IAEA-TECDOC-1232/Rev. 1

IAEA TECDOC SERIES

IAEA-TECDOC-1232/Rev. 1

Assuring the Competence of Nuclear Power Plant Contractor Personnel

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ASSURING THE COMPETENCE OF NUCLEAR POWER PLANT CONTRACTOR PERSONNEL

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ASSURING THE COMPETENCE OF NUCLEAR POWER PLANT CONTRACTOR PERSONNEL

INTERNATIONAL ATOMIC ENERGY AGENCY
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FOREWORD

Contractor personnel provide essential services to nuclear power plants, both on- and off-site. In providing these services, contractor personnel face challenges similar to those encountered by nuclear power plant personnel. Accordingly, contractor personnel need to be similarly competent and to effectively interact with nuclear power plant personnel when performing their assigned duties. In 2001, the IAEA published IAEA-TECDOC-1232, Assuring the Competence of Nuclear Power Plant Contractor Personnel, providing guidance on the involvement of contractor personnel at nuclear power plants and the methods used to ensure the competence of these personnel. That initial publication was developed in response to a recommendation by the IAEA's Technical Working Group on Nuclear Power Plant Personnel Training and Qualification.

IAEA-TECDOC-1232 has been reviewed and updated by a team of experts using data gathered from Member States and on the basis of further reviews via the Nuclear Energy Capacity Building Hub, a network on the IAEA CONNECT platform. The results presented in this revised publication reflect the latest practices of the involvement of contractors at nuclear power plants and the means currently used to ensure the competence of these personnel.

This publication addresses current operational nuclear power plants as well as nuclear power plants which are being built and commissioned, and offers a framework for ensuring the competence of contractor personnel.

The IAEA expresses its appreciation to all Member States for their valuable contributions and to the individuals who provided data on the subject. The IAEA wishes to thank all the participants for their contributions to this publication. The IAEA officer responsible for this publication was L. Halt of the Division of Nuclear Power.

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CONTENTS

1. INTRODUCTION

1.1. BACKGROUND

The nuclear landscape has changed significantly over the last 15 years including changes to technology, workforce and safety standards. Also, a number of new nuclear programmes have been initiated, and older NPPs have entered life extension or decommissioning phases.

The use of contractors (also called service suppliers in other publications) is an important way to ensure competent resources for any nuclear activity, and it continues to play a key role within the overall workforce. The IAEA publication NP-T-3.21 [1] outlines the general procurement and supplier needs and specification process, and it provides a common technical basis for dialogue between plant operators and regulators when dealing with procurement issues. Therefore, there are similarities in both principles and process with this publication and NP-T-3.21 [1].

As part of any new build organization, existing NPP or decommissioning organization, there are regulatory, safety and site license requirements to consider. These include the requirement that all work is carried out by personnel who are suitably qualified, experienced and trained to perform their duties.

Any NPP needs to have the capability, in terms of staffing and expertise, to understand the safety case for the plant and the limits under which it will be operated. The organization, including any potential contractors, will need to understand the safety and other important implications of any work undertaken by the contractor, take responsibility for it and have adequate supervision.

The human resources strategy for the organization, and within that the workforce planning strategy, will be a determining factor in deciding the category and number of contractor personnel (as described in Section 3). Contractor personnel are likely to perform tasks that are of a specialized, temporary or less frequent nature, or tasks where it is not economically practicable to hire or maintain a full–time employee to support an organization. Typical situations include for example:

- Services being delivered by the contractors that are subject to different quality standards and based on a graded approach;
- The contractors performing work on–site or off–site;
- Contractors involved on a short–term basis e.g. specific maintenance task or inspection or long–term basis e.g. grounds maintenance or catering services;
- Contractors involved in plant routine activities or performing unique/specific activities;
- Activities dealing with plant safety systems or systems important for safety, which are likely to place specific demands on competence;
- Unique skills and services offered by specialised contractors;
- Necessary additional personnel for particular tasks (e.g. in outages).

1.2. OBJECTIVE

The objective of this publication is to assist NPPs and other organizations to ensure that contractor personnel are competent and effectively interface with NPP personnel when

performing assigned duties. Also, it seeks to provide an understanding of the definition and use of contractors and how they are engaged through the contracting process.

1.3. SCOPE

This publication mainly focuses on assuring the competence of contractor personnel working in NPPs, while recognizing that some contractors also operate 'off–site' and on other nuclear facilities.

