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Authorization of nuclear power plant control room personnel: Methods and practices with emphasis on the use of simulators

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FOREWORD

In 2002 the IAEA published a revision to Safety Guide NS-G-2.8, *Recruitment, Qualification and Training of Personnel for Nuclear Power Plants*. This Safety Guide provides recommendations on the authorization of designated personnel who have a direct impact on nuclear safety. The IAEA Technical Working Group on Training and Qualification of Nuclear Power Plant Personnel recommended that an additional report be prepared that provided information on the practices in Member States on the use of simulators in the authorization of control room staff. This publication has been prepared in response to that recommendation. In gathering information for the report, Member States were asked to: respond to a survey on the use of simulators and the involvement of regulatory body in operator authorization; and to complete a questionnaire on their practices in authorizing control room staff.

Safety analysis and operating experience consistently indicate that human error is a major contributor to nuclear power plant (NPP) accident risk. With the recent world wide emphasis and implementation of full scope simulators for nuclear power plant personnel training, operators spend a large portion of their training time on simulators. As described in the foreword to IAEA-TECDOC-1411, *Use of Control Room Simulators for Training of Nuclear Power Plant Personnel,* simulators provide operators an opportunity to learn and practice the abilities that are required in accident and infrequently used plant evolutions. Because of their fidelity, full scope simulators are now used by most Member States in the authorization examinations of control room personnel. This situation is becoming more common as more plants acquire modern full scope plant referenced simulators.

This publication provides information and examples based upon experience in a variety of Member States. The body of the report provides general information that represents the practices of the Member States that contributed to the development of the report. This information was obtained from the mentioned above survey and questionnaire, and also from a survey of the Member States' regulations, procedures and other documents. Only a few examples of practices are included in the printed publication, with complete documents and more comprehensive examples included in the accompanying CD-ROM.

Appreciation is expressed to all Member States for their valuable contributions and the individuals who provided information on the subject. Particular appreciation is expressed to J. Fraser (Canadian Nuclear Safety Commission, Canada), A. Kraut (Gesellschaft für Anlagen und Reaktorshicherheit, Germany) and J. Yoder (IAEA Consultant, United States of America) for their assistance in the development and compilation of this publication. Particular thanks are due to J. Yoder for his editorial work. The IAEA officers responsible for this publication were A. Kazennov and A. Kosilov of the Division of Nuclear Power.

EDITORIAL NOTE

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CONTENTS

1. INTRODUCTION

1.1. Background

Authorization of control room personnel is a normal practice in all Member States. The authorization of personnel is required for personnel having a direct bearing on safety in accordance with IAEA Safety Guide No. NS-G-2.8 *Recruitment, Qualification and Training of Personnel for Nuclear Power Plants* [1]. The methods and practices for this authorization, however, are not identical and the organization granting the authorization may be different. In most Member States only the regulatory body can grant the authorization whereas in a few Member States the operating organization has the responsibility to grant the authorization. In addition, the organization responsible for the preparation, review, and approval of the various types of examinations and their administration and grading also varies more widely. Even within a single Member State, practices vary for the initial authorization and the periodic renewal of an individual's authorization.

The various authorization processes usually are based on written and/or oral examinations and in many cases also on the testing of practical skills. Differences in the authorization processes also exist in the examination methodology and in the scope of the practical examinations (e.g. plant walkthrough, use of simulators). The fairly recent increase in the availability of full scope simulators, in particular full-scope plant-referenced or plant-specific control room simulators provides an additional, efficient tool for testing the practical skills of the candidates for authorization.

To ascertain more detailed information on current practices on the authorization of control room personnel in the Member States, a questionnaire was prepared and sent out for them to complete and return to IAEA. In addition, a table to collect information on current practices for the use of simulator examinations in the authorization process was also prepared and sent to Member States for their completion. A copy of the questionnaire is included in Annex I of this report and also on the accompanying CD-ROM. The responses of the Member States are summarized in Section 2.6 of this report and the complete responses from each Member State are included on the accompanying CD-ROM. A composite of the table, Simulator Based Authorization Examinations for Control Room Personnel, is discussed and included in Section 2.7 of this report.

Even though some Member States have long established regulations and operating organization administrative procedures for authorization and periodic re-authorization, changes continue to be made to improve the effectiveness of the examination process as well as to improve the cost effectiveness of the process. In addition, some Member States are currently in the process of implementing periodic renewal of authorization based on completion of requisite re-examinations. Accordingly, this document provides the opportunity to present the various approaches and processes used as an information aid to anyone implementing or considering the implementation of improvements in their authorization processes.

1.2. Purpose

The purpose of the document is to provide practical information on the methods and practices used by Members States for the authorization of control room personnel by the regulatory body or other entity designated by a State in order to ensure plant safety and the availability of competent personnel for nuclear power plant operation. The document highlights the use

of simulators in the authorization process. It is recognized that authorization examinations of Control Room (CR) personnel may be prepared and conducted by the regulatory body, another external organization, or by the operating organization.

1.3. Relationship to other IAEA publications

IAEA Safety Guide No. NS-G-2.8 *Recruitment, Qualification and Training of Personnel for Nuclear Power Plants* [1] provides recommended actions, conditions or procedures for authorization. This document provides an elaboration and examples of the many methods used to implement the recommendations contained in the Safety Guide. This document also complements IAEA technical documents on specifications for simulators IAEA-TECDOC-995 [12]; the guidebook on NPP personnel training Technical Report Series No. 380 [2]; training the staff of the regulator IAEA-TECDOC-1254 [3]; and means for evaluating and improving the effectiveness of training IAEA-TECDOC-1358 [13]. Since this document emphasizes the use of a simulator for the authorization of control room personnel, it is recommended that readers first become familiar with the overall use of a simulator in the training of personnel that is addressed in IAEA-TECDOC-1411 *Use of control room simulators for the training of nuclear power plant personnel* [4]. In addition, this document discusses the use of written, oral, and performance examinations; and readers can use it in conjunction with an IAEA document providing guidance for the development and implementation of competency assessments for nuclear industry personnel, that is expected to be published in 2006 [5].

1.4. Structure of the publication

This publication considers the methods for the authorization of nuclear power plant control room personnel with an emphasis on the use of simulators in the authorization process. There is also a brief description of written examinations, oral examinations, and walkthrough examinations, and the process for re-authorization of control room personnel. It is therefore applicable to operating organizations, regulatory bodies, and other organizations involved in the authorization of control room personnel. Throughout this publication the abbreviation NPP means the operating organization of one or more nuclear power plants and any associated training organization.

The main text of the publication is contained in six sections, including this introduction. Section 2 is an overview of the authorization and re-authorization processes. Section 2 also summarizes the responses received to a questionnaire used to obtain information on current practices in the authorization of control room personnel as well as a summary of the responses to a survey to obtain information on the use of simulators in the authorization process. Section 3 describes the applicable examination methods. Section 4 details the simulator examination processes. Section 5 describes the selection and training of the various individuals involved in the examination and assessment processes. Section 6 provides some concluding remarks based on Member State practices.

The six printed sections are followed by a list of publications referred to in this publication and twenty-eight appendices giving examples of relevant documentation. Annex I contains the questionnaire sent to Member States on their authorization practices. Annex II contains the survey sent to Member States on the use of simulator assessments in the authorization process as well as the involvement of NPP and Regulatory Body (RB) organizations in the assessment process. Annex III gives the contents of the accompanying CD.

The CD-ROM that accompanies this publication contains over 50 reports — submitted by various organizations and experts from the IAEA Member States — with examples of publications that are used or related to the authorization of control room personnel. The material is submitted in English or in the language of the Member State.

1.5. Terminology

The terms related to the authorization of control room personnel, as used in this report, are consistent with the terms introduced in the IAEA-TECDOC-1358 [13]. For convenience, key terms used here, or terms that may require clarification, are given below.

Assessment – A structured activity by which the knowledge and/or skills and/or attitudes of an individual are measured using one or more methods. The exact purpose of assessment (confirming competence, predicting future performance etc.) determines which assessment method is used. Assessment is often conducted at the end of a training session or course to determine the extent to which trainees have met the training objectives.

Assessment Method – A method of assessing an individual or group. A Multiple-Choice Question, Essay-type Question, Oral Question, Assignment, Project, Quiz, Walk-Through and Observation, are some typical assessment methods.

Assessor - An individual responsible for the assessment of trainees, who is fully qualified at, or above, the level to be attained by the trainee in the area to be assessed.

Authorization – Formal authorization is the granting of written permission, usually by a regulatory body or other entity as may be designated by a State, to perform specified activities and to discharge specified responsibilities, or the document granting such permission. (Reference IAEA Safety Guide No. NS-G-2.8, Section 7.1.)

Certification – The process by which an authoritative organization/body provides written endorsement of the satisfactory achievement of competence of an individual. Certification can follow the satisfactory completion of a performance-based training programme or of a theoretical course of study.

Cognitive Domain – One of three areas used to classify learning objectives, containing those relating to knowledge-based mental processes. Also known as the Knowledge Area. The accepted taxonomy (ascending order or level of complexity) within the Cognitive Domain is:

- Knowledge: Recognises and recalls information.
- Comprehension: Interprets, translates or summarizes given information.
- Application: Uses information in a situation different from original learning context.
- Analysis: Separates wholes into parts until relationships are clear.
- Synthesis: Combines elements to form new entity from the original one.
- Evaluation: Involves acts of decision making based on criteria or rationale.

Critical Sequence – A prioritized order in which task elements must be performed to assure successful task performance.

Critical Step – A step within an activity or task that, if omitted or performed incorrectly, prevents the activity or task from being performed correctly.

Critical Task – A task that, if not performed to the specified standard, results in a serious adverse effect upon job performance or safety. Training must be provided for Critical Tasks.

Cue – A prompt, signaling that a response is needed. An initiating cue is a signal to begin responding, performing a task or undertaking a task performance step. An internal cue is a signal to go from one element of a task to another. A terminating cue indicates that no further response is required.

Examination – An assessment in the form of a formal series of questions or tests which trainees must complete, usually in a fixed time and normally under controlled conditions, to ensure there is no unauthorized collaboration. Examinations are often administered at the conclusion of a training course or programme. Less formal tests take place during or after training sessions and lessons.

Full-Scope Simulator – A simulator incorporating detailed modeling of those systems of the referenced plant with which the operator interfaces in the actual control room environment; replica control room operating consoles are included.

Job Performance Measure – A test used to assess the level of performance of a job incumbent or trainee on a specific task, or set of tasks, against pre-determined standards.

Learning Taxonomy – A classification of cognitive, affective and psychomotor behaviours in three taxonomies (hierarchical orders or levels of ascending complexity). Devised by Benjamin S Bloom and his colleagues to interpret teaching, learning and assessment and applied in many training environments. Three Domains or areas are identified, Affective Domain (Attitudes Area), Cognitive Domain (Knowledge Area) and Psychomotor Domain (Skills Area). Also termed Bloom's Hierarchy or Taxonomy.

Licence (for an individual) – An authorization in writing granted by a Regulatory Body to an individual to perform specified work.

Licensed Operator – An individual who possesses a valid licence to operate a specified facility, granted by a Regulatory Body in accordance with the relevant national legal requirements.

Licensing – The issuing of a licence by a Regulatory Body.

NPP – As used in this publication the abbreviation NPP means the operating organization of one or more nuclear power plants and any associated training organization.

Objective Test – A test or assessment in which subjective bias is eliminated by providing the answers to questions as fixed choices. The answers, therefore, require no qualitative interpretation and can be marked with reliability by non-subject specialists or electronically, e.g. by a computer.

Other-Than-Full-Scope Control Room Simulator – A simulator that does not provide the same human-machine interface as does the plant to which it is referenced. The model of the plant thermo-hydraulic and neutronics characteristics may be the same as that of a full-scope control room simulator, or may be less comprehensive. Generally, for a simulator of this type,

the human-machine interface is provided through computer driven displays and either touch-screen or mouse-control of on-screen buttons. These displays and controls may be similar to those of the referenced plant, or may be simplified. Examples of the names given to such simulators have included: Analytical Simulator, Functional Simulator, Graphics Simulator, and Multi-functional Simulator.

Plant referenced simulator – A simulator modeling the systems of the reference plant with which the operator interfaces in the control room, including operating consoles, and which permits use of the reference plant procedures. (From reference [9].)

Reference plant – The specific nuclear power plant from which a simulation facility's control room configuration, system control arrangements, and design data are derived. (From reference [9].)

Validity – In examinations, the degree to which an examination measures what it purports to measure. (From reference [9].)

Walk-through – A method of oral assessment in the trainee's work area where the assessor(s) and trainee "walk through" or alongside the plant and the assessor(s) asks the trainee questions relating to items of equipment or plant relevant to the trainee's training objectives.

2. OVERVIEW OF THE AUTHORIZATION PROCESS OF THE CONTROL ROOM PERSONNEL

2.1. Positions of the authorized control room personnel

The identification of personnel to be formally authorized is described in the IAEA Safety Guide NS-G-2.8 *Recruitment, Qualification and Training of Personnel for Nuclear Power Plants* [1] which states the following in paragraph 7.8:

"As a minimum, the persons who occupy the following positions should be formally authorized:

(1) The shift member(s) designated to directly supervise operation of the plant or of the unit and who decides on safety related measures during normal operation, incidents or accidents, gives commands to the shift and is responsible for the safe performance of the unit (that is, the shift supervisor and the deputy shift supervisor, who may take over these functions).

(2) Operators who handle safety related instrumentation and control equipment (that is, the reactor control room operator)."

Persons belonging to the first group of personnel (item (1) above) may be, for instance, plant shift supervisors, unit shift supervisors, shift technical advisors or safety engineers. In one Member State even some nuclear power plant personnel nominated for the emergency team are authorized.

Persons belonging to the second group (item (2) above) are, in particular, reactor operators/ primary side operators/ senior engineers on reactor control. In some Member States turbine operators/ secondary side operators/ senior engineers on turbine control are also included in

this group of personnel. In a few Member States there are additional authorized or certified job positions/functions, e.g. field operators, control room physicists or senior electricians.

Deputies to these job positions or substitutes to authorized persons generally need the same authorization for the function to be fulfilled.

As stated in Section 7.1 of NS-G-2.8 and as used in this publication, authorization means the following:

> Formal authorization is the granting of written permission, usually by a regulatory body or other entity as may be designated by a State, to perform specified activities and to discharge specified responsibilities, or the document granting such permission.

The terms "authorize" and "license" are used interchangeably in this publication, while the term "certify" is used when the nuclear power plant grants the authorization.

As part of a questionnaire used to obtain information from Member States on methods for authorization of control room personnel (see Section 2.6 for a summary of the questionnaire responses and Annex I for a copy of the questionnaire) all responding Member States identified control room positions that must be authorized or certified.

In general the responses to the questionnaire identified a wide variation in the job titles or names of the positions. However, in all cases, supervisory positions were identified as well as control room operator positions. The following Table 1 was developed based on the Member State responses and lists the various positions within the control room that are required to be authorized. Appendix I contains a summary of the abbreviations used for various job positions identified in Table 1. Some Members States use the terms license or certification, however, in this report the term authorization is used interchangeably with the term license. The term certification is used only when the responsibilities reside with the NPP.

TABLE 1. CONTROL ROOM AUTHORIZED JOB POSITIONS

	Plant/Dual Unit Shift Supervisor	Unit Shift Supervisor	Deputy Shift Supervisor	Senior Reactor Operator	Control Room Operator[3]	Reactor Operator [1]	Turbine Operator[2]	Special Positions
Brazil		X				X	X	SF
Bulgaria[6]	X	X				X		
Canada	X	X	X[9]		X			
China	X	X	X			X	X	Electrical operator
Czech Republic	X	X				X	X	CRP, SE, FP
France	X	X			X[8]			SSS, SE, PIEP
Germany		X	X			X		

	Plant/Dual Unit Shift Supervisor	Unit Shift Supervisor	Deputy Shift Supervisor	Senior Reactor Operator	Control Room Operator[3]	Reactor Operator [1]	Turbine Operator[2]	Special Positions
Hungary		X				X	X	Sen Electr
India	X		X[11]		X[11]			
Japan		X[10]				X		
Korea		X				X		STA
Lithuania	X	X		X				STO, SUO
Mexico		X	X			X	X	
Pakistan		X	X	X		X		
Romania		X			X		X	CRA
Russia		X				X	X	SENPPUC[4]
Slovakia		X				X	X	HRU, SE, CRP
Slovenia		X		X		X	X	STA
Spain	X	X			X[12]	X[12]	X[12]	
Sweden		X				X	X	FO
Ukraine		X				X		RDSS, UO[5]
USA	X[7]	X[7]		X		X		

Remarks:

(1) Reactor Operator (RO) ≈ Primary Side Operator (PSO) ≈ Senior Engineer on Reactor Control (SERC).

(2) Turbine Operator (TO) ≈ Secondary Side Operator (SSO) ≈ Senior Engineer on Turbine Control (SETC) ≈ Balance of Plant Operator (BOPO) ≈ Secondary Control Area Operator (SCAO).

(3) CR operators may be either primary or secondary side operators, or both (CA).

(4) For RBMK: Senior Engineer on NPP Unit Control (SENPPUC) ≈ Senior Unit Operator (SUO).
In addition, for all Russian NPPs the employees who occupy the following non-control room positions must be authorized on corresponding CR positions if their job descriptions contain the requirements to substitute for the CR personnel positions at least in some cases: Reactor shop shift supervisor (RSSS), Turbine shop shift supervisor (TSSS), and NPP shift supervisor (NPPSS).

(5) RDSS in all Ukraine NPPs except Zaporizhzhya NPP. UO for Zaporizhzhie NPP only.

(6) The RB defines the functions and the NPP submits a list of the position names that will perform these functions, for RB approval.

(7) In the US the Dual/Unit SS's must be authorized as an SRO.

(8) At EDF a CR operator may be either primary or secondary operator depending on the shift organization an turn over. The authorization is general and covers these two positions.

(9) CRSS is a "Control Room Shift Supervisor", supervising only the control room staff.

(10) For the shift supervisor, a certification is required by law.

(11) The Deputy SS, in India, is called an Assistant Shift Charge Engineer for Fuelling (F) or Operations (OP). The Control Room Operator, in India is called a Control Engineer (F) or (OP).
(12) The license allows operating the controls in CR. However, the license may be released with the restriction to only operate the reactor=NSS controls (Reactor Operator) or to only operate the Balance of plant controls (Turbine Operator)—Spain.

The responsibilities of control room personnel can be broadly described as monitoring and control of plant systems, and supervision of the plant operation, from the control room in all operational modes in accordance with relevant rules, operating and administrative procedures and technical specifications to ensure safe and reliable operation of the nuclear power plant. For each position in the control room, specific duties and responsibilities are defined. In addition to a summary of abbreviations, Appendix I also contains a brief statement of the responsibilities for each of the positions. Unless specifically trained and authorized, a person authorized for one job position is not permitted to substitute for another authorized job position.

The requirements for the selection and training of control room personnel are normally defined in Member States regulations and related regulatory documents and country specific standards. Items 10, 20, 21, 22, 24, 29, and 34 listed in Annex III, Part 5 are examples of the regulations and standards from several Member States. References [7] and [8] are examples of country specific industry standards that contain education, experience, and training requirements.

The minimum number of personnel required to be in the control room during different modes of operation are also included in regulatory documents. Annex III, part 5, Item 35 is an example of minimum control room staffing requirements that addresses single unit and multiple unit nuclear power plant sites.

2.2. Elements of the authorization process and responsibilities of the plant and regulatory body

The responsibility for the authorization of control room personnel varies among all of the Member States. The following lists the general responsibilities for the major elements in the authorization process:

- Qualification requirements (e.g. education, experience, training, medical) supplemented by industry standards: Regulatory Body (RB).
- Conducting training including on-shift experience: NPP or separate training center.
- Examinations:
  - Preparation: RB and/or NPP.
  - Review and Approval: RB may review and approve examinations prepared by NPP.
  - Conducting/Administration of examinations: RB or NPP, and sometimes jointly.
  - Grading: RB or NPP and sometimes jointly.
- On-shift experience (doubling/co-piloting/shadowing): NPP CR personnel.
- Issuance of Authorization: RB.
- Maintenance of conditions of authorization (medical, proficiency, continuig training): NPP CR personnel.

— Periodic examinations and reauthorization: RB and NPP and sometimes jointly.
— Inspections and Audits: RB and/or NPP.

The authorization process generally includes written, oral, and operating/performance examinations (see Section 3 and 4). For each of the examination elements the responsibilities of the RB and NPP may vary depending on the type of examination. The responsibilities of the RB and the NPP for initial authorization and re-authorization examinations also vary, but the trend is for the NPP to be given more of the responsibilities for the re-authorization examinations with the RB providing reviews and inspections of the training programmes and the examinations.

Appendix II contains several diagrams of the initial authorization process. Appendix III and Appendix IV are examples of steps in the process of developing and administering an examination.

Section 2.7 contains specific information for the above elements related to simulator based authorization examinations. The Member State responses to the questionnaire and the summary of these responses in Section 2.6 provide country specific practices for other types of examinations.

2.3. Documentation related to the authorization process

The types of documentation related to authorization include (but are not limited to these):

— regulations addressing education, experience, medical, psychological, fitness for duty (drug and alcohol testing), training, and examination requirements, and authorization administrative details;
— regulatory guides or other regulatory documents that expand on the regulations;
— national or utility standards on medical requirements, psychological examinaitons, simulator requirements, and personnel selection, training and qualification requirements;
— examination procedures and standards (Appendix V is one example of the table of contents of a assessor standard);
— inspection and audit procedures (items 36, 37, and 38 listed in Annex III, Part 5, are examples of such inspection procedures);
— records related to each individuals authorization.

2.4. Initial authorization

2.4.1. Preliminary requirements for entering the authorization programme

The IAEA-TECDOC-1063 *World survey on nuclear power plant personnel training* [6] identifies the education and experience requirements for control room personnel for 20 Member States who participated in the survey. Almost all Member States require a university degree for control room personnel and 4-6 years of relevant experience. Two Member States reported a high school/secondary school diploma as the minimum education requirement for control room positions. Appendix VI is an example of education and experience requirements. In the questionnaire developed for this report most Member States also identified that a medical examination was a preliminary requirement and some Member

States also indicated that psychological examinations were also required. Appendix VII is an example of a medical examination form that must be completed and submitted to the regulatory organization. Most Member States conduct extensive interviews during selection of candidates and some also use aptitude tests.

2.4.2. Initial training programme and topics for initial examination

In order to be eligible to apply for and take the examinations required for initial authorization, Member States require that an initial training programme must be completed. The IAEA-TECDOC-1063 *World survey on nuclear power plant personnel training* [6] also contains information on the length of initial training programmes for control room personnel. However, the survey reported a very wide range in the length of the initial training programmes. This variation is probably due to the difference in initial education and experience requirements for the control room job positions and also on whether personnel selected for control room positions must first receive training and qualify as a field operator in the nuclear power plant. For example, since the content of a field operator training programme (typically about one year) covers topics also applicable to the control room operator job position, the length of the reactor operator training programme may be shorter in those Member States that require qualification as a field operator before entry into the reactor operator training programme. While a definitive length for an initial training programme is difficult to specify exactly, in general the length of the initial training programme for a control room operator and a control room turbine operator entry level position in the control room is a minimum of one year. The training programme consists of classroom, on-job training (OJT) in the plant, simulator training, and self-study. The IAEA world survey [6] also reported 20–50 % classroom, 30–50 % simulator training, and the remainder OJT and self-study for a typical initial training programme for a control room operator job position. The survey also indicated that all Member States base the content of their training programmes on the Systematic Approach to Training as described in reference [2] and summarized in Section 3 of this publication.

As described in reference [1], the goals of initial training programmes include the following:

- "to complement any formal education in the general areas of technology and science;
- to provide an understanding of safety management, procedures and standards of performance;
- to impart a knowledge of nuclear technology and of the plant concerned;
- to provide an understanding of the principles of operating and maintenance of specific plant systems and equipment;
- to develop specific skills relating to the job assignment;
- to emphasize safety aspects of te plant in general and specific safety aspects relating to the tasks assigned;
- to inculcate appropriate attitudes towards safety."

The IAEA-TECDOC-1411 *Use of control room simulators for training of nuclear power plant personnel* [4], contains several examples and outlines for an initial training programme for a control room operator. Appendices VIII, IX and X are examples of the contents or the requirements of an initial training programme for a control room operator. Item 17 listed in Annex III, Part 5, is an example of a guideline which provides an approach to simulator training for control room operators.

In a number of Member States, the control room operator position is divided into two or more separate positions, such as one the primary side (e.g. reactor control) and the other for the secondary side (e.g. turbine control). The field operator positions are also separated in a similar way. The entry-level education and experience requirements for the various positions may be different as well as the training programmes. The two job positions each have their own authorizations examinations and personnel in the positions are only permitted to operate the controls for their respective job position (e.g. reactor control or turbine control) unless qualified for both positions. In one Member State (IN) candidates are prepared for the examinations using the guideline documents for control room operators and experienced control room staff (Shift Supervisors).

2.4.3. Initial authorization and special conditions

Upon completion of the initial training programme, authorization examinations are conducted. The preparation, conduct, grading and issuance of an authorization, license or certificate are the responsibility of the regulatory body, the NPP, or a combination of both organizations. Contractor support may also be used by the RB or NPP. Sections 2.6 and 2.7 contain information on individual Member States practices for the authorization of personnel, and Sections 3 and 4 contain information on the various types of authorization examinations used by Member States. In addition to the authorization examinations, several Member States have special requirements that must be met before taking the authorizations examinations or after the examinations are taken but before final authorization is granted. The two most common practices are the following:

On-shift experience requirement:

A number of Member States require that a candidate be assigned to work as an extra person in the control room during routine plant operations for an established minimum length of time *before* being eligible to take the authorization examinations. During this time, the trainee is permitted to operate plant controls under the direct supervision of an authorized control room person. The on-shift experience is in addition to the normal on the job training received during the initial training programme. The length of time for the on-shift experience ranges from 3 to 6 months.

Doubling requirement:

A number of Member States require that a candidate be assigned to work as an extra person in the control room during routine plant operations for an established minimum length of time or number of shifts *after* taking the authorization examinations. During this time the candidate is allowed to operate plant controls under the supervision of one, or in some cases two, authorized control room person(s). This practice is referred to as doubling or co-piloting. The length of time for the doubling is normally from 1 to 2 months (in a one case it is 6-12 months) or the number of shifts is specified (e.g. 12 shifts). The time period may also be different for operator and supervisor positions. Doubling is also used when changing job positions. In addition, the doubling may occur before or after the authorization is granted by the RB but the final NPP authorization is granted only after the doubling.

The purpose of these two practices is similar (to gain hands-on experience as a team member). The doubling practice after authorization is required in some Member States because a trainee is not allowed to operate plant controls, even under supervision, during initial training. With the current availability of full-scope simulators, trainees now are able to receive extensive hands-on training with either practice.

Appendix XI is an example of a form that must be submitted to the regulatory organization when applying for an authorization. Appendix XII is an example of a letter granting an authorization.

2.5. Continuing training, reauthorization and special conditions

2.5.1. Continuing training requirements

In order to retain an active authorization, Member States require the individual to participate in a continuing training programme. The IAEA-TECDOC-1063 *World survey on nuclear power plant personnel training* [6] also contains information on the length of continuing training programmes for control room personnel. The median and average training hours per year reported were 183 and 193 hours per year, respectively, for a control room reactor operator. The number of continuing training hours for the plant shift supervisor and unit or control room supervisor were similar, which is indicative of the continuing trend to train control room personnel as a team both in the classroom and on the plant's simulator.

Continuing training programmes are structured commensurate with the specific control room assignment and are usually conducted over a two-year cycle. Continuing training programmes for control room personnel typically consist of preplanned classroom training, on-job training, and simulator training on a regular and continuing basis throughout the two-year period. The world survey [6] indicated a range of classroom and simulator training of about 25–50% each (typically ~ 100 hours or more of simulator training), with the remainder of the training on the job or self-study. As described in reference [1], continuing training programmes include topics such as:

- "improve the knowledge and skills of personnel when changes in the scope of jobs are identified;
- maintain and, in selected areas enhance the skills and knowledge necessary to accomplish routine, abnormal, and emergency duties;
- increase the level of understanding of selected applied fundamentals that were presented in initial training, with emphasis in areas of demonstrated weakness;
- maintain an awareness of the responsibility for the safe operation of the plant and the consequences of negligence and faults;
- correct deficiencies in personnel performance that have been determined through the analysis of plant operational experience;
- maintain personnel's knowledge of appropriate plant modifications and procedure changes for areas in which they are assigned;
- emphasize lessons learned from industry and plant specific operating experience to prevent the repetition of errors;
- emphasize subjects identified by managers and supervisors;
- enhance the performance of operational personnel through timely training for infrequent, difficult and important operational tasks."

Reference [4] contains examples of simulator training programme content and example scenarios used for training. During the continuing training programme authorized personnel may receive periodic written, oral, and performance examinations that are prepared and conducted by the NPP or its associated training center. Reference [10] is an example of a

Member State standard for continuing training of authorized control room personnel. Appendix XIII is an example of continuing training and examination requirements.

2.5.2. Special conditions and re-authorization

In order to maintain an authorization, several conditions have to be met. These may include:

- participation in the continuing training programme;
- periodic examinations;
- medical and psychological fitness;
- performance of the job functions;
- formal re-authorization on some fixed time period (e.g. 2–6 years).

With respect to performance of the job functions, most Member States require that the authorized person perform the duties of the job position for minimum number of hours or operating shifts. This practice is referred to as a proficiency requirement in some Member States. The following are some typical examples:

- two weeks every six months;
- three shifts per quarter;
- seven 8-hour or five 12-hour shifts per quarter;
- twenty shifts per year.

In addition, restrictions are commonly placed on the length of time a person may be assigned to a job position outside the control room or be absent from authorized job duties. This period is usually up to one year and may vary depending on the job position, its complexity, the particular individual and his/her assignment, the number of changes to the plant that may have occurred during the individual's absence, etc. Upon return the person must be evaluated and/or receive refresher training on selected topics such as plant changes and usually has to perform the duties of the job position under supervision, for a minimum time period, such as 40 hours. Periodic medical examinations are also normally required.

The time period for validity of an authorization, license, or certificate varies among Member States. The authorization validity ranges from 2 to 6 years. However, irrespective of the length of time, participation in a continuing training programme that is typically based on a two-year cycle is required. The NPP is also usually required to prepare and conduct periodic written, oral, and performance (e.g. simulator, Job Performance Measure (JPM), walkthrough) examinations. For example, annual simulator examinations may be required and biannual written examinations. Section ES-601 of reference [9] and item 5 listed in Annex III, Part 5, are examples of reauthorization examination requirements and procedures. Appendix XIV is an example of portions of a procedure for the written reauthorization examination.

2.6. Summary of responses

With the assistance of an international team of experts, a questionnaire was developed to obtain more detailed information on current methods and practices for the authorization of control room personnel. The questionnaire (Annex I) was sent to potential respondents representing the Member States' operating organizations, NPPs, utilities, nuclear facilities,

training centres, and organizations involved in rendering training services for nuclear power plants and nuclear facilities. Responses from eighteen countries were received, collated and analyzed by the international experts. A summary of these responses is presented in this section. The actual responses to the questionnaire may be found in Annex III, Part 5, on the CD ROM that accompanies this publication.

In the summary of the completed questionnaires given in the following paragraphs certain countries are identified as following particular practices. It should be emphasized, that to keep this section within a reasonable size, examples of only a few of the responding countries are quoted; in many cases other countries, not quoted, follow similar practices. However, the identification of a specific country will enable the reader to refer to the appropriate name in Annex III, and from there, to the relevant sections of Parts 5 on the CD to obtain further details on the authorization process in that country.

In quoting Member States of the IAEA in this section, abbreviations or code elements taken from the International Standard Codes for the Representation of Names of Countries (ISO-3166 Part 1: 1997 [11]) have been used in preference to stating a country's full name. The relevant code elements are identified in the Abbreviations and Code Elements section of this publication.

The summary of responses from Member States to the questionnaire is presented by first listing the question followed by a summary and analysis of the responses received. In addition, in order to facilitate development of the following summary information, tables were developed for each of the twelve questions. These tables are also included on the accompanying CD-ROM.

Q.1 *Please briefly describe the job positions (titles, duties, etc.) of the CR personnel that must be authorized.*

All Member States identified control room positions that must be authorized. There was a wide variation in the job titles or names of the positions. In all cases, supervisory positions were identified as well as panel operator positions. The positions can be grouped into the following two categories of personnel who are in the control room or control room area:

- Shift Supervisors (e.g. Shift Control Engineer, Shift Manager, or Shift Charge Engineer, Unit Shift Supervisor, CR Shift Supervisor).
- CR operators, which can be reactor operators, turbine/balance-of-plant operators, or operators responsible for all plant systems.

In a number of Member States, positions outside the control room are also authorized such as, but not limited to CR physicist (CZ), Safety Engineer (CZ, FR, SK), Fuel Physicist (CZ) and Radiological Protection Supervisor (ES).

Section 2.1 and Appendix I contain tables that identifies the job titles and abbreviations, respectively, used by each Member State. These tables were derived based on responses to question 1 as well as the responses to the simulator examination table, discussed further is Section 2.7.

Q.2 *After initial authorization, is re-authorization periodically required? If yes, what is the frequency?*

In almost all the Member States, re-authorization is required by the regulator. In most of the cases, it is required every 2 or 3 years but it may vary from 1 to 6 years depending on the Member State requirements. In one Member State the period required for re-authorization is dependant on the particular job position. In some Member States the authorization frequency is extended after the first re-authorization (e.g. period changes from 6 to 8 years). The extension is usually based on job performance. For example, in one Member State (UA) the extension (to 4 years) is based on having no violations or claims from the RB. The regulator is involved in the re-authorization process, but in some cases, re-authorization is performed by the NPP (FR, GB, JP, SE) or with the support of the Training Division (FR).

In GB, the re-authorization is not required by the regulatory body, however, the line managers supported by simulator staff continuously monitor individual and team performance on the simulator and in the work place. Any necessary training or reassessment is conducted. A similar process is used in Japan and Sweden.

In DE there is also no re-authorization required by the regulatory body, but the persons in charge of the authorised shift personnel must regularly assess their personnel according to the "Guideline for programmes for maintaining the technical qualification of responsible (authorised) shift personnel in nuclear power stations". This assessment is based on systematic observation of the performance of duties, discussions after lectures and seminars and observation of simulator training by operation department managers or head of Training and Qualification Department and qualified trainers from simulator trainings centre. On completion of a three-year programme (cycle for continuing training), the success of the training must be individually assessed and reported to the regulatory body. The operation department head confirms that the CR personnel concerned are still authorised.

Q.3 *Are there any special requirements that must be met in order to obtain an initial authorization (e.g. doubling) or retain a current authorization (i.e. participation in continuing training, participation on shift for a specific amount of time each month, quarter or year)? Please describe or provide a copy of the requirements.*

All Member States require completion of initial training as a precondition for initial licensing examinations and that participation and completion of continuing training is necessary to retain an individual's authorization or license. Passing a medical examination was also reported as being required by most Member States either directly in the responses to the questionnaire or in the supplementary material provided. A number of Member States mentioned education and experience requirements in response to this question.

Of particular interest were any special requirements such as doubling, on-shift experience, or proficiency requirements. Prior to initial authorization a number of Member States (DE, FR, MX, RO, RU) require a period of time to be spend on-shift **after** the authorization examinations are completed and passed and usually before the trainee is allowed to independently operate the plant controls. This is commonly referred to as "doubling". This time period varies from 1–2 months or is defined by specifying a specific number of shifts (e.g. 12 shifts) that must be completed. The time periods also vary depending on the job position (reactor operator, shift supervisor). Some other Member States (BR, CA, CN, CZ, ES, IN, MX, SK, US) require a period of on-shift experience to be completed **before** the authorization examinations are taken. This period of on-shift experience is normally performed after the trainee completes most of the initial training programme classroom, OJT, and simulator training. While on-shift the trainee participates in all phases of day-to-day operations and is permitted to operate the controls of the plant only under direct supervision.

The time period for this on-shift experience varies from 3 to 6 months. One Member State (FR) indicated that doubling (3–12 months) is a practice and not a RB requirement.

In order to retain a current authorization, a number a Member States (ES, GR, MX, PK, RO, SE, US) require a specific number of shifts (sometimes referred to as "watches") to be performed or time periods that an individual must be on-shift. The number of shifts required is specified on a quarterly or yearly basis (3–7 shifts/quarter or 20–40 shifts per year). One Member State (DE) specifies the proficiency requirement in the following way: "If shift supervisors or reactor operators have not performed this function for at least a total of two weeks within a period of six months, they must undergo a training period of at least one week before redeployment. If the function concerned has not been performed for more than six months but less than a year, at least two weeks training is required before redeployment. If the function concerned has not been performed for more than a year, the technical competence examination must be repeated". Another Member State (ES) indicated that no longer than a one-year interruption of the performance of authorized duties was permitted. In some Member States (IN), the reinstatement requirement depends on the length of the time absent from the position.

Some Member States (CZ, RU, SK, UA) also indicated that psychological examinations were required in addition to medical examinations.

Q.4 *Does your authorizing body (regulatory, plant, etc.) conduct any of the following types of initial or re-authorization examinations or tests of your control room personnel? For each type of examination used for initial authorization or re-authorization please identify whether the regulatory body or the plant is responsible, for preparation, review, approval, administration (conducting), and grading of the examination, and who issues the authorization document to the individual.*

The accompanying CD-ROM contains a table which summarizes the Member State responses to each of the four sub-questions listed and discussed below.

Q.4.1 Written *exams?*

YES NO

If "yes", please briefly describe the written exams including:

(a) How frequently are the exams conducted?

(b) What is the "size" of the exam, i.e. how many questions, how many marks?

(c) How do the assessors (examiners) determine the topics and scope of knowledge that is tested (e.g. job and task analysis, job competency analysis, regulatory body requirements, PSA, etc.)?

(d) What style of questions is used [essay, multiple-choice, etc.]?

(e) Is the exam conducted in a 'closed-book' or open-reference setting ["open reference" means the examinees have access to the same operating documentation which is available in the plant's control room]?

(f) What is the pass mark?

(g) Do you make your bank of exam questions and answers available to the control room personnel for study?

In most Member States, written examinations are conducted. In a few Member States (GB, JP, RU, UA), written examinations are not conducted, however, these Member States use oral examinations.

The detailed requirements for the examinations such as frequency, size and pass-mark vary from country to country, however, most written examinations are 'closed-book' with the questions or questions bank made available for the candidates.

The source of topics and the scope of knowledge are based on regulatory body requirements and analysis of plant processes and staff responsibilities (Job and Task Analysis, Job Competency Analysis, and/or Probabilistic Safety Assessment - PSA). In the Member States that replied, the scope of the examination includes Design Basis Accidents.

Q.4.2 *Oral exams?*

YES NO

If "yes", please briefly describe the oral exams including:

(a) How frequently are the exams conducted?

(b) How long is the oral exam, i.e. length of time, how many questions, how many marks?

(c) How do the assessors (examiners) determine the topics and scope of knowledge that is tested (e.g. job and task analysis, job competency analysis, regulatory body requirements, PSA, etc.)?

(d) Are the exams administered by an oral board? If yes, do you have administrative procedures for the conduct of the Board?

(e) Is the exam conducted in a 'closed-book' or open-reference setting ["open reference" means the examinees have access to the same operating documentation which is available in the plant's control room]?

(f) What is the pass mark?

Oral examinations are given by most Member States, however in CA, they may be used only by special request from an NPP to the regulatory body. As discussed in question 4.1 above, in some Member States these examinations are used instead of written examinations.

The detailed requirements for frequency, size and topics vary between Member States. Pass/fail criteria can be clearly defined as in SK (pass mark assigned if all Oral Examination Board (OEB) members give a better than Insufficient Grade of "4", which is >90%) or JP (Pass mark is assigned for an overall mark of 80% and a mark of 60% in each of the four topic areas, with five questions in each area). In GB and the UA, the pass/fail criteria are left mostly to the OEB. In IN, the OEB consists of internal members from the NPP and external members from other bodies. A pass/fail decision is based on a consensus of only the external members.

The topics and scope are generally obtained from Member State documents and regulatory body requirements, and the analysis of plant processes and staff responsibilities (Job and Task Analysis, Job Competency Analysis and/or PSA) as well as the applicable NPP operating procedures.

Q.4.3 *Walkthrough Exams?*

YES NO

If "yes", please briefly describe the walkthrough exams including:

(a) How frequently are the exams conducted?

(b) How is the walkthrough examination administered (i.e. through the use of Job Performance Measure or another method)?

(c) How do the assessors (examiners) determine the topics and scope of knowledge and skills that are tested (e.g. job and task analysis, job competency analysis, regulatory body requirement, PSA, etc.)?

(d) Is oral questioning used during the conduct of the walkthrough?

(e) Are oral questions pre-scripted or prepared in advance of the exam?

(f) What is the scope of the walkthrough exams (i.e. how long, how many JPMs, and/or topics are covered in relationship to simulator exams)?

(g) What is the basis or method of grading and the pass mark?

Almost half of the Member States indicated that they use walkthrough examinations. In RU, two plant sites (one a BN-600 fast breeder reactor, one a EGP-6 reactor) use these examinations in the work place since they do not have a full scope simulator.

Some Member States use walkthrough examinations to test operators on knowledge and skills required outside the control room. Oral questioning is almost always used during walkthrough examinations. In most of the Member States, questions are prepared in advance. One Member State (US) indicated that they use Job Performance Measures for the conduct of the control room and plant walkthrough examinations.

Depending on the Member State, they may perform only oral examinations or walkthrough examinations. In several Member States both oral examinations and walkthrough examinations are performed (BR, IN, MX, PK).

Q.4.4 *Simulator-based tests?*

YES NO

If "yes" please briefly describe the simulator-based tests, including:

(a) How frequently are the tests conducted?

(b) How do the assessors (examiners) determine the topics and scope of knowledge and skills that are tested (e.g. job and task analysis, job competency analysis, regulatory body requirement, PSA.)? Are attitudes assessed? If yes, how?

(c) What is the scope of the test scenarios? [for example: do the scenarios cover exclusively abnormal and emergency events, or do they include some normal operations?]

(d) Do you have specific requirements for the number of malfunctions, transients, required operator actions, etc., to be included in an examination scenario? If so, please describe or provide the procedure or guidance you use for preparation of scenarios, if possible.

(e) Do you do individual testing, team testing, or a combination of these tests?

(f) If you perform team testing, is the team composed of the same number of staff as would normally be present in the control room?

(g) If a team is tested, is each operator on the team evaluated, or is only team performance evaluated?

(h) How many assessors (evaluators) are used?

(i) Is a written assessment (evaluation) guide used by the assessors (evaluators) during the test?

(j) If a written assessment (evaluation) guide is used, what is the level of detail in the guide? [i.e. does the guide describe the expected actions of each person to be evaluated?]

(k) What is the performance basis for the assessment (evaluation)? [For example, in the US NRC document NUREG-1021 "Operator Licensing Examination Standards for Power Reactors", simulator-based assessment of licensed operators is based on "Critical Tasks" and "Generic Competencies"].

(l) What are the pass/fail criteria? Is each operator subject to a pass/fail decision or does the whole team pass or fail?

Simulator Based Tests (SBT) are required by the regulatory body for the authorization of control room operating staff by most Member States. At the time of this questionnaire SK planned to implement formal requirements for SBT in 2005. At the present time, UA has no regulatory body requirements for SBT, however they do use simulator-based tests for operator training as well as individual and team assessment. In the future, they plan to use simulators as an official part of the authorization process. The details of the current practices in UA can be found in their response to the questionnaire on the CD-ROM.

The frequency, the topics and the scope of scenarios are different from initial authorization to re-authorization and from one Member State to another.

Both individuals and teams can be tested, as well as the individuals in a team setting. To focus on individual performance, walkthroughs and or JPMs are used where other control room staff does not support the candidate. The range of individual and team testing by Member States was as follows:

- individuals in a team setting — 4 Member States;
- individuals- 7 Member States;
- individuals and Teams — 7 Member States.

Two Member States indicated that there are pass/fail criteria for a whole team (UA, but not yet an official part of the RB license evaluation; and US), the remainder perform "team assessments". These numbers were summarized for all Member State replies that provided specific individual and team assessment information, not just those where full scope simulators are used for formal authorization purposes.

Most of the Member States use scenario events from normal, abnormal and emergency operations in response to events within the plant's safety envelope or the Member State equivalent.

Q.5 *Do you have requirements for the education, experience, training, or special requirements (e.g. certification of assessors) of assessors (examiners)? If yes, please describe or provide an example of the education and experience requirements. For training, please discuss or provide examples of course outlines, table of contents, etc. In particular, examples of the training of assessors (examiners) on test development and observation skills.*

For many Member States reporting the use of Examinations Boards (see question 6), no formal training requirements for the board members are established. Board members generally must meet, as a minimum, the qualifications for the job position they hold such as Operations Manager, Supervisor, etc. and are selected based on their experience. Where Boards are used a number of Member States (PK, CN, KO) reported that they require Board members to hold or have held a reactor operator or senior reactor operator license (authorization) for those members with a high school education or a university degree and related nuclear power plant training and/or experience. One Member State (PK) requires a university degree, a license as a senior operator, and advanced simulator and classroom instructor training.

Where examination boards are not used (BR, MX, SE, US), assessors are generally required to hold or have held a reactor operator license and complete classroom instructor training or simulator instructor training depending on their assessor duties. One Member State (MX) requires assessors to have a university degree and has a very well defined training programme that includes topics such as observation skills training.

Q.6 *Do you use Examination Boards? If yes, please describe or provide examples of membership, duties, and responsibilities. Also describe or provide an example of the education and training, or any other special requirements for Board members.*

Twelve Member States use an Examination Board in the authorization process. The membership and the specific functions of the examination boards in the authorization process vary. The following are the major variations:

- Membership composed of all regulatory personnel (KO). In ES, one of the members is proposed by the NPP.
- Membership composed of regulatory and NPP personnel (CN, CZ, DE, HU, PK, RO, RU, SK, UA).
- Membership composed of all NPP personnel (FR).
- Membership composed of regulatory, NPP, and central training organization personnel (SK).
- Membership composed of independent training centre (JP).
- Preparation and conduct of the written examinations (ES); conduct (CN, CZ, RU,).
- Preparation and conduct of simulator examinations (KO), conduct (CN, CZ, HU, RO).
- Conducting oral examinations or interviews (CN, CZ, DE, HU, JA, KO, RO, RU, SK, UA).

Six Member States (BR, CA, GB, MX, SE, US) do not use Examination Boards. In these Member States the authorization examinations (written, oral, walkthrough, or simulator) are developed and administered either by the regulatory body, the NPP training centre, or a central training centre organization (see question 4). One Member State (GB) reported using a Nuclear Training Board to oversee the overall training programmes.

Q.7 *Please provide or describe any laws, ordinances, decrees, or other legal provisions relevant to the authorization of CR personnel?*

Most of the Member States have cited and provided different types of documents (regulatory, national standards, examination procedures, etc.) related to the authorization of personnel. The documents written in English have been considered in the development of this technical document. All the documents provided by the Member States are on the CD-ROM that accompanies this publication.

Q.8 *If you use a less than full scope simulator, (e.g. graphical, basic principles, analytical, etc.) please describe how and the extent to which it is used in the authorization process.*

All the Member States responding to the survey indicated that they use full-scope simulators in their training of control room personnel. Several Member States currently do not require use of the full-scope simulator in the authorization process, but plan to in the future. Several of the Member States (CA, CZ, FR, SE, UA) also use less than full-scope simulators such as desktop simulators and analytical simulators in their training programmes. However, no one used the less than full-scope simulators in the authorization examination process.

Q.9 *Do you use contractors for preparing or performing any of the authorization examinations? Please describe.*

For the different Member States the responsibility of the examination process varies between the regulatory body, the NPP, or a combination of both organizations. Most of the Member States do not use any contractor at all in the examination process (CN, CZ, FR, HU, IN, KO, MX, PK, RU, RO, UA). Several countries do use contractors in the examination process. For example, ES uses a contractor to support the examination board during the simulator exam (the regulatory body is responsible) and CA is only using contractors to provide assistance in the preparation of examinations. Three Member States (BR, ES, JP) use independent training centres or contractors that provide training services, including examinations, for the utilities. In DE contractors are used for nuclear fundamentals training and partly for the corresponding examinations.

Q.10 *Do you use any supporting information management technology tools for examination management (e.g. planning, preparation, conduct, assessment, recording of results, etc.) or any other data base management tools? If so, please describe or provide information about the tools used.*

The survey indicated that all Member States utilize standard office software products. Several Members States (CA, CZ, IN, MX, RU) reported that they used examination development software to prepare, conduct, and/or to record the examinations results, although in some cases the software is not yet used for authorization examinations. Products such as “PC-Exam”(MX), “SimScore” and “ExScore” (CA), “VECTOR” (RU) and locally developed software (CZ) were mentioned. A few Member States reported using training record management systems (GB, HU), and others reported using commercial Learning Content Management Systems such as VISION (US) and Plateau (SE, US). These tools provide for the management of training programme analysis, design, and development material as well as trainee records.

Q.11 *Please identify any changes to the authorization process you are planning and any general trends (e.g. authorization procedures, length of exams, types of questions used, simulator scenario content, assessment methods, etc.).*

Almost all of the Member States indicated that they were considering some changes to the authorization process or noted trends or new areas of emphasis in their current authorization processes. The following is a summary of the changes to the authorization process being considered:

- developing a process for the regulatory body to certify the overall training process (BR);
- transferring the responsibility for the examination process from the regulatory body to the utility organization (CA);
- revising the authorization process to be similar to the United States (RO, MX);
- revising the authorization process to include simulator examinations (SK, UA);
- incorporating computer based written examinations as part of the formal examination and not just for preliminary tests (UA);
- updating authorization documents to reflect experience gained since 1986, separating guidance and mandatory requirements, and revising simulator examinations process to reflect that all plants now have plant referenced simulators (ES);
- considering making simulator assessor training mandatory (GB);
- revising the number of questions on initial authorization written examinations and consolidating some of the simulator rating factors and competencies (US);
- completing the revision of utilities certification processes to be fully consistent with the Electric Association Guidelines (JP).

The following are some of the trends noted:

- increasing emphasis on practical skills rather than academic knowledge (CH, KO);
- increasing emphasis on team skills training simulator scenarios for nominal on load operations (GB);
- increasing emphasis on work control system and lock and tagging processes (US);
- continuing the review and updating of written examination questions and simulator scenarios (CN, CZ, IN, US);
- implementing a new data system to manage and track instructor qualifications for all 19 Operations Training Centers (FR).

Q.12 *Please provide or describe any other information you feel would be relevant or useful in the development of the technical document.*

Many Member States provided copies of relevant documents separately from the questionnaire and these are included in the Annex III, Part 5, listing of contents on the accompanying CD-ROM. This information was also in used in the development of various sections of this publication and reviewed to identify relevant examples that have subsequently been incorporated in this publication.

2.7. Summary of the tables concerning simulator based authorization examinations for CR personnel

The IAEA Technical Working Group on Nuclear Power Plant Personnel Training and Qualification suggested the development and distribution of the survey (Annex II) on Member States practices on the use of simulator based authorization examinations for main control room personnel. The Member States responses are included in the accompanying CD-ROM, as listed in Annex III. The results of this survey are summarized in Table 2, and show the organization (licensee, regulatory body) that grants the license or authorization to the candidates and illustrates the involvement of these organizations in the respective examinations, in particular the simulator based examinations.

A summary of the answers from twenty-three Member States[1] leads to the following observations:

In accordance with recommendations in the IAEA Safety Guide NS-G-2.8, the relevant job positions of the control room personnel are authorized by the regulatory body or at least certified by the operating organization in each Member State. In addition there are some positions with advisory functions to the control room personnel which are authorized in some countries. (This advisory function may, of course, also be taken over by persons having an authorization/license for a supervisory function for the unit/plant and working only part time in this function.)

In most cases (more than 2/3 of the cases) the authorizations are granted by the responsible regulatory body, see Figure 1. The responsibility for granting an authorization in a Member State may vary with the job position to be authorized. Whereas, for instance, shift supervisors and reactor operators are authorized by the regulatory body, turbine operators may be authorized or certified by the operating organization. In Figure 1 the lower level authorizations are not considered.

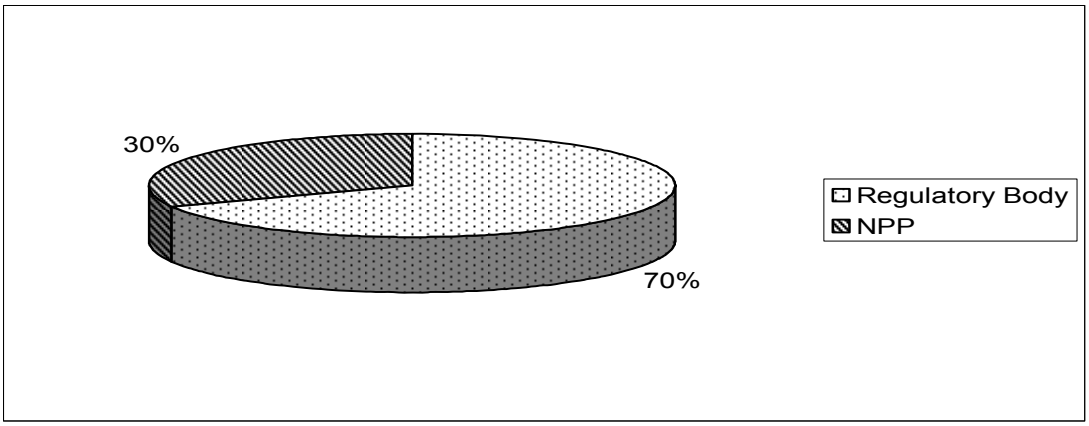


Fig. 1. Authorization/License granting organization.

Even if the regulatory body does not grant the authorization it may be involved in the respective examinations. In approximately 75 % of the responding Member States the regulatory body takes an active role in the respective examinations (see Figure 2).

[1] These are the Member States listed in the table in Annex III, Part 4. For Romania, the information related to shift supervisors and control room operators is used.

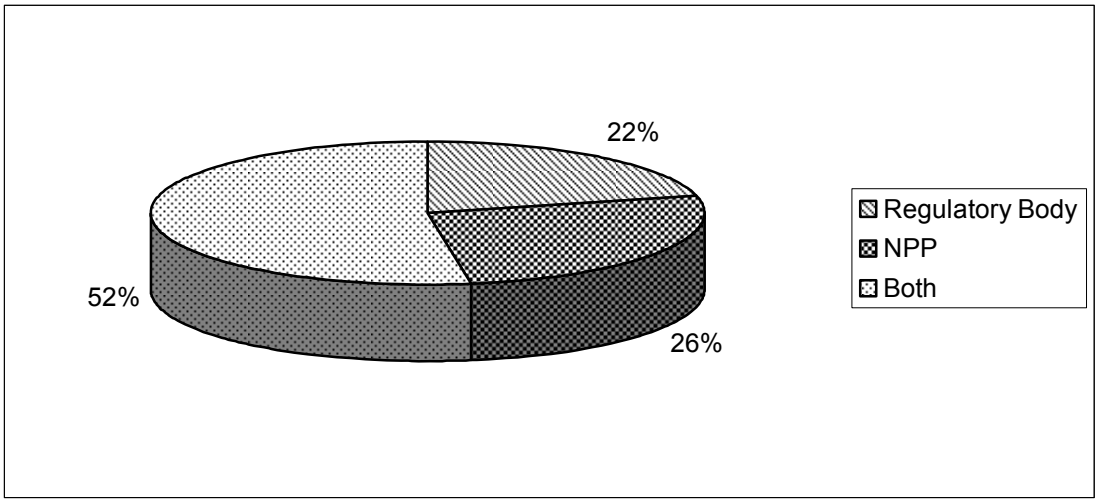


Fig. 2. CR personnel examination involvement.

An important part of these examinations for the two groups of NPP personnel described in paragraph 7.8 of NS-G-2.8 are simulator-based examinations. Such examinations are held by almost all responding Member States. In the few Member States without explicitly required simulator based authorization examinations there are performance assessments of the candidates during regular simulator training. These performance assessments are for instance done by a representative from the respective NPP and a simulator instructor who are especially trained for this task. In one Member State (BU) simulator based examinations as part of the formal authorization process are optional.

The involvement of the regulatory body in these simulator-based examinations varies according to national procedures and according to the job position to be authorized. In one Member State (RO), the simulator based examination for shift supervisors and CR operators is conducted by the NPP and the regulatory body whereas the simulator based examination for the CR assistant (advisory function) is only conducted by the NPP and there is no simulator based examination for the so called "secondary control area operator".

The regulatory body plays an active role (at least as an observer) in the simulator-based examinations in most of the responding Member States which conduct these simulator based examinations. There are only 5 countries among the responding Member States in which simulator based examinations are held without the participation of the regulatory body. In these cases the regulatory body plays only a minor role or no role at all in the authorization process of the CR personnel. The situation in the Member States can be summarized as follows:

— RB involved in the examination (14);
— RB not involved (5) (but may perform reviews or inspections of training programmes);
— assessment during simulator training by instructors and NPP representatives (4).

(According to the answers in Table 2, SK was counted among the 14 Member States in which the RB is involved in simulator-based examinations, as for instance, SK will start SBT in 2005.)

TABLE 2. SIMULATOR-BASED AUTHORIZATION EXAMINATIONS FOR CONTROL ROOM PERSONNEL

Legend: *MCR – Main Control Room; NPP – Nuclear Power Plant; RB – Regulator Body.*

Member State	NPP MCR Staff Licen-sing (formal authori-zation) Re-quired (Y/N)	License Issued by (Y/N)		Examined by (Y/N)		Roles in simulator based examinations											
		NPP	RB	NPP	RB	Observes only (Y/N)		Prepares examination (Y/N)		Conducts examination (Y/N)		Participates in assessment of individual's performance (Y/N)		Issues Results (Y/N)		Ensures compliance with standards (Y/N)	
						NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB
BRAZIL	Y	N	Y	N	Y	Y	N	N	Y	N	Y	N	Y	N	Y	Y	Y
BULGARIA	Y	N	Y	N	Y	N	N	Y	N	N	Y	Y	Y	N	Y	Y	Y
CANADA[1]	Y	N	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y
CHINA[2]	Y	N	Y	Y	N[2]	N	N	Y	Y[2]	Y	Y[2]	Y	Y[2]	N	Y[2]	Y	N
CZECH REP	Y	N	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y
FRANCE [3]	Y	Y	N	Y	N	Y	N	N	N	N	N	N	N	N	N	Y	N

Member State	NPP MCR Staff Licen-sing (formal authori-zation) Re-quired (Y/N)	License Issued by (Y/N)		Examined by (Y/N)		Roles in simulator based examinations											
		NPP	RB	NPP	RB	Observes only (Y/N)		Prepares examination (Y/N)		Conducts examination (Y/N)		Participates in assessment of individual's performance (Y/N)		Issues Results (Y/N)		Ensures compliance with standards (Y/N)	
						NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB
GERMANY[4]	Y	Y	Y	Y	Y	N	N	N	N	N	N	Y	N	Y	N	Y	N
HUNGARY[5]	Y		X	X	(X) (5)			X		X	X	X	X		X	X	
INDIA[6]	Y	Y[6]	Y[6]	Y	Y**	Y*	N**	N	NA	Y*	N**	Y*	N**	Y*	N**	Y^{+}	Y^{++}
JAPAN[7]	Y	Y	N	Y	N			(Y)		(Y)				(Y)		(Y)	
KOREA	Y	N	Y	N	Y				Y		Y		Y		Y		Y
LITHUANIA	Y	Y		Y	Y			Y		Y		Y		Y		Y	
MEXICO	Y	N	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	N	Y	N	Y
ROMANIA[8]	Y	N	Y	Y	Y	N	N	Y	N	N	Y	Y	Y	N	Y	Y	Y

Member State	NPP MCR Staff Licen-sing (formal authori-zation) Re-quired (Y/N)	License Issued by (Y/N)		Examined by (Y/N)		Roles in simulator based examinations											
		NPP	RB	NPP	RB	Observes only (Y/N)		Prepares examination (Y/N)		Conducts examination (Y/N)		Participates in assessment of individual's performance (Y/N)		Issues Results (Y/N)		Ensures compliance with standards (Y/N)	
						NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB
ROMANIA[9]	Y	Y	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y	N
ROMANIA [10]	Y	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
RUSSIA[11, 12, 13]	Y	N	Y	Y	N	N	N	Y	(Y)	Y	N	Y	Y	Y	Y	Y	Y
SLOVAKIA[1 4]	In 2006	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y
SLOVENIA	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y
SPAIN[15]	Y		Y		Y				Y	Y	Y		Y		Y		Y
SWEDEN [16 17]	Y	Y	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y	N
SWEDEN[18]	Y	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N

Member State	NPP MCR Staff Licen-sing (formal authori-zation) Re-quired (Y/N)	License Issued by (Y/N)		Examined by (Y/N)		Roles in simulator based examinations											
		NPP	RB	NPP	RB	Observes only (Y/N)		Prepares examination (Y/N)		Conducts examination (Y/N)		Participates in assessment of individual's performance (Y/N)		Issues Results (Y/N)		Ensures compliance with standards (Y/N)	
						NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB
UK[19]	Y	-	-	Y	N							Y	N			Y	
UKRAINE[4]	Y	N	Y	Y	Y	N	N	Y*	N	Y*	N	Y	N	Y	N	Y	N
USA[20]	Y	N	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y

COMMENTS:

[1] Simulator-based authorization examinations in Canada are in a state of transition. Some examination responsibilities have been given to licensees. Examinations are prepared and conducted jointly by the NPP and RB. The CNSC maintains an active role to ensure compliance. In the maturity situation, the licensees will conduct the examinations with CNSC Compliance oversight. The CNSC will still review the authorization applications and issue certifications.

[2] The Regulatory Body (NNSA) is not involved in the exams but another governmental body prepares, conducts etc. the exams.

[3] At EDF, the appropriate expression used is "nuclear safety habilitation" instead of "license". This formal authorization is required by the Regulator.
The decision to "habilitate" is under the responsibility of the Plant Manager (and accordingly the authorization is not directly led or granted by the Regulator). It is made based on real life activities at the plant and on the results of the examinations made at the EDF Training and Development Division – SFP. With regard to the habilitation EDF has an official agreement from the Regulator. Internal inspections (by the EDF Nuclear Inspection Department) and external inspections (by the Regulator) are regularly performed in order to guarantee the conformity and efficiency of this device. So the roles and responsibilities between EDF and the Regulator in the authorization process are clearly identified. Each side is involved in the authorization process. In the scope of the training environment, the examination on FSS is totally prepared, conducted and under the entire responsibility of SFP which has the agreement from the EDF/DPN (based on training requirements) and the Regulator.

[4] Since Training Centres in Ukraine are NPP's subdivisions all actions of Training Centre considered as "NPP" involvement. * Simulator exit examination is an obligatory condition for permitting to formal examination, thus, could be considered as a part of exam. Performance assessments by an NPP representative (e.g. training manager, operation manager) and the simulator instructor are made periodically during simulator training and at simulator exit test.

[5] The participation of the regulator on exams is not mandatory.

[6] The NPP issues the license based upon the recommendations of the Regulatory Body

* As a part of authorization by NPP as per approved procedure.
** Regulatory Body audits evaluation aspects of written exams and other prerequisites and are responsible for oral examination.
[+] This is done by NPP according to corporate approved guidelines. NPP reports to Head quarters about the actual content of the performed training programme.
[++] Regulators audit the implementation of the guidelines on random sampling basis during their audit visit.

[7] Certification is required by law for shift supervisors. Training centers (independent organizations by electric utilities) conduct the respective certification examinations and send the results to the utilities. JEAG 4802-2002 requires the following three areas for the simulator-based examination: a) plant operation in normal conditions (e.g. critical approach operation); b) judgment at abnormal conditions; and c) countermeasures at abnormal conditions.

[8] For shift supervisor and control room operator.

[9] For control room assistant.

[10] For secondary control area operator.

[11] The employees, who occupy the following positions, are not the CR personnel, but they must be authorized on corresponding CR positions if their job descriptions contain the requirements to substitute the CR personnel positions at least in some cases:

- Reactor shop shift supervisor
- Turbine shop shift supervisor
- NPP shift supervisor

[12] Inter-regional territorial division of Rostechnadzor (Russian regulatory body, formerly Gosatomnadzor) should beforehand approve the examination themes prepared by NPP examination team.

[13] Two representatives of the inter-regional territorial division of Rostechnadzor (Russian regulatory body, formerly Gosatomnadzor) should participate in the examination team activity in the obligatory order.

[14] Slovakia is preparing simulator based authorization examinations for control room personnel based on new legislative documents. Those documents also actually are preparing, because we change old legislative system (law, act, etc.). Training centres prepare simulator examination by co-operation regulatory body and NPP. VÚJE Trnava prepares simulator exams for NPP Jaslovské Bohunice and Training Centre Mochovce prepares for NPP Mochovce. Training centres will issue Authorizations with regulatory body's agreement. Regulatory body also will participate in examination commission.

[15] The utility contractor supports the Examination Board during the administration of the simulator exam.

[16] For Shift Supervisor, Reactor Operator and Turbine Operator.

[17] Most of the units in Sweden have individual simulator based examinations in the initial training. It is KSU (training centre owned by the NPP) that prepares the tests and together with the NPPs conducts and assesses the results of the individuals. The NPP have the final responsibility of the assessment. There is no single test for individuals in the retraining.

[18] For Field Operator.

[19] In the UK there is no "final" exam as such. The "exams" are a combination of the simulator based assessment, and the successful completion of the Operation Engineer Training Programme. The simulator-based assessment scenarios are designed by the simulator tutors (to a company standard), and the students are assessed against the Company Standard Assessment Criteria by their Shift Charge Engineer and an independent observer (somebody divorced from the immediate line management and with the knowledge and the experience to assess control room operational standards).
Operators are not "licensed" by the NII. Their competence is assessed internally. The NII may conduct audits on the procedures.

[20] The following table provides information on the roles of the NPP and NRC for the initial examinations and for the requalification examinations. NRC used to prepare and administer all examinations. In 1995, NRC gave the responsibility for preparation and administering requalification examinations to the NPP. Currently the NPP also prepares the initial examinations (written and operating test), with NRC administering only the simulator and walkthrough operating test and the NPP administering the written examination.

	Who **PREPARES**		Who **REVIEWS & APPROVES**		Who **ADMINISTERS & GRADES**		Who **ISSUES LICENSE**	
Exam Type	**Initial**	**Requal**	**Initial**	**Requal**	**Initial**	**Requal**	**Initial**	**Requal**
Fundamental Theory Exam (one time exam)	NRC	-------	NRC	--------	NPP administers, NRC grades	---------	---------	--------
Written	NPP	NPP	NRC	NPP	NPP	NPP	NRC	NRC
Walkthrough	NPP	NPP	NRC	NPP	NRC	NPP	NRC	NRC
Simulator	NPP	NPP	NRC	NPP	NRC	NPP	NRC	NRC

NRC may prepare initial examinations upon request. NRC also prepares at least one initial examination per calendar year in each of 4 Regions to certify new examiners and/or to maintain NRC examiner proficiency. NRC conducts inspections of requalification programmes and as a result of these inspections may decide to administer requalification written examinations or operating tests (i.e. simulator and walkthrough examinations). In such cases the examinations are typically developed by the NPP and parallel grading (NRC and NPP) is done. The parallel grading gives NRC the opportunity to evaluate the ability of the NPP examiners.

3. OVERVIEW OF EXAMINATION METHODS

3.1. General aspects

3.1.1. Basis for examination content

One of the essential requirements for safe and reliable nuclear power plant operation and maintenance is the availability of competent personnel. The systematic approach to training (SAT) is recognized world wide as the international best practice for attaining and maintaining the qualification and competence of nuclear power plant personnel. The IAEA publication *Nuclear Power Plant Personnel Training and its Evaluation: A Guidebook*, Technical Report Series No. 380, IAEA, Vienna (1996) [2], provides information on the reasons why SAT is now the international best practice for the training and qualification of NPP personnel; and also provides a detailed description of SAT methodology.

With a systematic approach to training, the competence requirements of control room personnel in an NPP can be established, validated, and met in an objective manner. Furthermore, with SAT based training, it can be demonstrated that all required competencies have been attained, through the process of performance based examinations. An overview of the SAT process is given in Figure 3.

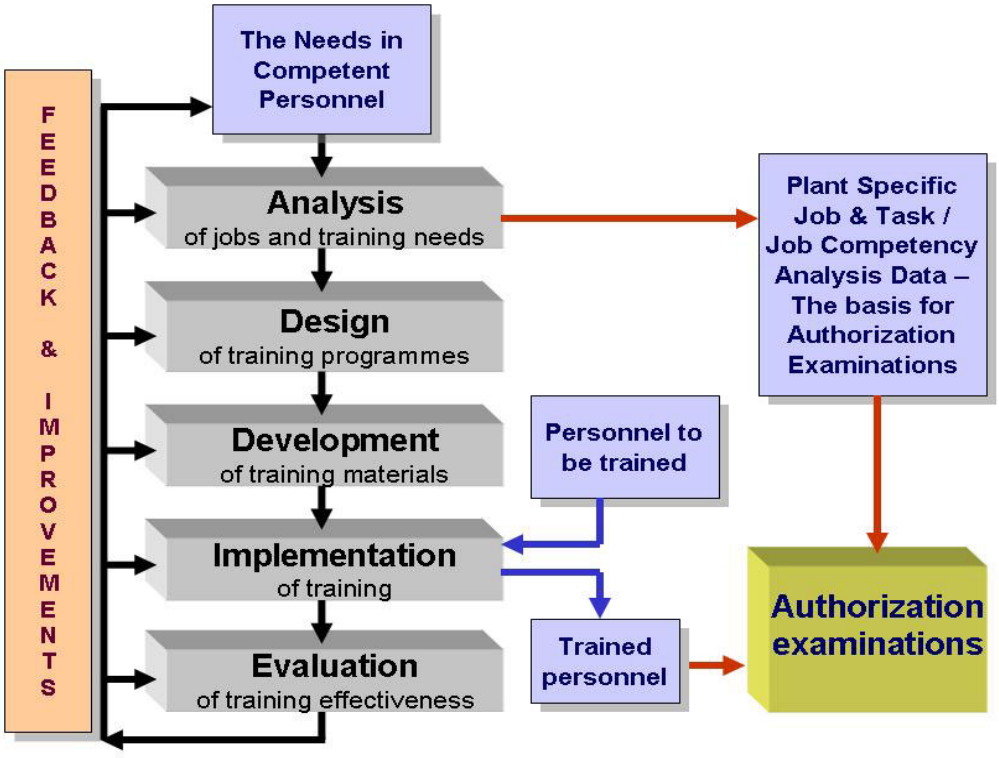


Fig. 3. Overview of the SAT process.

SAT consists of five interrelated phases, which are:

ANALYSIS — This phase comprises the identification of training needs and the competencies (knowledge, skills, and attitudes) required to perform a particular job.

DESIGN — In this phase, competencies are converted into measurable training objectives. These objectives are organized into a training plan.

DEVELOPMENT — This phase comprises preparation of all training materials so that the training objectives can be achieved.

IMPLEMENTATION — In this phase, training is conducted by using the training materials developed.

EVALUATION — During this phase, all aspects of training programmes are evaluated on the basis of the data collected during each of the other phases. This is followed by suitable feedback leading to training programme and plant improvements.

In accordance with the IAEA Technical Report Series No. 380 [2], job and task analysis or job competency analysis should be conducted. Competencies and tasks required for competent job performance are identified, documented, and included in the training programme as a result of a job and task analysis or job competency analysis. Training objectives that identify training content and define satisfactory performance are derived from these tasks. Effective examinations require training objectives to be carefully selected and classified prior to test development. Training objectives identify the knowledge and skills that are necessary to perform the job or task. A properly designed training objective will allow the test developer to determine the specific aspects of the knowledge, skills, or attitudes to be measured by a test item. The establishment of a direct relationship between the actual job requirements, the training programme training objectives, and the individual test items improves the validity of the authorization examinations. The validity of authorization examinations can be improved by:

- ensuring a good analysis of the job has been conducted;
- ensuring that knowledge; skills; and, as applicable, attitudes have been identified;
- ensuring that training objectives for both knowledge and skills are based on task requirements;
- identifying the type of performance dictated by the objectives (cognitive, psychomotor, affective);
- ensuring action verbs used in objectives measure what they were intended to measure;
- designing test specifications to ensure that objectives are covered adequately;
- reviewing the examinations with subject matter experts (SMEs), supervisors, and training specialists;
- piloting the examination or sample test items with SMEs and trainees;
- comparing examination results to actual job performance;
- ensuring that the examination and test items are changed to be consistent with revised job requirements.

All Member States have implemented SAT and base their examinations on plant specific job and/or competency analysis. In one Member State (US) knowledge and ability catalogs were developed to help improve the validity of examinations. Annex III, Part 5, Item 31 and 32 lists these catalogs; one for pressurized water reactors, and one for boiling water reactors. These catalogs were based on a comprehensive and in-depth industry wide job and task analysis (JTA) conduced by the Institute of Nuclear Power Operations (INPO). The JTA was then reviewed and modified by a team of individuals from the regulatory body, universities and NPP personnel. The catalogs provide a good means of developing examination specifications; however, because the knowledge and ability statements are fairly general and plants are not standardized, plant specific job and task analysis still needed to be conducted along with more plant specific performance-based and measurable training objectives. Examinations can then be developed that are valid using the catalogs, the plant analysis and design data and the reference material listed in Table 3, Reference Material for Examination Preparation in the following Section 3.1.2. Other Member States have implemented similar catalogs, such as (RU), which has a catalog for CR personnel tasks that is used for the development of written, oral, and performance examinations.

The following subsections are not intended to be a comprehensive treatment of examination design, development, and implementation or of test item development. Rather the subsections are intended to provide a brief overview with links to references with more in-depth treatment of the subject and Member State documents provided on the accompanying CD-ROM. In particular, detailed information on examination design, development, and implementation of examinations and test item development is planned to be included in an IAEA publication [5] that is expected to be published in 2006. References [9], [14], [15], and [16] also provide similar information. There are many excellent textbooks on these subjects. These references were selected since they are not copyrighted or proprietary, are cost free, and are readily available in English. Items 3, 5, 6, and 7 listed in Annex III, Part 5, from another Member State (CA) also provide a more thorough treatment of examination methods.

3.1.2. Description of the methods of examination

Assessments used to verify competence upon completion of initial training and during continuing training should be related as much as possible directly to actual job tasks performed in the job environment with normally available tools and procedures. The ultimate goal of the assessment process is to ensure that control room personnel possess the requisite knowledge, skills, and attitudes to operate the plant safely, reliably and effectively.

Three assessment methods in the form of examinations are generally used, alone or in combination, by all Member States. These are the following:

- Written examinations: Written examinations are used to measure knowledge and sometimes attitudes.
- Oral examinations: Oral examinations are used either in an office setting or in the control room, plant, or simulator during actual or simulated hands-on task performance. Oral examinations are best used to test knowledge and attitudes, as well as communication skills.
- Performance examinations (Simulator and Walkthrough): Performance examinations are used to evaluate knowledge, skills, and attitudes as well as communication skills and teamwork. Performance examinations are the best methods to measure actual performance to job specific criteria. A simulator examination can be used to assess an

entire control room team as well as an individual. A walkthrough examination can be used to assess an individual on a single task in the control room or the plant and can be used in cases were a simulator may not be available.

Section 3 provides an overview of the written, oral, and walkthrough examinations and a brief introduction to simulator examinations. Section 4 then provides more emphasis on simulator examinations.

The examinations are complementary. For example, in some Member States the written examination must be completed before performance examinations are conducted. In others, the simulator or walkthrough examinations may be combined with oral questioning.

In order to prepare these examinations, a significant amount of reference material is required. Table 3 contains a typical list of the reference material required by the regulatory body when they prepare the authorization examinations. The amount of effort required to develop the various types of examinations can be significant (e.g. 200–300 hours for a 100 question written examination; 40-60 hours to develop two-three simulator examination scenarios; 60-80 hours to develop 10-15 walkthrough examinations).

TABLE 3. REFERENCE MATERIAL FOR EXAMINATION PREPARATION

(1) Materials used by the plant to ensure operator competency

(a) The following types of materials used to train operators for initial authorization, as necessary to support examination development:

- Learning objectives, student handouts, and lesson plans.
- System descriptions, drawings, and diagrams of all operationally relevant flow paths, components, controls, and instrumentation.
- Questions and answers specific to the facility training programme that may be used in the written examinations or operating examinations. Copies of Nuclear Power Plant-generated simulator scenarios that expose the candidates to abnormal and emergency conditions.
- Material used to clarify and strengthen understanding of normal, abnormal, and emergency procedures.
- Complete, operationally useful descriptions of all safety system interactions and, where available, balance-of-plant system interactions under emergency and abnormal conditions, including consequences of anticipated operator errors, maintenance errors, and equipment failures. as well as plant specific risk insights based on probabilistic risk analysis (PRA).

These materials should be complete, comprehensive, and of sufficient detail to support the development of accurate and valid examinations without being redundant.

(b) Questions and answers specific to the facility training programme that may be used in the written examinations or operating tests.

(c) Copies of facility-generated simulator scenarios that expose the applicants to abnormal and emergency conditions, including degraded pressure control, degraded heat removal capability, and containment challenges, during all modes of operation, including low-power conditions. (A description of the scenarios used for the training class may also be provided.)

(d) All JPMs used to ascertain the competence of the operators in performing tasks

within the control room complex and outside the control room (i.e. local operations) as identified in the facility's job task analysis (JTA). (JPMs should evaluate operator responsibilities during normal, abnormal, and emergency conditions and events, and during all modes of operation including cold shutdown, low power, and full power.)

(e) Operating utility guides, standards, safety norms, regulations, and industrial standards, where applicable.

(2) Complete index of procedures.
(3) All administrative procedures applicable to NPP operation or safety.
(4) All integrated plant procedures (normal or general operating procedures).
(5) All emergency procedures (emergency instructions, abnormal or special procedures).
(6) Standing orders.
(7) Surveillance procedures.
(8) Fuel handling and core loading procedures.
(9) All annunciator and alarm procedures.
(10) Radiation protection manual (radiation control manual or procedures).
(11) Emergency plan implementing procedures.
(12) Technical Specifications or similar technical requirements documents.
(13) System operating procedures.
(14) Technical data book and plant curve information used by operators as well as the facility precautions, limitations, and set points document.
(15) The following information pertaining to the simulation facility:

- list of all initial conditions;
- list of all malfunctions with identification numbers and cause and effect information;
- a description of the simulator's failure capabilities for valves, breakers, indicators, and alarms;
- the range of severity of each variable malfunction (e.g. the size of a reactor coolant or steam leak, or the rate of a component failure such as a feed pump, turbine generator, or major valve);
- a list of modelling conditions (e.g. simplifications, assumptions, and limits of simulation) and problems that may effect simulation;
- a list of any known performance test discrepancies not yet corrected;
- a list of differences between the simulator and the reference plant's control room;
- simulator instructor's manual/guide.

(16) Any additional plant-specific material that has been requested by the regulatory body examiners to develop examinations that meet the guidelines of the regulations and standards

As well as ensuring that control room personnel are technically competent, the training programmes should help candidates understand and become familiar with the specific techniques to be used in the subsequent authorization examinations. This will help to ensure that they will not be penalized by the specific examination techniques used, such as major simulator scenarios or oral board examinations.

3.2. Written examinations

3.2.1. Development

A written examination is primarily a test of an operator's knowledge. Written examinations are used by almost all Member States in the authorization process. The written examination for an operator typically contains a representative selection of questions on the knowledge, skills, and abilities needed to perform operator duties. The questions are derived from regulatory requirements, country specific national standards, operating organization guidelines, and from learning objectives derived from a job task or competency analysis for the training programme. Information in Safety Analysis Reports, system description manuals, operating and emergency procedures, operating experience and event reports, and other materials is used in the development of written examinations.

Table 4 contains a typical list of topics from which a representative sample of written questions may be developed for a control room operator position. Examples of topics for other control room job positions can be found on the CD-ROM that accompanies this publication.

TABLE 4. TYPICAL LIST OF TOPICS INCLUDED IN A WRITTEN EXAMINATION FOR A CONTROL ROOM OPERATOR

(1) Fundamentals of reactor theory, including fission process, neutron multiplication, source effects, control rod effects, criticality indications, reactivity coefficients, and poison effects.
(2) General design features of the core, including core structure, fuel elements, control rods, core instrumentation, and coolant flow.
(3) Mechanical components and design features of the reactor primary system.
(4) Secondary coolant and auxiliary systems that affect the facility.
(5) Facility operating characteristics during steady state and transient conditions, including coolant chemistry, causes and effects of temperature, pressure and reactivity changes, effects of load changes, and operating limitations and reasons for these operating characteristics.
(6) Design, components, and functions of reactivity control mechanisms and instrumentation.
(7) Design, components, and functions of control and safety systems, including instrumentation, signals, interlocks, failure modes, and automatic and manual features.
(8) Components, capacity, and functions of emergency systems.
(9) Shielding, isolation, and containment design features, including access limitations.
(10) Administrative, normal, abnormal, and emergency operating procedures for the facility.
(11) Purpose and operation of radiation monitoring systems, including alarms and survey equipment.
(12) Radiological safety principles and procedures.
(13) Procedures and equipment available for handling and disposal of radioactive materials and effluents.
(14) Principles of heat transfer thermodynamics and fluid mechanics.

Written examinations may use any one or more of the following question formats:

— essay;
— multiple choice;
— matching;
— short answer;
— filling the blank.

However, most Member States use either multiple choice, short answer, or essay type questions. Multiple choice questions are easy to administer and enable a large number of knowledge items to be tested in a short period of time. They are particularly useful to measure the recall and comprehension levels of intellectual (cognitive) ability. They can also be used to measure higher cognitive levels such as analysis, synthesis, and evaluation, but need care in their formulation. Short answer questions require the trainee to provide a phrase, sentence or diagram as a response. Theses types of questions have the benefit that, unlike multiple choice questions, no stimulus by way of possible answers is provided. Essay questions provide the most satisfactory written means of assessing a trainee's competence at high levels of intellectual ability. While essay questions based on objectives included in the training programme are relatively easy to develop, the judging and grading of answers is much more difficult and takes longer than with the other two types of questions.

In the development of a written examination a test specification or sampling plan is typically first developed to ensure that the written examination covers all of the topics included in the training programme. In order to ensure test reliability and validity test questions are directly linked to job tasks and associated learning objectives and are usually reviewed by one or more subject matter experts. In addition, some Member States have specific requirements pertaining to the cognitive level of the questions. A number of Member States also utilize examination question banks. These question banks are sometimes made available for study by trainees if the number of questions in the bank is large (~700 questions). Other special requirements and restrictions are also usually established for examination banks. For example, restrictions are placed on the number of questions that can be used from the bank on any examination (e.g. 75 %), a minimum number of new questions need to be developed and added to the bank each year, existing questions must be reviewed periodically for accuracy and continued validity, and some percentage of the questions in the bank need to be revised periodically.

Appendices XVI and XVII contain example of written test item review and verification checklists. Appendix XVIII is an example question validation checklist. References [5], [9], [14], and [15] contain additional guidance for the development of written examinations, including information on developing test specifications, question writing guidance, cognitive levels, test reliability and validity, examination banks, and implementation and grading. Reference [9] is also included on the CD-ROM that accompanies this publication. Items 5 and 6 listed in Annex III, Part 5, also provide similar information.

3.2.2. Review and approval

The organization that prepares the written examination varies in Member States. In some, the regulatory body prepares and administers the written examination, but in most the nuclear power plant is responsible for preparation and conduct of the written examination. In almost all cases the regulatory body exercises a level of oversight that may range from preparing and

conducting the written examinations; reviewing and approving the written examinations prepared by the nuclear power plant or associated training center; approving the training programmes; or auditing and reviewing the training programmes and examinations.

The practices for initial examinations and re-examinations for re-authorization are similar, although in some Member States, the role of the regulatory body in the re-authorization process is more limited (auditing and review).

3.2.3. Administration

In most Member States the written examinations are administered by the nuclear power plant or associated training center. The length of the examinations varies. The number of questions ranges from about 25 to 100 per examination; and the time for the examination ranges from 1 to 8 hours. For cost reasons, written examinations are usually scheduled to be administered to a group of candidates at one time rather than on an individual basis. The examinations are also almost always conducted at the nuclear power plant training center. Appendix XIX is an example of instruction for taking a written examination.

3.2.4. Assessment

The point value for each individual question is usually the same. For multiple choice and short answer type questions, a passing score is typically 70-80 percent. In a few cases lower passing scores were reported to be used. In some cases a minimum passing score on each section of the examination (e.g. 70%) and an overall passing score (80%) are established. Where essay type questions are used, individual questions may be graded on a more subjective basis using descriptors such as excellent, good, satisfactory, and unsatisfactory. These are then converted to a point value to arrive at an overall score.

The results of the grading, particularly for essay questions, are usually reviewed by at least one other person. In addition, examination questions are reviewed across all individuals who took the examination to evaluate if there were any problems with individual questions (e.g. all candidates provided an incorrect answer to the same question which may indicate some problem with the question). Appendix XX is an example of a grading procedure. Appendix XXI is an example of a post-examination review checklist for both a written test and a performance examination.

3.3. Oral examinations

3.3.1. Development

An oral examination is a test of an operator's knowledge as well as comprehension of coherence and causal connections during which the operator answers oral questions related to the job position. Oral questioning is typically used during on-job training (OJT) and as a final examination before authorization. When used as a final oral examination they may be conducted by an individual assessor or by an examination board. Oral examinations are also sometimes used as a progress review to assess a trainee's progress toward completion of portions of a training programme. Oral examinations test an individual's knowledge of theoretical concepts, equipment and systems operation, normal, abnormal, and emergency operating procedures, administrative controls, and other areas based on job task or competency analysis. To ensure content validity, oral questions are usually based on the training objectives from the training programme.

Oral examinations for operator authorization are also used as part of job performance measure (JPM) examinations. When used a part of a JPM, the oral questions typically are related to steps in a procedure and actions the operator has taken to complete the JPM. In some Member States it is required to write down the questions asked as well as the operators answers to the questions. This practice provides documentation of the scope and content of questions and a means of assuring that the questions are valid and related to job requirements. When used as a final examination, the oral questions are typically written in advance or chosen from a question bank. When oral examination boards are used, board members are usually allowed to ask questions that are not pre-selected or as a follow up question to further probe an operator's knowledge. A representative of the training organization is usually a member of the oral examination board and helps to assure the oral questions are based on valid learning objectives. Section 5.2, Examination Boards, contains additional discussion of examination board membership and functions.

Oral examinations are an effective method to probe an individuals understanding and usually ask questions related to the "why's, how's, and what if's". The following are examples of these types of questions.

- Why does the safety system actuate at that pressure?
- Why does step one come before step two, and what would be the consequences of reversing the order?
- Why does the process work as it does?
- How does the process respond to specific action?
- How does the operator respond to a specific plant condition?
- What happens to process indications in system A if system B does this (describe the action)?
- What action(s) can the operator take if process indications show this symptom (describe the symptom)?

References [5] [16] contain guidance and examples of oral questioning methods and practices during on-job training (OJT) and oral examinations. The references also contain guidance for use of oral examination boards and examples of grading methods. Item 6 listed in Annex III, Part 5, contains a procedure for written and oral examinations. Appendix XXII also contains an example of oral questioning grouped by the types of questioned used.

3.3.2. Review and approval

Oral examination questions are usually developed in advance by the NPP training organization, examination board, or assessor based on the learning objectives derived from job task or competency analysis. Oral questions are also selected from approved examination banks. When oral boards are used, a representative from the NPP training organization is either a member of the oral board or an observer and assures that the questions are directly related to job requirements. In some cases the individual questions and answers are completely documented or, as a minimum, summarized.

3.3.3. Administration

Oral examinations typically are only administered to one person at a time. The examinations may be administered by the regulatory body, a central training facility, or by personnel designated by the NPP. A requirement may be specified for the minimum number of

members on an oral examination board, such as in Ukraine, where the minimum number is three.

Oral examinations conducted by an oral examination board or individual assessor may last from 30 minutes to 1–2 hours. To assure that all areas are covered during the oral, an examination plan or outline is typically developed that addresses theory, system and component operation, normal, abnormal, and emergency operating procedures, administrative controls, and other areas based on the job task/competency analysis. The grading of the oral examination may be pass/fail or on a 4 or 5 point scale. When a board examination is given each member assigns a grade and the grades are then averaged for an overall grade. Table 5 contains an example of a final oral examination board grading sheet.

TABLE 5. EXAMPLE OF FINAL ORAL EXAMINATION BOARD GRADING SHEET

AREA	BOARD MEMBER GRADE	BOARD MEMBER GRADE	BOARD MEMBER GRADE	BOARD MEMBER GRADE	BOARD MEMBER GRADE	OVERALL AREA GRADE
THEORY	3.1	3.0	3.2	N/A	3.1	3.1
SYSTEMS & COMPONENTS	3.3	3.3	3.4	N/A	3.4	3.35
NORMAL OPERATIONS	3.4	3.3	3.5	N/A	3.5	3.43
ABNORMAL OPERATIONS	3.4	3.4	3.6	N/A	3.4	3.45
ADMINISTRATIVE CONTROLS	3.3	3.3	3.5	N/A	3.4	3.38
TECHNICAL SAFETY REQUIREMENTS	3.5	3.3	3.2	3.4	3.5	3.38
FINAL BOARD GRADE						* 3.1

* Minimum grade for passing the Board is 3.2.

I _____ (print name), Board Chair of the Oral Board for

_____ (print trainee name), assign a grade of _____, and declare this Board a PASS OR FAILURE (circle one).

_____ (signature Board Chair)

The number of questions used as part of oral questioning during a JPM, typically are 2–3, with perhaps a few follow-up questions. The number of JPMs may range from 4–5 to as many as 10–15. The length of time for a JPM ranges from 10–20 minutes. The JPMs are either performed on the simulator or in the actual control room. In some Member States, a few JPMs also assess the operators' knowledge of operation of systems and equipment located outside the control room. Section 3.4 contains additional information on JPMs.

3.3.4. Assessment

As indicated is Section 3.3.3, oral examinations may be graded as pass/fail or on a point system. The results of an individual assessor or board examination are usually reviewed by a

third party for consistency and accuracy. If the regulatory organization conducted the examination, after this review the oral examination results are then combined with other examination results and the NPP is notified, and in most Member States the individual is issued a license, authorization, or some other type of certificate. If the NPP conducted the examination, after the review and combination with other examination results, depending on individual country practices, the regulatory organization may be notified and they issue the license, authorization, or certificate. If not, then the NPP senior manager issues the authorization or certificate.

3.4. Walkthrough

3.4.1. Development

A walkthrough examination is a test of an operator's knowledge, skills and attitudes to safely operate plant systems and equipment. For plants without access to a full-scope simulator this type of examination is normally used. In some Member States, this type of examination is also used in addition to, or in conjunction with, the simulator examinations. The walkthrough examination is usually administered through the development of Job Performance Measures (JPM) which are a test of an operator's ability to perform one specific task, or set of tasks (as opposed to a simulator scenario which typically tests multiple tasks and integrated plant operations).

The topics chosen for the selection of JPMs to be tested is usually based on regulatory requirements, country national training standards, and learning objectives contained in the operator training programme. A range of JPMs is typically used with 10–15 separate JPMs used during initial examinations for authorization. For re-authorization, a smaller number of JPMs are usually used (4–5).

The practices for development of JPMs vary. In some countries the regulatory body prepares and administers the JPMs, while in other countries the NPP prepares and administers the examinations. The trend is for the NPP to prepare and administer the JPMs, with the regulatory body either approving the JPMs before use, or auditing the satisfactory development and implementation of the examinations.

The content of a JPM is similar to a simulator scenario. A JPM contains sections for initial conditions, initiating cues, references and tools, time limits, critical steps, expected actions, and criteria for successful completion. Table 6 is an example of the outline of the contents of a JPM. In some Member States two types of JPMs are used. One type addresses administrative topics that can be evaluated alone or as part of the simulator examination. The second type addresses single system or component operational task performance conducted in the simulator facility, the actual control room, or the plant. Appendix XXIII contains an example of administrative topics for JPMs. References [5] and [9] (Appendix C, Job Performance Measure Guidelines) contain addition information on the development of JPMs. This information is also included on the accompanying CD-ROM. In addition, IAEA TECDOC-1411 *Use of control room simulators for training of nuclear power plant personnel* [4] contains example of JPMs.

TABLE 6. JOB PERFORMANCE MEASURE CONTENT

Each JPM includes the following, as applicable:

(1) Initial conditions.
(2) Initiating cues.
(3) References and tools, including associated procedures.
(4) Reasonable and validated time limits (average time allowed for completion) and specific designation if deemed to be time critical by the facility licensee.
(5) Specific performance criteria that include:
   - detailed expected actions with exact criteria and nomenclature;
   - system response and other examiner cues;
   - statements describing important observations to be made by the trainee;
   - criteria for successful completion of the task;
   - identification of critical steps and their associated performance standards;
   - restrictions on the sequence of steps, if applicable.

3.4.2. Review and approval

As indicated in Section 3.4.1, the trend is for the regulatory body to review and approve the examinations, and in some countries to only audit the process used use by the NPPs to develop and administer the JPMs and the results.

3.4.3. Administration

The walkthrough examinations typically are only administered to one person at a time. In some cases, instead of administering a JPM separately, it may be linked or integrated with tasks performed as part of the simulator examination. In this case the individuals performance is evaluated both in the context of the simulator scenario and the JPM.

The length of each JPM is typically 10-20 minutes. The JPMs are conducted in the simulator facility or in the actual control room. When they are conducted in the control room, the JPMs are usually conducted as “walkthrough and talk-through”, without actual manipulation of controls.

3.4.4. Assessment

The grading of JPMs is mostly by pass/fail or satisfactory/unsatisfactory. When multiple JPMs are used, it is typically required that 80% of the JPMs must be passed.

3.5. Simulator examinations

The use of simulators to examine authorized staff can be seen as an extension of their use as described in IAEA TECDOC-1411 *Use of Control Room Simulators for Training of NPP Personnel* [4]. The methodology described in this section is detailed in Section 4 of this publication.

Full-scope simulators can provide a realistic and comprehensive environment to train and evaluate candidates for authorized control room positions in nuclear power plants. This process has become an essential part of the training process in most Member States. Given

the high capital cost of nuclear plants and their design for base-load operation, there is little opportunity to gain hands-on experience in many types of plant evolutions, such as power maneuvers. This situation is different from conventional plants, many of which operate in a "load following" mode and may be frequently shut down during periods of low power demand.

Nuclear power plant operators need training and their skills maintained, in the response to system upsets and emergencies. Plant safety and safe reliable operation is a high priority, so these skills are used infrequently, yet they must still be learned and maintained. A simulator is an excellent means for initial and continuing training in these skills.

Simulators provide a means to train and examine control room staff in a number of areas:

Technical skills: staff can be trained and examined in the monitoring of reactor systems and the manipulation of panel controls to respond to system upsets, or to make planned changes to plant operation.

Knowledge: staff can be evaluated on their knowledge of system(s) operation or response by such means as asking them to explain the system(s) response as seen on the simulator. Questions can also be asked on whether the procedures adequately deal with the scenario situation, or if there are other procedures to be followed that may not have been used due to the time constraints of the scenario. The focus of the questions should be on the simulator scenario, as oral examinations (Section 3.3) can be conducted without using a simulator.

Diagnostic capabilities: staff, in particular shift supervisors, shift technical advisors assessed with regard to ability to diagnoses complex plant situations.

Soft skills: such as communications, teamwork and conservative decision making can be examined in a team or individual scenarios on a full scope simulator.

Crew Supervisors: shift supervisory staff can also be trained and examined on simulators, especially in a team environment, where they must manage personnel response to system upsets. Technical knowledge can be tested in short scenarios where they must individually identify malfunctions and recommend the proper response. Such "diagnostic" scenarios, as described in Section 4.1, help to ensure the operating crew has adequate defense-in-depth to deal effectively with system upsets. Knowledge and soft skills training and assessment also apply to personnel in this position.

The methodology used can vary depending on Member States' practices and regulatory requirements, however there are some common practices used:

- the responsibilities for preparation, conducting and evaluation must be documented; the licensee or regulatory body can be responsible for different parts of the process, or work cooperatively, depending on Member States' requirements;
- an examination can consist of one or more scenarios;
- scenarios can be of different lengths depending on the objective(s) to be tested;
- candidate actions expected should be documented for consistency of evaluation and to ensure effective conduct of the examination;
- examination objectives and candidate actions expected should be based on documented licensee procedures and expectations;

— candidate evaluation criteria should be based on licensee expectations as well as regulatory requirements;
— examination results given to the candidates should be based on these documented criteria;
— examination results and lessons learned from the examination process can be valuable in; improving the examination process, identifying improvements to licensee procedures and training programme, as well as clarifying and improving regulatory expectations.

The authorization of CR staff is an important task that involves costly and scarce resources, such as: simulator time, trainers and simulator staff, examiners, and the candidates themselves. It is therefore very important that these examinations be conducted effectively and efficiently. There should be a high regard for the security of examination content when a number of operators are being examined, as well as the security of personal information regarding the individual's performance in the examination.

Videotaping: The use of video tapes to record control room personnel performance during simulator scenarios varies widely among Member States. Although information on the use of video cameras in the simulator was not specifically requested in the surveys used to prepare this publication, it appears that almost all Member States use video taping as part of the control room personnel training programmes. The information is used to provide feedback to control room personnel regarding their individual and team-related performance as well as some visible aspects of their technical performance. This information can be useful in reviewing the actions of individuals and confirming the notes made by observers/evaluators during the dynamic portion of a scenario. In some cases, the shift manager, or other operating staff, leads the feedback session for the shift crew as a self-assessment tool. In all cases it is important to use the information in a positive manner to focus on improving individual and crew performance.

Some Member States use video tapes to record actions during simulator authorization examinations, depending on such criteria as privacy laws as well as practices developed over many years of testing. In all cases, strict controls should be in place to protect the privacy of the information. In some cases there are formal restrictions on access to the video tapes and formal requirements to destroy the video tapes after a certain period of time.

3.6. Process for handling failure of examinations

The grading of written, oral, and performance examinations is discussed in Sections 3.2, 3.3, 3.4 and 4. Appendix XX also provides an example of a grading procedure. In the case of failure to pass an examination most Member States provide an opportunity for a candidate who has failed an authorization examination to challenge the grading of the examination(s) and to have an opportunity to retake the examinations. A typical process might be the following:

— Request a review of the grading of the examination after being informed of failure of one or all of the written, oral, or performance examinations.
— If the failure is valid, then after retraining and a specific time period (e.g. 2 months), the candidate can retake only the examination that was not passed.

— If the candidate fails the second examination, a reexamination on all of the examinations (written, oral, and performance) may be taken after retraining and a specific time period (e.g. 6 months).
— If the candidate fails the third examination, a reexamination on all of the examinations may be taken after retraining and a specific time period (e.g. 24 months).

In a few Member States only one reexamination is permitted. If the candidate fails the second attempt, he/she may not reapply. If the failure is on a reauthorization examination, the individual is usually immediately removed from the job and remediation training and a reexamination process similar to the above example is followed. In some Member States, failure of an individual to pass a reauthorization examination is viewed by the regulatory body as a possible problem with the NPP continuing training programme, and may be the cause for review and evaluation of the entire NPP continuing training programme by the regulatory body.

3.7. Examination confidentiality and security

The regulatory body and the nuclear power plant must be attentive to examination confidentiality and security measures. The regulatory body and the NPP must establish, implement, and maintain procedures to control examination security and integrity for examinations that they prepare, review, or administer.

The regulatory body typically requires NPP personnel involved in the preparation or administration of authorization examinations to be fully aware of the NPP's physical security measures and requirements and understand their security responsibilities. In most cases, individuals who are directly involved in the training of a candidate are limited or not permitted to be involved in the preparation, review, conducting or grading of the authorization examinations. Those individuals who are involved in the examination process typically are required to sign a document agreeing to maintain confidentiality. Table 7 is an example of a confidentiality agreement. Appendix XV contains several additional examples of confidentiality agreements for trainees and observers.

The examination outlines and final examinations must be positively and continuously controlled and protected as sensitive information.

The nuclear power plant or its associated training centre must also implement special security measures for simulator examinations to ensure that performance examinations on the simulator are maintained in three areas: the instructor station; the programmers' tools; and the external interconnections. Special measures may also need to be implemented to control access to examination question banks or computer networks that may be used for written examinations. The NPP has the responsibility for determining and implementing whatever measures might be necessary to ensure the integrity, security, and quality of all of the examinations, including any examinations prepared by contractors. The security of simulator examinations is discussed further in Section 4.8.1.

TABLE 7. EXAMINATION SECURITY AGREEMENT FORM

(1) **Pre-examination**

I acknowledge that I have acquired specialized knowledge about the licensing examinations scheduled for the week(s) of as of the date of my signature. I agree that I will not knowingly divulge any information about these examinations to any persons who have not been authorized by the chief examiner. I understand that I am not to instruct, evaluate, or provide performance feedback to those applicants scheduled to be administered these licensing examinations from this date until completion of examination administration, except as specifically noted below and authorized by the RB. Furthermore, I am aware of the physical security measures and requirements (as documented in the facility licensee's procedures) and understand that violation of the conditions of this agreement may result in cancellation of the examinations and/or an enforcement action against me or the facility licensee. I will immediately report to facility management or the chief examiner any indications or suggestions that examination security may have been compromised.

(2) **Post-examination**

To the best of my knowledge, I did not divulge to any unauthorized persons any information concerning the licensing examinations administered during the week(s) of ____. From the date that I entered into this security agreement until the completion of examination administration, I did not instruct, evaluate, or provide performance feedback to those applicants who were administered these licensing examinations, except as specifically noted below and authorized by the RB.

PRINTED NAME JOB TITLE / RESPONSIBILITY SIGNATURE DATE

1. _____

2. _____

3. _____

4. SIMULATOR EXAMINATIONS IN THE AUTHORIZATION PROCESS

4.1. Types and specifics of simulator examinations

Section 4 addresses the overall elements of simulator examinations. These examinations may be part of the authorization process or may only be part of the training program that is a prerequisite to an authorization process that may not include simulator examinations.

The types of simulator examinations can be considered from two perspectives: the types of personnel to be examined, and the types of systems conditions on which to be examined. Although there are links between these two type classifications, they can be considered separately.

4.1.1. Types of personnel evaluations to be conducted

The scope of this publication is limited to the testing of Control Room staff, which can include a large number of positions depending on the Member States allocation of duties. These positions can be:

- reactor operator;
- turbine operator;
- common systems operator;
- electrical system operator;
- control room supervisor;
- shift supervisor or manager;
- safety engineer;
- shift techncial adviser.

There can be tests for personnel to upgrade their authorization, for instance from position of operator to senior operator or shift supervisor. For example, Annex III, Part 5, item 4, Operating License – Darlington, contains requirements to upgrade from an Operator to Shift Supervisor.

For control room **operators**, (reactor, turbine or electrical systems), the types of examinations are mainly based on the skills required to safely and effectively operate the equipment. This can include normal and upset plant conditions and also operation under emergency circumstances. On the CD-ROM, item 7, "Simulator Based Examinations …", is an example from CA of the requirements for simulator examinations for the position of operator.

Although the focus may be on operating skills, personnel can also be examined on the wider range of skills needed to be a competent operator. These can include:

- communication skills;
- identification of the correct procedure to be used in an abnormal or emergency condition;
- recognition of abnormal conditions that need to be referred to shift supervision for approval to proceed or deviate from standard procedures;
- prioritizing actions when an event requires that reactor safety be given the highest priority;
- working in teams;
- executing actions in parallel in cases such as a generator oil leak that requires actions to ensure generator safety as well as actions to minimize the impact of the oil spill.

For control room **supervisors,** there is less emphasis on panel operating skills and more emphasis on the candidate's diagnostic and supervisory abilities. However, the candidates should also be examined on their systems knowledge to ensure that they are able to provide defense in depth when diagnosing events and identifying the actions to be taken during an abnormal condition. Annex III, Part 5, item 3, "Simulator Based Examinations …" is an example from CA of the requirements for simulator examinations for the position of shift supervisor.

The types of system events and conditions described in this section are primarily tools to assess individuals for initial authorization. In these cases, the focus is on the individual's performance.

Re-authorization of plant operators can be effectively done on a simulator, where the focus is usually on team performance and crew interaction. As well, the re-authorization evaluation scenarios may be deliberately limited to events that infrequently occur in the plant. Examples of these scenarios would be team response to Design Basis Accidents such as major loss of coolant accidents, boiler tube failures, or malicious acts by intruders. Annex III, Part 5, item 5, "Requirements for Requalification Testing …" is an example from CA of the requirements for simulator examinations for requalification testing of authorized shift personnel.

4.1.2. Types of system events and conditions

Major events that are based on reactor or balance-of-plant upsets can require the candidate to respond by using the plant procedures. This can cover a range of events from a turbine trip to a reactor trip or a major reactor coolant failure requiring the execution of emergency procedures. Where a major failure has occurred, the entry conditions to the required procedures are established by the scenario, and the operator is then required to take the appropriate actions.

Secondary malfunctions, such as additional equipment failures or instrumentation failures can be scripted into the scenario. These conditions can be used to evaluate the candidate's ability to diagnose these failures and respond by taking actions such as using backup equipment or systems to ensure the plant is placed into a safe state. These malfunctions can be scripted to occur on equipment related to, but not directly involved in the main event. These situations can be used to evaluate the candidate's knowledge of the event, as well the ability to prioritize and focus on those actions needed to place the plant into a safe condition.

Complex scenarios can be used to test supervisory staff in their abilities to make the correct decisions and provide the required operational approvals. In these situations, it is also required that the supervisor independently assess the plant conditions, confirm the entry conditions to the appropriate procedures and then monitor the actions taken. The supervisory staff needs to ensure that the actions taken are achieving the desired results. This series of actions is an essential part of the "defense-in-depth" approach.

Minor events that do not result in a major unit upset can be used to "warm-up" the individuals/teams and also assess a candidate's ability to properly diagnose the event and ensure that the correct response has occurred. An example would be the failure of an auxiliary cooling water pump and the backup pump starts. The candidate should then determine that the plant is still operating in a safe condition, using field checks as needed, and not cause an unnecessary shutdown transient.

As with major events, these scenarios can be made more complex by additional malfunctions of equipment or instrumentation. Operating staff can then demonstrate their knowledge of safe operating conditions and their skill in starting backup equipment, or using secondary indications to determine if the plant equipment and systems are operating safely.

These minor events can also be used in short tests that require a single candidate to diagnose an event and identify the correct response. This can be important in evaluating a person's individual skill and knowledge outside of a team setting and can remove any deliberate or inadvertent support from other members of the control room team.

Diagnostic events can be shorter scenarios, administered to operator or shift supervisor candidates, where the person is assessed alone, or with minimum support. These "Diagnostic Scenarios" minimize any influence that role players may have and focus on the individual's ability to diagnose an event and recommend the proper remedial actions. This is somewhat the same principle as with a JPM assessment. Item 3 listed in Annex III, Part 5, includes the process to prepare and administer such a test for initial certification of Shift Supervisors. The questions that could be used in such a test for a shift supervisor are given in Appendix XXVII. The use of these tests for requalification of operators and shift supervisors is described in item 5 listed in Annex III, Part 5.

Job performance assessment of individuals can also be done as described in Section 3.4.

4.2. Overview of process and methodology to develop and conduct simulator examinations

The objective of an authorization simulator examination is to help provide assurance to the authorizing authority that the candidate has the skills to perform the job with safety as the primary objective. Skills related to effective plant operation may also be a factor as improper operation may lead to safety concerns, such as not recognizing problems as they start to develop or excessive delays in placing backup equipment in service when the primary equipment fails or shows operating problems.

These examinations are also only a sample of the candidate's skills and are part of a comprehensive training programme that meets the requirements of the regulating authority. As described in Section 2.6, the involvement of the regulating authority varies, depending on Member State practices.

To a certain extent, knowledge as well as skills can be examined by using simulator tests. This can be done by using scenarios that have complex series of failures or operational requirements, which require the candidate to seek verbal approval for actions or procedural deviations. The candidates can then demonstrate, by their actions and communication that they understand that the goal of the procedure is not being met and that other action is required. Furthermore, by expecting candidates to suggest a course of action, they can demonstrate an understanding of the event as well as a conservative, safety oriented approach to the situation.

The **main requirement** of the examination is to create and document one or more scenarios to meet these evaluation objectives. The scenarios must be consistent with plant management expectations and consist of events that are fair, realistic, and yet present a challenge to the candidates. To accomplish this, there are a number of inputs to the process such as:

- operating procedures that give the actions for normal and abnormal events;
- role documents that describe the responsibilities of the positions being tested; these documents should describe the specific actions expected by the various positions, as well as when approvals or guidance should be sought from others;
- formal, documented, operating experience;
- problems that have occurred on these types of reactors but were not serious enough to require a formal operating experience type of report;

— positive events that have occurred on these types of reactors where failures were identified in their early stages and appropriate mitigating actions were taken to prevent them from becoming more serious;
— past examinations where candidates' performance identified a need for further testing in a particular area;
— recent modifications to procedures and equipment on which it is appropriate to test candidates;
— safety reports that identify the plant's design basis, beyond which the operator is not expected to be able to respond;
— design criteria that define the design basis in detail, to ensure the events are credible and to define the expected equipment response;
— design peculiarities of the simulator, e.g. deviations of the simulator from the reference plant.

These documents can be provided to the examiners by plant operating staff, training staff or the design authority. Operating experience can come from industry or internal licensee sources. In some cases, the regulator may identify deficiencies or special requirements that are to be made part of the test scenarios.

The **main steps** to achieve these requirements in simulator examinations are typically:

— design;
— development and verification;
— preparation of examination documentation;
— conducting of the tests;
— evaluation;
— feedback to the candidates;
— feedback to identify improvements to the examination process.

The output of the process should be a documented examination, that fairly meets the examination criteria, and that is properly administered. During the scenario verification step, the examiners should confirm the fidelity of the simulator response to the malfunctions used in the scenario.

The roles and responsibilities in performing these steps may vary depending on the Member State's practices. In some cases, the licensees prepare and conduct the examinations; in others the regulatory body may perform this function. Or, there may be a joint effort between the regulator and the licensee. It is essential that these responsibilities be documented and approved according to the practices of the Member State.

4.3. Development of simulator examinations

4.3.1. Examination objectives and requirements

The examination is developed to assess candidates' skills (Section 4.1) according to requirements described (Section 4.2). Development of examinations will include a more detailed description of the competencies to be assessed and the assessment criteria to be used to determine if the candidate has passed the examination.

Examination development is an iterative process starting with the competencies to be assessed that are then used to choose the scenario events and malfunctions. The expected actions of the candidates are developed and documented and when a first draft is completed, the required actions should be reviewed to ensure that the competencies have been adequately covered and that there is a clear and reasonable path that the candidates should follow. The examination should also be appropriate to challenge the candidate at the higher levels of performance given in the licensee role documents. As well, the examination should likely consist of a number of scenarios for each candidate so as to cover different systems at the level of performance expected and to cover the required competencies. Where a number of candidates are being tested, this will provide a break between scenarios for each candidate.

An overall objective should be to review the simulator capability to ensure that the required events are properly simulated. For instance, the simulator may not be modeled to include the failure of turbine generator lubricating oil or seal oil systems. In this case, candidates cannot be tested in the simulator on these events. When this occurs, the scope of the written certification examinations should be expanded to include written "skill-based" questions on the events that cannot be replicated on the simulator.

Simulators currently in use have considerable capability to model plant operation and response to transients. They are normally equipped with the ability to introduce many types of malfunctions such as piping failures of various sizes, control malfunctions and equipment malfunctions such as valve or pump failures in a number of modes. An example of minimum simulator modeling capabilities is listed in Annex III, Part 5, item 7, Section A.2.

4.3.1.1. Competencies to be assessed

This publication deals with the authorization of control room operating staff, for which there are a number of basic competency areas:

- system monitoring skills;
- panel operating skills, including adherence to procedures as well as self-checking and peer-checking;
- diagnostic and decision making;
- teamwork skills including communications skills;
- leadership and crew management.

To assess these competencies in a simulator examination, the examiners need to observe actions performed, or statements made by the candidate. The authorization candidates should be overt in their actions so the assessors can record such things as: what instruments they have observed, what procedures they are following and what information they have requested from others. This will allow the assessment staff to record that the action was demonstrated and give the candidate credit for the action when the examination is being assessed.

The detailed candidate performance requirements should be described by the licensee or the regulatory agencies in such documents as:

- Job and Task Analyses;
- training objectives and course material;

— licensee documentation that specifies staff operating responsibilities during normal operation as well as during plant upsets and emergencies.

IAEA-TECDOC-1411 [4] gives other sources and considerations in identifying candidate performance requirements. When team testing is done, assessment of group performance is also done, measured by the performance requirements documented by the licensee or in regulatory documents. In this situation, members of the team can be assessed as a whole, or individuals can be assessed.

4.3.1.2. Performance assessment

To evaluate candidates, assessment criteria are applied to the competencies identified. These criteria are designed to reflect the positions being evaluated, such as emphasizing panel equipment operating capability for operators and including a higher level of diagnostic capabilities for supervisory staff. In most cases, there are common skills required such as procedure compliance, panel monitoring and effective communication.

The assessment criteria should be predefined and documented by the licensee or the regulatory body. Documenting the criteria will help to ensure:

— the training staff and candidates are aware of the performance expectations;
— assessing staff have guidelines to by which they can judge (un)satisfactory performance;
— assessment is as objective as possible.

Again, by involving the licensee in preparing the criteria, plant expectations can be used in the setting of the assessment criteria. In this way, the simulator performance expected of the candidates can be as close as possible to the expected performance in the plant control room.

A variety of tools can be used to gather information during the examination:

— written observations of the candidate performance, using check sheets and/or written notes;
— video taping, with sound, of the candidate, and key support team actions (although in some Member States, this is not permitted);
— candidate’s written notes and log entries;
— simulator recording of plant parameters and alarm conditions;
— computer record of candidate panel operations (switching and control selections) and simulator operator actions.

With this information, candidates can be assessed on:

(a) Specific actions required by the design of the examination scenario:

— number of actions done correctly, such as following procedures correctly;
— correct diagnosis of faults;
— timely execution of required actions and fault diagnosis;
— prioritizing actions when multiple faults occur;

- recognition of situations where equipment faults place the plant in a situation not covered by procedures;
- requesting procedural deviations where required
- clear and concise communications;
- for supervisory staff, the proper management of control room and other plant resources.

(b) Errors that jeopardize plant safety

These are errors that the candidate makes by incorrect action or lack of action. They can be categorized in many ways, and a two-level system is given here:

Critical error – an action, or inaction, that has a serious immediate impact or is a potential threat to plant or public safety. One of these errors could warrant the failure of a candidate. These could be:

- causing a full or major impairment of a reactor safety system effectiveness;
- failing to take all the required actions in the case of the above failure;
- failing to take timely action that could have prevented the operation of a reactor safety system;
- failing to recognize the improper operation of a reactor safety system;
- taking an action that results in a violation of the designed plant safety parameters (e.g. violates Technical Specification parameters) for reactor power, fuel cooling or radioactivity containment.

Significant error – an action, or inaction, that may have a potential impact on plant or public safety. Depending on the circumstances, two or more of these errors could warrant the failure of a candidate:

- placing staff in a dangerous situation that could seriously affect their health or safety;
- causing a reduction in effectiveness of a safety system;
- not recognizing the reduction in effectiveness of a safety system;
- not taking timely and proper action to prevent the degradation of a plant safety system;
- taking an action that results in a violation of the designed plant safety parameters (e.g. violates Technical Specification parameters) other than the parameters for reactor power, fuel cooling or radioactivity containment.

The pass/fail standing of a candidate can be based on: performing a sufficient number of the actions in (a), and not committing actions that meet the failure requirements of (b).

4.3.1.3. Knowledge assessment

Knowledge can be assessed in simulator examinations by appropriate design of the scenarios. During the examination, there can be pre-scripted interventions by role players filling such positions as shift supervision, who ask for situational updates and the recommended actions yet to be taken in response to the event. At the end of the examination, after the simulator has been frozen, candidates can be questioned. The questions can be used to: determine

information such as the reasons the candidate took the actions performed during the dynamic portion of the examinations; clarify the actions taken by the candidate that may not have been obvious during the dynamic portion of the examination.

4.3.2. Design of simulator tests

The design of simulator tests needs to ensure that the competencies identified are tested; and there is sufficient opportunity for the candidates to demonstrate their skills in these competency areas; and to allow the assessment requirements to be met. Failure to meet these requirements could result in a number of consequences, such as:

- invalidate the results of the examination, causing it to be discarded;
- inadequately test the candidate, allowing certification of individual(s) who are not qualified;
- result in a challenge of the results by the candidate or licensee;
- place unreasonable demands on the candidate, resulting in the failure of competent individuals.

There are a number of types of scenarios that can be used, such as:

- situations where the candidate is required to carry out standard procedures to protect faulty equipment and prevent the deterioration of plant operation that would result in the actuation of automatic protection devices or systems;
- scenarios made up of initial and additional failures that require complex candidate response;
- short scenarios, in which the simulator is frozen after a specified time, that requires the diagnosis of the event and the recommendation of remedial actions to be taken and the procedure(s) to be followed;
- JPMs that require a candidate to carry out specific panel operations, or perform a “talk-through” of the actions that would be taken;
- performing a panel check, with stable plant conditions, to identify anomalies in the panel indications; this can be done, for example, to verify that an automatic action has successfully occurred, or that a system lineup is correct.

Typical major malfunctions that can be used are:

- reactor coolant pump trip;
- reactivity control mechanism failure;
- large or small leaks in the reactor coolant system;
- failure of primary and backup reactor control systems or computers;
- turbine generator trip on electrical or mechanical protection;
- steam or feedwater system leaks inside or outside of containment;
- electrical system failures that can have a major or minor impact on plant operation;
- failure of auxiliary systems that can have a range of effects on plant operation.

These malfunctions can be combined in many ways to create a variety of scenarios to test the competencies of candidates at all levels in the shift organization. These scenarios can vary in

length from an hour or more in a complex scenario to a few minutes for a JPM or panel check type of test. The length of the scenario should be such that the candidates are challenged and given an opportunity to demonstrate their abilities, yet not overwhelmed by the complexity or length of the test.

The "Attributes" of a scenario can be considered as the total number of malfunctions, contingencies, etc. There can be a minimum number or combination of these attributes such as:

- total malfunctions (5–8);
- malfunctions after Emergency Operating Procedure (EOP) entry (2-4);
- abnormal events (2–4);
- major transients (1–2);
- EOPs entered/requiring substantive actions (1–2);
- EOP contingencies requiring substantive actions (0–2);
- critical tasks (2–3).

A combination of scenario types can be used to make up an examination set. Longer scenarios can be used to evaluate candidates in a team setting; and shorter, more focused, scenarios can be used to evaluate the candidate's individual abilities.

4.3.3. Development of examination scenarios

4.3.3.1. General requirements and recommendations

The development of examination scenarios is the next logical step after the competencies and assessment requirements have been identified. In this phase, the scenario details are identified and documented. When this is done, the scenarios are then verified, in actual "scenario time" to ensure that the simulator can accurately replicate the plant behaviour; and that the expected candidate actions, given in the scenario, meet operational expectations and have the desired effect. At this time the initial scenario conditions are set up and the simulator operator actions are documented and verified as having the desired effect. The role player actions are also confirmed during verification, to ensure their actions are realistic, occur at the appropriate times, provide the required information to the candidate and have the required results where field operations are simulated. For each scenario it should be confirmed that at any stage of execution, or after any external action is initiated, the simulation remains within the design scope of the simulator.

4.3.3.2. Format and content of the scenarios

It is essential that the scenarios be documented as fully as possible. This will help to provide consistency in the assessment of candidates, and ensure the effective conduct of the scenarios to avoid any 'ad hoc' actions that could easily jeopardize the validity of the examination.

Examples of scenario documentation are attached as Appendices XXIV, XXV, and XXVI for a longer "comprehensive" test scenario:

- scenario initial conditions;
- scenario description;
- candidate action checklist.

Scenario description

This is a summary statement, giving the major events in the scenario and an outline of the major actions to be taken by the candidate. It should also identify the point at which the dynamic portion of the scenario will be ended and the simulator frozen. Other information can be given, such as:

— the type of scenario;
— the position in which the candidate will be tested;
— important "secondary malfunctions" that are scripted to occur, which the candidate must address.

Initial conditions

This is a description and/or listing of the plant initial conditions at the start of the scenario, identifying all the special conditions existing at the beginning of the scenario. Depending on the Member State practices, some conditions may not be identified and the candidate must determine them themselves. The information can include items such as:

— reactor power and generator load;
— special operating circumstances such as raising power after a long outage;
— heat sink conditions if the reactor is shut down;
— control rod or other reactivity control device status;
— time and day simulated in the scenario;
— equipment out of service;
— maintenance in progress in the plant;
— equipment tagged out as a precautionary measure but available for service if needed;
— shift crew support staff available to assist.

Initial plant conditions should be varied between scenarios, and not all plant equipment out of service should have an impact on the scenario. This will minimize the possibility of inadvertently revealing, to the candidate, the systems that will be tested in the scenario.

Candidate Action Checklist (CAC)

During scenario development, the candidate's expected actions are documented. They should be in an easily referenced and predetermined format, such as a table or checklist, to include such candidate actions as:

— monitor and check panel indications to determine the nature of event malfunctions;
— take panel operations in response to the malfunctions and the procedures that need to be followed;
— identify when failures have occurred that require deviation from procedures and seek any necessary approvals for these actions;
— get information or have actions taken in the field;
— instruct control room support staff to take actions or obtain information required;
— brief others, as required, on the status of the plant and the actions planned.

The CAC can also include a very brief summary of other key information for the examination team, such as:

- malfunction(s) description and alarms expected;
- simulator operator instructions to input malfunctions at the appropriate time or when triggered by candidate or role player actions, if these malfunctions are not part of the simulator automatic actions;
- expected simulator response as identified during development;
- role player actions and pre-determined verbal input;
- pre-determined end point of the scenario.

The CAC section should be as detailed as possible to ensure that:

- the examination observers haves sufficient information to easily record the candidate's performance while still being able to observe the candidate actions;
- the simulator operator knows when to initiate the required inputs, if they are not perfromed automatically by the simulator;
- the support team role players have the information needed to properly carry out their actions;
- the Lead Examiner can monitor the progress of the scenario and can:
  - stop the scenario at the predetermined end point;
  - intervene as needed through the role players to information or direction if the scenario takes a **minor** deviation from the expected path;
  - end the scenario prematurely in the event of a simulator misfunction or **major** deviation occurs such as a simulator malfunction or a candidate action that invalidates the scenario.

The planned end point of the scenario should be clearly identified to ensure consistency and validity of the examination. The Lead Examiner should make the decision to end the scenario in the event of a major deviation in the scenario as described above.

Questions

At the end of the scenario, questions can be used as previously described to assess candidate knowledge on:

- rationale for taking the expected actions during the scenario;
- understanding of the plant conditions;
- further procedures to be followed to place the plant in a safe state;
- whether the procedures available are adequate to deal with the plant situation.

The candidates may also be asked questions to clarify the reasons for unexpected actions taken during the scenario or to explain their understanding of events or transients where the expected actions were not taken.

It can be advantageous to have pre-planned questions at the end of each scenario, and brief the candidates that this will occur. In this way, the candidates will not feel that the questions are asked because they have likely made an error. If the examiners do want to question the

candidates because of unexpected actions taken, or actions not taken, this can be done as part of the pre-planned questions.

In some cases, these questions may reveal that the simulator indications did not occur as planned or that role players did not provide the required information. This input will be used to fairly assess the candidates' performance.

Role player instructions

These instructions are more detailed than in the CAC and will ensure that the team members playing the support staff roles know:

- when to enter/leave the control room as required;
- expected verbal information to be given to the candidate when asked;
- simulated field actions to be carried out;
- feedback to the candidate such as: information on field conditions, actions taken, equipment status and/or condition.

The instructions and information should be identified during scenario development. If the candidate makes unexpected requests, role players should respond as they normally would in the plant, **without** providing information that the candidate is expected to determine. When role players are unsure of their response they should consult the Lead Examiner as appropriate.

It is essential that this information be documented in the scenario and consistent for all scenarios. In this way, all candidates will be examined fairly and consistently and in accordance with the expectations used to develop the scenarios.

Simulator operator instructions

This section is more detailed than the CAC and contains details to:

- activate the scenarios and establish secure simulator operating mode;
- set up the control room panels with the appropriate initial conditions;
- input the planned malfunctions and equipment conditions as planned during scenario development; this can include the event sequence, timing as well as input when required by candidate actions, response to simulated field actions or Lead Examiner's cues;
- cue the end of the scenario.

As with the role players' instructions, these actions should proceed as planned in the scenario and be as consistent as possible for each candidate.

4.3.3.3. Simulator team preparedness

The complete Simulator Team can consist of a number of different types of staff who are directly involved in the examination process:

— examiners that developed the scenarios; these may also be the same personnel who observe the candidates during the scenario and who also assess the candidates' performance;
— role players who act as support staff in the control room;
— role players who are available by telephone and provide information or simulate actions taken in the field;
— simulator operator(s) including video camera operators;
— contractors involved in the process.

The examiners and simulator operators are involved in the design, preparation, development and verification of the scenarios.

There is also support staff that should be available when needed; these staff can include:

— simulator technical and maintenance staff to resolve simulator hardware or software problems;
— clerical support staff who prepare, copy or handle examination material;
— observers who have a defined need to observe the conduct of the examination.

The complete team, including any additional simulator operators and role players should be brought together for the final rehearsal of the scenarios. This will ensure that each scenario will proceed as planned and that all involved are familiar with their roles. The support staff will need to be briefed on the content of the scenarios and then practiced in their roles. At the same time the video and sound equipment as well as the simulator data gathering systems are tested to ensure they perform as expected.

In the rehearsals, the simulator setup and performance are also verified, and baseline information can be gathered such as:

— printouts of alarms received;
— trends of plant system parameters needed to monitor the conditions relevant to the examination scenarios.

This baseline information can be used in the assessment phase to ensure that the plant system parameters responded as expected; and to have a reference base, if needed, to compare to candidates' performance.

4.3.3.4. Availability of the assessment team

After the availability of the examination team members has been confirmed, the schedule for running the scenarios is set and the examination team and the candidates notified of their examination schedules.

It is essential that all members of the support team, as well as the candidates, are informed of the schedule and are fully committed to their roles in the examination process. The examination preparation and conducting is a complex process involving a number of key personnel; any delays are costly; and the unexpected absence of one person can jeopardize the schedule.

Should a role player or simulator operator is unavailable, a replacement person should be found and briefed on the examination scenarios and their role. Then, they should be practiced in their role to ensure that the scenario will proceed as planned. In the case of a non-role player member being absent, a replacement person should be fully briefed and practiced if required.

In both cases, it is preferable if an existing team member is "stepped up" to replace the missing person. This way, the person will already be familiar with the scenarios; and it will be simpler to fit them into their new role. Although the person stepped up will have to be replaced as well, this can usually also be done with a minimum of disruption.

4.4. Conducting simulator examinations

It is important that the examination proceed as scheduled, as the staff time will have been allocated, the simulator time will have been planned; and any disruptions will upset the schedule for this very valuable resource.

Conducting of each scenario should proceed as documented and rehearsed. The steps common to each scenario can be:

- gather the examination team and check simulator operation and setup;
- brief the candidate on the role to be played and identify the plant initial conditions specific to the scenario;
- confirm that any video and sound recording equipment used is functioning properly, and start the scenario when the candidate is ready;
- proceed with the scenario as planned;
- record, by the examiners, the candidate actions on copies of the scenario documentation;
- carefully observe the simulator performance to ensure that it functions as planned;
- as required, cue any simulator operator actions that are not initiated by candidate actions, timed interventions or other means;
- ensure that role players follow the actions as documented in the scenario;
- stop the scenario prematurely if the conditions identified below are met, as described at the end of this section;
- when the candidate has completed the scenario, freeze the simulator;
- the examiners should briefly confer in a remote area of the simulator, to confirm their written information recorded and determine if there are any clarification questions to be asked;
- ask any preplanned or clarification questions;
- instruct candidate to leave the simulator area;
- the examiners should make any notes on the candidate's performance at this time;
- gather the material from the scenario, including examiner notes, all material marked up by the candidate as well as simulator computer printouts, charts, trends and video tapes if used; in the case of simulators using chart recorders, the chart should be marked with the candidate's name and scenario, then advanced to fresh paper for the next candidate; ensure the material is clearly marked with the candidate's name and stored securely;

- the simulator operators should then proceed to set up the simulator for the next scenario;
- all documentation marked up by the candidate must be replaced; or with plastic coated operator aids, cleaned of any markings made;
- clarify any examination team concerns that may be raised and identify and discuss any performance deficiencies with the members of the team;
- make any essential changes to the conduct of the scenario for future candidates; this should only be done if absolutely necessary to ensure that all candidates are treated as equally as possible.

Premature termination of the scenario should be done if the following types of circumstances occur:

- a simulator misfunction occurs, which is observable by the candidate or the simulator operator; or that deviates from normal plant response, such that the planned scenario cannot be used to reliably record the performance of the candidate;
- the candidate must leave the simulator;
- a member of the support team has to leave the simulator, and this member's absence will jeopardize the conduct of the scenario or the reliable assessment of the candidate.

When such an event occurs, the simulator should be frozen; the candidate escorted from the simulator and kept in seclusion until the situation is resolved. The examiners will determine if the scenario can be fairly restarted or if it must be ended at that point. If the scenario is to be resumed, the candidate is brought back into the simulator when the examination is to resume. If a simulator fault has caused the interruption, the reason for the problem should be determined and rectified before resuming the scenario.

Scenario ad hoc changes during its conducting are not advisable and should only be done with the Lead Examiners approval if absolutely necessary to help the smooth flow of the scenario. Making these changes - that have not been previously verified - can easily result in:

- unexpected response of the simulator to the change;
- the change not having the desired effect;
- unexpected, but proper candidate response;
- not examining all candidates fairly and consistently.

4.5. Grading

4.5.1. Grading — individuals

Before assessment is done, the scenarios should be reviewed to ensure that they accurately reflected the expected actions and that the plant simulator responded as expected. Modifications should be made to the scenarios if there are changes that apply to **all** candidates. In this way, all the assessments will be done to a standard set of scenarios and performance expectations.

Candidate grading will proceed once all the examination scenarios have been completed. The assessors may be the same people who prepared and observed the examination. The assessors use the information that was gathered after each candidate's scenario and assess the results of

each scenario, then compile the results for the candidate's final assessment. The total result of all the scenarios is used as each scenario may have focused on slightly different systems, skill areas or level of ability.

As described in Section 4.3, the examination objectives, competencies to be tested and performance expectations should be integrated in preparing the scenarios. Therefore, the expected performance criteria should have been designed into the scenario. The performance assessment standards are then used to evaluate the candidates' actions and determine the final results.

Each Member State may have specific performance requirements and evaluation format. This may include:

- a required overall percentage pass mark on actions properly taken;
- a pass mark required for each skill area;
- the commission of no Critical Errors, as in Section 4.3.1.2 (b);
- allowing the commission of a minimum number or type of Significant Errors, as in Section 4.3.1.2(b).

Annex III, Part 5, item 7, "Simulator Based Examinations …" Section 4.5 provides examples.

4.5.2. Grading — examples

There are numerous techniques to grade candidate performance, which are based on the Member State practices in conducting the examinations. Examples of some practices and techniques are:

- Annex III, Part 5, item 5, "Simulator Based Examinations …", Appendix A.16, showing the tabular grading of a diagnostic test for a requalification examination;
- Annex III, Part 5, item 15, "Examples for TECDOC on Lessons Learned …." - an "Observation Report" table is shown assessing the candidate on four competencies categories, in seven levels of performance;
- Annex III, Part 5, item 23, "Comprehensive Test Scenario ….", page 34, shows a "Marking Matrix" assessing the candidate on seven competencies, in two levels of performance either "As per Expectations" or "Requires Improvement";
- Annex III, Part 5, item 29, "NUREG 1021", Form ES 301-6, giving a competency checklist for initial examinations;
- Annex III, Part 5, item 19, "Items for Team Performance Evaluations", is a "radar plot" diagram assessing six competencies on a scale of 5 to 10; this diagram is included in Appendix XXVIII.

4.5.3. Grading — group results and programme deficiencies

On occasion, with the same scenarios given to a number of candidates, there may be common deficiencies shown by the candidates. This could be the result of problems within the training process itself, in such areas as content or methodology.

In this case, there may be "class" remediation identified. This would require that all candidates undergo further training before being recommended for authorization. As well, the

class results may identify deficiencies within the training programme that need to be rectified before any further candidates are examined.

Common candidate shortcomings may be caused by plant procedures that are unclear or perhaps in error. This information should be provided as feedback to the plant operating organization to correct the procedures as appropriate.

4.6. Documenting the simulator exam process and results

4.6.1. Simulator examination process

As mentioned in Section 4.1.2, the examination process should be available and understood by all involved: the licensee, candidates and the regulatory body. This can be done by fully documenting the process, including the assessment criteria. In this way, the candidate performance competencies and assessment criteria can be reviewed and aligned with licensee plant operator expectations. The result should be an authorization process that is valid and fair as well as meeting the need for the authorization of competent operating staff. There are many ways of doing this, some of which are listed in Annex III, Part 5 item 7, Operating Procedure ST6- (RO), and item 29 of NUREG 1021.

4.6.2. Examination results

Documenting the results of the examinations will help to:

- ensure the candidate file is complete, with a recommendation for certification, or, especially where the reasons for candidate remedial training or failure must be documented;
- finalize the details of the scenarios used for future reference and use as well as comments on the examination techniques used, that can be positive or negative;
- provide feedback to the licensee on any lessons learned such as procedures that need to be improved;
- identify simulator shortcomings that need to be rectified.

Where Member States frequently authorize a large number of staff, an analysis can be done of pass/fail rates and the reasons for these rates. This can help ensure that the tests are valid and provide sufficient discrimination so that only competent operators pass the examinations and are authorized.

As described in 4.5.3, there may be “group” remedial training needed, which needs to be documented to identify candidate deficiencies as well as training programme deficiencies.

4.7. Post-examination activities

Using the candidates’ results documentation (see the previous section), follow-up activities can include:

- written recommendation that the candidate meets the simulator examination requirements for authorization;
- remedial candidate/class training before authorization; this can include the need for further simulator examination(s) depending on the candidate results, and the additional training can be focused on the areas of the deficiencies identified;

— where the candidate receives a failing grade, a decision needs to be made on whether the candidate should return, or not, to the training programme; this decision is dependent on the Memer State practices and the regulatory body policies;
— ensure the candidates' files contains the results of the examination process, including all the relevant feedback their performance.

Follow-up activities, not focused on the candidate, should be completed, such as:

— file the scenario documents for future reference and/or make them available to the licensee and other authorized parties as per the Member State practices;
— provide feedback to the licensee on operating deficiencies found in procedures;
— identify simulator deficiencies to the training/examining facility;
— identify training feedback, positive or negative to the training facility;
— provide a post-examination analysis of the examination that can identify positive or negative aspects of the examination process and the scenarios used.

An example of a checklist that can be used in these activities is listed in Annex III, Part 5, item 29, NUREG 1021, Form ES 501-1 "Post Examination Checklist", that gives ten items for follow-up activities.

4.8. Simulator examination administration, security and supervision

4.8.1. Confidentiality and security

This topic was introduced in Section 3.1.4 and can be considered in the following categories: simulator security; personnel security; examiner independence.

Simulator security involves the physical facility as well as the computers involved. Software security must be in place so that only authorized staff has access to the scenarios and that examination confidentiality is maintained. This can be achieved by such means as software security within the computers or by transferring the scenario files to separate discs when they are not being used. When simulators are linked to remote sites such as classrooms, measures must be taken to ensure that there is no interference with the scenarios from these facilities. There must be physical security of the simulator area so that unauthorized personnel cannot observe the control panels or hear the examination team during the development or conduct of the examinations. This will prevent deliberate or accidental entry during examination work. The latter is also important to avoid disruptions during the conduct of the examination.

These requirements also apply to any special office areas that are used for examination development.

Personnel security is essential so that only the examination team is aware of the scenario content. Each member of the team should be briefed on the need for security and sign a security agreement. To avoid inadvertent breaches, there should be **no** discussion of the examination outside the secure areas of the simulator, or the special examination office areas.

The candidates must also be briefed on the need for examination security, especially when there are a number of candidates who will be tested over a period of days.

Similarly, information on individuals' performance and examination results should be treated in accordance with each Member States' policies on the handling of this kind of information.

Examiner independence can be considered as a form of examination security. The examination manager, as described in 4.8.3, should be independent of the training organization. This will help to ensure an impartial and fair examination. As well, any staff assigned to work on the examination team, should not be involved in further candidate training and must make no attempt to influence the content of the examination scenarios.

4.8.2. Administration

This phase of the simulator examination process can include planning the examination activities and the need to schedule the examination team and simulator time, which is described in Section 4.8.3. To ensure effective use of the simulator, initial scenario development and subsequent documentation preparation can be done in a secure office area and not in the simulator facility. In scheduling the examination, there are a number of advantages in running each scenario for all candidates before moving on to the next scenario, such as:

- It minimizes setup time for the scenario;
- the role players and simulator operators can finish with one set of "roles" before changing to the next scenario;
- security is improved; once all candidates have completed one scenario, a security breach in that scenario is not as significant as if it had occurred earlier in the process.

Administrative activities may include:

- the final preparation of documents;
- preparation/photocopying of a supply of documents for the examination;
- the preparation and filing of examination results;
- provision of secure office space outside the simulator as well as a secure means of collecting and disposal of draft and extra document copies made during the process.

This work is subject to the requirements of examination security as well as the confidentiality of personal information. Even the activities of photocopying of extra procedures for the examination should be done in a way that does not reveal the content of the examination.

4.8.3. Supervision

As previously described, a simulator examination involves a number of valuable, skilled personnel in the examination team. The candidates are also an expensive "resource", whose careers are dependent on the examination results. The simulators usually have a very full schedule.

Due to these and other factors, there should be a single, competent individual assigned to manage the examination process to ensure that the examination team functions well together through all stages of the process. This person can also deal with any conflicts between the licensee and regulatory body, with simulator schedules, maintenance needs and other requirements. Any breaches of security can also be referred to this person for appropriate action.

A Lead Examiner, who can be the examination manager or another competent person, should be appointed for each examination. This person ensures the scenarios are conducted efficiently and acts promptly to resolve issues such as role player or simulator operator questions and premature ending of a scenario in the event of a simulator malfunction or other significant event.

Line and training management who provide staff or resources to the examination should be aware of their role and the need for their participation. This will help to provide competent staff to support the examination process, which is also of benefit to plant line management.

The documentation of the examination process is described in Section 4.6. By formally identifying the responsibilities of all parties, including the licensees and the regulatory body, it will help to ensure that the examination process is carried out efficiently and effectively.

4.8.4. Quality assurance

One of the principles of quality assurance is to "do the right things right the first time". This can be achieved by following the process as described in this document to ensure:

- scenarios are well designed, documented and verified on the simulator;
- candidate performance is fairly and properly assessesd with appropriate feedback provided;
- plant management expectations are used when developing performance expectations and evaluation standards;
- proper security and confidentiality are maintained;
- the examination team is competent and well briefed on their roles;
- the simulator functions as expected and responds to the events as anticipated;
- auditable programs are in place to update the simulator to match plant changes and ensure there is an adequate simulator configuration management system.

Quality control checklists can be used to identify and record the execution of many of these actions. An example is given in Appendix XXIX "Simulator Examination Design Checklist". For further details and clarifications, see Annex III, Part 5, item 7, "Simulator Based Examinations…," Appendix A.11.

Another checklist example is listed in Annex III, Part 5, item 37, "Excerpt from NRC Inspection Procedure 711111 Simulator Scenario Review Checklist".

5. SELECTION AND TRAINING OF INDIVIDUALS INVOLVED IN THE PROCESS

5.1. Simulator assessor selection

The selection of personnel who are responsible for the development and administration of simulator examinations varies in Member States. The selection of personnel is also dependent on whether the regulatory organization or the NPP performs these functions. In some cases the functions are also split between the regulatory organization and the NPP. In others, a central training organization that may be part of the countries utility organization may perform the functions for the NPP. In almost all cases, the selection of personnel requires that

they have a university degree in engineering or science and a specified number of years of nuclear experience. In addition, most Member States require that the simulator assessors hold or have held a control room operator authorization (licence or certification) for the type of NPP that they will be assigned as assessors/examiners. Some also require courses or degrees in education. IAEA-TECDOC-1254 *Training of the staff of the regulatory body for nuclear facilities: A competency framework* [3] contains more detailed information on the selection and training of regulatory personnel.

5.2. Training of simulator assessors

Once the assessors have been selected, training is needed to ensure that they have competency in plant operation as well assessing human performance in meeting the expected competency standards of the candidate.

Training of the assessors typically addresses the following areas:

- Working as a part of the assessment group in a team environment.
- Observation and diagnostic skills for evaluating human performance and identifying the areas of weakness to support the assessment decision and to make the evaluation decision in an objective manner.
- Interviewing and questioning techniques to assess the candidate to support the evaluation decision.
- Knowledge and understanding of the applicable requirements for the competencies that must be included in the simulator examinations.
- Knowledge and understanding of observation practices and the procedures to assess these observations to determine if the candidate performance meets the applicable assessment standards, for example:
  - observation and evaluation techniques - methods of evaluating students performing tasks so performance is measured accurately and recorded for use in performance evaluations;
  - diagnostics - the process of analyzing and solving problems logically during exercise scenarios;
  - teamwork - the importance of team skill in the control room.
- Knowledge of the simulator's specific capabilities as well as its software and hardware limitations in modeling plant performance. This is needed to be able to develop examination scenarios that meet the required assessment standards and to assess the candidate's actions taken during the examination.
- Where regulatory organization staff are involved in the assessment of simulator examinations, the competencies given above are required, as well as other applicable competencies described in reference [3] in Chapters 3 and 4, such as knowledge of the legal basis and regulatory process applicable to the authorization of control room staff. Assessors typically are required to complete a simulator instructor training course with particular emphasis on the development and practice of evaluation skills. Table 8 is an example outline of a typical simulator instructor training course. References [4] and [17] also contain examples of simulator instructor training courses.

TABLE 8. EXAMPLE SIMULATOR INSTRUCTOR TRAINING PROGRAMME

(TERMINAL OBJECTIVES)

Upon completion of the training, the simulator instructor participant will be able to:

(1) Discuss the role and responsibilities of a simulator instructor using adult training techniques.
(2) Identify how to use effective oral questioning techniques and how to develop and administer effective oral evaluations.
(3) Develop and conduct effective scenarios.
(4) Conduct observations in the simulator.
(5) Enhance and evaluate trainee performance in the simulator.
(6) Conduct and facilitate post-exercise critiques to improve operator performance.
(7) Utilize the simulator to administer Operator examinations.

5.3. Training for other types of examinations

Assessor who prepare or conduct written, oral, and walkthrough examinations also need to be trained. In most Member States this training is accomplished by attendance at portions of instructor training courses that address the development of these types of examinations. Further information on instructor training is contained in IAEA-TECDOC-1392, Development of Instructors For Nuclear Power Plant Personnel Training [17].

References [5] and [9] provide information useful for the development and administration of written, walkthrough, oral, and simulator examinations. In particular, NUREG 1021, Operator Licensing Examiner Standards for Power Reactors [9], includes Appendix B, Written Examination Guidelines; Appendix C, Job Performance Measure Guidelines; and Appendix D, Simulator Testing Guidelines.

There are also other useful examples listed in Annex III, Part 5, such as items 2 to 7.

5.4. Examination boards

Examination Boards (EB) are used by many Member States for preparing or conducting authorization examinations and final recommendations for authorization of a candidate. The requirements for examination boards are typically contained in Member State's national laws or regulations. These requirements typically identify the functions and responsibilities of the boards, their membership, and board member qualification requirements.

Usually the membership of Examination Boards is composed of representatives of the regulatory body, the NPP operating organization, or a combination of personnel from both organizations. In some Member States, examination boards are composed of personnel from central training organizations in conjunction with, or separate from, the NPP and regulatory body.

The selection of personnel for examination boards also varies. Typically members should be senior managers from the NPP; or — in the case of regulatory personnel — should be specifically qualified for the job position through prior education, training, and experience. Where examination boards are used for simulator examinations in the authorization process,

representatives from the NPP or central training organization are required. These personnel should typically have simulator instructor training; and may also be required to have held or currently hold an authorization, licence, or certificate at a similar type plant for the job position being examined.

The role and functions of examination boards also varies significantly among Member States. The functions may be one or more of the following:

— preparing or conducting written examinations;
— preparing or conducting simulator examinations;
— preparing or conducting oral examinations;
— preparing and conducting walkthrough examinations;
— inspecting, reviewing and oversighting the authorization process including activities such as:
  - reviewing a candidates training records;
  - observing or participating in examinations;
  - reviewing the overall training programme and examination results;
  - making final recommendations regarding authorizations; and/or
  - making the final decision to authorize a candidate.

In those cases where the examination board is composed entirely of regulatory personnel, the reference [3] discusses a common approach used by most regulatory bodies to recruit staff using a job specification that includes qualifications and experience. Typically the recruitment pool are persons who possess a first or second level university degree and who have between 5 to 10 years of experience within the nuclear industry or a related field. In the terms of the model presented in this report, these persons would be considered as having already demonstrated application of their fundamental knowledge within the nuclear industry.

The use of consultants in specialized areas may also be necessary. Occasionally, owing to a heavy short-term workload, it may be necessary to augment the regulatory body's staff with consultants with knowledge and experience equivalent to that of the regulatory body's staff. This may take any of the following forms:

— experts provided by other governmental bodies, technical societies or research institutes;
— consultants or members of advisory committees of recognized skill and experience, so long as they are effectively independent of the operator or its contractors; or
— experts provided by or under the auspices of international organizations.

It is essential that regulatory bodies apply a systematic approach to identify current and desired competencies, determine the gaps, and design and implement necessary corrective measures including training programmes, if necessary, to address the desired regulatory body competencies.

6. CONCLUSIONS

The questionnaire and simulator survey responses gathered for this document reflect a variety of effective methods for authorization of control room personnel.

The following are key points identified in the Member State information provided for this technical document and in the final review meeting attended by representatives from many countries responding to the questionnaire and survey:

- All Member States have or are implementing the systematic approach to training. The analysis required by this training methodology is increasingly being used to validate the written, oral, and performance examinations used in the authorization process. This not only assures that the examinations are valid and reliable, but also that they are a fair measure of the operators required knowledge, skills, and attitudes.
- Simulator examinations are seen as an indispensable tool to help ensure safe NPP operation; however they should be properly resourced with knowledgeable training, support and assessment personnel, whose skills are normally in high demand throughout the organization.
- Depending on Member State practices, simulator instructors and assessors may be required to maintain or have held an authorization as an operator, or - at a minimum - ensure they receive the appropriate simulator instructor and/or simulator assessor training.
- In general, the approach to the authorization process should add value to the overall control room personnel training programmes and wherever possible, be supportive of training activities and continuous improvement. This will help to ensure a positive relationship between the operating organization(s) and the regulatory body.
- In a few Member States the duration/length of the authorization is dependent upon job performance. By maintaining good performance, including active participation in continuing training, an individual is not subject to formal authorization examinations as often. This can be a positive motivation and also reduce stress.
- The involvement of the operating organization's staff and management in the preparation of examinations helps to improve the quality of the tests and also to build confidence in the process.
- The objectivity of the personnel assessment process is very important to help ensure the added value of the authorization process.
- In a number of Member States there is a trend to greater involvement in the authorization process by the operating organizations that have the best knowledge of the plant operating procedures and systems behavior. However, to meet the national requirements of 70% of the responding Member States (Section 2.7, Figure 2) and maintain the required regulatory expertise, the RB continues to have some level of involvement in the simulator examination process.
- Before assessing personnel in a simulator, it is important that they are properly introduced to the testing techniques and examination process to be used and have an opportunity to participate in practice sessions before the actual tests. This will provide an opportuntiy for self-evaluation and also will reduce the stress of subsequent examinations.
- In a number of Member States, the regulatory bodies obtain feedback from the nuclear power plants on the authorization process in order to continually improve the process and, in particular, the examinations. Feedback mechanisms such as 'operator feedback programmes', 'frequently asked questions' compilations, and periodic meetings are some of the methods used to provide feedback.
- Member States continue to make improvements to the authorization process including, for instance:

- more and better use of multiple choice questions in written examinations;
- improved examination planning ands test specifications;
- improved grading methods; particularly, the improvement of assessment criteria and standards for simulator examinations to reduce their subjectivity;
- increased emphasis on team skills during simulator re-authorization examinations;
- development, conducting and grading of the examinations by the NPPs to better assure plant specificity, with granting of an individual's authorization by the regulatory body or, as designated, by the operating organization;
- improvements to oral examination board questions and grading.

Additional sources of information: The IAEA and many Member States now maintain internet sites where regulations and other supporting information can be readily obtained. The IAEA has developed the Electronic Nuclear Training Catalogue (ENTRAC) that provides a method for gathering, sharing, and maintaining training information amd materials. This Internet site (http://entrac.iaea.org) contains the information from the accompanying CD-ROM and includes other information on examination design, development and implementation.

APPENDIX I. SUMMARY OF ABBREVIATIONS OF JOB POSITIONS

Abbreviation	Meaning	Responsibilities	Country
BOPO	Balance of Plant Operator	Operation of systems and control boards of Balance of Plant Systems	Mexico, Slovenia
CRA	Control Room Assistant	Advisory activity in case of plant disturbances/ incidents	Romania
CRP	Control Room Physicist	Control during reactor startup	Czech Republic, Slovenia
CRSS	Control Room Shift Supervisor	Control room staff supervision	Czech Republic
DSS	Deputy Shift Supervisor	Overall plant operations Technical management	Canada, Germany, Mexico, Pakistan France
FO	Field Operator	Auxiliary operator to perform activities and operations outside of the main control room	Sweden
FP	Fuel Physicist	Control of fuel assembly manipulations	Czech Republic
HRU	Head of Reactor Unit	Overall plant operations	Slovakia
MCRO	Main Control Room Operator	Operation of systems and control boards of either reactor control or Balance of Plant Systems	Canada, France, Romania
NPPSS	Nuclear Power Plant Shift Supervisor	May substitute Unit Shift Supervisor	Russia
PIEP	Personnel Involved in Emergency Plan	Provides technical assistance to the Shift Supervisor in order to deal with accident situations	France
PSO	Primary Side Operator	Operation of systems and control boards of primary side systems	Slovakia
PSS	Plant Shift Supervisor	Overall plant operations	Lithuania, Spain

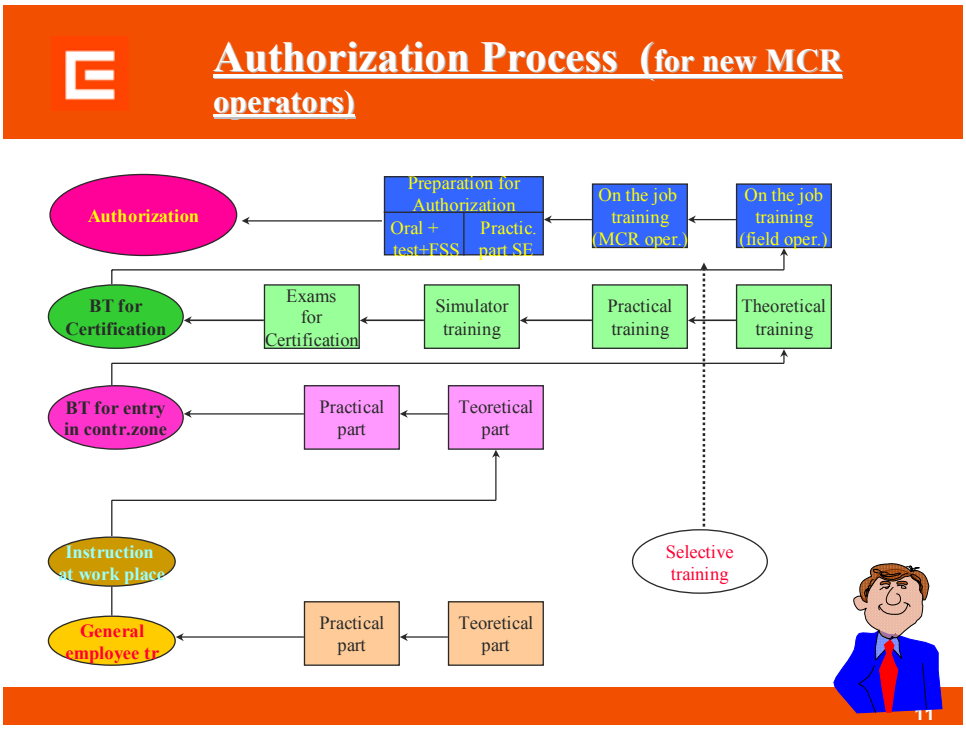
Abbreviation	Meaning	Responsibilities	Country
RDSS	Reactor Department Shift Supervisor	May substitute the Senior Engineer on Reactor Control	Ukraine (except Zaporozhzhie NPP)
RO	Reactor Operator	Operation of systems and control boards of reactor control	Brazil, Germany, Hungary, Korea, Mexico, Pakistan, Slovenia, Spain, Sweden, Ukraine. Canada, USA also includes operation of balance of plant systems
RSSS	Reactor Shop Shift Supervisor	May substitute the Senior Engineer on Reactor Control	Russia
SCAO	Secondary Control Area Operator	Provides technical assistance to the Shift Supervisor during plant events	Romania
SE	Safety Engineers	Advisory activity e.g. during normal operation and in case of plant disturbances/ incidents	France, Czech Republic, Slovakia
Sen Electr	Senior Electrician	Provides technical assistance during loss of offsite and station blackout events	Hungary
SERC	Senior Engineer on Reactor Control	Reactor and its technological systems control	Russia
SETC	Senior Engineer on Turbine Control	Turbine and its technological systems control	Russia
SENPPUC	Senior Engineer on NPP Unit Control	Unit technological systems control	Russia
SF	Shift Foreman	Overall plant operations	Brazil
SRO	Senior Reactor Operator	Overall plant operations	Lithuania, Pakistan, USA
SS	Shift Supervisor	Overall plant operations	Brazil, Canada, Czech Republic, Germany, Korea, Mexico, Pakistan, Romania, Slovakia, Slovenia, Sweden, USA
SSO	Secondary Side Operator	Operation of systems and control boards of secondary side systems	Brazil, Slovakia
SSS	Senior Shift	Overall plant operations	France

Abbreviation	Meaning	Responsibilities	Country
	Supervisor		
STA	Shift Technical Advisor	Advisory activity in case of plant disturbances/ incidents	Korea, Slovenia
STO	Senior Turbine Operator	Operation of systems and of main turbine	Lithuania
SUO	Senior Unit Operator	Plant operations	Lithuania
TO	Turbine Operator	Operation of systems and control boards of main turbine	Hungary, Spain, Sweden
TSSS	Turbine Shop Shift Supervisor	May substitute the Senior Engineer on Turbine Control	Russia
U0O	Unit 0 control room operator	control room supervising nuclear operator	Canada (at Bruce and Darlington NPPs)
UO	Unit Operator	Operation of systems and control boards of reactor control and Balance of Plant Systems (may substitute for the reactor operator)	Ukraine (only for Zaporozhzhie NPP)
US	Unit Supervisor	Overall plant operations	Czech Republic
USS	Unit Shift Supervisor	Overall plant operations	Hungary, Lithuania, Russia, Spain, Ukraine

APPENDIX II. EXAMPLES OF INITIAL AUTHORIZATION PROCESSES

BULGARIA

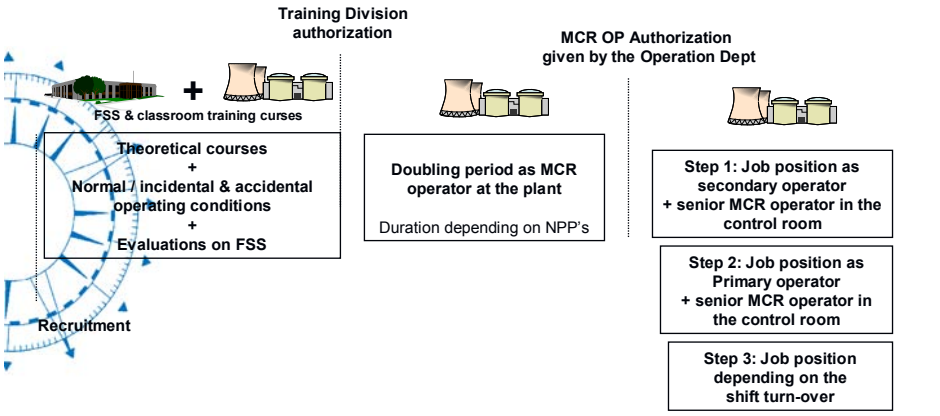
CZECH REPUBLIC



FRANCE

EDF initial authorization process

Young technicians recruited as MCR (*) operators



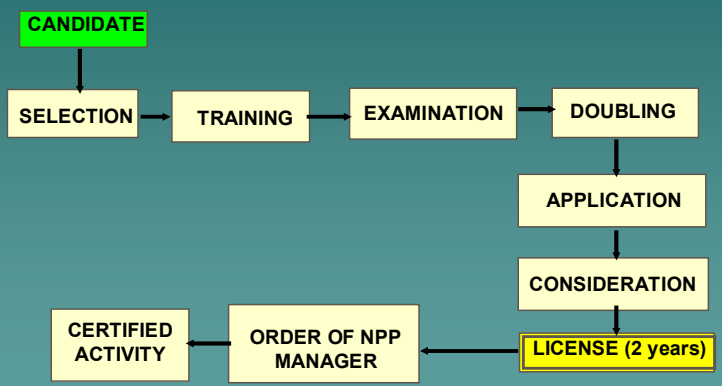
AIEA – « Authorization of CR operators » - June 2005 - CP - © EDF/SFP

(*) Main Control Room

UKRAINE

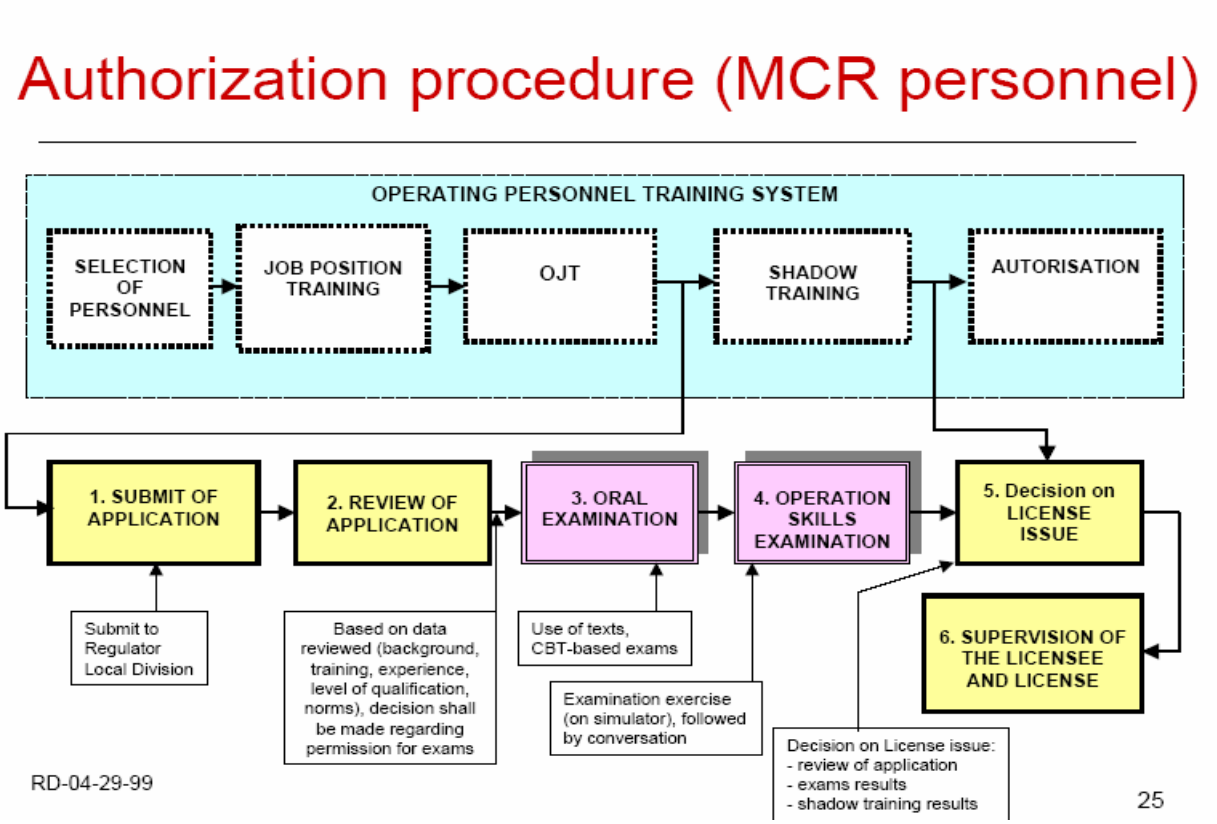
IAEA Technical
Meeting on Authorization of NPP Control Room Personnel
Vienna, 13-16 June 2005

INITIAL LICENSING PROCESS

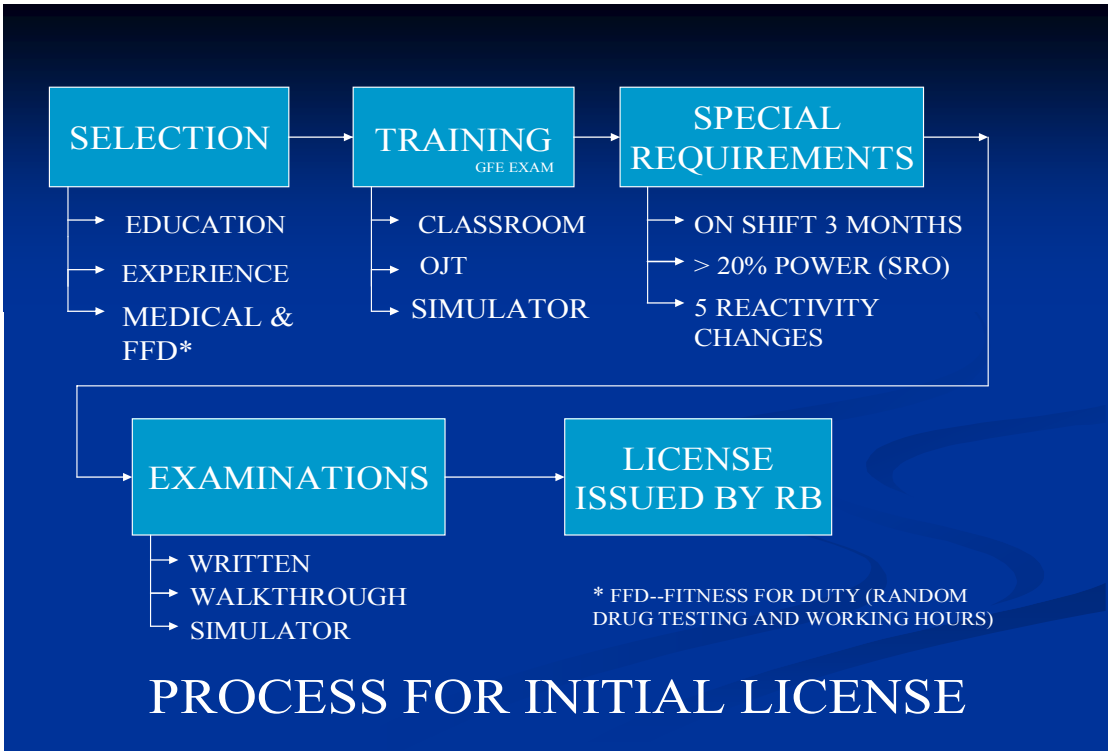


11

RUSSIA



UNITED STATES



APPENDIX III. EXAMPLE OF STEPS IN THE EXAMINATION PROCESS (CANADA)

Operational Procedure, CNSC-STI
Section 4.1, Planning of Examinations
Page 9, Rev. 2.2, Date: 2002-07-26

4 Actions

4.1 Planning of examinations

At least 20 weeks before an examination, the Director of PCD:

(a) prepares the schedule for the design, development, conduct and marking of the examination and for other related activities, using the following guidelines.

(i) Design of one or two similar examinations

- One day for the LE to review the information provided by the licensee.
- Ten days for the ET to complete the design of the examination questions and to have the questions approved by the Director of PCD for development of the marking guide.

(ii) Development of one or two similar examinations

- Four days per examination for the DT to review the questions and start developing the answers.
- Fifteen days for the licensee's representatives to complete the first draft of the marking guide at their facility.
- Two days per examination for the ET to review the first draft of the marking guide prepared by the Licensee's representatives.
- Ten days per examination for the DT to review the examination questions and answers and to make changes as required.
- Five days for the ET to finalize the examination paper(s) and the marking guide(s) and for the Director of PCD to review them.
- Three days for the LE, and ET if required, to modify the examination paper(s) and the marking guide(s), taking into account the comments of the Director of PCD, and to obtain the necessary approvals.

(iii) Marking of candidates' answers

- 0.75 day per candidate for marking a General Examination
- 1 day per candidate for marking a Station Specific Examination
- 0.5 day per candidate for marking a Supplementary Station Specific Examination
- 0.7 day per candidate for marking a Certification Examination for ROs at MAPLE reactors

— 0.3 day per candidate for marking a Certification Examination for Mos at MAPLE reactors

Note: The number of candidates selected for second marking will be determined by the examination results and the selection criteria stated in this procedure. For planning purposes, assume this number to be 25% of the candidates.

(iv) Other related activities

— Four days for a PCD audit of the conduct of a written regulatory examination by the licensee, when applicable.
— Three days to prepare the required examination result letters and to complete examination follow-up activities.

(b) Sends a letter to the licensee, as shown in Appendix A.1 A or A.1 B, requesting the information, documentation and resources required to prepare the examination.

(c) Assigns an LE and the required number of additional PCD Officers to the ET.

APPENDIX IV. EXAMPLE OF STEPS IN THE EXAMINATION PROCESS (USA)

ES-201 Examination Preparation Checklist Form ES-201-1

Facility: _____ Date of Examination: _____

Examinations Developed by: Facility / NRC (circle one)

Target Date*	Task Description / Reference	Chief Examiner's Initials
-180	1. Examination administration date confirmed (C.1.a; C.2.a & b)	
-120	2. NRC examiners and facility contact assigned (C.1.d; C.2.e)	
-120	3. Facility contact briefed on security & other requirements (C.2.c)	
-120	4. Corporate notification letter sent (C.2.d)	
[-90]	[5. Reference material due (C.1.e; C.3.c)]	
-75	6. Integrated examination outline(s) due (C.1.e & f; C.3.d)	
-70	7. Examination outline(s) reviewed by NRC and feedback provided to facility licensee (C.2.h; C.3.e)	
-45	8. Proposed examinations, supporting documentation, and reference materials due (C.1.e, f, g & h; C.3.d)	
-30	9. Preliminary license applications due (C.1.l; C.2.g; ES-202)	
-14	10. Final license applications due and assignment sheet prepared (C.1.l; C.2.g; ES-202)	
-14	11. Examination approved by NRC supervisor for facility licensee review (C.2.h; C.3.f)	
-14	12. Examinations reviewed with facility licensee (C.1.j; C.2.f & h; C.3.g)	
-7	13. Written examinations and operating tests approved by NRC supervisor (C.2.i; C.3.h)	
-7	14. Final applications reviewed; assignment sheet updated; waiver letters sent (C.2.g, ES-204)	
-7	15. Proctoring/written exam administration guidelines reviewed with facility licensee and authorization granted to give written exams (if applicable) (C.3.k)	
-7	16. Approved scenarios, job performance measures, and questions distributed to NRC examiners (C.3.i)	

* Target dates are keyed to the examination date identified in the corporate notification letter. They are for planning purposes and may be adjusted on a case-by-case basis in coordination with the facility licensee.

[ ] Applies only to examinations prepared by the NRC.

APPENDIX V. EXAMPLE TABLE OF CONTENTS OF ASSESSOR STANDARDS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

APPENDIX VI. EXAMPLE OF EDUCATION AND EXPERIENCE REQUIREMENTS

Amendment No. 4
Nuclear Power Reactor Operating Licence
Page 16 of 25
PROL 13.04/2008

APPENDIX E

CERTIFICATION REQUIREMENTS
FOR
NEW AUTHORIZED NUCLEAR OPERATORS,
UNIT 0 CONTROL ROOM SUPERVISING NUCLEAR OPERATORS,
CONTROL ROOM SHIFT SUPERVISORS AND SHIFT MANAGERS

1 Qualification requirements

Authorized Nuclear Operators and Unit 0 Control Room Supervising Nuclear Operators

1.1 An authorized nuclear operator or a unit 0 control room supervising nuclear operator shall, at the time of certification, meet the requirements specified in paragraphs 1.1.1 to 1.1.3.

1.1.1 EDUCATION: High school diploma that includes credits in science and mathematics.

1.1.2 EXPERIENCE: Minimum of two years of plant experience at the nuclear facility prior to beginning the training relevant to the position specified in section 2.

- Two years of plant experience at a CANDU plant and one year of additional plant experience at the nuclear facility
- Two years of plant experience at a nuclear power plant other than a CANDU plant and one year and six months of additional plant experience at the nuclear facility.

1.1.3 TRAINING: As specified in section 2.

Control Room Shift Supervisors and Shift Managers

1.2 A control room shift supervisor or a shift manager shall, at the time of certification, meet the requirements specified in paragraphs 1.2.1 to 1.2.3.

1.2.1 EDUCATION: Baccalaureate in engineering or science from a recognized university. Acceptable alternatives to this university degree are:

- certification as reactor operator or shift supervisor at a Canadian nuclear power plant
- certificate of qualification as stationary engineer second class in Canada

- two-year technician or technologist diploma from a recognized institution in a discipline relevant to power engineering, with three years of experience in that discipline
- three-year technologist diploma from a recognized institution in a discipline relevant to power engineering, with two years of experience in that discipline
- academic qualifications that meet the requirements for registration as a professional engineer in Canada.

1.2.2 EXPERIENCE: Minimum of two years of plant experience at the nuclear facility prior to beginning the training relevant to the position specified in section 2. Acceptable alternatives to this experience are:

- two years of plant experience at a CANDU plant and one year of additional plant experience at the nuclear facility
- two years of plant experience at a nuclear power plant other than a CANDU plant and one year and six months of additional plant experience at the nuclear facility
- three years of experience in a technical support position related to the operation of a CANDU plant and one year of additional plant experience at the nuclear facility.

APPENDIX VII. EXAMPLE MEDICAL EXAMINATION FORM

NRC FORM 396 (4-2004) 10 CFR 55.21, 55.23, 55.25, 55.27, 55.31, 55.33, 55.57

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0024 EXPIRES: 01/31/2006

Estimated burden per response to comply with this information collection request: 15 minutes. NRC requires this information to determine that the physical condition and health of operator licensees is such that the applicant would not be expected to cause operational errors endangering the public health and safety. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0024), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

CERTIFICATION OF MEDICAL EXAMINATION BY FACILITY LICENSEE

NAME OF APPLICANT

FACILITY	FACILITY DOCKET NUMBER

A. MEDICAL EXAM INFORMATION

THIS IS TO CERTIFY THAT THE ABOVE NAMED APPLICANT FOR AN OPERATOR/SENIOR OPERATOR LICENSE HAS BEEN EXAMINED BY A PHYSICIAN AND THAT THE APPLICANT HAS BEEN FOUND TO MEET THE SAFEGUARDS AND FITNESS FOR DUTY REQUIREMENTS FOR LICENSED OPERATORS AT THIS FACILITY.

PRINTED NAME *(of physician)*	STATE AND LICENSE NUMBER	MOST RECENT MEDICAL EXAMINATION DATE

BASED ON THE RESULTS OF THE PHYSICAL EXAMINATION, INCLUDING INFORMATION FURNISHED BY THE APPLICANT, THE PHYSICIAN HAS DETERMINED THAT THE APPLICANT'S PHYSICAL CONDITION AND GENERAL HEALTH ARE SUCH THAT THE APPLICANT WOULD NOT BE EXPECTED TO CAUSE OPERATIONAL ERRORS ENDANGERING PUBLIC HEALTH AND SAFETY. I CERTIFY THAT IN REACHING THIS DETERMINATION, THE GUIDANCE CONTAINED IN ANSI/ANS 3.4-1996, ANSI/ANS 3.4-1983, OR ANSI/ANS 15.4-1988 (N380) WAS FOLLOWED AS ENDORSED BY THE APPLICABLE NRC REGULATORY GUIDE, AND THAT DOCUMENTATION IS AVAILABLE FOR REVIEW BY NRC. IF THE GUIDANCE IN THE APPROPRIATE ANSI/ANS DOCUMENT IS NOT COMPLIED WITH, AN ACCEPTABLE ALTERNATIVE METHOD, WHICH HAS BEEN APPROVED BY NRC, WAS USED.

ON THE BASIS OF THE RECOMMENDATION OF THE PHYSICIAN, IT IS REQUESTED THAT THE APPLICANT'S OPERATOR LICENSE BE CONDITIONED AS FOLLOWS:

	1. NO RESTRICTIONS
	2. CORRECTIVE LENSES BE WORN WHEN PERFORMING LICENSED DUTIES
	3. HEARING AID BE WORN WHEN PERFORMING LICENSED DUTIES
	4. RESTRICTED LICENSE OR EXCEPTION -- Provide explanation and attach supporting medical evidence for NRC review.
	5. RESTRICTION CHANGE FROM PREVIOUS SUBMITTAL -- Provide explanation for restriction change and attach supporting medical evidence for NRC review.
	6. INFORMATION ONLY

PROPOSED WORDING OF RESTRICTION *(Block 4 above)*

GUIDANCE USED IN REACHING THIS DETERMINATION:

- ☐ ANSI/ANS 3.4 - 1996
- ☐ ANSI/ANS 3.4 - 1983
- ☐ ANSI/ANS 15.4 - 1988 (NON-POWER)
- ☐ OTHER (Specify) _____

RELATIONSHIP OF RESTRICTION TO DISQUALIFYING CONDITION *(Briefly indicate how restriction will correct the disqualifying condition)*

EXPLANATION FOR RESTRICTION CHANGE *(Block 5 above)*

B. CERTIFICATION

ANY FALSE STATEMENT OR OMISSION IN THIS DOCUMENT, INCLUDING ATTACHMENTS, MAY BE SUBJECT TO CIVIL AND CRIMINAL SANCTIONS. I CERTIFY UNDER PENALTY OF PERJURY THAT THE INFORMATION IN THIS DOCUMENT AND ATTACHMENTS IS TRUE AND CORRECT.

PRINTED NAME AND TITLE *(Senior Management Representative on Site)*	SIGNATURE	DATE

In accordance with 10 CFR 55.5, Communications, this original form shall be submitted to the appropriate NRC office as follows: **BY MAIL ADDRESSED TO:**

REGIONAL ADMINISTRATOR, REGION I
U.S. NUCLEAR REGULATORY COMMISSION
475 ALLENDALE ROAD
KING OF PRUSSIA PA 19406-1415

REGIONAL ADMINISTRATOR, REGION II
U.S. NUCLEAR REGULATORY COMMISSION
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, S.W., SUITE 23T85
ATLANTA, GA 30303-8931

REGIONAL ADMINISTRATOR, REGION III
U.S. NUCLEAR REGULATORY COMMISSION
2443 WARRENVILLE RD, SUITE 210
LISLE, IL 60532-4352

REGIONAL ADMINISTRATOR, REGION IV
U.S. NUCLEAR REGULATORY COMMISSION
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-8064

U.S. NUCLEAR REGULATORY COMMISSION
EQUIPMENT AND HUMAN PERFORMANCE BRANCH
DIVISION OF INSPECTION PROGRAM MANAGEMENT
WASHINGTON, DC 20555-0001

RESEARCH AND TEST REACTORS
U.S. NUCLEAR REGULATORY COMMISSION
OPERATING REACTOR IMPROVEMENTS PROGRAM
DIVISION OF REGULATORY IMPROVEMENT PROGRAMS
WASHINGTON, DC 20555-0001

NRC FORM 396 (4-2004) PRINTED ON RECYCLED PAPER

APPENDIX VIII. TRAINING PLAN OUTLINE FOR KRSKO NPP (SLOVENIA) LICENSED OPERATOR INITIAL TRAINING PROGRAMME

Programme phase	*6.1.1.1. Topic Area*		Duration
Phase A	Science and Engineering Fundamentals		**~80 days**
	Theoretical topics /classroom/		
	Introduction to Nuclear Technology	6 h	
	Nuclear Physics	36 h	
	Reactor Physics	75 h	
	Radiation Protection	30 h	
	Chemistry	8 h	
	Thermodynamics	26 h	
	Design and Operational Limits	12 h	
	Hydrodynamics	7 h	
	Valves, Pumps, Turbine	9 h	
	Heat Processes in NPP	23 h	
	Electricity	35 h	
	Instrumentation and Control	26 h	
	Bases of Nuclear Safety	40 h	
	Material Science	29 h	
	Review of selected topics (scheduled)	45 h	
	Exercises /laboratory, TRIGA reactor, Basic Principle Simulator/		
	Nuclear Physics	6 h	
	Reactor Physics	20 h	
Phase B	**Plant systems and operation**		**~160 days**
Phase B1	Introduction to Plant Systems /classroom/		20d
Phase B2	On-the-job Training on the Field Operator (FO) Positions /self study of training material and plant documentation; familiarization with plant layout, systems and equipment locations; follow operations activities with operations personnel; follow-up by operations and training personnel/		70d
	FO - Primary Systems	17 d	
	FO - Condensate System and Diesel Generator	12 d	
	FO - Main Turbine and Steam Systems	19 d	
	FO - External Cooling Systems	8 d	

	FO - Electrical Equipment	9 d	
	FO - Water Treatment Systems	5 d	
Phase B3	Detailed Plant Systems and Operation /classroom, simulator demonstrations/		70d
	Plant Systems – 13 weeks classroom lessons (~81) Simulator demonstrations – 3 to 6 hours per week Walk-downs of Plant Systems – 2 to 4 hours per week Self study		
Phase C	**Plant Operation Simulator Training** /classroom 4 h/day, simulator 4 h/day/		**~85 days**
	Special Introductory Topics: • Plant Design Basis Documentation • Human Performance and Reactor Operator Skills • Introduction to Procedure Usage and Standards of Operation • Work Safety	5d	
	Normal operations AOP's introduction Abnormal operations Emergency operations Abnormal & Emergency operations Rx start up certification & audit Exam preparation & Final exam	12 d 3 d 15 d 25 d 10 d 5 d 10 d	
Phase D	**On-the-job Training in Main Control Room** /self study of training material and plant documentation; familiarization with MCR control boards; follow operations activities with MCR personnel; follow-up by operations and training personnel/		**~70 days**
	Positions: • Reactor Operator • Balance of Plant Operator • Electrical Equipment Operator		
Final examination for RO license administered by a Panel of experts, appointed by Slovenian Nuclear Safety Administration.			**3 days**

APPENDIX IX. EXAMPLE OF REQUIREMENTS FOR INITIAL TRAINING

Responsible shift personnel

(1) Shift supervisors and deputy shift supervisors

(a) Shift supervisors shall furnish proof of graduation from a state or state-approved professional college or engineers' college (conferring the German degree of "Ing. grad.") in a line in keeping with their respective tasks, deputy shift supervisors shall at least furnish proof of training as a technician including a state or state-approved final examination or the passing of the examination for the master's certificate in a line in keeping with their respective tasks. Both shift supervisors and deputy shift supervisors shall have received special training in nuclear engineering and shall furnish proof of

(b) the required knowledge in the fields of nuclear physics, reactor physics, energy release and thermohydraulics, reactor engineering, reactor safety, radiological protection, fire protection, industrial safety and nuclear law;

(c) the required knowledge of the layout of the applicant's nuclear power plant and its behaviour during normal operation and accidents, of the operating instructions existing at the plant (e.g. operating manual, safety specifications), including the auxiliary and substitute measures for unforeseen event sequences[2] as well as of the codes and guidelines to the extent they refer to the activities of the shift supervisor;

(d) their ability to determine and arrange for the implementation of the measures required for the safe operation of the plant and the assurance of safety in the case of safety-relevant events;

(e) at least three years of practical experience at a nuclear power plant (including the time for acquiring the knowledge in accordance with (c) and for nuclear power plant simulator training in accordance with (f)), of which at least half a year of practical experience shall have been acquired as shift reactor operator at the applicant's nuclear power plant;

(f) training on a suitable nuclear power plant simulator[3] lasting
at least eight weeks for work in a nuclear power plant with a pressurised water reactor and
— at least seven weeks for work in a nuclear power plant with a boiling water reactor.

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[2]Proof of the knowledge of the auxiliary and substitute measures for unforeseen event sequences shall be furnished to the extent these measures are laid down in the operating instructions.

[3]A suitable nuclear power plant simulator in the sense of this Guideline is the full-scale simulator that is most representative for the respective nuclear power plant. The training on a plant-specific partial simulator is to be treated as equal to the training on a full-scale simulator if the simulation of the respective events (normal operation, accidents, event combinations) with regard to progression, plant-dynamic behaviour, representation of safety-relevant parameters, and measures to be performed corresponds to the respective plant, especially the corresponding regulations of the operating manual (including protection-goal-oriented procedure) and if the partial simulator takes the safety-relevant systems of the simulated plant into account. The responsible licensing or supervisory authority shall decide whether it approves of training times on the partial simulator by the appropriateness of the respective course programmes that are valid at the time.

Shift supervisors and deputy shift supervisors shall be obliged to have passed the examination of technical qualification in accordance with sec. 4 by the time they first act with responsibility in the function concerned.

Shift supervisors and deputy shift supervisors shall have to acquire for half a year the practical experience as the utility's reactor operator with responsibility after passing the examination of technical qualification in accordance with sec. 4 unless this experience has already been gained before in a position as reactor operator with responsibility.

(2) Reactor operators

Reactor operators shall have received special training in nuclear engineering and shall furnish proof of:

(a) training as a technician including a state or state-approved final examination or the passing of the examination for a master's certificate or at least a journeyman's certificate as defined in the German Handicraft Code or a completed training as a skilled worker in a technical line or as a power plant worker in the line of nuclear engineering;

(b) the required knowledge in accordance with clause 1 (b) to the extent it refers to the activities of a reactor operator at the applicant's nuclear power plant;

(c) the required knowledge in accordance with clause 1 (c) to the extent it refers to the activities of a reactor operator at the applicant's nuclear power plant;

(d) the ability to determine and arrange for the measures required for the safe control of the nuclear steam supply system and the associated auxiliary nuclear systems as well as for the assurance of safety in the case of safety-relevant events;

(e) at least two years of practical experience at different relevant stages in the operation[4] of a nuclear power plant (including the time for the acquisition of knowledge in accordance with (c) and for nuclear power plant simulator training according to (f)), of which at least half a year of practical experience shall have to be gained in shift operation at the applicant's nuclear power plant;

(f) training on a suitable nuclear power plant simulator[7] lasting
— at least eight weeks for work in a nuclear power plant with a pressurised water reactor and
— at least seven weeks for work in a nuclear power plant with a boiling water reactor.

Reactor operators shall be obliged to have passed the examination of technical qualification by the time they first act with responsibility in this function.

A maximum of half a year of practical experience in the operation of fossil-fired power plants may be accepted as part of the practical experience as defined in (e) above.

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[4]Relevant stages are e.g. reactor plant, auxiliary nuclear systems, measurement, control and regulating systems, electrical systems, radiological protection.

APPENDIX X. EXAMPLE OF INITIAL TRAINING

SIMULATOR LICENSING TRAINING AT DAYA BAY NPP

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Abstract
This article introduces the simulator licensing training courses, achievement and practices at Daya Bay NPP. It also shows the way for staffs to obtain the RO and SRO licenses.

Key words: Training/Simulator/RO/SRO/License/Re-qualification/

1. Preface

Operations of Daya Bay NPP have set new records with both units maintaining operations without any unplanned shutdown or disconnection from the grids over a period of 293 and 318 days respectively between two refueling-outages, and the total output to the grid was 13.6 billion kWh. Moreover, several operating indicators have reached the upper ranks defined by WANO. This best operating records for the station since commercial service in 1994 are due to the continuous implementation of the management police in the plant during past 6 years, and also due to the contributions from operating staffs who have played vital roles in operating the station with high responsibilities, technical knowledge and skills, which partially gain from the simulator training.

The Simulator training at Daya Bay NPP started when the full scope simulator was installed and commissioned in the training center of Daya Bay in 1992. Since then the simulator has been used to train operating licensing staffs and operating management staffs in the initial licensing training and requalified licensing training courses. It has been also used for noon-licensing training, verification of operating procedures and strategies, reoccurrence of abnormal situations happening on the site.

After eight years of implementation and development of the different simulator training courses, the training center of Daya Bay NPP has gained plentiful experience and significant achievements. We have developed over 14 courses and trained over hundreds of operators to get and maintain RO and SRO licenses for Daya Bay NPP, Ling Ao NPP and Qin Shan NPP. This article will show you how the simulator licensing training is conducted at Daya Bay NPP.

2. The process to get RO/SRO licenses at Daya Bay NPP

RO candidates are selected from field operators who have had academic degrees in science and technology, had at least two years of working experience in the operating shift, finished all necessary OJT, and got excellent marks in classroom training courses.

Selected RO candidates will participate in simulator training courses phase by phase. Failed in one phase, they wouldn't be able to proceed to the later training courses, and have to restart the course afterward.

SIMULATOR TRAINING COURSES

TYPE	CODE	ABBREVIATION	CONTEN OF COURSE	PERIOD	TRAINEERS
License Training	500	M0	Pre-simulator training	2W	RO candidates
	501	M1	Normal operation training	2W	
	502	M2	Abnormal and transient operation training	2W	
	503	M3	Incident and accident operation training	2W	
	508	M8	Comprehensive training before RO examination	1W	
	504	M4	Loss of various electric power supply	2W	Licensed RO
	513	MC	Coordinator simulator training	2W	Licensed RO
	505	MR	Normal simulator retraining	1W	Licensed RO and SRO
	506	MS1	Complex and multiple accident simulator retraining	1W	
	507	MS2	Practical simulator retraining + SPI/U	1W	
	509	RM4	Enhanced training on the loss of electric power supply	3D	
	510	MST	Real life simulating training	1D	All staffs in the operation shift
Non-License Training	511	MM	Senior manager simulator training	1D	Managers
	512	ME	Engineer simulator training	2D	Engineers

APPENDIX XI. EXAMPLE CANDIDATE AUTHORIZATION APPLICATION FORM

NRC FORM 398 (11-2000) **10 CFR 55.31, 55.35, 55.47, and 55.57** — **U.S. NUCLEAR REGULATORY COMMISSION**

PERSONAL QUALIFICATION STATEMENT--LICENSEE

TO REMAIN VALID, THIS FORM MUST NOT BE ALTERED

APPROVED BY OMB: NO. 3150-0090 EXPIRES: 11/30/2003

Estimated burden per response to comply with this mandatory collection request: 1.2 hours. NRC requires this information to ensure that applicants/licensees meet all the requirements for taking reactor operator examinations. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0090), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

DATE RECEIVED *(To be completed by NRC)*

1. APPLICANT'S FULL NAME *(Last, First, Middle)* **AND ADDRESS** *(Include ZIP Code)*

4. TYPE OF APPLICATION *(Check applicable boxes)* — HOT — COLD

- a. NEW
- b. RENEWAL
- c. UPGRADE
- d. MULTI-UNIT *(AMEND TO INCLUDE ADDITIONAL UNIT)*
- e. REAPPLICATION
  - 1 - FIRST
  - 2 - SECOND
  - 3 - THIRD
- f. WAIVER REQUESTED *(Justify on Reverse)*
  - 1 - WRITTEN *(Category)*
  - 2 - OPERATING *(Category)*
  - 3 - ELIGIBILITY
  - 4 - MEDICAL
  - 5 - OTHER
- g. DATE PASSED GENERIC FUNDAMENTALS EXAMINATION *(IF APPLICABLE)* — MM — YY

2. CITIZENSHIP

- a. UNITED STATES
- b. OTHER (Specify)

3. BIRTH DATE — MONTH — DAY — YEAR

5. TYPE OF LICENSE APPLIED FOR

- a. OPERATOR (RO)
- b. SENIOR OPERATOR (SRO)
- c. LIMITED SRO (LSRO) *(e.g., Fuel Handler)*

6. PREVIOUS LICENSE(S) HELD

a. DOCKET NO.	RO	SRO	LSRO	b. LICENSE NUMBER	c. EXPIRATION DATE (MONTH / DAY / YEAR)	d. FACILITY DOCKET NUMBER
55-						50-

7. NAME AND ADDRESS OF APPLICANT'S EMPLOYER *(Include ZIP Code)*

8. NAME OF APPLICANT'S FACILITY — FACILITY DOCKET NUMBER

9. ADDITIONAL FACILITY DOCKETS *(Multi-unit Licenses)*

10. CURRENT POSITION AT FACILITY

- a. PLANT SUPERINTENDENT
- b. ASSISTANT PLANT SUPERINTENDENT
- c. SHIFT SUPERVISOR
- d. STAFF ENGINEER
- e. SHIFT TECHNICAL ADVISOR/SHIFT ENGINEER
- f. INSTRUCTOR
- g. SENIOR CONTROL ROOM OPERATOR
- h. CONTROL ROOM OPERATOR
- i. AUXILIARY UNIT OPERATOR/ TRAINEE/TURBINE BUILDING/EQUIPMENT OPERATOR *(NON-LICENSED OPERATOR)*
- j. OTHER *(Specify)*

11. EDUCATION

a. HIGH SCHOOL	c. MAJOR AREA(S) OF STUDY	NUMBER OF YEARS	HIGHEST DEGREE (Use Code)
GRADUATE	ENGINEERING *(FIELDS)*		
GED EQUIVALENCY	OTHER		
NO			
b. NUMBER OF YEARS OF COLLEGE			

DEGREE CODES (To be used for *"HIGHEST DEGREE"* obtained)
0 - NONE
1 - CERTIFICATE
2 - ASSOCIATE
3 - BACHELOR
4 - MASTER
5 - DOCTORAL

d. VOCATIONAL/TECHNICAL TYPE OF TRAINING	NUMBER OF MONTHS	CERTIFICATE RECEIVED YES	NO

12. FACILITY OPERATOR TRAINING PROGRAM

a. IS THE OPERATOR TRAINING PROGRAM ACCREDITED BY THE NATIONAL NUCLEAR ACCREDITING BOARD? — YES — NO

b. IS A "PLANT-REFERENCED SIMULATOR" (AS DEFINED IN 10 CFR 55.4) USED IN THE OPERATOR TRAINING PROGRAM? — YES — NO

13. TRAINING *(SINCE LAST APPLICATION - SEE INSTRUCTIONS)*

	a. MONTH AND YEAR FROM	TO	b. NUMBER OF WEEKS
1 -- NUCLEAR POWER PLANT FUNDAMENTALS (Classroom)			
2 -- PLANT SYSTEMS CLASSROOM			
OBSERVATION			
3 -- OPERATING PRACTICE CONTROL ROOM OPERATIONS ON SHIFT			
SIMULATOR OPERATING *(Includes Classroom)*			
SIMULATOR NAMES			
a.			
b.			
CERTIFIED STARTUP PROGRAM COMPLETED — YES — NO			
c. NUMBER OF SIGNIFICANT CONTROL MANIPULATIONS: PLANT / SIMULATOR			
4 -- SRO INSTRUCTION			
5 -- EXTRA PERSON ON SHIFT IN CONTROL ROOM *(13-WEEK MINIMUM)*			
a. TIME ON SHIFT ABOVE 20% POWER *(6-WEEK MINIMUM)*			
6 -- REQUALIFICATION			
7 -- OTHER *(Specify)*			

14. EXPERIENCE *(DO NOT DOUBLE COUNT -- SEE INSTRUCTIONS)*

	a. MONTH AND YEAR FROM	TO	b. NUMBER OF MOS.
NAVY 1 - RO			
2 - EOOW/PPWO			
3 - EWS/PPWS			
4 - ERS/CRW			
5 - OTHER *(Specify)*			
FOSSIL 6 - OPERATOR			
7 - SUPERVISOR			
8 - PLANT STAFF			
9 - OTHER			
COMMERCIAL NUCLEAR *(Including Research/Test Reactor)* 10 - REACTOR OPERATOR *(Licensed)*			
11 - SENIOR OPERATOR *(Licensed)*			
12- SHIFT SUPERVISOR *(Licensed)*			
13 - STAFF/SHIFT ENGINEER *(Licensed)*			
14 - OPERATOR *(Nonlicensed)*			
15 - PLANT STAFF			
16 - OTHER *(Specify)*			

NRC FORM 398 (11-2000) — PRINTED ON RECYCLED PAPER

15. EXPERIENCE DETAILS

a. POSITION TITLE	FROM	TO	b. FACILITY	c. DUTIES

16. FOR RENEWALS ONLY

a. HOURS OPERATED FACILITY:			b. DATE AND RESULT OF MOST RECENT FACILITY REQUALIFICATION EXAM	DATE	RESULT			
		< 100 (LESS THAN)						
		100 - 1000				PASS		FAIL
		> 1000 (MORE THAN)						

17. COMMENTS

18. NRC FORM 396, CERTIFICATION OF MEDICAL EXAMINATION BY FACILITY LICENSEE, IS ATTACHED

ANY FALSE STATEMENT OR OMISSION IN THIS DOCUMENT, INCLUDING ATTACHMENTS, MAY BE SUBJECT TO CIVIL AND CRIMINAL SANCTIONS.

19a. I certify under penalty of perjury that the information in this document and attachments is true and correct in accordance with the instructions. I further certify that I have notified my current employer of: (1) all previous employers; (2) any instance where I have been tested by a Health and Human Services (HHS) Certified Drug Testing Laboratory or a Licensee's testing facility for alcohol or a controlled substance, and the test results exceeded the cutoff levels established pursuant to 10 CFR Part 26; (3) any instance where I have been arrested for the sale, use, or possession of a controlled substance described in 10 CFR Part 26; and (4) any reasons for removal or revocation of unescorted access at a nuclear facility. I also authorize the NRC to submit the results of examinations to my employers for use in preparing retraining programs, as necessary.

SIGNATURE - APPLICANT	DATE

CHECK APPLICABLE BOX

☐ b. I certify that the above named individual has successfully completed the facility licensees requirements to be licensed as an Operator/Senior Operator pursuant to Title 10, Code of Federal Regulations, Part 55; and that the individual has a need for an Operator/Senior Operator license to perform his/her assigned duties and that the facility will be made available for the examination. I also certify under penalty of perjury that the information in this document and attachments is true and correct in accordance with the instructions.

☐ c. RENEWAL ONLY I certify that the above named individual meets the approved requalification program (with the exceptions noted in item 17) as required by section 50.54(i-l) of 10 CFR 50, and that he/she has discharged his/her licensed responsibilities competently and safely. I also certify under penalty of perjury that the information in this document and attachments is true and correct.

TRAINING COORDINATOR		SENIOR MANAGEMENT REPRESENTATIVE ON SITE	
PRINTED OR TYPED NAME AND TITLE		PRINTED OR TYPED NAME AND TITLE	
SIGNATURE	DATE	SIGNATURE	DATE

FOR NRC USE

WAIVER *(Check or Complete items, as applicable)* ☐ MEETS REQUIREMENTS ☐ DOES NOT MEET REQUIREMENTS *(Explain below)*

CATEGORY	GRANTED BY		DENIED BY	
	HEADQUARTERS	REGION	HEADQUARTERS	REGION
WRITTEN				
OPERATING				
ELIGIBILITY				
MEDICAL				
OTHER				

SIGNATURE	DATE

Instructions for completing NRC form 398, Personal Qualification Statement – Licensee

To remain valid, this form must not be altered

4. Type of application

(a) **New** – "x" if you are a new applicant. Complete each category of the form completely, following the instructions below. This is to include all education, training and experience that you have received up to the date of this application. Note: See item 12 – there is an exception. Also, this block is to be marked if previous new application was withdrawn. Please write "Withdrew" next to "New".

For 4.b through 4.e, complete each category completely, but indicate only the education, training, and experience you have received since your last application. Note: see item 12 – there is an exception.

(b) **Renewal** – "x" if you are renewing current license.

(c) **Upgrade** – "x" if you hold a RO license and are now applying to upgrade your license to a SRO.

(d) **Multi-unit** – "x" if you currently hold a license at your facility and are applying to amend your current license to add an additional unit.

(e) **Reapplication** – "x" if you have previously been denied a license and are reapplying.

(f) **Waiver request** – "x" the applicable waiver requested and justify in comments section (item 17).

(g) **Date passed generic fundamentals examination (GFE)** – this is not applicable to research reactors or licenses limited to fuel handling. Enter the month and year the generic fundamentals examination of the written examination was passed. If the GFE was not taken, you must have passed an NRC licensing examination on the applicable reactor type (PWR or BWR) after February 1, 1982, which led to the issuance of an NRC license or instructor certification. This does not include requalification examinations.

11. Education – indicate both academic and vocational/technical post high school education. For major area(s) of study, indicate the number of years spent in each college curriculum and the highest degree received, using the degree code provided. For vocational/technical education, including programs such as nuclear power school, military training, air conditioning/refrigeration/ diesel mechanic school, etc. indicate the number of months in each program and whether a certificate or degree was awarded. If additional space is needed, continue under comments (item 17).

12. Facility operator training program – check the appropriate box in items 12.a and 12.b.

Note:

- **!** Checking "Yes" in item 12.a indicates that the applicant has completed a SAT-based training program that is accredited by the national nuclear accrediting board and meets the education and experience requirements outlined by the national academy for nuclear training in its current guidelines for initial training and qualification of licensed operators.

- **!** If "Yes" is checked in both items 12.a and 12.b then items 13. (Training), 14. (Experience), 15. (Experience details), and 17. (Comments) do not have to be completed with the following exceptions: (a) All new applications (item 4.a) must include the number of significant control manipulations that affect reactivity or power level in item 13.3.c; (b) Certified instructors seeking an SRO license must complete items 14. and 15.; and (c) Any exceptions of waivers from the education and experience requirements outlined by the national academy for nuclear training must be explained in item 17.

13. Training – all new applications must provide evidence that the applicant, as a trainee, has successfully manipulated the controls of the facility for which a license is sought. At a minimum, five significant control manipulations must be 10 CFR 55.31(b). List the five significant control manipulations in item 17.

All requalification training time is to be accounted for in the requalification item 13.6. Please do not "double list" the time spent in requalification training for classroom or simulator time under items 13.1, 13.2, or 13.3.

14. Experience – a minimum of 6 months at the site for which the license is sought is required, for each position held. Complete item 15. Do not double count time. If you had overlapping duties, the months should reflect the proportionate amount of time you were assigned to those particular duties. In no case should the number of months reported for a particular time period exceed the number of months that are in that time period.

15. Experience details – include position title, time period - from/to, facility, and a brief Description of duties performed while serving in that position. If more space is needed, use comments (item 17), or if necessary, attach additional information.

16. For renewals only – (a) Check the box that most accurately reflects the approximate number of hours since previous renewal or issuance of license if first renewal, (b) Enter date and result of most recent facility requalification examination.

17. Comments – use this space to include any extra information or clarification for other items on the application form. If the space provided is not sufficient, you may attach extra information with your application.

18. NRC form 396, certification of medical examination by facility licensee – must accompany this application unless a waiver of the medical examination is being requested.

19. Signatures – sign and date item 19.a. Obtain your training coordinator's signature and that of your senior management representative on site.

Detach these instructions and submit the completed original NRC forms 398 and 396 to the appropriate address. (See reverse side for addresses and for the privacy act statement.)

APPENDIX XII. EXAMPLE OF A LETTER GRANTING AUTHORIZATION

NRC Letterhead

(Date)

LICENSE

(Applicant's name)

(Street address)

(City, State, Zip code)

Pursuant to the *Atomic Energy Act of 1954*, as amended; the *Energy Reorganization Act of 1974*, as amended; and Public Law 93-438, and subject to the conditions and limitations incorporated herein, the Nuclear Regulatory Commission hereby licenses you to direct the [licensed] [[fuel handling]] activities of [licensed] operators at, and to manipulate [all] [[fuel handling]] controls of the **(Name of facility, facility license number).**

Your License No. is SOP–**(number).** Your Docket No. is 55–**(number).** The effective date is **(date).** Unless sooner terminated or renewed, this license shall expire six years from the effective date.

This license is subject to the provisions of Title 10, Section 55.53, of the *Code of Federal Regulations*, with the same force and effect as if fully set forth herein.

While performing licensed duties, you shall observe the operating procedures and other conditions specified in the facility license authorizing operation of the facility. You shall also comply with the following condition**(s):**

- You shall wear corrective lenses while performing the activities for which you are licensed.

The issuance of this license is based upon examination of your qualifications, including the representations and information contained in your application for this license.

A copy of this license has been made available to the facility licensee.

For the Nuclear Regulatory Commission,

(Name and title of licensing official)

Docket No. 55 – **(number)**

cc: **(Facility representative who signed the applicant's NRC Form 398)**

[ ] Include only for unrestricted senior operators.

[[ ]] Include only for senior operators limited to fuel handling.

APPENDIX XIII. EXAMPLE OF CONTINUING TRAINING PROGRAMME REQUIREMENTS AND TESTING

Amendment No. 4
Nuclear Power Reactor Operating Licence
Page 24 of 25
PROL 13.04/2008

APPENDIX F
[Amended 2003.10]

REQUIREMENTS FOR CONTINUING TRAINING AND REQUALIFICATION TESTS FOR CERTIFIED OF AUTHORIZED PERSONS IN OPERATING POSITIONS

1. Continuing training requirements

1.1 During the term of their certification or authorization, authorized nuclear operators, unit 0 control room supervising nuclear operators, control room shift supervisors and shift managers shall meet the requirements specified in paragraphs 1.1.1 to 1.1.3.

1.1.1 Participate, on a regular basis, in continuing training appropriate to the knowledge and skill requirements of their position, covering:

- a review of the knowledge, learned in their initial training specified in section 2 of Appendix E, that is not maintained through day-to-day operation of the facility and that is required to work competently in their position
- simulator-based exercises that cover infrequent normal maneuvers
- simulator-based exercises that cover a sufficiently varied number of situations that challenge the diagnostic and problem solving abilities of the certified or authorized persons and ensure that they are, at all times, proficient in selecting and using abnormal and emergency operating procedures
- exercises and drills conducted at the facility on a regular basis throughout the program to practice the response to accidents and emergencies.

1.1.2 Participate, in a timely manner, in training appropriate to the knowledge and skill requirements of their position covering topics identified as a result of:

- changes to facility systems and equipment
- changes to licensee's and facility's policies, standards and procedures
- changes to regulatory requirements
- changes to the facility's operating licence or to documents referenced in the licence
- facility or industry experience and operating events.

1.1.3 Successfully complete, on a regular basis, knowledge and performance based evaluations set by the licensee that confirm and document that the person possesses the knowledge and the skills covered during continuing training.

2 Requalification Tests

2.1 During the term of their certification or authorization, authorized nuclear operators, control room shift supervisors and shift managers shall complete written and simulator based requalification tests, as specified in the document entitled: Requirements for the Requalification Testing of Certified Shift Personnel at Canadian Nuclear Power Plants, dated June 26, 2003, as amended from time to time.

2.2 Authorized nuclear operators, control room shift supervisors and shift managers requiring a renewal of certification before December 31, 2005 shall meet the requirements specified in paragraphs 2.2.1 and 2.2.2.

2.2.1 Have successfully completed one written requalification test administered in accordance with the requirements contained in the document referred to in paragraph 2.1, as amended in Appendix G of this licence.

2.2.2 Have successfully completed one comprehensive simulator based test, or have successfully completed one diagnostic simulator based test and have participated in one comprehensive simulator based test.

These tests shall be administered in accordance with the requirements contained in the document referred to in paragraph 2.1.

APPENDIX XIV. EXAMPLE OF WRITTEN REAUTHORIZATION TEST DESIGN, DEVELOPMENT, CONDUCT AND GRADING

WRITTEN REQUALIFICATION TESTS

This section establishes the requirements regarding the design, development, conduct and grading of written requalification tests, and regarding the development of questions for these tests.

1.1 Type of test

Written requalification tests are open-reference tests of multiple-choice questions where certified individuals have access to a defined set of approved reference material that is available in the control room at their plant.

1.2 Test frequency

Each certified individual shall successfully complete a written requalification test at least once every two calendar years.

1.3 Test bounding envelope

(a) All knowledge objectives suitable to formulate test questions for a given position shall be identified from:

- RO objectives for ROs at all plants and for SOSs at Pickering
- U0O objectives for U0Os at Bruce and Darlington
- RO and U0O objectives for SOSs at Bruce
- RO and SS objectives for SSs at Pickering, Point Lepreau and Gentilly 2
- RO, U0O and SS objectives for SSs at Bruce and Darlington

The objectives identified shall:

(i) cover all the knowledge that is deemed important to perform competently in the position;

(ii) support tasks that are rated as important in the plant's approved, up-to-date Job and Task Analysis for the position.

(b) Licensees' procedures shall specify the approved reference material available in the control room at a given plant that is accessible to certified individuals during written tests.

1.4 Question development

(c) Each question shall test knowledge at a cognitive level of comprehension, application or analysis in the Bloom's Taxonomy referred to in Appendix 15.

(d) Each question for a given position shall:

(i) be based on a knowledge objective identified as suitable for requalification testing;

(ii) be at the appropriate level for the position for which the question is designed;

(iii) be prepared by a qualified examiner in accordance with the criteria in Appendix 6;

(iv) be independently verified by a second qualified examiner to ensure that it meets the criteria in Appendix 6;

(v) be validated to ensure that it meets the criteria in Appendix 7 by:

- an individual currently certified at the plant in the position for which the question is designed;
- at least one additional individual who is currently certified at that plant in any position for which the question applies.

1.5 Test design

(e) The questions in a test for a given position shall be based on knowledge objectives that have been selected according to a sampling method which ensures that:

(i) the objectives are randomly selected from the set of objectives that have been identified as suitable for testing in accordance with paragraph (a);

(ii) no excessive emphasis is placed on a particular system, topic or type of objectives.

(f) Each test shall consist of 40 multiple-choice questions developed in accordance with the requirements of subsection 0.

(g) Each test shall include at least 8 questions that are either new questions or questions that were used on previous tests, but which have been significantly modified.

(h) The number of questions in a test already used in previous years on tests for the same position shall not exceed 10% of the total number of those previously used questions.

(i) Each test shall be designed such that it can be completed in three hours. The maximum amount of time allowed for completing the test shall be four hours.

1.6 Test development

Each test shall:

(j) be prepared by a qualified examiner in accordance with the criteria in Appendix 8;

(k) be independently reviewed by a second qualified examiner to ensure that it meets the criteria in Appendix 8;

(l) be approved by the Training Manager, after independent review and before being used.

1.7 Test conduct

(m) An invigilator shall be present at all times in the room where a test is being held.

(n) Tests shall be conducted in accordance with the instructions and rules of Appendix 12 and Appendix 13.

1.8 Test grading

(o) The completed answer sheet of each certified individual who took a test shall be graded against the test answer key.

(p) The results of each test shall be analysed by a qualified examiner to determine whether:

(i) any question is defective;

(ii) changes are required to the approved answer key.

(q) A question shall be deemed defective where the analysis of test results shows that it has either:

(i) more than one correct answer;

(ii) no correct answer or it is technically incorrect.

(r) A test shall be deemed invalid if more than 4 questions are found to be defective.

(s) When a valid test is found to contain defective questions:

(i) Its answer key shall be revised according to the following criteria:

- If a question has no correct answer or more than two correct answers, it is not taken into account in the grading.
- If a question has two correct answers, both answers are deemed to be acceptable in the grading.

(ii) The revised answer key shall be independently reviewed by a second qualified examiner and approved by the training manager.

(iii) The completed answer sheet of each certified individual who took the test shall be graded again using the revised answer key.

(t) When an invalid test is found to contain no more than 8 defective questions, the certified individuals who took that test may take a complementary test made of questions that replace the defective questions. The portion of the original test that was retained and the complementary test together shall meet the requirements of subsections 0 and 0.

(u) When an invalid test is found to contain more than 8 defective questions, the certified individuals who took that test shall take another test that meets the requirements of subsections 0 and 0.

(v) A fail grade shall be assigned to a certified individual who fails more than 8 questions of a valid test.

(w) The correct answers to all questions that a certified individual has answered incorrectly shall be fed back to the individual. All knowledge weaknesses revealed by a test shall be appropriately addressed by the licensee.

(x) Certified individuals who receive a fail grade in a test shall not return to the duties of their position until they have successfully completed appropriate remedial training, based on an analysis of the cause of their failure, and another test that meets the requirements of subsections 0 and 0.

1.9 Test coordination

All activities related to any given test shall be coordinated by a lead examiner.

APPENDIX XV. EXAMPLE SECURITY AGREEMENT FORMS

SECURITY AGREEMENT FOR WRITTEN REQUALIFICATION TEST MATERIAL

This agreement must be signed by any person who participates in the preparation, verification or validation of questions for written tests prior to their use.

- Persons employed on a regular basis as examiners must sign this agreement only once, when first being employed as examiner.
- Persons participating in any of those activities repeatedly, over an extended period of time, must sign this agreement before the start of each period of their participation and not less frequently than each year.
- Persons participating in any of those activities occasionally must sign this agreement each time before participating in any of those activities.

I will not knowingly reveal any information on the questions on which I will be working to any person who has not signed this security agreement, unless I have been notified that the security of those questions is no longer an issue.

I am aware of the physical, electronic and administrative measures and requirements, applicable to my role in the development of those questions, that are in place at the plant to prevent compromising the security of requalification tests.

I will immediately report to plant management any indication or suspicion that the security of test material may have been compromised.

I understand that violation of the terms of this agreement may result in the test material I will be working on being rejected.

_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date

SECURITY AGREEMENTS FOR REQUALIFICATION TESTS

Part A – Examiners and Test Support Staff

Any person working on a regular basis in the development, conduct or grading of requalification tests, either as an examiner or as test support staff, must sign this agreement only once, when first being given those responsibilities.

Until I have been notified that the security of a requalification test is no longer an issue, I will not knowingly reveal any information related in any way to the content of the test to any person other than:

- the examiners and assessors involved in the development, conduct and the grading of the test
- the certified individuals who have taken the test together, for comment or feedback
- with any other person who has signed this security agreement or a security agreement for that test

Discussions on a requalification test with any of these persons must take place in a secure environment to prevent compromising the security of the test.

Once I know which requalification tests have been selected to test a group of certified individuals, I will not participate in the instruction of, or give training feedback to these individuals until I have been notified that the security of the test is no longer an issue.

I am aware of the physical, electronic and administrative measures and requirements that are in place at the plant to prevent compromising the security of requalification tests.

I will immediately report to the lead examiner or to plant management any indication or suspicion that the security of a test may have been compromised.

I understand that violation of the terms of this agreement may result in a test being cancelled.

_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date

Part B – Certified individuals taking a test

This agreement must be signed by certified individuals who are scheduled to take a given requalification test.

To the best of my knowledge, I have not received any information relating in any way to the content of:

_<insert test identifier>_____
that I am about to take.

Until I have been notified that this agreement has been rescinded, I will not knowingly reveal any information related in any way to the content of this requalification test to any person other than the examiners and assessors involved in the conduct and the grading of the test, and the certified individuals who will have taken the test with me. I understand that discussions on this test with any of these persons must take place in a secure environment to prevent compromising the security of the test.

I will immediately report to the lead examiner or to plant management any indication or suspicion that the security of the test may have been compromised.

I understand that violation of the terms of this agreement may result in the test being cancelled.

_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date

Part C – Others

This agreement must be signed by any person who participates in the development, conduct or grading of a given requalification test, other than persons employed on a regular basis as examiners and test support staff, and the certified individuals scheduled to take the test.

Until I have been notified that this agreement has been rescinded, I will not knowingly reveal any information related in any way to the content of:

_<insert test identifier>_____

to any person other than:

- the examiners and assessors involved in the development, conduct and the grading of the test;
- the certified individuals who have taken the test together, for comment or feedback;
- any other person whose name and signature appear below.

Discussions on this requalification test with any of these persons must take place in a secure environment to prevent compromising the security of the test.

Once I know that this requalification test has been selected to test a group of certified individuals, I will not participate in the instruction of, or give training feedback to these individuals until I have been notified that the security of the test is no longer an issue.

I am aware of the physical, electronic and administrative measures and requirements, applicable to my role in the test, that are in place at the plant to prevent compromising the security of requalification tests.

I will immediately report to the lead examiner or to plant management any indication or suspicion that the security of the test may have been compromised.

I understand that violation of the terms of this agreement may result in the test being cancelled.

_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date
_____	_____	_____
Name	Signature	Date

APPENDIX XVI. WRITTEN TEST ITEM REVIEW CHECKLIST

The following checklist presents points that should be incorporated when constructing test items from the training objectives for the written examination.

General guidance

- Does the concept being measured have a direct, important relationship to the ability to perform the job?
- Does the test item match the learning objective? Does each test item measure one specific concept and reflect the actions, conditions, and standards of the objective being tested?
- Is the test item clear, concise, and easy to read? Does the test item contain only information relevant to the problem posed? Could it be stated more simply and still provide the necessary information? Can it be reworded or split up into more than one test item?
- Does the test item provide all necessary information, conditions, and assumptions needed for a fully correct response?
- Is the test item written at the highest appropriate level of knowledge or ability for the job position of the trainee being tested?
- Is the test item grammatically correct?
- Is the test item free of tricky (deceptive, misleading) wording and clues to the correct answer?
- Is the test item free of unnecessary difficulty or irrelevancy?
- Is the reading level appropriate for the target audience?
- Is the test item limited to one concept or topic?
- Are directions completing individual test items necessary for clarity? Do they repeat standard instructions provided to trainees at outset of testing?
- Does the test item have face validity?
- Are key points underlined?
- Is each test item separate and independent of all other test items?
- Are all parts of the test item on the same page?
- Are all required material, drawings, and accompanying test items clearly identified? Can the trainee easily locate them?
- Is there sufficient space provided for answers?
- Are the less difficult test items at the beginning of each section?
- Have your test items been reviewed by others?

Point values

- Point values are specified for whole test items and all subordinate parts (if more than one response is required).
- Values are assigned relative to other test items in terms of:
  - significance of successful performance of associated objective to task performance
  - learning difficulty and cognitive level

- number of responses required
- difficulty of problem.

— Specific values are assigned for parts of short answer and essay test items.
— Test items which test the same objective have comparable point values.

Short answer test items

— Is there one, short, definitely correct answer for each test item?
— Does the scoring key follow directly from the test item?
— Are clues to the answer avoided?
— Is the required degree of precision specified? For test items requiring computation, specify the degree of precision expected. Try to make the answer turn out to be whole numbers.
— Are the test item statements simple and direct without extensive qualification?
— Are the test item blanks the same length regardless of the number of words to be entered?
— Does the test item wording avoid grammatical clues to the correct response such as "a" or "an" before the blank?
— Limit the space allocated for each answer to encourage a single word or short phrase.
— For fill-in-the-blank test items, arrange the blanks to be of equal but adequate length.
— For fill-in-the-blank test items, do not omit words that are interdependent.
— For fill-in-the-blank test items, do not make sentences unrecognizable by leaving too many blanks.
— For a completion table, do not have more than six items in one column.
— For a completion diagram, include only necessary features and ensure that components are clearly referenced.
— Compose a detailed model answer, identifying important statements, steps, or parts, and allocate points for each test item subpart.

Multiple choice test items

— Does the test item have one focused topic, making it something other than a collection of true/false test items? Does the stem clearly express a single problem in a direct manner followed by response?
— Does the test item provide sufficient information to provide a basis for formulating the response?
— Is the test item or problem defined in the stem?
— Are tricky (deceptive, misleading) or irrelevant test items avoided?
— Are the answer options homogeneous, highly plausible, and comparable length?
— Are "none of the above and “all of the above” avoided?
— Is one response clearly the correct or best answer accompanied by three or four distractors?
— Is each test item stated positively, unless the intent is to test knowledge of what not to do?

- Is the test item free of "specific determiners" (e.g. logical or grammatical inconsistencies, incorrect answers which are consistently different, verbal associations between the stem and the answer options)?
- Are common misconceptions used as distractors?
- Are the answer options of the test items ordered sequentially?
- Is the test item free of trivial distractors? Does the stem include irrelevant, trivial detail or instructive information?
- Are the references, attachments, and data included in the stem or identified following the stem? The drawings accompanying the stem may proceed, be to the right of, or below responses or distractors as space permits.
- Are the correct responses varied from test item to test item in a random fashion?
- Are there equivalent and/or synonymous options that rule out both options for a trainee who recognizes the equivalence.

Matching test items

- Are tricky (deceptive, misleading) or irrelevant test items avoided?
- Is there a clearly correct answer or answers to the test item?
- Are clues to the answer avoided (e.g. grammatical clues, response patterns)?
- Do the directions clearly tell the trainees the basis on which to make the match and how to indicate their answers?
- Do the directions tell whether responses can be used more than once?
- Is each response a plausible answer for each premise?
- Are there more responses than premises if each response can only be used once?
- Are the responses arranged on one page in a logical order?
- Is the test item arranged so that the trainees can mark their answers easily?

Essay format test items

- Is the test item clearly and concisely worded WITHOUT AMBIGUITY?
- Does the test item illicit the correct response and no other responses? Does it clearly place bounds on the required response?
- Are point values, expected time to respond, expectations for exact answers or estimates clearly identified?
- Is enough information supplied to allow the knowledgeable trainee to correctly respond?
- Is the test item free of negative statements?
- Is the sample answer constructed to minimize subjectivity in grading? Are all significant requirements clearly identified, each with specific point values? Are alternate acceptable responses also included with the sample answer, where appropriate?

Drawing or labelling test items

- Are clear instructions provided concerning what is to be drawn, labeled, or sketched?
- Are clean, readable illustrations provided with parts to be labeled specifically identified?
- Does the test item require only one type of response per diagram?
- Are spaces provided for answers that require labeling a given drawing?
- Does the test item provide sufficient space for the required drawing/sketch?
- Are the points allocated for all parts of the drawing/sketch?

APPENDIX XVII. EXAMPLE QUESTION PREPARATION AND VERIFICATION CHECKLIST

QUESTION PREPARATION AND VERIFICATION CHECKLIST
FOR WRITTEN REQUALIFICATION TESTS

Plant: _____ Question number: _____

Position for which the question is designed: ANO/CRO ☐ SM/CRSS/SS ☐ U0CRO ☐

Question based on Objective # _____ and Task # _____

	Criteria	Preparer	Verifier
1.	I have complied with the terms of the Security Agreement for Written Requalification Test Material that I have signed.	☐	☐
2.	The question is based on a knowledge objective that has been identified as suitable for written requalification tests.	☐	☐
3.	The question tests knowledge at a cognitive level of comprehension, application or analysis in the Bloom's Taxonomy.	☐	☐
4.	The question is at the appropriate level for the position for which the question is designed.	☐	☐
5.	The question is operationally focused.	☐	☐
6.	The thought process necessary for answering the question closely parallels a mental activity that may take place on the job.	☐	☐
7.	There are four answer options.	☐	☐
8.	There is only one answer option that is correct.	☐	☐
9.	Answer options do not include ranges of values that overlap.	☐	☐
10.	No answer option uses the terms "none of the above", "all of the above", "always" or "never".	☐	☐
11.	No distracter is by itself a false statement. Each distracter is plausible.	☐	☐
12.	All 3 distracters are not easily identifiable as incorrect by individuals who do not have the knowledge required of the certified individuals in the applicable position on the specific topic covered by the question.	☐	☐
13.	All 3 distracters are clearly identifiable as incorrect by individuals who have the knowledge required of the certified individuals in the applicable position on the specific topic covered by the question.	☐	☐
14.	Information that is common to all answer options is included in the stem of the question.	☐	☐
15.	The stem of the question is stated positively, unless the intent is to test knowledge of what not to do.	☐	☐
16.	No blank space to be filled with the answer appears within the stem of the question.	☐	☐
17.	The stem of the question and the correct answer are technically accurate.	☐	☐
18.	Subject matter expertise was obtained, when necessary.	☐	☐

(continued on reverse side)

	Criteria	Preparer	Verifier
19.	The stem of the question and the answer options are free of clues or details that point to the correct answer.	☐	☐
20.	The stem of the question and the answer options are clear, grammatically correct and as concise as possible.	☐	☐
21.	Key words in the stem of the question are highlighted to draw the attention of certified individuals to any critical information necessary to understand the question.	☐	☐
22.	Any information that according to the relevant knowledge objectives must be available to answer the question is supplied with the question.	☐	☐
23.	The documentation pertinent to the question is referenced in the copy of the question to be kept on file and these references are up to date.	☐	☐
24.	The reasons why the correct answer is correct and each distracter is incorrect are documented in the copy of the question to be kept on file.	☐	☐

Prepared by: _____ Date:_____(Qualified examiner)

Verified by: _____ Date: _____ (2nd Qualified Examiner)

APPENDIX XVIII. QUESTION VALIDATION CHECKLIST

QUESTION VALIDATION CHECKLIST FOR WRITTEN REQUALIFICATION TESTS

Plant: _____ Question number: _____

Position for which the question is designed: ANO/CRO ☐ SM/CRSS/SS ☐ U0CRO ☐

	Criteria	Validator #1	Validator #2
1.	I have complied with the terms of the Security Agreement for Written Requalification Test Material that I have signed.	☐	☐
2.	I had no prior knowledge of the content of this question.	☐	☐
3.	The time I took to answer this question under examination conditions is:	min.	min.
4.	The question is operationally focused and its content is up to date.	☐	☐
5.	The thought process necessary for answering the question closely parallels a mental activity that may take place on the job.	☐	☐
6.	There is only one answer option that is correct.	☐	☐
7.	The question is at the appropriate level for the position for which the question is designed.	☐	☐
8.	All 3 distracters are not easily identifiable as incorrect by individuals who do not have the knowledge required of the certified individuals in the applicable position on the specific topic covered by the question.	☐	☐
9.	All 3 distracters are clearly identifiable as incorrect by individuals who have the knowledge required of the certified individuals in the applicable position on the specific topic covered by the question.	☐	☐
10.	The stem of the question and the correct answer are technically accurate.	☐	☐
11.	The stem of the question and the answer options are free of clues or details that point to the correct answer.	☐	☐
12.	The stem of the question and the answer options are clear.	☐	☐
13.	Key words in the stem of the question are highlighted to draw the attention of certified individuals to any critical information necessary to understand the question.	☐	☐

Validated by: _____ Date: _____ (Qualified Validator)

Validated by: _____ Date: _____ (2nd Qualified Validator)

APPENDIX XIX. INSTRUCTIONS FOR TAKING A WRITTEN EXAMINATION

RULES AND INSTRUCTIONS FOR CERTIFIED SHIFT PERSONNEL TAKING A WRITTEN REQUALIFICATION TEST

(1) Sign the Security Agreement for Requalification Tests before you begin the test.

(2) Cheating during the test will result in an automatic fail grade being assigned to the persons involved.

(3) Rest room trips are allowed, but only one person at a time may leave. Communication with anyone outside of the test room is prohibited.

(4) The test is an open-reference test where you have access to the approved reference material that is made available.

(5) Any additional information required to answer a question is supplied with the question.

(6) During the test, you are only allowed to use the approved reference material, the additional information, if any, supplied with the question paper and a non-programmable calculator.

(7) The test consists of 40 multiple choice questions. Each question is worth one mark.

(8) A fail grade is assigned when more than 8 questions are answered incorrectly.

(9) The test is designed to be completed in three hours. The maximum amount of time allowed for completing the test is four hours.

(10) Print your name, position title, employee number, the date of the test, and the title of the test or the test identification number in the space provided on the answer selection sheet.

(11) Read each question carefully before selecting your answer. Key words in the stem of a question are highlighted to draw your attention to any critical information necessary to understand that question.

(12) Mark your choice of answer for each question on the answer selection sheet.

(13) You may use the paper supplied for your rough work.

(14) When you have completed the test:

- (a) hand in your completed answer sheet and the question paper
- (b) hand in the paper supplied for your rough work for disposal;
- (c) initial the Written Requalification Test Invigilation Form and record the completion time beside your name;
- (d) leave the test room and do not remain in its vicinity.

(15) If you have questions, ask them before the test begins.

APPENDIX XX. EXAMPLE OF A GRADING PROCEDURE

1.1 Marking of a written examination

The Director of the Personnel Certification Division (PCD) designates the first and second markers. Normally, an Examination Team (ET) member performs the first marking and the Lead Examiner (LE) performs the second marking. Examinations should be marked as soon as practicable and more than one marker may be assigned for first marking. A Science Fundamentals Examination should be marked at an average rate of 125 marks per day. All other types of examination should be marked at an average rate of 100 marks per day.

1.1.1 Preparation for the marking

When the answer booklets are received by the PCD Administrative Assistant, they are forwarded to the first marker, along with a copy of the approved examination paper with its attached reference material and a diskette containing an electronic copy of the approved marking guide.

1.1.2 First marking

The first marker grades all candidates, as per the following instructions.

1.1.2.1 Make a separate copy of the approved marking guide for each candidate and name it *surname1* where surname is the candidate's surname and 1 indicates first marking.

1.1.2.2 Grade the answer of all candidates to a particular question or part of a question before proceeding to grade the next question or the next part of a question.

1.1.2.3 Grade an answer by checking in the marking guide of each candidate the answer elements mentioned in the candidate's answer booklets. **Do not write anything in the answer booklets.**

1.1.2.4 Document areas of concern, misconceptions and relevant additional information in an answer for subsequent review and consideration. Record these in the candidate's marking guide, immediately following the answer to which they belong. The following items are to be recorded:

(a) significant technical errors which are not, or not sufficiently, accounted for by using the marking guide;

(b) relevant additional information in the answer that is not included in the marking guide.

1.1.2.5 At the completion of the grading of a question, record in an examination comments file:

(a) any perceived difficulty encountered by a number of candidates with the question, as indicated by answers that are consistently incomplete or different from the answer in the marking guide;

(b) any recommendation for changes to the answer in the approved marking guide that you consider necessary before the marking guide is authorized.

1.1.2.6 At the completion of the first marking, calculate the candidate's exam score.

1.1.2.7 Assign a pass grade if a candidate scores at least 60% in the examination, with at least 50% in each question, and no significant technical error was made.

1.1.2.8 Assign a fail grade if a candidate scores less than 60% in the examination.

1.1.2.9 When a candidate does not meet the pass or fail criteria above:

(a) Review the answers for which the candidate scored less than 50% as well as the areas of concerns and the significant technical errors documented in the candidate's marking guide to determine the significance and extent of the knowledge deficiencies shown by the candidate. Document your conclusions at the end of the candidate's marking guide.

(b) Recommend a pass or fail grade for the candidate according to the following guidelines and justify your recommendation at the end of the candidate's marking guide:

— Recommend a pass grade if the knowledge deficiencies shown by the candidate are, in your judgement, not significant or extensive enough to warrant formal remedial training by the licensee.

— Recommend a conditional pass grade if the candidate has shown knowledge deficiencies that, in your judgement, are significant enough to warrant formal remedial training by the licensee, but not extensive enough to warrant a fail grade. The recommendation must include the remedial training required to obtain a pass grade. Normally, candidates who score less than 50% on a number of questions that are worth more than 25% of the examination should not be considered for a conditional pass.

— Recommend a fail grade if the candidate has shown knowledge deficiencies that, in your judgement, are serious enough to warrant such a grade.

1.1.2.10 Enter on the cover page of each candidate's marking guide the marks obtained by the candidate in percent and your recommended examination result.

1.1.2.11 Complete the *Examination Result Form* for each candidate.

1.1.2.12 Identify the candidates who you recommend should undergo a second marking.

1.1.2.13 Forward the marking guides, the examination result sheets, the *Examination Result Forms* and your examination comments file to the Director of PCD for review.

1.1.2.14 Return the candidates' answer booklets to the PCD Administrative Assistant.

1.1.3 Second marking

To ensure independence of the second marking, the second marker does not have access to the results of the first marking until the second marking has been completed. The Director of PCD selects candidates for a second marking according to the following criteria:

- Candidates with a score in the range from 57 to 63%
- Candidates for whom the first marker recommends a conditional pass
- Candidates who do not meet the fail criterion in paragraph 1.1.2.8 and for whom the first marker recommends a fail grade
- Other candidates for whom the first marker recommends a second marking
- Other candidates at the discretion of the Director of PCD

At least one of the candidates graded by each marker involved in the first marking must be selected for a second marking.

The Director of PCD requests the PCD Administrative Assistant to forward the answer booklets of the selected candidates to the second marker, along with a copy of the approved examination paper with its attached reference material and a diskette containing an electronic copy of the approved marking guide.

The second marker grades the selected candidates, as per the following instructions.

1.1.3.1 Make a separate copy of the approved marking guide for each candidate and name it *surname2* where surname is the candidate's surname and 2 indicates second marking.

1.1.3.3 Follow the instructions for first marking given in paragraphs 1.1.2.2 through 1.1.2.13.

1.1.4 Reconciliation of the results of the first and second markings

The Director of PCD requests the markers who have performed the first and the second marking to meet to discuss their results and to resolve any discrepancy between their two gradings and recommendations. The first and second markers perform this reconciliation as per the following instructions.

1.1.4.1 Make a separate copy of the approved marking guide for each candidate selected for a second marking and name it *surname3* where 3 indicates a reconciliation of the first and second markings. On the cover page, replace the file number by the personal file number of the candidate and enter the name and position of the candidate and your names.

1.1.4.2 Grade the complete examination of one candidate at a time.

1.1.4.3 Grade each answer by checking in the new version of the marking guide of a candidate the answer elements for which both markers gave credit in their respective marking guide. Whenever an answer element has been credited by only one of the markers:

(a) Refer to the candidate’s answer to determine whether credit is justified.

(b) If both markers concur that credit is justified, check the element in the marking guide. In case of disagreement, record the element in question for subsequent discussion with the Director of PCD.

Credit may be given for an answer element not mentioned explicitly in a candidate's answer if both markers conclude from an answer to another question that the candidate has this knowledge.

1.1.4.4 Compile in the new marking guide the areas of concern, misconceptions and relevant additional information in the candidate's answers agreed upon by both markers. Record these in the candidate's marking guide, immediately following the answer to which they belong. Record any persisting disagreement for subsequent discussion with the Director of PCD.

1.1.4.5 After completion of the above instructions for all candidates, review your respective examination comments file and make joint recommendations for changes to the approved marking guide that you consider necessary before the marking guide is authorized. Also add to the approved marking guide any comment that may help in preparing future examinations.

If you have recommendations for changes to the approved marking guide or if you have persisting disagreements, meet with the Director of PCD to discuss them. If the Director of PCD decides that changes to the approved marking guide are warranted, make the required changes to the marking guide.

1.1.4.6 Once the Director of PCD has authorized the marking guide, make any required change to the marking guide s*urname3* of each candidate and complete the grading and reconciliation.

1.1.4.7 Compare the recommendations made by each marker regarding the results of the candidates and formulate final recommendations with a documented justification where required. Document any persisting disagreement on the proposed result of a candidate at the end of the candidate's marking guide for subsequent discussion with the Director of PCD.

1.1.4.8 If significant changes to the approved marking guide were authorized, assess the impact that these changes might have on the results of the candidates who were not selected for a second marking.

1.1.4.9 Meet with the Director of PCD to discuss your recommendations on the candidates' results and, if applicable, the impact that authorized changes to the approved marking guide might have on the results of the candidates who were not selected for a second marking. Seek resolution of any persisting disagreement.

1.1.4.10 Complete any further work requested by the Director of PCD to finalize your recommendations of examination results and revise the candidates' marking guides accordingly.

1.1.4.11 For each candidate impacted by the reconciliation process:

(a) Enter on the cover page of the marking guide the marks obtained by the candidate in percent and your joint recommendation of examination result.

(b) Print the reconciled marking guides and sign on the cover page.

(c) Complete the Examination Result Form.

(d) Forward the reconciled marking guides, together with the corresponding examination result sheets and result forms, to the Director of PCD for authorization.

1.1.4.12 Draft a report to notify the Director of Program Evaluation and the Director of Human Performance of any significant training deficiency found during marking of the examination.

1.1.4.13 Return the candidates' answer booklets to the PCD Administrative Assistant for filing.

APPENDIX XXI. EXAMPLE POST-EXAMINATION CHECKLIST

ES-501 Post-Examination Check Sheet Form ES-501-1

Task description		**Date complete**
1.	Facility written exam comments or graded exams received and verified complete	
2.	Facility written exam comments reviewed and incorporated and NRC grading completed, if necessary	
3.	Operating tests graded by NRC examiners	
4.	NRC Chief examiner review of written exam and operating test grading completed	
5.	Responsible supervisor review completed	
6.	Management (licensing official) review completed	
7.	License and denial letters mailed	
8.	Facility notified of results	
9.	Examination report issued (refer to NRC MC 0610)	
10.	Reference material returned after final resolution of any appeals	

APPENDIX XXII. EXAMPLE OF TYPES OF ORAL QUESTIONS

Types of Questions	Examples
1. **Fact questions.** These questions ask for a single specific answer. They generally begin with one of four words: "what, where, who, and when."	• What is meant by shutdown margin? • Where are the administrative keys kept? • When do you use a 1/m plot? • Who is the Interim Station Emergency Manager?
2. **Broadening questions.** These questions ask for additional information beyond what has already been presented. They often begin with words like "what else, why, or why not."	• What other checks should be made to monitor water chemistry in order to extend steam generator life? • What else can be monitored to verify safety injection flow?
3. **Justifying questions.** These questions ask for the reasons underlying an answer. Traditional or new ideas can be challenged with this type of question. The words "why" and "how" usually introduce justifying questions.	• Why would you select that instrument to make the measurement rather than another? • How do we know that the SI pump is actually running?
4. **Hypothetical questions.** Questions in this category can be used to introduce new ideas or investigate alternative actions. They often begin with the words "if" or "suppose."	• Suppose both diesels did not start on a blackout. What would you do as an SRO? • If the turbine did not automatically trip from a reactor trip signal, how would this affect primary cool down?
5. **Alternative questions.** These questions present different prospectives for discussion. They generally begin with words like "which should we" or "which of these."	• Which of these procedures will guide you to a cold shutdown condition? • Which of these formulas should be used for computing Start-up Rate?
6. **Coordinating questions.** These questions are used to direct, channel, and summarize the discussion.	• How can we combine the suggestions we have up to this point? • Do we agree that this is the better procedure for the situation?

APPENDIX XXIII. EXAMPLE OF ADMINISTRATIVE TOPICS FOR A JOB PERFORMANCE MEASURE

"Conduct of Operations," evaluates the applicant's knowledge of the daily operation of the facility. The following subjects are examples of the types of information that should be evaluated under this topic: — shift turnover; — shift staffing requirements; — temporary modifications of procedures; — reactor plant startup requirements; — mode changes; — plant parameter verification (estimated critical position (ECP), heat balance, etc.); — short-term information (e.g. night and standing orders); — key control; — security (awareness and familiarity); — fuel handling.
"Equipment Control," addresses the administrative requirements associated with managing and controlling plant systems and equipment. The following subjects exemplify the types of information that should be evaluated under this topic: — surveillance testing; — maintenance; — tagging and clearances; — temporary modification of systems; — familiarity with and use of piping and instrument drawings.
"Radiation Control," evaluates the applicant's knowledge and abilities with respect to radiation hazards and protection (of plant personnel and the public). The following subjects exemplify the types of information that should be evaluated under this topic: — use and function of portable radiation and contamination survey instruments and personnel monitoring equipment; — knowledge of significant radiation hazards; — the ability to perform procedures to reduce excessive levels of radiation and to guard against personnel exposure; — radiation exposure limits and contamination control, including permissible levels in excess of those authorized; — radiation work permits; — control of radiation releases.
"Emergency Plan," evaluates the applicant's knowledge of the emergency plan for the facility, including, as appropriate, the responsibility of the reactor operator to decide whether the plan should be executed and the duties assigned under the plan. The following subjects are examples of the types of information that should be evaluated under this topic: — lines of authority during an emergency; — emergency action levels and classifications; — emergency facilities; — emergency communications; — emergency protective action recommendations.

APPENDIX XXIV. EXAMPLE OF SCENARIO INITIAL CONDITIONS

Reactor Power: 97 % **Generator Load:** 512 MW(e)

Average Zone Level: 44% **Unit Control Mode:** RCS/Manual

Fuelling Machines: In Fuelling Machine Service rooms, and empty of fuel.

State of Major Systems:

Unit 5 has been operating at approximately 97% FP with generator load at approximately

512 MW(e) for several weeks and is currently in steady state.

All Unit 5 systems are in the normal configuration for this load with the exception of the equipment out of service as identified below.

Equipment out of service:

Reactor auxiliary pump 5-3331-P2 is out of service for breaker maintenance. Work in progress in the shop.

Maintenance activities in progress:

Maintenance are working on the partial rod drop test resistors of SA1.

Standby Generator 5460-SG3 out of service under a Work Permit for repairs to the lubricating oil system.

Other station conditions:

Unit 8 is shut down and under Reactor Shutdown Guarantee (RSG).

Units 6 and 7 are operating normally at 100% FP.

Lake water temperature is 20 degrees C.

APPENDIX XXV. EXAMPLE SCENARIO DESCRIPTION

The scenario begins with the unit operating at full power. Maintenance work is in progress to repair a problem with Shutoff Rod 1 (SA1).

During this work, SA1 falls into core and then withdraws automatically. Reactor power will rapidly reduce to approximately 82% FP before stabilizing, requiring the candidate to respond to the upset.

Once the candidate has responded to this upset and stabilized the unit, the Shift Supervisor will return to the Control Room. Shortly thereafter, a Moderator System leak will occur. The candidate will enter Operating Manual 5-32000-5.7 and trip the reactor and complete the Power Reduction Action Guide.

The candidate will cool down the reactor following Operating Manual OM 5-33000-4.2.2. Prior to initiating cool down, the remaining Primary Heat Transport pressurizing pump (5-3331-P1) will trip, and the candidate will need to place the auxiliary (Fuelling Machine) pressurizing pumps in service, following the Operating Manual procedure. When these actions are completed, reactor cool down can proceed.

The scenario will end when the candidate has confirmed that reactor cool down is in progress.

APPENDIX XXVI. EXAMPLE OF A CANDIDATE ACTION CHECKLIST

START TIME: ____:____

The candidate will enter the simulator and be briefed by the Lead Examiner on the unit status and the on-going work.

At the request of the Lead Examiner, Simulator Operator initiate Shutoff Rod (SA1) drop

Page 112 line 5=1, line 6=enter (T), line 6=enter (F)

Annunciation: RCS 150 REACTOR POWER ERROR EXCEEDS 1%
RCS 252 ADJUSTER ROD OUTDRIVE INITIATED

Annunciation: (Window) REACTOR OVERPOWER DETECTOR HI/LO

(2.9)* [ ] Acknowledges alarms.
(1.2) [ ] Checks reactor power via RCS Status display.
(1.3) [ ] Checks power error via RCS Status or Limit Controller Diagram.

(1.3) [ ] Monitors SA1 is withdrawing from core via status lights.
(1.3) [ ] Checks that SA1 has fully withdrawn from core via panel position indicating meter.

(1.2) [ ] Checks reactor power steady at 82% FP via REACTOR CONTROL SYSTEM Status display.

(1.2) [ ] Checks Reactor Coolant system pressure via controllers .
(1.2) [ ] Checks Boiler Pressure stable via status display
(1.2) [ ] Checks boiler levels via meters or chart recorders.
(1.3) [ ] Checks Turbine Generator load reduced, MW decreasing

(3.5) [ ] Obtains Operating Manual 63710-5.13

(2.5) [ ] Updates Reactor Overpower Protection (ROP) monitor via keyboard.
(1.3) [ ] Checks reactor margins to trip via ROP Monitor display.

Maintenance calls from Control Equipment Room and informs candidate that they caused a spark on a connection of the SA1 test resistor however, everything is now normal.

(5.2) [ ] Acknowledges clearly the instructions/information received

Candidate Requests Control Maintenance to:
(2.6) [ ] Stop work.

(3.6) [ ] Candidate recognizes that situation is not addressed by procedures. Determines the actions required.

Candidate pages the Shift Supervisor
Shift Supervisor enters the CR

Candidate informs Shift Supervisor:
(5.4) [ ] SA1 has dropped into core and has fully withdrawn,
(5.4) [ ] the unit has stabilized at 82%,
(5.4) [ ] Operating Manual 63710 is being followed for actions,
(5.4) [ ] the ROP computer has been updated,
(5.4) [ ] the problem resulted from maintenance work.
(5.1) [ ] States persons name or title, unit number, system USI and/or description of component and uses phonetic alphabet when required.

Shift Supervisor acknowledges the information and informs the candidate that he will check with Control Maintenance regarding the work procedure.

* Competency Areas – these can be subdivided into detailed categories, and in this particular case they are:

- 1.x Control Room systems monitoring
- 2.x Actions before accessing procedures or taken without procedures "in hand"
- 3.x Diagnosis and decision making
- 4.x Actions taken with reference to procedures
- 5.x Communications

APPENDIX XXVII. EXAMPLE OF STANDARD QUESTIONS FOR A SHIFT SUPERVISOR (SS) DIAGNOSTIC TEST SCENARIO (DTS)

The standard questions listed below should be used as the basis for preparing the specific questions that will be asked to SS candidates at the end of each DTS. Some of the standard questions may have to be modified, as appropriate, to reflect the actual conditions of the scenario and to elicit the specific answers expected. The expected answer to each question should be documented in the DTS Examiner's Guide.

1. (a) What main abnormal plant condition did you diagnose?

   (b) What failure, or combination of failures, caused this condition?

   Candidates are expected to diagnose as specifically as possible the failure, or combination of failures, that caused the main abnormal plant condition that must be addressed, taking into account the severity of the deterioration of plant conditions and the urgency to take an appropriate course of actions. Question 1 b) will be asked when the rate of deterioration of plant conditions caused by the Primary Malfunction is sufficiently slow to give the candidates time to make a more specific diagnosis or when a specific diagnosis is required before taking the appropriate course of actions.

— Explain how you came to this conclusion.

When answering this question, candidates are expected to demonstrate that their diagnosis was based on control room and field information that supports a unique conclusion.

When there is more than one approach to reach the correct diagnosis, each acceptable combination of checks that supports a unique conclusion should be documented in the DTS examiner's guide. The answer given by a candidate will allow the examiners to determine which approach the candidate used to unambiguously reach the correct diagnosis and to eliminate the checks that should not be used for assessment because they are not relevant to the approach used by the candidate.

— What other problems did you observe while performing your diagnosis?

Candidates are expected to identify any other malfunction of indicator, equipment, component or control device that occurred while performing their diagnosis, including failure of any major automatic action.

— Outline the course of actions that should be taken, based on your diagnosis.

Candidates are expected to select the procedures that should be implemented and to use them to outline the course of actions that should be taken to address the main abnormal plant condition diagnosed and any other significant problem observed.

Whenever more than one procedure is to be implemented, candidates are expected to outline in the appropriate sequence the course of actions to be taken.

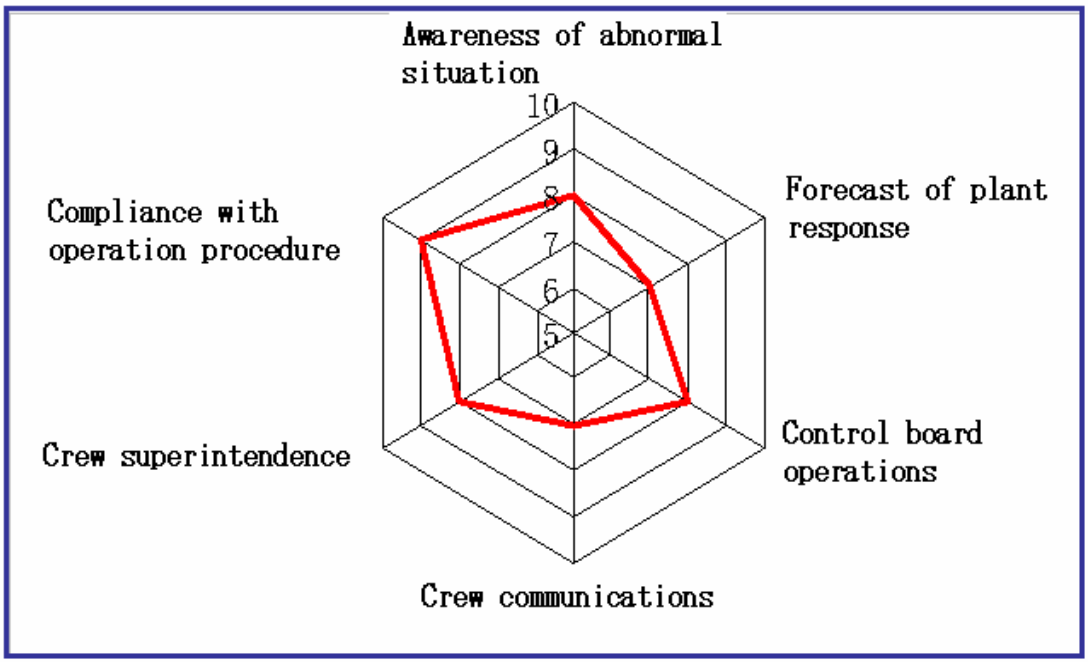
Whenever approved procedures do not exist, do not fully address the actual situation or give conflicting instructions, candidates are expected to describe the actions and checks they would ask control room personnel to perform.

2. (a) State the significant concerns you have as an SS considering the plant conditions existing at the end of the DTS.

Candidates are expected to identify the significant concerns they may have with respect to control of reactor power, cooling of the fuel, containment of radioactivity, impairments of special safety systems and standby safety support systems, compliance with Operating Policies &Principles, safe operation of plant systems and equipment, safety of plant personnel and protection of the environment.

(b) Which of those concerns do you consider the most important?

APPENDIX XXVIII. EXAMPLE TEAM PERFORMANCE EVALUATION CHART



Explanation:

- In this situation, the team performance is graded on a score of five to ten in the five competency areas around the circumference of the circular plot.
- Instructor comments and advice are attached separately to the report.

APPENDIX XXIX. EXAMPLE SIMULATOR EXAMINATION DESIGN CHECKLIST FOR SIFT SUPERVISOR CANDIDATES

Plant: _____ File: _____

Examination Session: _____

The simulator examination must meet the following criteria:

[ ] Initial plant conditions are varied among test scenarios.

[ ] At least one CTS or DTS starts with the reactor unit in a low power state.

[ ] Test scenarios cover a broad range of system operations, equipment malfunctions and unit upsets.

[ ] At least one CTS or DTS includes a category 4 Primary Malfunction.

[ ] At least one DTS includes a failure of a major automatic action during an upset which requires an immediate response by the candidates.

[ ] At least two test scenarios include one or more malfunctions or unit conditions not addressed specifically in the operating procedures that must be addressed by the candidates.

[ ] At least one CTS includes a combination of failures, or of plant conditions and failures, that requires the candidates to prioritize the actions of the Support Team (ST) and to direct their execution, with due consideration to plant conditions.

[ ] At least one DTS includes a combination of failures, or of plant conditions and failures, that requires the candidates to prioritize operator actions, with due consideration to plant conditions.

[ ] At least two test scenarios include a situation where a requirement in the *Operating Policies and Principles* is not met and must be addressed by the candidates.

[ ] At least one test scenario includes the occurrence of an impairment of a special safety system or of a standby safety support system that must be addressed by the candidates.

[ ] Candidates are expected to be tested in each competency area at least 20 times over the entire examination.

[ ] The dynamic duration of the two CTSs is expected to be between 75 and 120 minutes.

[ ] The dynamic duration of the four DTSs is expected to be between 30 and 45 minutes.

[ ] The duration of the PCTS is expected to be approximately 15 minutes.

[ ] The examination duration is expected to be between 2 and 3 hours.

At multi unit plants only

[ ] At least one CTS includes malfunctions that exist concurrently on the reactor unit and on unit 0, or on the reactor unit and on simulated systems common to more than one

reactor unit, that require the candidates to establish priorities, with due consideration to plant conditions.

[ ] The candidates are required to give detailed instructions to ST members on the actions to be taken during part of one CTS.

At single unit plants only

[ ] One CTS tests the candidates in the role of the RO.

NOTE:

- this checklist is for the initial examination of a shift supervisor, which will include two Comprehensive Tests (CTS), four Diagnostic Tests (DTS)and one Panel Check Test (PCT). For explanation and clarification see accompanying CD[xx], Appendix A.11.

- design check list for an operator initial examination CTS, is included in the accompanying CD [16], Appendix 11.

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[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Training the staff of the regulatory body for nuclear facilities: A competency framework, IAEA-TECDOC-1254, IAEA, Vienna (2001).

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[8] INSTITUTE OF NUCLEAR POWER PLANT OPERATIONS, Guidelines for Initial Training and Qualification of Licensed Operators, ACAD 00-0003, INPO, Atlanta (2000).

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[16] U.S. Department of Energy Handbook, Guide to Good Practices for Oral Examinations, DOE-HDBK-1080-97, September 1997.

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[20] INTERNATIONAL ATOMIC ENERGY AGENCY, Training Material and Technical Support for AMP Courses and AM Staff Training, IAEA, Vienna (2000).
[21] WORLD ASSOCIATION OF NUCLEAR OPERATORS, Guidelines for Simulator Training, WANO-90-022, (1990).

ANNEX I. IAEA QUESTIONNAIRE ON THE METHODS OF AUTHORIZATION OF CONTROL ROOM OPERATORS WITH EMPHASIS ON THE USE OF CR SIMULATORS

A technical document on "Methods of Authorization of Control Room Operators with Emphasis on the Use of CR Simulators" is currently being developed by IAEA and is to rely heavily on examples provided by member countries. Selected examples from each country will be included in the Appendices of the document. If appropriate, other examples will be included in Annexes on a CD ROM provided with the publication. The document will be available to download, via the Internet, from the Agency's web site.

Purpose

The purpose of the document is to provide practical information on methods used by authorizing organizations in Members States to establish or improve the authorization process of control room personnel in order to ensure availability of sufficient number of competent personnel for NPP operation, by use of actual examples from different countries. The document will highlight the use of simulators in the authorization process. It is recognized that authorization of CR personnel may be done by an external regulatory body or by the plant organization itself. Therefore, the emphasis in the document will be on the methods and processes used, since either approach to authorization has proven to produce acceptable results.

Scope

The document will consider the various types of examinations used such as written, oral, walkthrough, and simulator examinations in the authorization process. The document will include examples of the methodology used to develop, implement, and evaluate the results of the various types of examinations.

To assist with the development of the document, please provide answers to the questions in the Questionnaire provided below and provide documents/examples as appropriate:

LIST OF EXAMPLES DESIRED

Examples of regulations, administrative procedures, standards, guides, or handbooks that support the development, implementation and evaluation of various examination methods for both initial authorization and periodic reauthorization are requested. Examples that support or amplify answers to the questionnaire should also be provided, as appropriate. One example may address more than one of the examination types. As an alternative, a 1–2 paragraph description of a method or application that addresses one or more items from the questions or examples requested would also be acceptable. An electronic copy is preferred. Excerpts from larger documents such as laws, standards, norms, procedures etc., which are self-explanatory, may also be provided.

Where a document is considered useful, but is not available in English, please provide a short summary in English, which may be included in the main document, and a full copy in the national language, for inclusion on the CD.

Questionnaire:

(1) Please briefly describe the job positions (titles, duties, etc.) of the CR personnel that must be authorized.

(2) After initial authorization, is re-authorization periodically required? If yes, what is the frequency?

(3) Are their any special requirements that must be met in order to obtain an initial authorization (e.g. doubling) or retain a current authorization (i.e. participation in continuing training, participation on shift for a specific amount of time each month, quarter or year)? Please describe or provide a copy of the requirements.

(4) Does your authorizing body (regulatory, plant, etc.) conduct any of the following types of initial or re-authorization examinations or tests of your control room personnel? For each type of examination used for initial authorization or re-authorization please identify whether the regulatory body or the plant is responsible, for preparation, review, approval, administration (conducting), and grading of the examination, and who issues the authorization document to the individual.

4.1 Written exams?

YES NO

If "yes", please briefly describe the written exams including:

(a) How frequently are the exams conducted?
(b) What is the "size" of the exam, i.e. how many questions, how many marks?
(c) How do the assessors (examiners) determine the topics and scope of knowledge that is tested (e.g. job and task analysis, job competency analysis, regulatory body requirements, PSA, etc.)?
(d) What style of questions is used [essay, multiple-choice, etc.]?
(e) Is the exam conducted in a closed-book or open-reference setting ["open reference" means the examinees have access to the same operating documentation which is available in the plant's control room]?
(f) What is the pass mark?
(g) Do you make your bank of exam questions and answers available to the control room personnel for study?

4.2 Oral exams?

YES NO

If "yes", please briefly describe the oral exams including:

(a) How frequently are the exams conducted?
(b) How long is the oral exam, i.e. length of time, how many questions, how many marks?
(c) How do the assessors (examiners) determine the topics and scope of knowledge that is tested (e.g. job and task analysis, job competency analysis, regulatory body requirements, PSA, etc.)?

(d) Are the exams administered by an oral board? If yes, do you have administrative procedures for the conduct of the Board?
(e) Is the exam conducted in a closed-book or open-reference setting ["open reference" means the examinees have access to the same operating documentation which is available in the plant's control room]?
(f) What is the pass mark?

4.3 Walkthrough Exams?

YES NO

If “yes”, please briefly describe the walkthrough exams including:

(a) How frequently are the exams conducted?
(b) How is the walkthrough examination administered (i.e. through the use of Job Performance Measure or another method)?
(c) How do the assessors (examiners) determine the topics and scope of knowledge and skills that are tested (e.g. job and task analysis, job competency analysis, regulatory body requirement, PSA, etc.)?
(d) Is oral questioning used during the conduct of the walkthrough?
(e) Are oral questions pre-scripted or prepared in advance of the exam?
(f) What is the scope of the walkthrough exams (i.e. how long, how many JPM”s, and/or topics are covered in relationship to simulator exams)?
(g) What is the basis or method of grading and the pass mark?

4.4 Simulator-based tests?

YES NO

If "yes" please briefly describe the simulator-based tests, including:

(a) How frequently are the tests conducted?
(b) How do the assessors (examiners) determine the topics and scope of knowledge and skills that are tested (e.g. job and task analysis, job competency analysis, regulatory body requirement, PSA, etc.)? Are attitudes assessed? If yes, how?
(c) What is the scope of the test scenarios? [for example: do the scenarios cover exclusively abnormal and emergency events, or do they include some normal operations?]
(d) Do you have specific requirements for the number of malfunctions, transients, required operator actions, etc., to be included in an examination scenario? If so, please describe or provide the procedure or guidance you use for preparation of scenarios, if possible.
(e) Do you do individual testing, team testing, or a combination of these tests?
(f) If you perform team testing, is the team composed of the same number of staff as would normally be present in the control room?
(g) If a team is tested, is each operator on the team evaluated, or is only team performance evaluated?
(h) How many assessors (evaluators) are used?
(i) Is a written assessment (evaluation) guide used by the assessors (evaluators) during the test?

(j) If a written assessment (evaluation) guide is used, what is the level of detail in the guide? [i.e. does the guide describe the expected actions of each person to be evaluated?]

(k) What is the performance basis for the assessment (evaluation)? [For example, in the US NRC document NUREG-1021 "Operator Licensing Examination Standards for Power Reactors", simulator-based assessment of licensed operators is based on "Critical Tasks" and "Generic Competencies"].

(l) What are the pass/fail criteria? Is each operator subject to a pass/fail decision or does the whole team pass or fail?

(5) Do you have requirements for the education, experience, training, or special requirements (e.g. certification of assessors) of assessors (examiners)? If yes, please describe or provide an example of the education and experience requirements. For training, please discuss or provide examples of course outlines, table of contents, etc. In particular, examples of the training of assessors (examiners) on test development and observation skills.

(6) Do you use Examination Boards? If yes, please describe or provide examples of membership, duties, and responsibilities. Also describe or provide an example of the education and training, or any other special requirements for Board members.

(7) Please provide or describe any laws, ordinances, decrees, or other legal provisions relevant to the authorization of CR personnel?

(8) If you use a less than full scope simulator, (e.g. graphical, basic principles, analytical, etc.) please describe how and the extent to which it is used in the authorization process.

(9) Do you use contractors for preparing or performing any of the authorization examinations? Please describe.

(10) Do you use any supporting information management technology tools for examination management (e.g. planning, preparation, conduct, assessment, recording of results, etc.) or any other data base management tools? If so, please describe or provide information about the tools used.

(11) Please identify any changes to the authorization process you are planning and any general trends (e.g. authorization procedures, length of exams, types of questions used, simulator scenario content, assessment methods, etc.).

(12) Please provide or describe any other information you feel would be relevant or useful in the development of the technical document

ANNEX II. IAEA SURVEY ON SIMULATOR BASED AUTHORIZATION EXAMINATIONS

Organization: _____ Date (YY-MM-DD): _____

Contact Person: _____

Tel No: _____ E-mail: _____

Fax No: _____

SIMULATOR BASED AUTHORIZATION EXAMINATIONS FOR CONTROL ROOM PERSONNEL

Legend: *MCR – Main Control Room; NPP – Nuclear Power Plant; RB – Regulator Body.*

Member State	NPP MCR Staff* Licensing (formal authorization) Required (Y/N)	License Issued by (Y/N)		Examined by (Y/N)		Roles in simulator based examinations											
						Observes only (Y/N)		Prepares examination (Y/N)		Conducts examination (Y/N)		Participates in assessment of individual's performance (Y/N)		Issues Results (Y/N)		Ensures compliance with standards (Y/N)	
		NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB	NPP	RB

* Please list the job positions of NPP MCR staff for which licensing is required:

1. _____

2. _____

3. _____

4. _____

5. _____

Please include the comments, if necessary, to any information provide by you in the table (e.g. such comments may be addressed to participation of national or overseas training centres, etc.).

COMMENTS (if necessary):

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CA	Canada
CN	China
DE	Germany
ES	Spain
FR	France
HU	Hungary
IN	India
JP	Japan
KZ	Kazakhstan
MX	Mexico
RF	Russian Federation
RO	Romania
SK	Slovakia
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3	CA	Simulator Based Examination for Shift Supervisor at Nuclear Power Plants	Operating procedure CNCS-ST6(SS), Rev.1	4
4	CA	Nuclear Power Reactor Operating Licence – Darlington Nuclear Operating Station (Canadian Nuclear Safety Commission, PROL 13.04/2008	Operating license procedure for Darlington	3, 4
5	CA	Requirements for the Requalification Testing of Certified Shift Personnel at Canadian Nuclear Power Plants	Prepared by: the Inter-utility/CNSC Committee on Certified Shift Personnel Requalification Testing, rev. 1, 2003	2, 3, 4

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7	CA	Simulator Based Examinations for Reactor Operators at Nuclear Power plants	Operating Procedure CNSC-ST6(RO), Rev. 3, May 2002	4
8	CN	Presentations on training and licensing of NPP personnel in China	Presentations at a workshop in Wuhan in February 2005 include information on training and licensing.	2
9	CN	Simulator Licensing Training for Daya Bay NPP.	Article on simulator licensing training courses; includes methods for staff to obtain RO and SRO licenses [Daya Bay NPP] and 4 related files on simulator training	4
10	DE	Guideline relating to the proof of the technical qualification of nuclear power plant personnel of April 14, 1993, BfS Safety Codes and Guides – translation, Edition 2/96 (Gemeinsames Ministerialblatt, 1993, Nr. 20)	English translation of German Safety Guide on Richtlinie fur den Fachkundendenachweis von Kernkraftwerkspersonal vom 14 April 1993	2, 3
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12	DE	Guideline relating to programmes for the preservation of technical qualification of responsible shift personnel at nuclear power plants of 1 September 1993, BfS Safety Codes and Guides – translation, Edition 4/96 (Gemeinsames Ministerialblatt, 1993, Nr. 36)	English translation of German Safety Guide on Richtline fur Programme zur Erhaltung der fachkunde des verantwortlichen Schichtpersonals in Kernkraftwerken vom 1 September 1993	2, 3
13	DE	Use of Control Room Simulators for Training and assessment of NPP Personnel	Viewgraphs and paper	4
14	DE	Simulator observation forms and criteria	Four examples of forms used for simulator observations and the criteria used	4
15	ES	Examples for TECDOC on Lessons Learned with Respect to Methods for Authorization of Control Room (CR) Operators with Emphasis on the Use of a CR Simulator	Collection of examples provided by Tecnatom: (1) Simulator Form for RO and SRO Competency grading worksheet (in English) (2) Simulator Form for RO and SRO Competency grading worksheet (in Spanish) (3) Simulator Scenarios to conduct final examination (in Spanish) (4) Competency grading worksheet and grading summary Forms for RO and SRO (in Spanish) (5) Data base Form for final written question bank (in Spanish)	4

No	Country	Title	Description	Reference Chapter
16	FR	Initial training and retraining of French control room operators. Use of the simulators.	Example for a PWR 900 MW.	2
17	IN	Guidelines for Conduct of Full Scope Replica Simulator Training for Candidate Control Engineers (Kaiga-1 and RAR-3)	Provides basic guidelines for the systematic development and conduct of FSS training	4
18	JP	Training of operators for BWR in Japan.	Introduction of Japan Electric Association Guide 4802-2002 [Guideline for the Operator Training] Viewgraphs on Guideline for the Operator Training [BWR Operator Training Center Corp.]	2, 3, 4
19	JP	Scenario description, evaluation items, and training schedule	Three files related to simulator training.	4
20	KZ	Common Regulations for the Authorization of Personnel for the Right to Conduct Activities in the Field of Atomic Energy Use.	Sample regulation in English and issued regulation in Russian.	2
21	MX	A set of Mexico's materials on qualification requirements and reauthorization.	The materials in Spanish: - Examples of the detailed reports prepared by the regulatory body on reauthorisation process results for the senior reactor and reactor operators of Laguna Verde NPP Units 1 and 2. - Mexico's national standard on selection, qualification and training requirements for NPP personnel. - Example of scenario used by the regulatory body during the reauthorisation process for the senior reactor and reactor operators of Laguna Verde NPP Unit 1.	2, 3, 4
22	RF	A set of RF regulations and instructions related to authorization of NPP personnel.	The set of materials (in Russian) includes a regulations on organization of work with NPP personnel, qualification requirements for NPP personnel, a regulation on granting the authorizations, an instruction on conduct of authorization examinations, regulation on the scope of knowledge and skills subject to authorization examinations, a generic procedure on the use of simulators in the authorization examinations, a regulation on initial and continuing training of NPP personnel, and the requirements for initial and continuing training of instructors.	2, 3, 4
23	RO	Individual performance evaluation. Shift supervisor candidate. Comprehensive test scenario (Cernavoda NPP, #6/2003, Rev.1)	Simulator scenario for a performance evaluation of the shift supervisor candidate during multiple plant transients.	4

No	Country	Title	Description	Reference Chapter
24	UA	Ukraine's licensing requirements for personnel and for training.	Excerpts from Ukraine's national documents (in Russian).	2
25	UA	Zaporozhzhie NPP (Ukraine) licensing procedure.	Full text in Russian language.	2
26	US	NRC Requirements for Licensing and Qualifications of NPP Personnel	Viewgraphs of a presentation	2
27	US	Operator License Examinations	Viewgraphs of a presentation	3, 4
28	US	Frequently Asked Questions About Operator Licensing Programme	Printout from the US NRC web site	2
29	US	Operator Licensing Examination Standards for Power Reactors (the US NRC, NUREC-1021, Rev.9)	The standards for licensing examinations.	2, 3, 4
30	US	Important Regulatory Changes and Their Impact	Presentation on the upcoming changes in NUREG-1021 and their impact on Licensed Operator Training [Exelon Corporation].	3, 4
31	US	Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Pressurized Water reactors (NRC NUREG-1122, revision 2, 1998)	Catalog based on industry wide job and task analysis for PWRs.	3, 4
32	US	Knowledge and Abilities Catalog for Nuclear Power Plant Operators: Boiling Water Reactors (NUREG-1123, revision 2	Catalog based on industry wide job and task analysis for BWR's	3, 4
33	US	U. S. NRC NUREC 1262, 1987	Answers to Questions at Public Meetings regarding Implementation of Title 10, Codes of Federal Regulations, Part 55 on Operators' Licenses	2
34	US	Part 55 – Operator' Licenses	Regulation on licensing of operators	2
35	US	Statistics on Examination Grades	Examination results, material available on the internet	3, 4
36	US	10 CFR 54, Conditions of Licenses	Minimum control room staffing	2
37	US	IP 41500	Training and qualification effectiveness inspection procedure	2
38	US	IP 71111.11	Licensed operator requalification programme inspection procedure	2
39	US	NUREG 1220, revision 2	Training review criteria and procedures	2

ABBREVIATIONS

CR	-	Control room
FSS	-	Full-scope simulator
HRM	-	Human Resource Management
IAEA	-	International Atomic Energy Agency
INPO	-	Institute of Nuclear Power Operations (USA)
JCA	-	Job Competency Analysis
JPM	-	Job Performance Measure
JTA	-	Job and Task Analysis
KSA	-	Knowledge, skills, and attitudes
NPP	-	Nuclear power plant
OJT	-	On-job training
OEB	-	Oral examination board
RB	-	Regulatory Body
SAT	-	Systematic approach to training
TC	-	Training centre
QA	-	Quality assurance
WANO	-	World Association of Nuclear Power Plant Operators

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