT systems, training materials for basic principles simulator.

NPP personnel training is centralized with direct involvement of plant management under supervision of the regulatory and operating organizations.

Average training budget is between of 0.1% and 1% of the total operating budget. The salary of trainers is lower than the plant position salary.

Training Programs

Training methodology used is a form of SAT methodology and is under modernization on the basis of the latest SAT ideas..

Training programs are oriented to a high-level basic education and experience. The duration and setting of training have a great range due to different design of the units and to differences in training facilities which are available at different NPPs.

The total average annual number of persons in initial and continuing training is about 190 per unit and is determined now mainly by existing training facilities. This number is divided approximately in proportion 1 to 2 between training centres and NPP training departments.

Training Facilities

Physical facilities are under construction at NPPs.

The largest number of instructors are the instructors for training operators. The amount of staff in TCs is on average twice that at NPP TDs.

A full-scope simulator is situated now at the TC but the tendency is to provide all NPP TDs with simulators (2 full-scope simulator, and one multifunctional are now under development).

Training facilities for maintenance personnel are under development and were not represented in the answers.

Computers and audio-visual aids except for interactive video are widely used for training.

Conclusion

The modernization of NPP personnel training is now under way in the country.

23.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING SYSTEM

23.2.1. Overall description of training system

The infrastructure for the management and implementation of NPP personnel training involves the following organizations:

- State Committee for Atomic Energy Use (GOSCOMATOM);
- Ministry for Environment Protection and Nuclear Safety (MINECOBEZOPASNOSTY);
- Technical and Engineering Centre for personnel education in the atomic industry (ITC PC)
- Training Centres of Zaporozhye and Khmelnitsky NPPs, Training departments of South Ukraine, Rovno, Chernobyl NPPs;
- National Centre for Maintenance Personnel Training of Ukrainian NPPs (at Zaparozhye NPP);
- Education institutes and schools of Ukraine for power plants personnel.

The distribution of roles and responsibilities among the above-mentioned organizations is shown below.

For the for creation and modernization of the national training system for NPPs, GOSCOMATOM and Ukrainian NPP use the services of the following organizations:

VNIIAES (Russia) provides the development of full-scope simulators and other technical training facilities for Ukrainian NPP

ENIKO MIFI (Russia) provides the development of :
– regulatory and training documentation;
– CBT and simulators;
–instructors and managers training.

NTK T – 89 (Ukraine) provides the development of:
–CBT;
–typical training programs;
–information and training materials for training;
–regulation documents;
–*training courses for* NPP *personnel.*

Pedagogical and Engineering Academy (Ukraine) provides the pedagogical and psychological training for NPP instructors.

ENERGOPROECT Institute (Ukraine) provides the design of Training Centres (buildings, constructions).

LVOVORGRES (Ukraine) provides the development of databases in training and CBT.

23.2.2. Role of regulator in training

MINEKOBEZOPASNOSTI is the regulatory body with respect to training of NPP personnel. Its basic functions are:

- examination and coordination of documents governing the initial and continuing training of NPP personnel;
- issuing licenses to the training centres and NPP training departments for the right to conduct training of NPP personnel;
- supervision of NPP personnel training;
- testing managers and specialists of operating organizations and NPPs for their knowledge of safety rules and standards.
- establishing normative documents in personnel training and carrying out the licensing procedure for the NPP personnel (operators).

23.2.3. Specific positions for which training is available

In general for all job positions of Ukrainian NPPs training is required by normative documents, and should be done in accordance with training programs for each position. These training programs must provide the necessary level of knowledge and qualification as determined by the norms for each job position at the NPP.

Practical realization of training programs includes two main parts :

(1) On-the-job training at work places at the NPP.

(2) Special training in training centres or sometimes in NPP training departments when the necessary number of courses and training equipment are available for the job position.

At present the main part of training for operators consists of special training. Additional on-the-job training for this position takes place in the form of duplicating. For the main positions of Maintenance and Technical Support personnel special training is also available, but the full number of courses and training equipment needed are not available. The upgrading of training for these positions is now under development. After its completion, the special training for maintenance and technical support personnel will be available in training centres and in NPP training departments.

Instructor training usually includes training in the area of the job position for which the instructor will train personnel and also specialized training in pedagogy, psychology and use of training tools. For specialized instructor training in pedagogy etc., contractors from other organizations are usually used. Instructors are also given technical training on-the-job positions for which they provide training. For other job positions, in addition to their on-the-job training, some courses from training programs of the above-mentioned positions are used. The volume and number of courses in such cases are determined individually.

23.2.4. Co-operation inside country

The cooperation between of training organizations takes place on the following:

- Development of a SAT-based concept for training of Ukrainian NPP personnel
- Development of program for creating a SAT-based system for NPP personnel training
- Development of a structure for normative documentation in respect of personnel training
- Development of training materials for all types of simulator
- Development and realization of training courses for all categories of NPP personnel
- Development of materials for SAT implementation at Ukrainian NPPs.

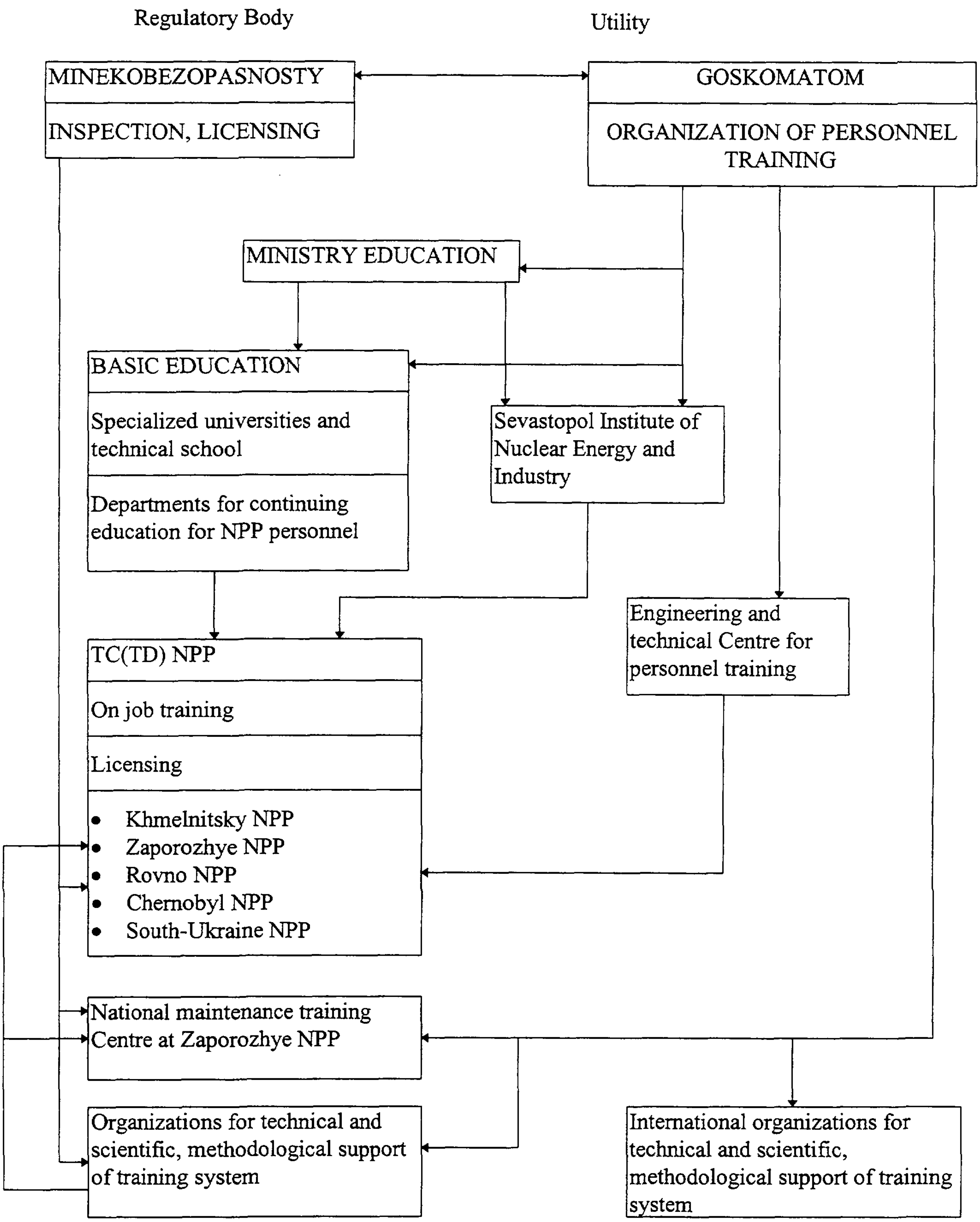

FIG. 3.20. Organizations and main functions of NPP personnel training system.

23.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

Rovno NPP

Contact:
Mr. O. Fedorov, Head of Training Department
Tel: (0038) 03636 62054

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries: No

Unique Training Facilities

None noted in survey

South - Ukrainian NPP

Contact:

Mr. S. Vybornov, Head of Training Department
Tel: (003) 8 051 36 44504
Fax:(003) 8 051 23 50050

Training practices which could be recommended for application in other training organizations:

Training System Upgrade Conceptual Document, approved by plant;
CBT systems for unit 3;
Functional-analytical simulators for reactor and turbine department for unit 3;
Training materials for basic principles simulator for unit 3.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

Chernobyl NPP

Contact:
Mr. D. Ovcharenko,
Deputy Head of Training Department
Tel: (003) 8 294 42056

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Yes
Unique Training Facilities
None noted in survey

Training Center (TC) Responses for the Survey

4. Khmelnitsky NPP TC

Contact:
Mr. V. Banchik, Head of Training Centre
Tel: (003) 8 038 48 3656
Fax: -

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Yes

Unique Training Facilities

None noted in survey

5. Zaporozhye NPP TC

Contact:
Mr. S. Popov,
Training Center Manager
Tel: (003) 8 061 39 36314
Fax:(003) 8 061 39 32099

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes

Fee for services: Yes

Unique Training Facilities

None noted in survey

23.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
• Is there a plant or operating organization training policy document?	4	1
• Does plant management routinely monitor training?	5	0
• Is training audited by a non-regulatory organization external to training department?	5	0
• Is plant management directly involved in establishing training needs?	5	0
• Is management and supervisory skills training provided?	5	0
• Is general safety training provided?	5	0
• Is emergency preparedness training provided?	5	0

Budget

Between 0,1 and 1 percent of the total operating budget is spent on training, based on 5 surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions.