This document can be used by a number of different groups of people, for example:

- Managers and team leaders of nuclear facilities who are responsible for the competence of NPP personnel including contractors;
- Training staff who are involved with assuring the competence of contractor personnel;
- Supply chain personnel who are involved with the contracting process;
- Subject matter experts (SME's) who are involved in the contract specification, contractor oversight and evaluation of the work carried out;
- Project managers and other staff who may be responsible for contractor personnel on site.

1.4. STRUCTURE

This publication is comprised of 6 Sections, 1 Appendix and 7 Annexes containing information supporting Member States in assuring the competence of NPP personnel:

- Section 2 describes the importance of using a management system (MS) to ensure the management of human resources and associated processes etc.;
- Section 3 outlines the definition and categories of contractors;
- Section 4 discusses establishing the need for contractor personnel;
- Section 5 outlines the contracting process and the assurance required for competence;
- Section 6 discusses how a contractor organization has to satisfy the site access requirements;
- Appendix 1 gives details of the questionnaire and responses issued to Member States in June 2018 regarding the use of contractors;
- Annexes 1-7 provide supporting examples for this publication ranging from considerations for a tender document to an example of site access training requirements at an NPP.

2. MANAGEMENT SYSTEM REQUIREMENTS

The IAEA Safety Standard Series publication [2] describes the application of a management system for facilities and activities, and indicates that a management system has to be used to provide a comprehensive framework for the arrangements and processes necessary to address all the goals of nuclear industry organizations. The policies and procedures of an NPP typically describe an integrated approach in which its personnel, including contractors, carry out their processes to achieve its objectives.

Ensuring the required competence of personnel is an important objective of managing human resources at an NPP and needs to be defined within the overall framework of the management system.

The training and qualification of personnel in a nuclear facility can be viewed as one of the most important supporting processes within the organization's management system. It is good practice for this to be fully integrated into this system as shown in FIG. 1.

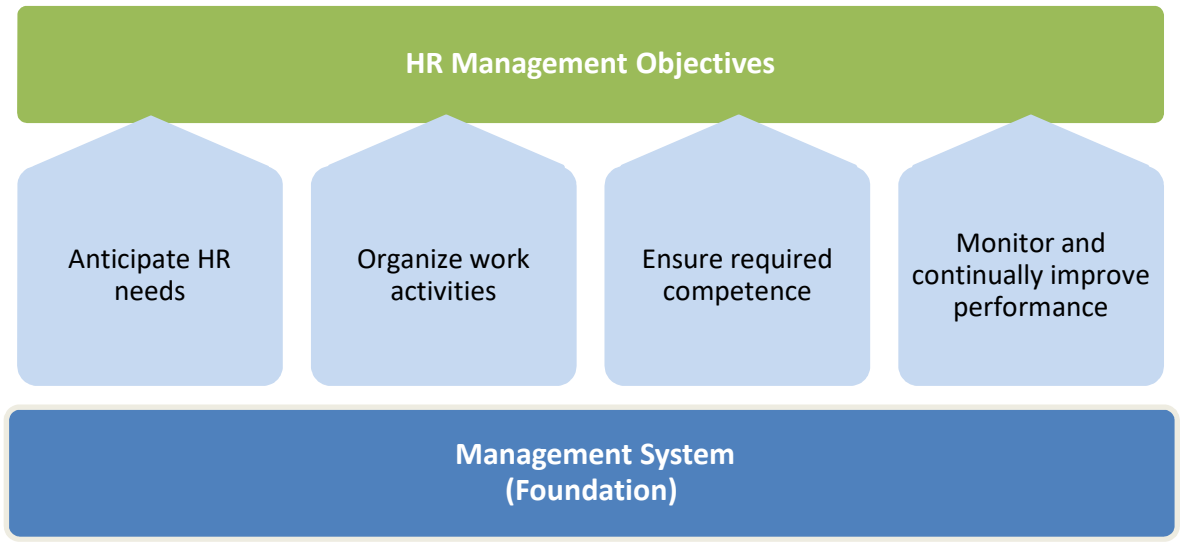

FIG. 1. Training and qualification process as shown within the Human Resource Management Objectives within the Management System.

The organization needs to ensure that all personnel have the competencies required to perform their assigned tasks by:

- Recruiting individuals who have education, experience and qualifications suited to their job positions;
- Recruiting individuals who have the attitudes and values appropriate to work in the nuclear industry and understand the safety culture;
- Providing initial training and qualification programmes based on job responsibilities that are systematically developed and implemented;
- Authorizing personnel for the unsupervised performance of tasks based upon the standards required for their job positions, supporting the safe and reliable operation of a nuclear facility;
- Providing refresher and continuing training programmes that ensure personnel maintain the competencies necessary for their job positions and are prepared to take on emerging tasks for unanticipated situations, as well as for potential advancement;
- Managing the training programmes to ensure that the facilities and human resources needed to maintain and implement the training programmes are available, and the quality of training continues to provide value to the organization [3].

In general, it is expected that there are responsibilities for both the NPP operator and the contractor regarding competence and qualification of contractor personnel. These responsibilities need to be considered carefully when contractor personnel are employed based on a graded approach. The IAEA TECDOC-1740 [4] provides guidance on, and examples of a graded approach to the application of the management system requirements for facilities and services.

3. DEFINITION AND CATEGORIES OF CONTRACTORS

An NPP operator will employ permanent staff who have a contract of employment, whereas contractors are defined as any personnel working for an NPP who are not directly employed by the NPP operator. Every contractor can be categorized based on the principles related to the necessary service they provide, e.g. according to the cost and risk of the services for the NPP.

A nuclear facility needs to ensure that all personnel, including contractors, have the competence needed to perform their required tasks by assigning individuals who have education, experience and qualifications suited to their job positions. Competence is the ability to perform to identified standards; it includes knowledge, skills and attitudes (KSA).

Assurance is required that contractor personnel meet the qualification criteria before undertaking any activities, as the site has a responsibility for establishing qualification criteria for its own personnel and for contractor personnel. Qualification is a formal statement of achievement, resulting from an auditable assessment; if competence is assessed, the qualification becomes a formal statement of competence and may be shown on a certificate, diploma, etc. [5]

The types of contractors, together with examples of work scope and site–specific requirements required by a contractor will vary according to their duties, assigned tasks, and the degree of responsibility and autonomy as exemplified in Table 1.

TABLE 1. GENERAL CATEGORIZATION OF CONTRACTORS WITH ASSOCIATED EXAMPLES OF WORK SCOPE AND SITE–SPECIFIC REQUIREMENTS

Type of contractor	Examples of work scope	Site specific requirements
– Off–site contractor – Remotely working from outside the nuclear site	– Training instructor – Safety case design engineer	– Not required
– On-site contractor – Contractor personnel who perform work at the NPP supporting core processes	– Irradiated waste processing staff	– Site induction – Safety rules authorisations – Onsite induction in emergency arrangements
– Long–term contractor – Contractor personnel who work on a continuing basis at the NPP for more than a year, under the management system of the NPP. Usually supporting certain job positions at the plant. Sometimes also known as contract partners or technical support organizations (TSOs)	– Maintenance technicians – Catering staff – Scaffolders – Transport services – Security	– Onsite induction in emergency arrangements – Safety rules authorisations – Nuclear safety culture – Site induction
– Short–term contractor – Contractor personnel who work at the NPP for a short period of time and are likely to be unescorted, usually, but not exclusively, during outages – Also, without significant risk implications and under direct supervision	– Workers with ‘hands-on’ experience – Heath physics technicians, Modification engineers – Knowledge workers, External auditors, Administrative personnel	– Additional authorisations relevant to scope of work – Onsite induction in Emergency arrangements – Site Induction

TABLE 1. GENERAL CATEGORIZATION OF CONTRACTORS WITH ASSOCIATED EXAMPLES OF WORK SCOPE AND SITE–SPECIFIC REQUIREMENTS

Type of contractor	Examples of work scope	Site specific requirements
– Certified contractor – Contractor personnel who require an official recognition of competence to be able to perform the job, usually from local authorities or other official agencies	– Welders – NDT inspectors	– Site induction – Safety rules authorisations – Nuclear safety culture – Emergency plan
– Contractor personnel working in the controlled zone – Contractor personnel who are under a higher risk of exposure to ionising radiations	– Health physics technicians – Steam generator and primary loop inspectors – Outage workers	– Site induction – Safety rules authorisations – Emergency Plan
– Contractor dealing with nuclear safety systems – Contractor personnel whose work affects structures, systems or components important to nuclear safety	– Primary loop, safety system, safeguards technicians, etc.	– Site induction – Safety rules authorisations – Nuclear safety culture – Emergency plan

4. ESTABLISHING THE NEED FOR CONTRACTOR PERSONNEL

It is recognized that contractor personnel are used to perform tasks that are of a specialized or temporary nature where it is not feasible to hire or maintain a full–time NPP employee.

The decision to use contractor personnel for specific tasks is likely to be determined by the following criteria:

- Strategic choices and required core competences for the NPP;
- Workload of the own personnel;
- Outages or major projects;
- Tasks requiring specialist competence;
- Cost minimization.

The IAEA document – Procurement, Engineering and Supply Chain Guidelines [1] details the ‘Identification of Need’ from the identification that an item or service should be purchased, the demand from major projects, through to establishing requirements, procurement planning and supplier selection and the definition of acceptance criteria and methods.

Outages are an important area where contractor resources are required. During outages, there may be a demand for a significant number of contractor resources to achieve the objective of optimizing the outage duration. The number of contractors and the type of works executed by them varies within each organization depending upon the specific needs and the type of outage. [6]

However, it needs to be recognized that the quality of work performed by the contractors during an outage plays a significant role in plant performance and its reliability. NPP organizations, therefore, can take significant efforts, including providing necessary training in some cases, to prepare them for successful outage performance. During outages, barriers such as the primary circuit and the containment may be open, and the safety systems overhauled. Recognition of

such reduced safety margins and the knowledge that several contractor organizations are working onsite are important for successful and safe outage performance.

Contractors may also be used in a variety of other situations to support NPPs as outlined in Table 1.

Typical situations include:

- Contractors performing work on–site or off–site. Off–site work may include all types of safety, environmental, stakeholder and engineering analyses and related work;
- Contractors involved on some short–term specific tasks, e.g. equipment maintenance or on a long–term ongoing basis such as cafeteria services and transport;
- Contractors involved in plant routine activities. This may include tasks such as general cleaning, plant maintenance or operation of radioactive waste facilities;
- Contractors involved in emergent work including breakdown maintenance;
- Contractors performing unique/specific activities requiring specific skills such as welding or using specialist technology;
- Contractors performing tasks that would be carried out by NPP personnel as part of the NPP organizational structure, particularly during outages or major projects;
- Contractor activities dealing with plant safety systems or systems important for safety, potentially setting more demands on contractor personnel competence.

Contractor personnel also provide services to new build and decommissioning organizations. These vary from large organizations supplying services for technology and many other aspects of engineering to smaller mechanical or electrical suppliers and other specialist service providers during the construction. Larger contractor organizations that deliver significant amount of the work are likely to have a bigger role to play either through their own execution of the work or through further subcontractors for whom they have the responsibility for.

Many NPPs use technical support organizations (TSOs) to support their work. TSOs comprise of experts who deliver technical and scientific services to NPPs and assist them with analyses in order to achieve high levels of safety and security. Such professional experts maintain high levels of competence, have long–standing experience, and are able to provide global, consistent technical and science–based answers and approaches to safety and security. The IAEA publication Ref. [7] aims to address aspects relevant to obtaining effective technical support and appropriately utilizing it in decision making on NPP programmes and project and plant safety and performance, by providing a common understanding of the technical support functions and their implementation throughout the plant's life cycle.

Finally, the need for careful and detailed workforce planning is a priority for all NPPs and as part of their strategy, the ratio and balance of permanent personnel versus contractors is a key consideration. [8]

5. PREPARATION FOR CONTRACTING

5.1. INTRODUCTION

The nuclear industry by its nature demands high standards to enable more defences and barriers - this may deter some contractors from working for an NPP operator if alternative work is available in other industries which may not deploy such high, safety critical standards.

All employees and contractors need to understand the safety culture of the organization and the nuclear professionalism expected as a behavioural standard, GSR Part 2 [2]:

"The organization shall put in place arrangements with vendors, contractors and suppliers for specifying, monitoring and managing the supply to it of items, products and services that may influence safety."

Specifying the requirements for such items is a key role of procurement documents.

NPPs are facing increasing pressure to reduce costs and improve financial and operational performance. Stringent regulatory requirements, globalisation, changing market and political conditions and increase in contract volumes and complexity have resulted in an increasing recognition of the importance and benefits of effective contracting.

An example of a high-level process and the organizational involvement required for contracting and assuring the competence of NPP contractor personnel is shown in FIG. 2.

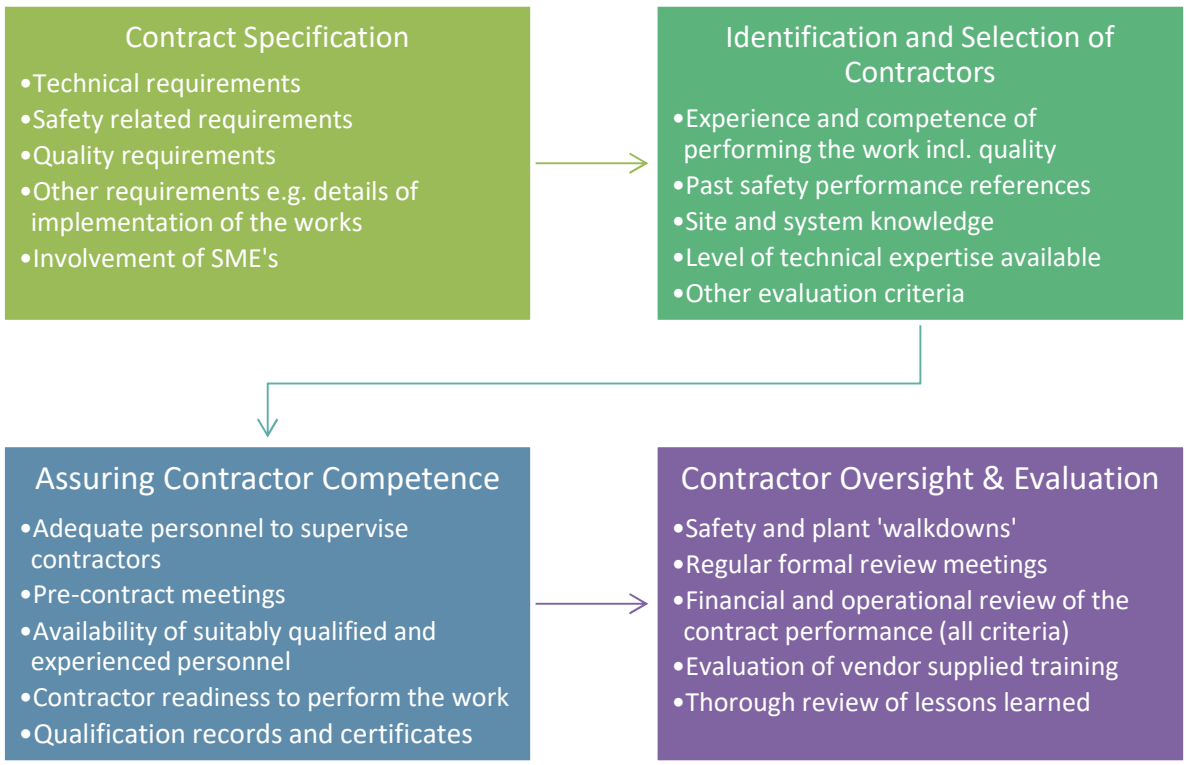

FIG. 2. High–level process and the organizational involvement required in assuring the competence of NPP contractor personnel.

5.2. CONTRACT SPECIFICATION

Contract specification is the process that enables both parties to create and agree on a contract to meet their obligations in order to deliver the objectives of the contract.

GSR Part 2 [2] states:

"The organization shall have a clear understanding and knowledge of the product or service being supplied. The organization shall itself retain the competence to specify the scope and standard of a required product or service, and subsequently to assess whether the product or service supplied meets the applicable safety requirements."

Thus, the NPP operator, or the license holder (if different), has the ultimate responsibility and is accountable for defining and controlling all work carried out on its behalf. In order to meet its regulatory responsibilities, the NPP operator needs to ensure that it has enough competent personnel to demonstrate the management and control of all types of contractor activities. Line managers, procurement personnel and subject matter experts (SMEs) in the operator/licensee organization responsible for the contractor's work develop the procurement strategy [1], define the duties and framework within which to complete the required work and deploy the contract. Each member of the team has to understand their role and area of responsibility in this, and these need to be clearly defined in the NPP management system.

The following areas usually form part of the contract specification and include details such as:

- Technical requirements;
- Specification and description of the tasks;
- Legal and regulatory requirements;
- Competence and qualification requirements;
- Radiological conditions;
- Safety related requirements;
- Equipment to be used;
- Management and supervision;
- Quality requirements (using a graded approach [4]);
- