Nuclear power plant operator licensing

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Authorisation

By virtue of section 55, second paragraph, point 3 of the Nuclear Energy Act (990/87) and section 29 of the Council of State Decision (395/91) on General Regulations for the Safety of Nuclear Power Plants, the Finnish Centre for Radiation and Nuclear Safety (STUK) issues detailed regulations concerning the safety of nuclear power plants.

YVL Guides are rules an individual licensee or any other organisation concerned shall comply with, unless STUK has been presented with some other acceptable procedure or solution by which the safety level set forth in the YVL Guides is achieved. This Guide does not alter STUK's decisions which were made before the entry into force of this Guide, unless otherwise stated by STUK.

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1 General

Pursuant to Section 20 of the Nuclear Energy Act (990/87), an application for an operating license for a nuclear facility can be approved if the applicant has available i.a. sufficient expertise and if the competence of the operating personnel and the operating organisation of the nuclear facility are appropriate. In accordance with section 55 of the Nuclear Energy Act, the Finnish Centre for Radiation and Nuclear Safety (STUK) shall establish qualification requirements for the individuals involved in the use of nuclear energy and shall control the meeting of these requirements.

According to Section 119 of the Nuclear Energy Decree (161/88), STUK sees to it that the licensee's organisation is appropriate and adequate, that the individuals participating in the use of nuclear energy meet the qualification requirements set and that appropriate training has been offered to them. Pursuant to section 128 of the Nuclear Energy Act, only an individual approved by STUK for this specific purpose may operate the reactor and plant systems in the main control room of a nuclear facility.

Section 25 of the Council of State Decision (395/91), presents the following: "Nuclear power plant personnel shall be well suited for its duties, competent and well trained. Initial, complementary and refresher training programmes shall be established for the personnel. For ensuring safety in all situations, competent personnel shall be available in a sufficient number." To fulfill these requirements it is essential to develop both control room activities and the training and approval methods of operators. The use of a training simulator is necessary when the skills of the operators and co-operation within the shift team are developed, demonstrated and assessed.

This Guide describes the licensing procedure for nuclear power plant operators. The requirements for the basic education, work experience and the initial, refresher and complementary training of nuclear power plant operating personnel are presented in Guide YVL 1.7.

The documents referred to in this Guide are made available to STUK in accordance with Guide YVL 1.2.

2 Scope

This Guide applies to the nuclear power plant operator licensing procedure referred to in section 128 of the Nuclear Energy Decree. The licensing procedure applies to shift supervisors and those operators of the shift teams of nuclear power plant units who manipulate the controls of nuclear power plant systems in the main control room. The qualification requirements presented in the Guide also apply to nuclear safety engineers who work in the main control room and provide support to the shift supervisors, operation engineers who are the immediate superiors of shift supervisors, heads of the Operational Planning Units and simulator instructors. The operator licensing procedure for other nuclear facilities is decided case by case.

A shift team which works in the main control room normally includes at least three persons approved on the basis of this Guide, one of whom is an approved shift supervisor and two are approved operators. The Technical Specifications define for each operational state of the nuclear power plant the minimum number of shift supervisors and operators in the main control room and at the plant site.

The duties of the shift supervisor and operators are defined in the licensee's organisational manual and in the administrative rules. The job titles referred to in section 128 of the Nuclear Energy Decree are typically shift supervisor, reactor operator or turbine operator. Depending on the operating organisation, the job descriptions of similar posts differ somewhat from each other. Therefore, there are also differences in the qualification requirements which STUK takes into account when the approval decisions are prepared.

3 Principles of licensing

The licensee has primary responsibility for the development, maintenance and verification of the qualifications of the nuclear power plant shift supervisors and operators and for the conducting of their examinations. The licensee shall, in addition to the examinations, also otherwise follow how the shift supervisors and operators perform their duties.

3.1 Application and preconditions for an approval

The licensee shall file an application with STUK for an approval for a nuclear power plant shift supervisor or operator. The application shall concern the shift supervisor or operator duties mentioned in the licensee's administrative rules and organisational manual. The operator licensing application shall in addition be focused on the manipulation of the reactor or the turbine, or both. A license granted for a shift supervisor and an operator is plant unit specific and of a specified duration. A licensed shift supervisor can also perform the duties of an operator at the plant unit in question.

The qualification level of a shift supervisor is also required of operation engineers who are the immediate superiors of shift supervisors, nuclear safety engineers who work in the main control room and provide support for the shift supervisors, and the leading simulator instructor. For the heads of the Operational Planning Units the qualification level of a shift supervisor is recommendable but not absolutely necessary. For other simulator instructors, operator qualifications are a precondition. The licensee shall take care of the maintenance of these qualifications. If STUK's approval is required for these persons, this Guide shall be followed. STUK's approval can also be applied for the persons in question so that they can work in the control room work under the supervision of a licensed shift supervisor or operator to maintain their professional skill; the preconditions for application and validity of this kind of approval appear in subsections 3.2 and 3.3.

Before the licensee files an application for STUK's approval of an applicant as a shift supervisor or an operator, the licensee shall find assurance of the applicant's competence to discharge his responsibilities.

In addition to the requirements presented in Guide YVL 1.7, the preconditions for the approval of a shift supervisor or an operator include
— medical examination
— verification of trustworthiness
— written examination
— on the job training
— personal demonstration of professional skill at a simulator
— oral examination.

In the application of a shift supervisor's and an operator's (as well as a control room trainee's) license the following information shall be presented:
— a reference to the previous approval decision
— basic education and work experience
— extract from the training register showing initial, refresher and continuing training
— certificate of medical examination
— proof of verification of trustworthiness
— records of the written examination
— information relating to on the job training and work in the main control room (not applicable to the control room trainee application)
— record of demonstration of professional skill at a simulator (not applicable to the control room trainee application)
— record of oral examination (not applicable to the control room trainee application).

Licensing of shift supervisors and operators is initiated by a written examination as prescribed in subsection 4.2 of this Guide. After an approved written examination, a request to STUK shall be made for approval of the applicant as a control room trainee in his potential duty assignment.

Comprehensive on the job training shall be arranged for the control room trainees approved by STUK. A plan for the control

room training must be prepared, and there must be a record showing the tasks and operations performed.

At least eight weeks of simulator training must be provided during the initial training period. At the end of simulator training a personal demonstration of professional skill at a simulator according to subsection 4.4.1 of this Guide shall be arranged for the applicant.

An oral examination in compliance with subsection 4.3 of this Guide can be arranged on the applicant's passing of the written examination, comprehensive on the job training in the control room and demonstration of professional skill at the simulator.

On the trainee's passing the oral examination, an application can be filed for the issuance of the shift supervisor's or operator's license. The first shift supervisor's or operator's license is valid for two years at most.

3.1.1 New nuclear power plant

At a new nuclear power plant there shall be a sufficient number of shift supervisors and operators licensed in compliance with this Guide before fuel loading to the reactor may commence.

The licensee shall recruit the individuals to be licensed as shift supervisors or operators early enough to provide time for adequate initial training and to facilitate their familiarisation with the facility and its operation during the trial run.

For adequate initial training, a full-scope replica training simulator should be in use at least one year before fuel loading to the reactor is started.

For comprehensive on the job training, the applicant shall participate in the trial run of the nuclear power plant. Work during power ascension tests and the making available to STUK of the report relating to the work are a precondition for the continuation of a license also after the completion of tests required in the facility's trial run programme.

3.1.2 Nuclear power plant in operation

For the provision of comprehensive on the job training, the trainee is entitled to manipulate the controls in the main control room under the supervision of a licensed shift supervisor or an operator. The licensee shall arrange for the applicant an opportunity to participate in different types of control tasks. Plant start-up, increase of power level, decrease of power level, plant shutdown and periodic testing of safety related equipment and systems shall be included. The on the job training shall last at least six months.

In addition to the above, a requirement for approval as a shift supervisor is that the individual has, at least for six months, performed the functions of a nuclear power plant operator of which at least three months as a reactor operator.

If the individual has no earlier operating experience and is intended to be trained to perform the functions of a shift supervisor, a shift supervisor's written examination can be arranged already in connection with the examination for an operator's license.

3.1.3 Transfer of an operator to another function or to a parallel plant unit

Depending on the operator functions mentioned in the administrative rules and organisational manual, an operator or a shift supervisor applicant may need more than one approval for different functions. Each approval presupposes separate on the job training, demonstration of professional skill and oral examination when applied for the first time. In such a case, on the job training, demonstration of professional skill and oral examination are focused on the duties the shift supervisor or operator is going to take care of.

In case an approval to a parallel plant unit is required for a licensed shift supervisor or an operator, the necessary training on the differences between the plant units shall be arranged. For an approval to a parallel, almost identical plant unit, separate on the job training or demonstration of professional skill are not required but the approval can be requested after an approved oral examination.

3.2 Renewal of a license

Before filing an application for license renewal the licensee shall find assurance of the maintenance of the shift supervisor's or operator's competence.

The renewal of a shift supervisor's or an operator's license presupposes
— medical examination
— verification of trustworthiness
— regular participation in main control room duties
— regular participation in refresher training
— teamwise demonstration of professional skill at a simulator
— oral examination.

A precondition for the renewal of a license is also participation in the teamwise demonstration of professional skill at a simulator in compliance with subsection 4.4.2 of this Guide.

On the trainee's passing the oral examination as prescribed in subsection 4.3 of this Guide, an application can be filed for the continuation of the shift supervisor's or operator's license.

In the application for the renewal of a shift supervisor's or an operator's license the following information shall be presented:
— a reference to the previous approval decision
— basic education and work experience
— extract from the training register showing initial, refresher and continuing training
— certificate of medical examination
— proof of verification of trustworthiness
— information relating to control room work
— record of teamwise demonstration of professional skill at a simulator
— record of the oral examination.

The application for the renewal of a license can be filed with STUK not later than two weeks before the expiration of the validity of the license. The renewal of a license is recommended to be applied simultaneously for each operator function to be maintained. A renewed shift supervisor or operator license issued by STUK is valid at most for three years at a time.

When applying for or renewing a licence referred to in subsection 3.1 on the basis of which control room duties can be performed to maintain competence under the supervision of an approved operator or shift supervisor, the application shall include the information presented above with the exception of the records of the demonstration of professional skill at a simulator and of an oral examination. STUK's decision is valid at most for six years at a time.

If a valid license has expired, the requirements for its renewal are defined case by case. The licensee shall make a proposal to STUK of the measures required. For the renewal of a license after temporary working outside the control room the following requirements for refresher and complementary training shall be taken into account:

— If such temporary working lasts 6–12 months, the person in question shall participate in refresher training in the extent annually required. In addition, an opportunity shall be arranged for the person to demonstrate his professional skill at a simulator in compliance with subsection 4.4.1 if he has not already done so during the current license period. After this, the expired license granted earlier by STUK is automatically extended until the end of its period of validity.

— If temporary working lasts more than a year, the person in question shall complete any unperformed annual refresher training

and shall give a personal demonstration of professional skill at a simulator in compliance with subsection 4.4.1, and an oral examination shall be arranged for him for the renewal of his license.

3.3 Conditions for maintaining the license

A precondition for the maintenance of a license is that the shift supervisors and operators participate regularly in annual refresher training which includes enough simulator training.

The shift supervisor shall maintain his operational preparedness to control the reactor and the turbine by annual simulator training. An operator who wishes to maintain STUK's approval for more than one operator post must act periodically in the posts in question to maintain his operational preparedness.

The licensee shall present the required minimum amounts of simulator training and acting in different posts in a procedure which shall be sent to STUK for information.

For a shift supervisor or an operator who works temporarily outside the control room in a job comparable to control room work, and whose approval the licensee wishes to maintain, an opportunity shall be arranged to periodically perform control room work for the maintenance of his license. Also this minimum amount of work shall be presented in the above mentioned procedure.

For former shift supervisors or operators who work permanently outside the control room in posts closely related to the control room activities, whose licences have expired and who must maintain their respective competence, an opportunity shall be arranged to periodically act as an extra operator or shift supervisor in the control room in addition to the normal shift team. Such persons, mentioned in subsection 3.1 and approved in compliance with subsection 3.2, are e.g. simulator instructors, persons working in operational planning duties and nuclear safety engineers working in the main control room in support of the shift supervisor. The person in question works under the supervision of a licensed operator or a shift supervisor. The amount of annual simulator training and control room working shall be presented in the above mentioned procedure.

Acting as head of the operations of a nuclear power plant unit or as head of the planning of operations are comparable with control room work if the person in question has earlier acted as a shift supervisor.

A valid license can expire if the physical condition of the person in question changes or, if he, in discharging his responsibilities, grossly or repeatedly violates safety requirements. A valid license expires also if the shift supervisor or operator has not been actively performing operator duties for over six months or if the amount of refresher training at a simulator, the demonstration of professional skill at a simulator or the amount of control room work significantly deviate from what is required. In cases such as these, the licensee shall make a proposal to STUK for revocation of the license.

4 Medical examination, written and oral examinations and demonstration of professional skill

4.1 Medical examination and suitability for a job

For the application of a licence for a shift supervisor or an operator and for the renewal of a license, a certificate of special medical examination is required. Appropriate aptitude tests are also necessary.

The physical condition of a licensed shift supervisor or an operator shall be such that he is able to discharge his responsibilities

under normal operating conditions, during abnormal occurrences and emergencies. The observation of alarm and indication lights, for example, presupposes a normal sense of colour. In addition, in connection with the inspection, the use of intoxicants shall be cleared. The examining physician shall be aware of the responsibilities of the individual in question at the nuclear power plant and the respective aptitude requirements. It shall be indicated in the certificate of medical examination that the examination was arranged for the licensing of a shift supervisor or an operator.

The licensee shall see to it that, in addition to the above medical examination, appropriate and regular health control is provided for the individuals in question.

4.2 Written examination

The written examination shall be administered when a shift supervisor or an operator is licensed for the first time. In cases where a license has expired STUK can require the administration of a written examination.

In the written examination, the applicant shall understand the following:
- the nuclear power plant's basic safety principles
- nuclear and radiological safety requirements
- reactor's thermal and physical properties
- reactor design and operating principles
- design and functions of the primary and secondary circuits, safety systems and important auxiliary systems
- design and functions of the protection systems and main control systems
- design and functions of the electricity supply systems
- dependence of safety systems on each other and on auxiliary systems (e.g. electricity supply, cooling, location, etc.)
- fire fighting principles
- main features of behaviour of the nuclear power plant during abnormal occurrences and under accident conditions
- main features of the Technical Specifications
- the administrative and operating procedure system of the nuclear power plant unit, e.g. quality assurance manual and emergency plan.

The degree of difficulty of questions made to the applicants for the shift supervisor's license shall be more demanding than those made to the applicants for the operator's license. For arranging the written examination, the licensee shall present STUK with a proposal for the questions to be asked not later than two weeks prior to the intended examination date. STUK assesses the degree of difficulty of the questions and discusses any question changes with the licensee, where necessary. STUK adds some questions of its own. The minimum extent of the examination is ten questions and the maximum duration six hours. Copies of the applicants' answers shall be handed over to STUK's representative without delay after the examination.

The licensee shall evaluate the replies question by question. Evaluation by a scale from 0 to 5 is recommended. The acceptance criteria is at least 70% of the total number of points. In addition, no significant shortages are allowed in the applicant's knowledge of the essential topics of nuclear power plant safety. On the basis of its own judgment the licensee can ask for STUK's approval of the applicant as a control room trainee.

STUK evaluates the applicant's suitability as a control room trainee on the basis of the material of judgment of the written examination.

In case the applicant fails to pass the written examination, re-examination can be arranged in three months' time at the earliest from the date of denial of the previous examination.

4.3 Oral examination

Oral examination is a prerequisite for the licensing of a shift supervisor or an operator.

The oral examination shall be arranged in the main control room or in a closely associated

room as well as at the plant for one individual at a time. The examination covers the following areas:

— the plant unit's technical and administrative procedures and rules as well as the Technical Specifications
— design and operation of the plant unit and its system functions during normal operation
— operation of the plant unit and its system functions during abnormal occurrences and under accident conditions
— plant knowledge.

In the examination the applicant shall be able to answer questions fluently by making use of documents in the control room, computer equipment etc. The applicant is not required to have memorised all details by heart. The applicant shall be familiar with the factual contents of documents made available for shift supervisors or operators and where they are kept in the main control room as well as be familiar with the identification system of the plant. In addition the applicant shall know the location of the display and control equipment in the control room and shall be able to demonstrate, on the basis of the operating procedures, the actions necessary during an abnormal occurrence or an accident. The applicant shall also be able to demonstrate in practice the carrying out of these actions in the main control room or on the plant site. The degree of difficulty of the questions presented to applicants for a shift supervisor's license are more demanding than those presented to applicants for an operator's license.

When licensing an operator candidate for the first time, plant rounds shall always be made in connection with the oral examination to find assurance that the applicant has an insight into the plant and into the components layout at the plant and that he is able to manipulate controls external to the control room, if necessary. When renewing the license, less extensive plant rounds are made during an oral examination.

The licensee shall appoint at least two examiners to the oral examination, one of whom shall keep a record of the examination. The operations engineer of the plant unit in question or another person who has respective qualifications and experience shall be among the licensee's representatives. At least one power company examiner shall have competence corresponding to at least the examination in question. STUK usually sends two examiners to the examination.

Prior to the commencement of the examination, the licensee and STUK's representatives agree on at least six questions to be presented. The majority of the questions are posed by the licensee in each of the above mentioned areas. The questions and the answers therein shall be prepared in advance. Records shall be maintained on the questions and the main points of the questions.

Replies to all questions will be evaluated separately. Evaluation by a scale from 0 to 5 is recommended. Requirements for the approval of the examination comprise a sufficient total number of points and a sufficient number of points in each area. The acceptance criteria is 70% of the total number of points and 50% in each sub-area. If the total number of points is lower than 70% but exceeds 60%, the examiners consider the need for extra training for the applicant. If the total number of points is lower than 60%, the applicant is rejected.

When licensing a shift supervisor or an operator for the first time, the shift supervisor or operator can be either approved or denied approval in the oral examination. Re-examination can be arranged in three months' time at the earliest. In the case of extra training, an approval is granted either for a period of time shorter than (the normal) three years, or the validity of a license will be extended by three to six months for remedial instruction after which the applicant can only be approved or rejected in a re-examination.

All examiners shall confirm the evaluation of the examination with their signatures. In case of dissenting views, individual evaluations will be entered in the record. The approval of an examination requires that each examiner on his/her part approves the result.

4.4 Demonstration of professional skill

4.4.1 Demonstration of professional skill at a simulator when applying for a licence for the first time

When licensing a shift supervisor or an operator for his job for the first time either to a new or operating nuclear power plant, personal demonstration of professional skill at the simulator is a precondition.

The purpose of the demonstration of professional skill is to prove that an operator or shift supervisor applicant has working methods which take safety aspects into account. During the demonstration, two types of operational conditions shall be run:

— conditions for interpreting Technical Specifications during which the applicant evaluates the plant condition on the basis of alarm system signals and other plant data, deviations from normal operating conditions and determines and performs the necessary actions

— conditions relating to the use of emergency procedures, during which the applicant acknowledges the disturbance, performs the first checks required by the procedure, notices an equipment functioning abnormally, corrects the situation and determines the necessary further actions.

The acceptability of the performance of an applicant shall be assessed according to the written procedure which concerns the demonstration of professional skill [2]. The procedure shall be sent to STUK for information.

4.4.2 Teamwise demonstration of professional skill at a simulator when renewing a license

The purpose of the teamwise demonstration of professional skill at a simulator is to prove that the shift team has working methods which take safety aspects into account and good co-operation capabilities and that the shift team can manage the measures needed during abnormal occurrences and accident conditions. The demonstration shall be arranged during regular annual simulator training once in every three years. A shift team must manage the abnormal occurrences and accident conditions which shall be run during the demonstration. In the assessment, attention shall be paid to the performance of the shift team as a whole.

The acceptability of performance of the shift team shall be assessed according to the procedure required in subsection 4.4.1.

5 Operator training

Adequate initial, refresher and continuing training are among the requirements set for shift supervisor and operator licensing and the renewal of licences. Initial, refresher and continuing training programmes according to Guide YVL 1.7 shall be drawn up for shift supervisors and operators. Information on training shall be indicated in the application as prescribed in subsections 3.1 and 3.2.

The initial training of operator and shift supervisor applicants shall be carried out according to Guide YVL 1.7. During the initial training phase simulator training shall include normal operation of a plant and its systems as well as abnormal occurrences and accidents. The simulator used in the training shall be a plant identical full-scope training simulator whose behaviour during transient and accident conditions adequately well corresponds to the plant's behaviour. The shift supervisor applicant shall also have good readiness to take care of his tasks related to the emergency plan and radiation protection.

Issues which have bearing on the safety of the nuclear power plant shall be reviewed at least every three years. Any deficiencies which emerge during oral examinations and

demonstrations of professional skill shall be taken into account in the requalification programmes.

The requalification programme for shift supervisors and operators shall, where applicable, also apply to personnel groups referred to in section two of this Guide of whom a qualification level necessary for the shift supervisor or operator is required.

6 References

1 IAEA, Safety Series No. 50-SG-01. Safety Guides. Staffing of Nuclear Power Plants and the Recruitment, Training and Authorization of Operating Personnel, 1991.

2 IAEA, Guidebook on Training to establish and maintain the Qualification and Competence of NPP Operations Personnel, TECDOC-525 (rev. 1) subparagraph 4.5.9.2, 1994.