1 *the same as the plant position salary
4 *lower than the plant position salary

Numbers indicate the numbers of plants and training centers responding as indicated.

23.5. TRAINING PROGRAMS

23.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE	GE	GE	TS	SS	SS
Prerequisite years of experience for this program	8	5	2	1	0	0

Job Position / Training Program	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE	GE	TS	GE/TS	GE	GE
Prerequisite years of experience for this program	2	0	0	0	3	Varies

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma, SS = secondary school diploma].

23.5.2. Training methodology

Job Position / Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	0	5	0	5	0	5	0	5	0	5	0	5
Job analysis is used to determine training needs.	0	5	0	5	0	5	0	5	0	5	0	5
Training needs are used to design measurable training/learning objectives.	0	5	0	5	0	5	0	5	0	5	0	5
Training materials are based on training/learning objectives	0	5	0	5	0	5	0	5	0	5	0	5
Training implementation involves assessment of whether training/learning objectives are achieved.	0	5	0	5	0	5	0	5	0	5	0	5
Evaluation is based on training goals. Feedback of needed improvements takes place.	0	5	0	5	0	5	0	5	0	5	0	5

* Numbers indicate the numbers of plants and training centers responding as indicated.

23.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	0	5	0	5	0	5	0	5	0	5	0	5
Job analysis is used to determine training needs.	0	5	0	5	0	5	0	5	0	5	0	5
Training needs are used to design measurable training/learning objectives.	0	5	0	5	0	5	0	5	0	5	0	5
Training materials are based on training/learning objectives	0	5	0	5	0	5	0	5	0	5	0	5
Training implementation involves assessment of whether training/learning objectives are achieved.	0	5	0	5	0	5	0	5	0	5	0	5
Evaluation is based on training goals. Feedback of needed improvements takes place.	0	5	0	5	0	5	0	5	0	5	0	5

23.5.3. Initial and continuing training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	164	0–380	139	0–300	103	0–200	108	0–160	15	0–45	16	0–48
Lab/Workshop	2	0–10	4	0–20	4	0–20	8	0–40	27	0–80	54	0–160
Process or Control Room Simulator	44	0–96	48	0–200	27	0–96	0	0–0	0	0–0	32	0–96
Self-Study	184	24–480	298	60–700	350	43–610	154	26–320	37	0–80	116	0–320
Formal On-the-Job Training	598	160–1000	1336	360–1800	600	320–850	501	130–680	198	150–280	167	150–192
Total Initial Training	992	184–1966	1825	420–3020	1191	363–1776	771	156–1300	277	150–485	385	150–816

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	64	5–114	61	5–114	61	5–114	61	5–114	26	10–42	26	10–42
Lab/Workshop	1	0–5	1	0–5	1	0–5	1	0–5	10	0–20	10	0–20
Process or Control Room Simulator	31	0–58	31	0–58	31	0–58	12	0–40	0	0–0	0	0–0
Self-Study	23	0–40	23	0–40	23	0–40	19	0–40	5	0–10	15	0–30
Formal On-the-Job Training	2	0–10	4	0–20	2	0–10	4	0–20	25	10–40	25	10–40
Total Continuing Training	119	5–232	122	5–232	119	5–232	97	5–219	61	20–112	71	20–132

23.5.3. Initial and continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	155	10–360	14	0–20	124	0–360	139	20–300	118	5–400	33	0–60
Lab/Workshop	5	0–20	14	0–20	5	0–20	2	0–10	31	0–152	0	0–0
Process or Control Room Simulator	29	0–96	0	0–0	24	0–96	24	0–96	0	0–0	30	0–80
Self-Study	210	60–500	40	0–80	105	0–340	144	0–340	94	10–400	120	0–360
Formal On-the-Job Training	248	10–506	5	0–10	305	0–526	290	20–500	120	0–500	53	0–160
Total Initial Training	647	80–1482	73	0–130	563	0–1342	599	40–1242	363	15–1452	236	0–660

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	37	0–60	9	0–10	33	0–40	46	0–100	40	0–100	39	0–100
Lab/Workshop	5	0–10	5	0–10	3	0–10	3	0–10	9	0–40	0	0–0
Process or Control Room Simulator	8	0–10	0	0–0	10	0–40	2	0–6	0	0–0	0	0–0
Self-Study	37	0–50	15	0–30	25	0–80	15	0–40	27	10–50	34	0–40
Formal On-the-Job Training	11	0–40	0	0–0	15	0–60	15	0–40	32	0–160	53	0–160
Total Continuing Training	98	0–200	29	0–50	86	0–210	81	0–196	108	10–350	126	0–300

23.5.4. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	5	9	29	45	84	58
Average annual number of persons who participate in continuing training 1991–1995	26	204	122	205	400	270

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	8	3	7	18	5	3
Average annual number of persons who participate in continuing training 1991–1995	32	9	35	85	12	3

Total number of personnel trained by training centers

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	2	16	26	32	N/A	N/A
Average annual number of persons who participate in continuing training 1991–1995	10	42	122	189	N/A	N/A

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	30	4	1	30	10	3
Average annual number of persons who participate in continuing training 1991–1995	150	0	25	100	20	3

23.6. TRAINING FACILITIES

23.6.1. Physical facilities

Nuclear Power Plant Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	3	0	2
Maintenance Workshops	2	1	N/A
Radiation Protection/Chemistry Labs	1	2	N/A
Other Labs/Workshops	2	1	1
Simulator(s)	2	1	1
Self Study Rooms	3	0	1
Library(ies)	3	0	1
Dedicated Instructor Offices/Work Space	3	0	1
Technical and Training Documentation Area	3	0	1
Training Material Preparation Area	2	1	1
Large Lecture Room	2	1	1
Dining Facilities	2	1	1
Student Housing Facilities	0	3	0

*Numbers indicate the numbers of plants and training centers responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	2	0	7
Maintenance Workshops	0	2	0
Radiation Protection/Chemistry Labs	0	2	0
Other Labs/Workshops	0	2	0
Simulator(s)	2	0	3
Self Study Rooms	2	0	2.5
Library(ies)	2	0	1
Dedicated Instructor Offices/Work Space	2	0	12/16
Technical and Training Documentation Area	1	1	1
Training Material Preparation Area	2	0	2
Large Lecture Room	2	0	1
Dining Facilities	1	1	1
Student Housing Facilities	0	2	0

*Numbers indicate the numbers of plants and training centers responding as indicated.

23.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities (part time positions were not indicated)

	Number of Full Time Positions		Part Time Positions		
			Number	Full Time Equivalent	
Instructors	Average	Range		Average	Range
Operations	9	6–13			
Maintenance	2	0–2	3		
Radiation Protection	1	0–1			
Chemistry	1	1–1			
Other Instructors	1	0–2			
Management and Support Staff					
Management	2	2–2			
Simulator Support	2	0–3			
Maintenance Support	2	0–4			
Training Material Development	2	2–3			
Education Specialist	1	1–1			
Others	2	0–7			

Training Centres

Numbers are the **average** for reporting facilities (part time positions were not indicated).

	Number of Full Time Positions		Part Time Positions		
			Number	Full Time Equivalent	
Instructors	Average	Range		Average	Range
Operations	18	7–30			
Maintenance	8	3–13			
Radiation Protection	1	1–1			
Chemistry	3	2–5			
Other Instructors	4	2–7			
Management and Support Staff					
Management	6	5–6			
Simulator Support	8	6–9			
Maintenance Support	4	3–4			
Training Material Development	13	8–18			
Education Specialist	1	0–1			
Others	1	0–3			

23.6.3. Control room simulators

Type (Full-scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Compact	Units 1,2 (1)	1	Units 1,2 (1)	760
Basic principles	Unit 3(1)	1	Unit 3 (1)	1500
Basic principles	Unit 3, (2)	2	Unit 3 (2)	80
Functional	Unit 2 (2)	2	Unit 1,2 (2)	80
Functional-analytical (reactor)	Unit 3 (2)	2	Unit 3 (2)	implemented in 1996
Functional-analytical (turbine)	Unit 3 (2)	2	Unit 3 (2)	implemented in 1996
Full-scope	Unit 3 (2)	2	under construction	will be implemented in 1997
Full-scope	Unit 1 (4)	4	Unit 1 (4)	on going
Basic principles	Unit 1 (4)	4	Unit 1 (4)	2
Local Simulator	Unit 1 (4)	4	Unit 1 (4)	12
Full-scope	Unit 3 (5)	5	Units 1-6 (5)	900

23.6.4. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer based training	5	0
Interactive video	0	5
Establishing and maintaining your training database	4	1
Generating examinations	5	0
Keeping student records	4	1
Production of training materials	5	0

*Numbers indicate the numbers of plants and training centers responding as indicated

Visual aids available at facility

	Yes*	No*
White Boards	5	0
Overhead projectors	4	1
Slide projectors(such as 35mm)	4	1
Flip charts	4	1
Video equipment	5	0
Computer liquid crystal display panel or computer projector	1	4
Video conferencing	3	2

*Numbers indicate the numbers of plants and training centers responding as indicated.

24. UNITED KINGDOM

24.1. SUMMARY AND CONCLUSIONS

- **Availability of Training for NPP Personnel from Other Countries**

  Generally training is available for personnel form other countries.

- **Management Involvement**

  Utilities reported full management involvement in the training process. Management establishes the training policy, determines the training needs and monitors the delivery of training.

- **Salaries of Trainers**

  The salaries of trainers in the United Kingdom is generally the same as similar positions in the plant with some plants reporting lower and some plants reporting higher salaries.

- **Use SAT Methodology**

  Training for reported positions in the United Kingdom is generally based on the SAT methodology. However, job analysis has been done in only about two thirds of the facilities.

- **Initial and Continuing Training Programs – Settings and Duration**

  The duration of the initial training programs show a wide variation. This is expected since each utility designed their program for the skill set required for the plant position and the job progression path in each station.

  All programs utilize both the classroom and on-the-job settings. The operator programs make use of the control room simulator while the maintenance, chemistry and radiation protection technician utilize the laboratory setting.

- **Physical Facilities**

  Training is conducted at both the plant sites and at training centres.. Control room simulators are located at both plants and training centres well as maintenance, chemistry and/or radiation protection laboratories. All have fully equipped lecture facilities and instructor facilities. A few have dining facilities and one has a dormitory facility. The maintenance training facilities are well equipped with a variety of simulators, tools and mock-ups. All training centres heavily utilize computers and all are utilizing computer based training.

- **Staffing**

  Training is typically provided by dedicated full time instructors.

24.2. OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING

24.2.1. Organization

The UK Government is proceeding to privatize parts of the UK nuclear industry in midsummer 1996. In preparation for this, reorganizations took place on I January 1996, to divisionalise the various groups involved. This report is based on these new divisionalised groupings.

A new company, Magnox Electric (MEP), will remain in public ownership and be responsible for the following magnox power stations: Sizewell A, Hinkley Point A, Dungeness A, Oldbury, Bradwell and Wylfa, together with the decommissioning stations at Berkeley, Trawsfynydd and Hunterston A. A new private company, British Energy, will be created with two operating subsidiaries, Nuclear Electric Ltd and Scottish Nuclear. Nuclear Electric Ltd (NEL) will be responsible for the following power stations: Heysham 1, Heyshaim 2, Hartlepool, Dungeness B, Hinkley Point B and Sizewell B. Scottish Nuclear will own Hunterston B and Torness.

(Note that except for Sizewell B which is a PWR station, all British Energy's stations are AGRS.)

British Nuclear Fuels will not be affected by the proposals and will continue to operate Magnox stations at Calder Hall and Chapel Cross, as well as fuel manufacture/processing plants at Springfields and Sellafield.

Similarly AEA will riot be affected by the current privatization programme and continue with decommissioning activities at Dounreay (PFR and DFR) and Sellafield (WAGR).

Finally the Ministry of Defense (Royal Navy) operate nuclear powered submarines.

Within Nuclear Electric, the Training and Development Branch (part of the Human Resources Department), is responsible for the provision of technical and management training. Currently three training centres are in use: Oldbury Training Centre specializing in gas cooled reactor training; Cliff Quay Training Centre specializing in PWR training and Agecroft Training Centre specializing in craft and support skills training. These training centres meet the station demand for off-site trailing as well as full scope simulator training.

Within Magnox Electric, the Training and Development Branch (part of personnel Departiment) is responsible for the provision of technical and management training. Currently Magnox Electric have a generic magnox simulator and training team based at Oldbury Training Centre. Craft and support skills training is secured from Agecroft Training Centre on a commercial basis.

The Scottish Nuclear stations, Hunterston B and Torness have a strong technical training capability on site (including full scope simulators) with central provision for management skills training.

In all three companies, each station has a training section on site to secure training provision for the on site training needs and also to liaise with off site agencies for external training.

Detailed information about the arrangements within BNFL and AEA are currently not available to the author.

24.2.2. Training methodology

Prior to the formation of Nuclear Electric plc, its predecessor, the CEGB, had developed standard specifications for the training of nuclear power station personnel. These specifications were regularly revised in the light of experience and changes to post profiles.

Over the past five years these specifications have been replaced by competence profiles based on detailed analysis of current post profiles over the complete range of station posts having an involvement with nuclear safety.

The training profiles for Sizewell B (PWR) station were produced following an extensive study of world wide best practices in PWR training. This work followed the SAT methodology. In both gas cooled and PWR technologies the training programmes generally follow the pattern of training centre learning followed by a period of practical consolidation back at the station prior to return to a training centre. This pattern is then repeated throughout the overall training programme.

24.2.3. Overview of training system for NPP personnel

The UK training system for NPP staff is best illustrated by the following summary of the operations staff development:-

Historically, our field operators were recruited with basic school leaving qualifications and chiefly utilizing on the job training were developed into field operators. They were encouraged to undertake technical studies and if successful after some five years experience were in a position to seek promotion to foreman or supervisor posts.

The control room staff historically were recruited as graduates and were able to progress, with experience through the posts of desk engineer, CCR supervisor and then Shift charge Engineer – the whole sequence taking some seven years.

In recent times we have found that our better field operators are very keen and capable of obtaining the necessary technical qualifications and progressing from field operator/supervisor to desk engineer and above. Indeed some of our most competent shift CCR staff are ex field operators.

A similar situation exists on the maintenance side where nowadays a number of our engineers have progressed through the apprentice/craftsman route to obtain promotion to the engineering posts. The experience is not repeated (apart from a few exceptions) in the reactor and health physics/chemistry areas where we still recruit at E or GE level to fill vacancies.

24.2.4. Role of the regulator

In the United Kingdom, the Nuclear Installations Inspectorate (NII) are responsible for regulation of the nuclear industry. Each nuclear station must have a nuclear site license to allow it to operate. Attached to each license are a set of conditions to be met covering a wide range of topics from emergency arrangements to operating rules and including training. The NII will specify that certain arrangements shall be made and implemented. Such arrangements cannot then be changed without NII approval. The onus is thus placed on the operating company to ensure that such arrangements are implemented at station level.

In the case of training the condition is "The licensee shall make and implement adequate arrangements for suitable training of all those on site who have responsibility for any operation which may affect safety". By means of company directives and detailed site documentation it is ensured that the specification, achievement and monitoring of adequate training can be demonstrated.

The NII monitor the situation during their regular site inspection visits and also by special inspection visits to the training centres.

24.2.5. Specific positions for which training is available

(1) All operations staff
(2) All engineering/maintenance staff
(3) All technical support staff
(4) Instructors (Classroom and Simulators)
(5) Generic induction training is available to all station staff

24.2.6. Co-operation within the UK

Historically there has always been a full interchange of information, operational experience and training expertise between the various companies in the UK.

With the planned privatization of parts of the industry, detailed arrangements have been put in place (particularly in the areas of training and operational experience) to ensure that this cross transfer will continue into the future.

As a specific example, several of the courses provided at Oldbury Training Centre will be resourced by trainers from both NEL and MEP and available to students from both companies as well as Scottish Nuclear.

24.3. TRAINING ORGANIZATIONS

Nuclear power plant (NPP) training department responses for the survey

1. Bradwell Power Station

Contact:
Mr. S. Butcher, Training & Development Officer
Tel: 01621 873240
Fax: 01621 873299

Training practices which could be recommended for application in other training organizations:

Fire & Rescue Training,
Off Site Monitoring Training

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Negotiable
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

2. Hinkley Point 'A' Power Station

Contact:
Mrs. Hayley Atkin, Head of Training & Development
Tel: 01278 65445
Fax: 01278 654215

Training practices which could be recommended for application in other training organizations:

Training Specifications

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: N/A
Unique Training Facilities

None noted in survey

3. Oldbury Power Station

Contact:
Mr. Peter R. Hardman, Training Engineer
Tel: 01454 416631
Fax: 01454 893733

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: N/A

Unique Training Facilities

None noted in survey

4. Sizewell 'A' Power Station

Contact:
Mr. S. Jefferies, Training Engineer
Tel: 01728 653484
Fax: 01728 653520

Training practices which could be recommended for application in other training organizations:

Coaching for Performance

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

5. Trawsfynydd Power Station

Contact:
Mr. Colin Digweed, H.R. (Training)
Tel: 017 665 43356

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: N/A

Unique Training Facilities

None noted in survey

6. Wylfa Power Station

Contact:
Mr. Gordon M. Warren, Training Officer
Tel & Fax: 01407/733387
Fax: 01407/733264

Training practices which could be recommended for application in other training organizations:

Breathing apparatus training carried out on-site in a specially built training facility. Instruction for breathing apparatus provided by station and local fire service instructors to approved standards.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: Yes
Fee for services: No

Unique Training Facilities

None noted in survey

7. Dungeness B Power Station

Contact:
Mr. S.A. Johnson
Tel: 01797 343345
Fax: 01797 343006

Training practices which could be recommended for application in other training organizations:

Use of simulator training for non operations staff personnel

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: No

Unique Training Facilities

None noted in survey

8. Hartlepool Power Station

Contact:
Mr. I. Emmerson, Training & Development Officer
Tel: 01429 853342
Fax: 01429 853398

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: N/A

Unique Training Facilities

None noted in survey

9. Heysham 1 Power Station

Contact:
Mr. Ian McMinn, Section Head Training & Development
Tel: 01524 8633246
Fax: 746 3246, 01524 855104

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: No
Loan personnel to other countries: Yes
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

10. Heysham 2 Power Station

Contact:
Mr. John Klotz, Training & Development Officer
Tel: 01524 863890
Fax: 01529 863589

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: N/A

Unique Training Facilities

None noted in survey

11. Hinkley 'B' Power Station

Contact:
Mr. N. Skelton
Tel: 44 (0) 1278 654241
Fax: 44 (0) 1278 654389

Training practices which could be recommended for application in other training organizations:

None noted in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: N/A

Unique Training Facilities

None noted in survey

12. Sizewell B Power Station

Contact:
Mr. R.W. Pooley, Training Section Head
Tel: 01728 653261
Fax: 01728 653260

Training practices which could be recommended for application in other training organizations:

Use of CD-ROM training technology

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Yes

Unique Training Facilities

None noted in survey

13. Hunterston B

Contact:
Mr. Ian Shaw, Training Engineer
Tel & Fax: 01294 822411

Training practices which could be recommended for application in other training organizations:

Use of full scope simulator for familiarization training of maintenance personnel. Integration of full scope simulator in emergency exercises

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

14. Torness Power Station

Contact:
Mr. K. Barbary, Training Engineer
Tel: 01368 8 63500

Training practices which could be recommended for application in other training organizations:

Health physics competency based training scheme. Job and task analysis

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Negotiable

Unique Training Facilities

Reactor vessel and reactor internal mockup

B. Training Centre (TC) Responses for the Survey

15. British Nuclear Fuels:

Fuel Division Springfield

Contact:
Mr. Chris Marlton-Thomas
Tel: 01772 764154
Fax: 01772 763444

Training practices which could be recommended for application in other training organizations:

Competency based testing on engineering and operational skills. Based on externally originated, in-house developed and validated skill units.
Cultural change workshops for section managers that define implementation of skills programs.
Methods of identifying reasons for non-implementation of new skills.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Probably
Fee for services: Yes

Unique Training Facilities

None noted in survey

16. Oldbury Training Centre, Nuclear Electric Limited
(Shared facility with Magnox Electric plc.)

Contact:
Mr. E.G. Bridges, Group Head,
Training Development & Delivery
Tel: 01454 422215
Fax: 01454 422432

Training practices which could be recommended for application in other training organizations:

Effective use of basic principles simulators
Involvement of shift charge engineers in operator training and assessment
Use of secondees on plant simulators to maintain up-to-date knowledge.
Involvement of company specialists in the production and delivery of training.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

Partial scope generic Magnox simulator, switching simulator, reactor vessel mock-up

17. Cliff Quay Training Centre

Contact:
Mr. G. Hodges, Principal
Tel: 01473 292102
Fax: 01473 292111

Training practices which could be recommended for application in other training organizations:

Use of full scope simulator linked to Technical support Centre at Sizewell B to run site emergency exercises.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

18. Agecroft Training Centre

Contact:
Mr. C.D. Fowler, Training & Development Manager
Tel: 01454 422257
Fax: 01454 422432

Training practices which could be recommended for application in other training organizations:

None listed in survey

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

Control boards at electrical control room

19. Oldbury Training Centre , Magnox Electric plc.
(Shared facility with Nuclear Electric Ltd)

Contact:
Mr. John Foulkes, Technology Training Team Leader
Tel: 01454 422243
Fax: 01454 422430

Training practices which could be recommended for application in other training organizations:

Involvement of shift managers in annual simulator refresher training and assessment.
Extensive use of basic principles simulator for theoretical training.
Mobile switching simulator.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

Five full scope simulators, switching simulator

24.4. MANAGEMENT ROLE AND RESPONSIBILITY

	Yes*	No*
• Is there a plant or operating organization training policy document?	17	
• Does plant management routinely monitor training?	17	
• Is training audited by a non-regulatory organization external to training department?	12	5
• Is plant management directly involved in establishing training needs?	16	1
• Is management and supervisory skills training provided?	17	
• Is general safety training provided?	17	
• Is emergency preparedness training provided?	17	

Budget

Between one and three percent of the total operating budget is spent on training based on 6 surveys answering this question.

Salary

All surveys reported salaries of trainers are the same as the salary of similar no-shift plant positions.

Numbers indicate the numbers of plants and training centres responding as indicated.

24.5. TRAINING PROGRAMS

24.5.1. Entry level requirements

(Numbers give ranges of prerequisite education or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	GE (2), E(3), E/TS(1) TS(3)	GE(2),E(3),E/TS(1), TS(3)	GE(2),E(3), E/TS(1),TS(3)	E/TS(1),TS(3), TS/SS(1),SS(4)	GE/E(1), E/TS(1),SS(4)	GE/E(1), E/TS(1),SS(4)
Prerequisite years of experience for this program	N/A (13), 2(2), 3(1), 5(1),7(1)	N/A(12), 2(2), 3(2),4(2)	N/A(12),0(2) 1(1),2(1),3(2)	N/A(12), 0(3),1(1), 2(1),3(1)	N/A(11),0(3)3(1), 4(3)	N/A(11), 0(3),3(1), 4(3)

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	GE/E(1),E(1), E/TS(1),TS(3), SS(2)	GE/E(1),E(3), E/TS(1),TS(4), SS(1)	GE(),E(),E/TS(), TS()	GE(2),GE/E(1),E(1),E/TS(1), TS(2),SS(2)	GE/E/TS(1), E(2),E/TS(1),TS(3), TS/SS(1), SS(2)	GE(3),GE/E(5),E/TS (2),TS(1)
Prerequisite years of experience for this program	NA(12), 0(4), 4(1), 6(1)	NA(12), 0(3), 2–5(1), 4(1), 6(1)	NA(12), 0(3), 1–3(4), 3(1), 6(1)	NA(12), 0(3), 2(4), 4(1), 6(1)	NA(12), 0(4), 2(2), 4(2), 5(1)	NA(13), 0(4), 2(2), 4(1), 5(1)

*[GE = graduate engineer or dipl. engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma, SS = secondary school diploma].

24.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	15	1	15	1	15	1	15	1	16	1	16	1
Job analysis is used to determine training needs.	11	6	11	6	11	6	11	6	12	6	12	6
Training needs are used to design measurable training/learning objectives.	15	1	15	1	15	1	15	1	16	1	16	1
Training materials are based on training/learning objectives	11	1	17	0	17	0	17	0	18	0	18	0
Training implementation involves assessment of whether training/learning objectives are achieved.	17	0	17	0	17	0	17	0	18	0	18	0
Evaluation is based on training goals. Feedback of needed improvements takes place.	13	4	16	4	16	4	16	4	14	4	14	4

* Numbers indicate the numbers of plants and training centres responding as indicated.

24.5.2. Training methodology cont.

Job Position / Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	15	1	15	1	15	1	15	1	16	1	16	1
Job analysis is used to determine training needs.	11	6	11	6	11	6	11	6	12	6	12	6
Training needs are used to design measurable training/learning objectives.	16	0	16	0	16	0	16	0	17	0	17	0
Training materials are based on training/learning objectives	17	0	17	0	17	0	17	0	18	0	18	0
Training implementation involves assessment of whether training/learning objectives are achieved.	17	0	17	0	17	0	17	0	18	0	18	0
Evaluation is based on training goals. Feedback of needed improvements takes place.	13	4	13	4	13	4	13	4	14	4	14	4

24.5.3. Initial and continuing training programs - settings and duration

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	328	70-500	324	70-500	307	70-500	167	60-320	164	70-280	164	70-280
Lab/Workshop	0		0		0		0		0		0	
Process or Control Room Simulator	183	120-320	213	120-320	175	60-280	71	15-200	77	15-200	77	15-200
Self-Study	130	50-320	185	50-320	175	30-320	222	NA	137	NA	137	NA
Formal On-the-Job Training	859	30-1500	826	30-1500	826	30-1500	508	30-1000	170	30-400	170	30-400
Total Initial Training	1292	350-2291	1282	350-2291	1226	270-2291	807	270-2040	1506	180-8160	1671	180-8160

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	45	20-67	45	20-67	54	20-95	37	20-67	62	20-190	62	20-190
Lab/Workshop	0	0	0		0		0		10	NA	10	NA
Process or Control Room Simulator	60	40-80	48	20-80	43	20-80	12	4-20	13	5-20	13	5-20
Self-Study	0	0	17	NA	17	NA	18	15-20	15	NA	15	NA
Formal On-the-Job Training	30	20-40	30	20-40	30	20-40	30	20-40	40	30-50	40	30-50
Total Continuing Training	131	80-164	109	40-164	94	20-164	60	20-80	84	20-190	84	20-190

24.5.3. Initial and continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs and TCs)

Initial Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	164	70–280	244	40–384	297	70–560	280	70–560	219	70–280	298	70–500
Lab/Workshop	0		0		40	NA	40	NA	0		0	
Process or Control Room Simulator	77	15–200	108	15–200	200	NA	200	NA	152	15–400	247	120–400
Self-Study	137	NA	84	30–137	0		0		0		0	
Formal On-the-Job Training	170	30–400	287	60–400	645	30–2000	193	30–450	207	30–550	471	30–1013
Total Initial Training	373	180–620	412	300–620	808	300–2180	512	250–850	488	280–810	683	0–1500

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	50	20–117	42	20–97	52	20–119	37	20–55	27	20–40	46	20–84
Lab/Workshop	10	NA	10	NA	10	NA	0		0		0	
Process or Control Room Simulator	13	5–20	13	5–20	20	NA	20	NA	13	5–20	50	20–80
Self-Study	15	NA	15	NA	22	NA	22	NA	0		15	NA
Formal On-the-Job Training	40	30–50	50	NA	33	15–50	33	15–50	40	NA	35	30–40
Total Continuing Training	73	20–129	62	20–105	76	20–119	59	20–90	48	20–85	74	0–129

24.5.4. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	85	111	113	636	382	203
Average annual number of persons who participate in continuing training 1991–1995	108	165	275	962	566	303

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	182	45	82	24	60	15
Average annual number of persons who participate in continuing training 1991–1995	306	50	126	44	54	16

24.5.5. Total number of personnel trained by training centres

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	149	229	381	50	60	60
Average annual number of persons who participate in continuing training 1991–1995	881	1607	3460	206	50	50

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	70	4	8	8	31	32
Average annual number of persons who participate in continuing training 1991–1995	50	0	0	0	26	2

24.6. TRAINING FACILITIES

24.6.1. Physical facilities

Nuclear Power Plant Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	14	0	4.7
Maintenance Workshops	9	5	2.0
Radiation Protection/Chemistry Labs	6	8	1.5
Other Labs/Workshops	6	8	1.4
Simulator(s)	5	9	1.6
Self Study Rooms	12	2	1.3
Library(ies)	9	5	1.2
Dedicated Instructor Offices/Work Space	11	3	3.9
Technical and Training Documentation Area	11	3	1.3
Training Material Preparation Area	5	9	1.0
Large Lecture Room	12	2	1.0
Dining Facilities	11	3	1.3
Student Housing Facilities	0	11	

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	4	0	4.75
Maintenance Workshops	1	3	.25
Radiation Protection/Chemistry Labs	0	4	0
Other Labs/Workshops	1	3	1
Simulator(s)	4	0	4.5
Self Study Rooms	4	0	2.25
Library(ies)	4	0	1
Dedicated Instructor Offices/Work Space	4	0	2.5
Technical and Training Documentation Area	4	0	2.75
Training Material Preparation Area	3	1	.75
Large Lecture Room	3	1	1.25
Dining Facilities	4	0	1
Student Housing Facilities	1	3	.25

*Numbers indicate the numbers of plants and training centres responding as indicated.

24.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities

	Number of Full Time Positions		Part Time Positions		
			Number	Full Time Equivalent	
Instructors	Average	Range		Average	Range
Operations	1.07	0–10		0.34	0.05–1.0
Maintenance	8.33	15–3		3	2–4
Radiation Protection	2	3		2.67	0.1–0.5
Chemistry	0			0.06	0.02–0.1
Other Instructors	2.83	1–10		0.2	NA
Management and Support Staff					
Management	1.5	0–6			
Simulator Support	0.25	0–3			
Maintenance Support	0.64	0–6			
Training Material Development	0.43	0–4			
Education Specialist	0.14	0–2			
Others	1.86	1–8			

Training Centres

Numbers are the **average** for reporting facilities

	Number of Full Time Positions		Part Time Positions		
			Number	Full Time Equivalent	
Instructors	Average	Range		Average	Range
Operations	6.0	5–11			
Maintenance	3.25	1–10			
Radiation Protection	0.5	0–1	1	0.6	
Chemistry	0.25	0–1			
Other Instructors	1.75	1–4			
Management and Support Staff	Average	Range		Average	Range
Management	3.0	1–4			
Simulator Support	2.25	0–6			
Maintenance Support	1.0	0–4			
Training Material Development	2.25	0–5	1	0.5	
Education Specialist	0.25	0–1			
Others	1.5	0–4			

24.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	Location of simulator	For what unit(s) is this a replica simulator?	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full scope	13	13	13	9202
Full scope	14	14	14	1200
Full scope MCR	17	12	12	1000
Full scope ASR	17	12	12	40
Full scope	16	11	11 Both Units	750
Full scope	16	7	7 Both Units	750
Full scope	16	8,9	8,9 All Four Units	1200
Full scope	16	10	10, Both Units	750
Part Task	6		6	
Partial Scope	19		1,3,4,6, Dungeness A	1600
Switching Simulator*	19,16		1,3,4,6,7,8,9,10,11, Dungeness A	800
Basic principles	17		12	250
Basic Principles	19,16		1,3,4,6,7,8,9,10,11, Dungeness A	1400
Fundamental Principles	19,16		1,3,4,6,7,8,9,10,11, Dungeness A	1200

24.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		7,11,14,16,19
	Reactor vessel head		
	Reactor internals	16	8.14,16,19
	Control rod drive mechanism		14
Steam Generator	Complete		19
	Primary side channel head		12
	Tube examination equipment		
	Steam generator inspection manipulator		
	Handling tools of manhole		
Reactor coolant pump(or primary loop recirculation pump)	Internal part	15	19
	Pump shaft seal	15	
	Pump body	15	
Main gate valve	Internal part	15,18	
	Body	15,18	
Fuel manipulator equipment	Manipulator crane	15	
	Dummy fuel	15	16,13,19
	fuel-handling tools	13,15	13
	Fuel-loading simulator		
Pumps		12,14,15,18	
Valves		7,13,14,15,18	
Supporting structures		15,18	
Welding-practice equipment		15,18	
Compressor	Instrumentation air compressor	15,18	
Laser alignment		14,15,18	
Other		13,14	

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Switchgear equipment		13,14,15,18,19	16,19
Reactor coolant pump motor		15	
Control-rod drive mechanism control system		14	14
Control boards at electrical control room	Rod position indicator system	18	
	Reactor control and protection rack	14,18	
	Protective relay system	18	14
	Ex-core nuclear instruments	14,18	
	In-core nuclear instruments	18	
	Generator automatic voltage regulator	18	
	Constant voltage constant frequency power source	18	
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	13,14,15,18	7
	Radiation measurement equipment	7,13,14,15,16,18,19	14,16,19
	Controller	13,14,15,18	
	Other	13,15	
Measurement system for motor-operated valves		14,15,18,19	
Digital control device		3,13,14,15,19	
Other		13,15	
Common			
Non-destructive testing equipment		14,15,18	
Transparent power plant	See-through	19	
	Functional		
Other			

*Numbers correspond to the NPP or TC listed in Part II.

24.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer based training	19	0
Interactive video	19	0
Establishing and maintaining your training database	19	0
Generating exams	4	15
Keeping student records	18	1
Production of training materials	19	0

*Numbers indicate the numbers of plants and training centres responding as indicated.

Visual aids available at facility

	Yes*	No*
White boards	19	
Overhead projectors	19	
Slide projectors(such as 35mm)	19	
Flip charts	19	
Video equipment	19	
Computer liquid crystal display panel or computer projector	17	2
Video conferencing	12	7

*Numbers indicate the numbers of plants and training centres responding as indicated.

25. UNITED STATES OF AMERICA

25.1. SUMMARY AND CONCLUSIONS

The country contact conducted the US survey by sending the survey to training managers of plants that are members of the National Academy for Nuclear Training. Twenty four of seventy surveys were returned.

INPO previously conducted a similar of US training facilities in 1992 (1992 Survey of Nuclear Training Activity in US Electric Utilities, ACAD 92-007, September 1992.). These surveys were conducted on a biennial basis from 1986 until 1992. Although this survey and the INPO survey differed in several aspects some comparisons can be made. The following table compares the duration of the various training programs accredited by the National Academy. Note that 72 plants responded to the 1992 survey compared to 24 plants for the 1996 survey.

Essentially no change occurred in the duration of the programs for positions that are licensed by the Nuclear Regulatory Commission. The other programs show a decrease in the duration of the initial programs and an increase in duration of the continuing training programs. This trend is hypothesized to be due to the maturity of the US plant staffs resulting in fewer entrants and the need to efficiently qualify personnel to become productive members of the plant staff. The maturity of the plant staffs has increased the emphasis on continuing training which may account for the moderate increase in duration of the continuing training programs.

Training Program	Training Type	Average INPO 1991 (hours)	Average IAEA 1996 (hours)	Percent Change 91–96 (hours)	Range INPO 1991 (hours)	Range IAEA 1996 (hours)
Control Room Supv.	Initial	1616	1533	–5%	680–3520	800–3350
Control Room Supv.	Continuing	244	235	–4%	32–400	128–320
Control Room Oper.	Initial	2092	2087	0%	800–2920	1321–3350
Control Room Oper.	Continuing	244	235	–4%	32–400	128–329
Equipment Operator	Initial	2120	1651	–28%	400–8320	600–3776
Equipment Operator	Continuing	163	182	10%	16–346	64–304
Mechanic	Initial	1976	1465	–35%	120–8960	240–8000
Mechanic	Continuing	76	82	7%	16–432	6–168
Electrician	Initial	2044	1398	–46%	120–9000	150–8000
Electrician	Continuing	81	86	5%	10–200	36–186
I&C Technician	Initial	2316	1691	–37%	200–8000	130–6880
I&C Technician	Continuing	85	141	40%	16–240	36–776
RP Technician	Initial	1960	1340	–46%	80–8000	400–4800
RP Technician	Continuing	89	90	1%	8–200	32–220
Chemistry Tech.	Initial	2060	1422	–45%	80–8000	256–4720
Chemistry Tech.	Continuing	87	92	5%	7–260	32–175

The maturity of the plant staffs and the pressures of economic competitiveness are thought to account for the reduction in the number of full time training positions shown in the following table.

Positions	Average Number Reported 1992 Survey	Average Number Reported 1996 Survey
Instructors	45	33
Other Professional Positions	19	12
Clerical and Others	12	5

Management Involvement

All utilities reported full management involvement in the training process. Management establishes the training policy, determines the training needs and monitors the delivery of training.

Salaries of Trainers

The salaries of trainers in the United States of America is generally the same as similar positions in the plant with some plants reporting lower and some plants reporting higher salaries.

Use SAT Methodology

Training for all reported positions in the United States of America is based on the SAT methodology with the exception of QA/QC inspector training. Only three of the 24 utility training centre responded to the questions on application of SAT to QA/QC technician training. Because of the many aspects of these jobs in the USA it is difficult to apply the SAT model. The SAT model works well for the materials testing potion of a QC tasks but poorly to the job observation tasks of a QA evaluator.

Initial and Continuing Training Programs – Settings and Duration

The duration of the initial training programs show a wide variation. This observation is consistent with the 1992 National Academy survey. This is expected since each utility designed their program for the skill set required for the plant position and the job progression path in each station.

All programs utilize both the classroom and on-the-job settings. The operator programs make extensive use of the control room simulator while the maintenance, chemistry and radiation protection technician utilize the laboratory setting. This is an expected result given the large capital investment US utilities have made in site specific simulators and laboratories.

Physical Facilities

All training centres are located at or near a plant site. All have site specific control room simulators and 23 of 24 have maintenance laboratories. Seventeen of 24 have chemistry and/or radiation protection laboratories. This smaller number of training centre chemistry/radiation protection laboratories is thought to reflect the larger investment in these laboratories which have few other uses where as maintenance laboratories can serve as practical work spaces. All have fully equipped lecture facilities and instructor facilities. Many have dining facilities and one has a dormitory facility. The maintenance training facilities are well equipped with a variety of simulators, tools and mock-ups. All training centres heavily utilize computers and 75% are utilizing computer based training.

Staffing

Operator training is typically provided by dedicated full time instructors while more part time instructors are used in maintenance, chemistry and radiation protection technician training. Most facilities have full time educational specialists.

25.2. SYSTEM OVERVIEW OF NUCLEAR POWER PLANT PERSONNEL TRAINING

25.2.1. Organizations and responsibilities

1. National Academy for Training of Nuclear Power Plant Personnel

Training is conducted under the auspices of the National Academy for Nuclear Training. Each utility that operates a nuclear plant is a member of the National Academy. Each nuclear power plant is a branch of the National Academy.

2. Operating Utility

Each utility that operates a nuclear plant has the responsibility for training the personnel that operate the plant. A training centre is located at every nuclear power plant. In the case of some of the larger utilities some training is conducted at a central training centre.

3. Nuclear Power Plant and Training Centre

Each plant is responsible for conduct of training. The content of each program is determined by the requirements of the National Academy guidelines and the needs of the plant departments. Curriculum is typically determined by curriculum committees composed of plant and training personnel. Classroom, laboratory, and simulator training are typically conducted by the training centres. On-the-job training is typically conducted by plant personnel. The plant or site department head has responsibility for the program(s) that provides training to personnel in their departments.

4. Contractor Supplied Training

Most training is provided by the plant training centre. Contractors typically provide specialized training in areas outside the expertise of the plant training department.

25.2.2. Training methodology

The systematic approach to training methodology is utilized by all nuclear power plants.

25.2.3. Role of regulator in training

25.2.3.1. Regulations applicable to training

a) United States Nuclear Regulatory Commission (Code of Federal Regulations)

- Utilities are to maintain the accreditation of their nuclear power plant training programs
- NRC conducts initial Senior Reactor Operator(SRO) and Reactor Operator(RO) license examinations and issues SRO and RO licenses to individuals.
- Utilities are to conduct requalification training for licensed operators (RO and SRO licensed individuals).

b) National Academy for Nuclear Training

- Accredits utility training programs. An independent Accrediting Board is charged with making accreditation decisions.

- Accreditation is renewed every four years. The Accrediting Board may renew accreditation, place a program on probation or revoke accreditation. To date accreditation has not been revoked.

25.2.3.2. Inspections and reviews

a) Nuclear Regulatory Commission

- The NRC conducts an inspection of the licensed operator requalification training program once per review cycle. Review cycles are determined by overall pant performance and typically range from 12 to 24 months.

- The NRC also conducts "for cause" inspections of training programs based on plant performance that may be linked to training deficiencies.

b) Institute of Nuclear Power Operations (INPO)

INPO conducts reviews of training as part of the periodic comprehensive review of plant performance. These review are typically conducted on a 12 to 18 month interval.

c) National Academy for Nuclear Training

- The Academy conducts a review of each program, based on the utility's self evaluation report, as part of the initial accreditation and accreditation renewal processes. The Academy's review is included in the self evaluation report that is presented to the Accrediting Board.

- The Academy may conduct special reviews of a training program when the INPO comprehensive review indicates the utility is not maintaining a training program in accordance with the accreditation requirements.

25.2.4. Training programs

1. Accredited Training Programs

- Non-licensed operator
- Reactor operator
- Senior reactor operator
- Operations shift supervisor
- Licensed operator requalification
- Shift technical advisor
- Electrical maintenance technician
- Mechanical maintenance technician
- I&C technician
- Maintenance supervisor (Currently only the mechanical maintenance supervisor training program is accredited. requirements for the accreditation for all maintenance supervisor positions are to be issued in 1996.)
- Chemistry technician
- Radiation protection technician
- Engineering support personnel

2. Other Training Programs

- Plant and radiation controlled area access

- Emergency preparedness
- Industrial safety
- Chemical hazards
- Fire brigade
- Management development

25.2.5. Co-operation within country

1. Training materials

- Some common training materials have been developed by groups of utilities in the same geographical area.
- The National Academy for Nuclear Training issues a training resources catalog on a biannual basis.

2. Exchange of trainees and trainers

- A limited exchange of trainees and trainers occurs. This is typically done for specialized training such as Motor Operated Valve surveillance testing or special chemical analyses.

3. Exchange of Information

- Information is shared in periodic meetings of the regional training associations.
- Information is shared electronically through the INPO Nuclear Network.
- An operating experience data base is maintained by INPO and shared with all utilities.

25.3. TRAINING ORGANIZATIONS

Nuclear Power Plant (NPP) Training Department Responses for the Survey

1. Energy Operations Inc., Waterford 3

James Cain, Energy Education Centre

Contact:
Mr. J. M. O'Hern, Training Manager
Tel: 504 739 6000
Fax: 504 739 6007

Training practices which could be recommended for application in other training organizations:

Use of industry peers as part of our internal self assessment process
The use of accelerated learning techniques for initial and continuing training topics to keep information interesting and challenging

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

2. Energy Operations, Inc., Grand Gulf Nuclear Station, Unit I

Contact:
Mr. Marion A. Dietrich, Manager
Tel: (601) 437-9689
Fax: (601) 437-6363

Training practices which could be recommended for application in other training organizations:

Cut away training aids
Interactive for maintenance fundamentals

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Negotiable
Training personnel: Negotiable
Loan personnel to other countries: No
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

3. Houston Lighting & Power Company

South Texas Project Elec. Generating Station
Nuclear Training Department

Contact:
Mr. L. Glen Weldon
Tel: 512-972-8365
Fax: 512-972-7797

Training practices which could be recommended for application in other training organizations:

Use of the "camera man" video camera to record continuing training presentation for playback to those individuals who were unable to attend. The camera tracks the instructor and records quality sound without requiring other staff to operate equipment.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Negotiable

Unique Training Facilities

Steam generator PORV actuation circuitry

4. Commonwealth Edison Company

La Salle Training Department

Contact:
Mr. Thomas C. Johnson, Projects Leader
Tel: 815-357-6761 Ext. 2997
Fax: 815-357-6761, ext. 2048

Training practices which could be recommended for application in other training organizations:

Trainers, plant management and workers meet periodically to discuss short term and long term training needs. This reinforces line management ownership of training. Each operating crew has an SRO licensed instructor assigned to it serving as a "crew partner." The "crew partner" determines the specific training needs of the crew and spends several days each quarter on shift with this crew and observes the crew's performance in the simulator. The 'crew partner" meets with the shift supervisor to discuss the training week and to develop the crew training plan.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Negotiable
Training personnel: Negotiable
Loan personnel to other countries: Negotiable
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

5. Washington Public Power Supply System

Plant Support Facility (Training Centre)

Contact:
Mr. William D. Shaeffer
Tel: (509) 377 8266
Fax: (509 377 8662

Training practices which could be recommended for application in other training organizations:

Incorporation of operating experience into dynamic simulator scenarios.
Advanced radiation worker team training to improve teamwork and reduce radiation exposure.
Use of the maintenance training simulator for task based training of operators, maintenance technicians and radiation protection technicians.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

6. Carolina Power and Light Co.

Brunswick Nuclear Plant

Contact:
Mr. George P. Barnes, Manager – Training
Tel: 910 452 2197
Fax: 910 457 2803

Training practices which could be recommended for application in other training organizations:

Operators are tasked to start up the plant on the simulator without the us of procedures. This is done to increase the "skill" of the operators and to enforce "big picture" thinking.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Negotiable
Training personnel: Yes
Loan personnel to other countries: Negotiable
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

7. Carolina Power and Light Company

Harris Energy and Environmental Centre

Contact:
Mr. Joe Collins, Harris Training Section Manager
Tel: (919) 362 3332
Fax: (919) 362 3446

Training practices which could be recommended for application in other training organizations:

Use of a fully functional loop trainer/simulator. This trainer is a fully integrated, three loop, full flow and control mock-up for use in all aspects of power plant training. The system is composed of a heat transfer loop, circulating water loop, and a cooling loop all controlled via manual and process control interfaces. The simulator has been used to provide cross-discipline training to maintenance personnel and is planned to be used by all plant disciplines to enhance their skill development.

Simulator crew assessments are conducted using a printing white board with specific categories to address crew strengths and weaknesses. Copies are made for each session with one copy going to the crew and the other maintained on the simulator instructor station for reference during the nest training cycle.

Crew facilitators are used during crew critiques of simulator sessions to help resolve crew training deficiencies.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: Yes
Fee for services: No

Unique Training Facilities

Fully functional loop trainer/simulator (see recommended training practices above).

8. Union Electric

Callaway Plant

Contact:
Mr. Mark J. Milawski, Supervisor
Tel: 573-676-8409
Fax: 573 676 4481

Training practices which could be recommended for application in other training organizations:

Interdepartmental integrated training where crafts from two or more work groups attend a presentation and work on a project together as a group (i.e. Radiation Protection and Operations working on a steam generator tube leak as a simulator exercise. Instrument & control and electrical maintenance technicians working on motor operated valves.)

Job rotations between training instructors and first line supervisors.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes (must be proficient in the English language)
Training personnel: Yes (must be proficient in the English language)
Loan personnel to other countries: Negotiable
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

9. Duquesne Light Company

Beaver Valley Power Station
Nuclear Training Centre

Contact:
Mr. Ernest Chatfield, General Manager
Tel: 412 393 5710
Fax: 412 393 5933

Training practices which could be recommended for application in other training organizations:

A self checking trainer is used to provide hands-on training to emphasize all aspects of self checking.
Molar ratio control training for chemistry technicians

Use of trouble shooting trainer to provide hands-on training of maintenance technicians

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Yes

Unique Training Facilities

Self checking trainer

10. Southern California Edison

San Infer Nuclear Generating Station, Units 2 & 3
Nuclear Training Division

Contact:
Mr. Scott Wylie, Training Specialist
Tel: (714) 368 8445
Fax: (714) 368 8996

Training practices which could be recommended for application in other training organizations:

Instructors are assigned as crew mentors for each crew. The mentor serves as the principal point of contact for the crew on operator training issues.
Use of fluorescent dye as simulated contamination for radiation protection and chemistry technician training.
Maintenance supervisors and workers periodically serve as instructors.
Use of a operational piping skid for operator and maintenance training. Also used to test components before installing them in the plant.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: NA

Unique Training Facilities

Operational piping skid

11. Florida Power Corporation

Crystal River Unit 3

Contact:
Mr. Rolf C. Widell, Director: Nuclear Operations Training
Tel: 352 563 4529
Fax: 352 563 4620

Training practices which could be recommended for application in other training organizations:

Simulator training critique process

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Negotiable

Unique Training Facilities

None noted in survey

12. New York Power Authority

Indian Point 3

Contact:
Mr. Dale Spoerry, Training Manager
Tel: 914 736 8901
Fax: 914 736 8943

Training practices which could be recommended for application in other training organizations:

A remedial training and re-examination policy that provides for progressive remedial training following examination failure. This remedial training activities specific to questions and objectives missed, retaking the training course and examination, or an academic review board involving line and training management.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: NA

Unique Training Facilities

None noted in survey.

13. Rochester Gas & Electric Corporation

R. E. Ginna, Nuclear Training

Contact:
Mr. Gary D. Meier, Department Manager
Tel: 716 771 6622
Fax: 716 724 8263

Training practices which could be recommended for application in other training organizations:

None noted in survey.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes (For short duration only)
Fee for services: Negotiable

Unique Training Facilities

None noted in survey.

14. Arizona Public Service Co.

Palo Verde Nuclear Generating Station
Nuclear Training Department

Contact:
Mr. John C. Velotta, Director
Tel: 602 393 1785
Fax: 602 393 2487

Training practices which could be recommended for application in other training organizations:

ALARA Work Area Radiation Simulator Facility: The facility is used to train radiation workers how to control their radiation exposure. Instructors can program the system to simulate up to ten point and line sources for any source strength. The simulator then monitors up to four workers as they work in facility. Each individual's dose rate and total dose is calculated every second. Feedback is provided to the workers on their ALARA practices.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

ALARA Work Area Radiation Simulator Facility

15. Pennsylvania Power and Light Co.

Susquehanna Training Centre

Contact:
Mr. William H. Lowthert, Manager
Tel: 717 542 3328
Fax: 717 542 7017 or 717 542 3855

Training practices which could be recommended for application in other training organizations:

Maintenance crew training for continuing training.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey.

16. IES Utilities

Duane Arnold Energy Centre Training Center

Contact:
Mr. Keith Young, Training Manager
Tel: 319 851 7229
Fax: 319 851 7571

Training practices which could be recommended for application in other training organizations:

The training management action request system allows all site personnel to request training department action.
Reactor engineers and I&C, electrical and mechanical maintenance technicians participate in simulator training sessions and perform activities similar to those performed in the plant control room.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

None noted in survey

17. Duke Power Co.

McGuire Nuclear Station

Contact:
Mr. Lee N. Fester, Training & Technology Support Supervisor
Tel: 704 875 4161
Fax: 704 875 4329

Training practices which could be recommended for application in other training organizations:

Crew self critiquing of simulator scenarios to find areas for improvement.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes

Training personnel: Yes
Loan personnel to other countries: Negotiable
Fee for services: No

Unique Training Facilities

18. GPU Nuclear

Oyster Creek Training Dept.

Contact:
Mr. Don Stellhorn, Administrative Support
Tel: 609 971 4183
Fax: 609 971 2110

Training practices which could be recommended for application in other training organizations:

Use of optical examination scoring in General Employee Training classes.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: No
Training personnel: No
Loan personnel to other countries: No
Fee for services: NA
Unique Training Facilities

None noted in survey

19. Wisconsin Public Service

Kewanee Nuclear Power Plant

Contact:
Mr. James S. Guay, Superintendent Nuclear Training
Tel: 414 388 2560 ext. 2436
Fax: 414 388 0819

Training practices which could be recommended for application in other training organizations:

Software to assemble simulator scenarios

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Negotiable
Fee for services: Yes

Unique Training Facilities

None noted in survey

20. Omaha Public Power District

Fort Calhoun Station

Contact:

Mr. Richard Conner
Tel: 402 533 6010
Fax: 402 533 6115

Training practices which could be recommended for application in other training organizations

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Negotiable

Unique Training Facilities

21. Energy Operations, Inc.

Arkansas Nuclear One

Contact:
Robert Holeyfield
Tel: 501-858-6938
Fax: 501-858-6820

Training practices which could be recommended for application in other training organizations

Electrical technician initial training classes are taught periodically as a part of continuing training to maintain basic skills.
Subject matter experts are used as guest instructors to improve the technical quality of the instruction as well as increase the credibility of the training.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Negotiable

Unique Training Facilities

22. TU Electric

Comanche Peak Steam Electric Station (CPSES)

Contact:
Chuck Kesinger
Tel: 817-897-5996
Fax: 817-897-5115

Training practices which could be recommended for application in other training organizations

Use of an electronic classroom for training activities. The electronic classroom allows the instructor to use computer generated graphics and script during lectures. The classroom has 35 response "PADS" to provide student feedback to the instructor during a presentation.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: Yes
Fee for services: Yes

Unique Training Facilities

Electronic classroom

23. Tennessee Valley Authority

Browns Ferry Units 2 &3

Contact:
Robert P. Greenman
Tel: 205-729-3470
Fax: 205-729-3419

Training practices which could be recommended for application in other training organizations

Removed the qualifications for all OJT trainers and TPE evaluators and requalified all current trainers and evaluators.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: Yes
Loan personnel to other countries: No
Fee for services: Negotiable

Unique Training Facilities

24. Commonwealth Edison

Braidwood Station

Contact:
John Walker
Tel: 815-458-2801 Ext. 2375
Fax: 815-458-3803

Training practices which could be recommended for application in other training organizations

Planned rotation between line supervisors and training instructors.

Availability of Training for Personnel from Organizations in Other Countries

NPP personnel: Yes
Training personnel: No
Loan personnel to other countries: Yes
Fee for services: Negotiable

Unique Training Facilities

25.4. MANAGEMENT ROLE AND RESPONSIBILITIES

	Yes*	No*
• Is there a plant or operating organization training policy document?	24	
• Does plant management routinely monitor training?	24	
• Is training audited by a non-regulatory organization external to training department?	24	
• Is plant management directly involved in establishing training needs?	24	
• Is management and supervisory skills training provided?	24	
• Is general safety training provided?	24	
• Is emergency preparedness training provided?	24	

Budget

Between 1.3 and 9.4 per cent of the total operating budget (average 4.3 per cent) is spent on training, based on 24 surveys answering this question.

Salary

Salaries of trainers as compared to the salary of similar non-shift plant positions.

Four plants reported higher than the plant position salary
Fourteen plants reported the same as the plant position salary
Two plants reported lower than the plant position salary

*Numbers indicate the numbers of plants and training centres responding as indicated.

25.5. TRAINING PROGRAMS

25.5.1. Entry level requirements

(Numbers of plants reporting prerequisite requirement or experience)

Job Position / **Training Program**	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Education or certification prerequisite(s) for this program*	SS(19), E(1), GE(1)	SS(22)	SS(22)	SS(22)	SS(23)	SS(22)
Prerequisite years of experience for this program	2(1),3(2), 4(2), 5(4), 6(2),8(2), 10(5)	2(5),4(7),5(2),6(1) 7(3)	1(1),2(4),3(10), 4(2),5(2)	NA(8),1(2),2(4)	NA(8),2(2), 3(6),5(1)	NA(8),2(1), 3(6)

Job Position / **Training Program**	Instrumentation & Control	Quality Assurance Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Education or certification prerequisite(s) for this program*	SS(8), TS(12), E(2),	SS(11), TS(1), E(1), E/SS(1)	SS(15), TS(7)	SS(12), TS(9), E(1), GE(1)	SS(17), E(2), SS/TS(1)	SS(18), E(1), SS/TS(3)
Prerequisite years of experience for this program	NA(8),1(1),2(1),3 (4),4(1),5(2), 6(2)	NA(9),2(2),3(1), 4(2),7(1)	NA(9),2(2), 3(1),4(2),7(1)	NA(10),2(3), 3(3),4(2)	NA(5),2(1), 3(2),4(3),5(2)6 (2),9(1)	NA(4),2(1),3(3),4 (3),5(4),6(2), 7(1),9(1)

*[GE = graduate engineer or diploma engineer degree (4–6 years university study); E = engineering degree (2–3 years university study); TS = technical school diploma, SS = secondary school diploma].

25.5.2. Training methodology

Job Position / **Training Program**	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	24		24		24		24		24		24	
Job analysis is used to determine training needs.	24		24		24		24		24		24	
Training needs are used to design measurable training/learning objectives.	24		24		24		24		24		24	
Training materials are based on training/learning objectives	24		24		24		24		24		24	
Training implementation involves assessment of whether training/learning objectives are achieved.	24		24		24		24		24		24	
Evaluation is based on training goals. Feedback of needed improvements takes place.	24		24		24		24		24		24	

* Numbers indicate the numbers of plants and training centres responding as indicated.

25.5.2. Training methodology cont.

Job Position / **Training Program**	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*	Yes*	No*
Systematic Approach to Training (SAT) is used	24			3	24		24		24		24	
Job analysis is used to determine training needs.	24			3	24		24		24		24	
Training needs are used to design measurable training/learning objectives.	24			3	24		24		24		24	
Training materials are based on training/learning objectives	24			3	24		24		24		24	
Training implementation involves assessment of whether training/learning objectives are achieved.	24			3	24		24		24		24	
Evaluation is based on training goals. Feedback of needed improvements takes place.	24			3	24		24		24		24	

25.5.3. Initial and continuing training programs – settings and duration

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Plant or Station Shift Supervisor		Unit or Control Room Supervisor		Control Room Operator		Field Operator		Mechanical Maintenance		Electrical Maintenance	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	631	80–2500	657	104–2500	1055	441–2500	720	80–2216	550	100–1000	587	100–1440
Lab/Workshop	220	160–280	280	40–520	213	20–520	61	12–140	273	15–1000	189	25–400
Process or Control Room Simulator	228	40–560	314	80–840	391	90–840	31	10–40	121	40–274	40	40–40
Self-Study	133	40–240	157	40–240	274	40–1000	286	30–1408	70	40–100	130	100–160
Formal On–the–Job Training	294	80–640	496	120–720	516	120–640	804	400–1980	1066	40–6800	1125	20–6800
Total Initial Training	910	120–3350	1533	800–3350	2087	1321–3350	1651	600–3779	1465	240–8000	1398	150–8000

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	127	64–216	131	64–216	131	64–216	146	50–264	57	20–120	59	20–130
Lab/Workshop	14	4–20	27	4–72	11	4–20	41	24–60	32	8–80	34	8–80
Process or Control Room Simulator	94	60–160	96	60–160	95	60–160	27	4–128	16	6–25		
Self–Study	16	10–20	16	10–20	16	10–20	20	8–46	6	4–8	6	4–8
Formal On-the-Job Training	16	4–24	16	4–24	16	4–24	27	10–60	30	20–40	30	20–40
Total Continuing Training	221	128–320	235	128–320	235	128–320	182	64–304	82	6–168	86	36–186

25.5.3. Initial and continuing training programs – settings and duration cont.

(Hours listed are the **average** number of hours for all NPPs)

Initial Training Program	Instrumentation & Control		Quality Assurance Quality Control		Radiation Protection		Chemistry		Instructor Teaching Skills Training		Simulator Instructor Skills Training	
	Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person		Hours of Training per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	791	60–3000	210	24–618	536	80–1411	641	100–1380	68	20–150	31	4–80
Lab/Workshop	254	20-969	100	40–161	177	20–740	91	8–200	23	2–99	10	2–20
Process or Control Room Simulator	30	20–40					40	40–40	56	56–56	32	12–60
Self-Study	70	20–120	183	8–500	385	20–920	473	120–680	42	4–100		
Formal On-the-Job Training	1137	30–5780	190	80–400	893	160–4160	972	120–4160	42	8–100	60	20–160
Total Initial Training	1691	130–6880	337	24–800	1279	400–4800	1422	256–4720	106	20–305	66	8–200

Continuing Training Program	Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person		Annual average number of training hours per person	
Program Setting	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
Classroom	100	24–543	24	15–60	73	38–138	73	28–120	26	8–80	14	4–32
Lab/Workshop	41	12–233	8	8–8	14	2–25	16	4–30	9	2–20	9	4–16
Process or Control Room Simulator	5	2–6			2	2–2			16	8–32	7	4–10
Self-Study	7	4–10			4	4–4			2	2–2		
Formal On-the-Job Training	90	20–260	16	16–16	32	4–100	29	20–50	32	32–32		
Total Continuing Training	135	36–776	22	15–60	90	32–220	92	32–175	31	8–100	20	8–40

25.5.4. Number of persons in initial and continuing training

Total number of personnel trained by nuclear power plant training departments

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Average annual number of persons completing program 1991–1995	85	188	245	238	349	188
Average annual number of persons who participate in continuing training 1991–1995	264	595	696	823	1425	866

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	162	87	560	161	207	80
Average annual number of persons who participate in continuing training 1991–1995	1056	214	1085	603	731	237

Total number of personnel trained by training centres

Training Program	Plant or Station Shift Supervisor	Unit or Control Room Supervisor	Control Room Operator	Field Operator	Mechanical Maintenance	Electrical Maintenance
Number of persons completing program 1991–1995	NA	NA	NA	NA	NA	NA
Average annual number of persons who participate in continuing training 1991–1995	NA	NA	NA	NA	NA	NA

Training Program	Instrumentation & Control	Quality Assurance /Quality Control	Radiation Protection	Chemistry	Instructor Teaching Skills Training	Simulator Instructor Skills Training
Average annual number of persons completing program 1991–1995	NA	NA	NA	NA	NA	NA
Average annual number of persons who participate in continuing training 1991–1995	NA	NA	NA	NA	NA	NA

25.6. TRAINING FACILITIES

25.6.1. Physical facilities

Nuclear Power Plant Training Departments

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	24	0	16
Maintenance Workshops	23	1	4
Radiation Protection/Chemistry Labs	17	7	1
Other Labs/Workshops	13	11	2
Simulator(s)	24	0	1
Self Study Rooms	21	2	3
Library(ies)	21	3	1
Dedicated Instructor Offices/Work Space	24	0	41
Technical and Training Documentation Area	22	2	2
Training Material Preparation Area	13	11	2
Large Lecture Room	23	1	2
Dining Facilities	14	9	2
Student Housing Facilities	1	23	0

*Numbers indicate the numbers of plants and training centres responding as indicated.

Training Centres

Existing Facilities	Available at location		Number of Dedicated Rooms
	Yes*	No*	Average for reporting facilities
Classrooms	NA	NA	NA
Maintenance Workshops	NA	NA	NA
Radiation Protection/Chemistry Labs	NA	NA	NA
Other Labs/Workshops	NA	NA	NA
Simulator(s)	NA	NA	NA
Self Study Rooms	NA	NA	NA
Library(ies)	NA	NA	NA
Dedicated Instructor Offices/Work Space	NA	NA	NA
Technical and Training Documentation Area	NA	NA	NA
Training Material Preparation Area	NA	NA	NA
Large Lecture Room	NA	NA	NA
Dining Facilities	NA	NA	NA
Student Housing Facilities	NA	NA	NA

*Numbers indicate the numbers of plants and training centres responding as indicated.

24.6.2. Training department staffing

Nuclear Power Plant Training Department

Numbers are the **average** for reporting facilities.

	Full Time Positions		Part Time Positions Reported as FTE	
Instructors	Average	Range	Average	Range
Operations	18	9–29	2	1–2
Maintenance	7	3–12	3	1–6
Radiation Protection	3	1–7	3	1–4
Chemistry	1	1–3	1	1–1
Other Instructors	6	1–11	2	1–2
Management and Support Staff				
Management	5	3–9		
Simulator Support	5	1–11	1	
Maintenance Support	1	0–8		
Training Material Development	1	0–5		
Education Specialist	2	0–5		
Others	5	0–12	1	

Training Centres

Numbers are the **average** for reporting facilities.

	Number of Full Time Positions		Part Time Positions	
Instructors	Average	Range	Average	Range
Operations	NA	NA	NA	NA
Maintenance	NA	NA	NA	NA
Radiation Protection	NA	NA	NA	NA
Chemistry	NA	NA	NA	NA
Other Instructors	NA	NA	NA	NA
Management and Support Staff				
Management	NA	NA	NA	NA
Simulator Support	NA	NA	NA	NA
Maintenance Support	NA	NA	NA	NA
Training Material Development	NA	NA	NA	NA
Education Specialist	NA	NA	NA	NA
Others	NA	NA	NA	NA

24.6.3. Control room simulators

Type (Full Scope, Compact, Part Task, Basic Principles, or Multifunctional)	For what unit(s) is this a replica simulator?	Location of simulator	Personnel from what unit(s) train on this simulator?	Number of hours simulator was used for training in 1995
Full Scope	1	1	1	1500
Full Scope	2	2	2	
Full Scope	3, Unit 1	3	3, Units 1&2	3650
Full Scope	4, Unit 1	4	4, Units 1&2	4300
Full Scope	5	5	5	160
Full Scope	6, Unit 1	6	6, Units 1&2	
Full Scope	7	7	7	2419
Full Scope	8	8	8	2080
Full Scope	9, Unit 1	9	9, Unit 1	1172
Full Scope	9, Unit 2	9	9, Unit 1	1028
Full Scope	10, Unit 2	10	10, Units 1&2	2795
Full Scope	11	11	11	1000
Full Scope	12	12	12	1600
Full Scope	13	13	13	2600
Full Scope	14	14	14	3740
Full Scope	14	14	14	3740
Full Scope	15	15	15	2000
Full Scope	16	16	16	2266
Full Scope	17	17	17	
Full Scope	18	18	18	1000
Basic Principles	18	18	18	100
Full Scope	19	19	19	
Full Scope	20	20	20	1800
Full Scope	21	21	21	
Full Scope	22, Unit 1	22	22, Units 1&2	3400
Full Scope	23, Unit 2	23	23, Units 1,2 & 3	5178
Full Scope	24	24	24	1400
Full Scope	25, Unit 1	25	25, Unit 1	1280
Full Scope	25, Unit 2	25	25, Unit 2	1264

24.6.4. Maintenance training equipment

Mechanical

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Reactor	Reactor pressure vessel		21
	Reactor vessel head		6,23
	Reactor internals		14,21,23
	Control rod drive mechanism	2,5,14, 15, 18,19	4,6,11,13,16 19,20,21,22, 23
Steam generator	Complete		3,19
	Primary side channel head	13	1,8,9,10,121 4,20,21,23
	Tube examination equipment	13,14	
	Steam generator inspection manipulator	13,14,20	
	Handling tools of manhole	7,9,10,13,14,20	1 ,12,21
Reactor coolant pump (or primary loop recirculation pump	Internal part	10,14	3,10,24
	Pump shaft seal	2,14	1,3,4,6,7,9,1 0,1216,18,19 ,20,21,23,24
	Pump body	10,14	4,16,18,24
Main gate valve	Internal part	5,6,9,12,13,14,15,24	1,8,11,23
	Body	5,6,9,12,13,14,15,24	1,8,11,16,18 23
Fuel manipulator equipment	Manipulator crane		
	Dummy fuel	3,7,15,20	1,10
	fuel-handling tools	3,10,15,20	10
	Fuel-loading simulator		
Pumps		2,3,5,6,7,8,9,10,11,12,13,14, 15,16,18,20,22,24	1,2,3,4,9,162 1
Valves		2,3,5,6,7,8,9,10,11,12,13,14, 15,16,18,19,20,22,24	1,4,9, 16,21
Supporting structures		3,7,10,11,16,18,2022	4,13,16
Welding-practice equipment		3,5,6,7,9,10,12,14,1516,18,20,23, 24	1
Compressor	Instrumentation air compressor	3,5,7,10,12,14,15,18,20,23,24	1,3,8
Laser alignment		2,3,5,6,7,10,11,12,1418,20,23,24	1,16,21
Other		7,10,14,15,18,23	1,4

*Numbers correspond to the NPP or TC listed in Part II.

Electrical and Instrumentation

Plant Component	Training Equipment	Real and Dedicated for Training*	Mock-up*
Switchgear equipment		2,3,4,5,6,7,9,12,13,1415,16,18,20	1,3,4,8,11,16,21,23
Reactor coolant pump motor			3,23
Control-rod drive mechanism control system		5,10,14,15,19,20,22	1,4,7,11,18,21
Control boards at electrical control room	Rod position indicator system	2,10,12,14,18,20	11,23
	Reactor control and protection rack	13,14,22	18,21,23
	Protective relay system	3	1,3,4,9,11,12,15,16, 18,20,23
	Ex-core nuclear instruments	13,14,22	
	In-core nuclear instruments	2,3,4,5,6,15,16,18,22	4,20,23
	Generator automatic voltage regulator	3	12
	Constant voltage constant frequency power source	3,14,15,16,20	12,14,18
Instruments	Transmitter (water level, pressure, flow, volume, etc.)	2,3,4,5,6,7,9,10,11,1314,15,16,18,19,20,22	1,4,8,9,12,15,16,21, 23
	Radiation measurement equipment	2,3,4,5,6,7,9,11,12,1314,15,16,18,19,20,22	1,4,7,10, 15,16
	Controller	2,3,4,5,6,9,10,11,12, 13,14,15,16,18,19,20,22	1,4,8,15, 16,23
	Other	3,10,11,15,16,18,19, 20,23	1
Measurement system for motor-operated valves		3,4,5,6,7,9,12,14, 15,16,18,19,20	1,4,8,11, 15,16,23
Digital control device		4,5,6,12,13,18,19,20	4,11,23
Other		7,18,20	1,11
Common			
Non-destructive testing equipment		4,7,11,20	4,9
Transparent power plant	See-through		4,9,11,14,18,23
	Functional		11
Other		7	18

*Numbers correspond to the NPP or TC listed in Part II.

24.6.5. Use of computers and visual aids

Computers are used for

	Yes*	No*
Computer based training	18	6
Interactive video	14	10
Establishing and maintaining your training database	24	0
Generating exams	22	2
Keeping student records	24	0
Production of training materials	24	0

*Numbers indicate the numbers of plants and training centres responding as indicated.

Visual aids available at facility

	Yes*	No*
White boards	24	0
Overhead projectors	24	0
Slide Projectors(such as 35mm)	24	0
Flip charts	24	0
Video equipment	24	0
Computer liquid crystal display panel or computer projector	24	0
Video conferencing	17	7

*Numbers indicate the numbers of plants and training centres responding as indicated.

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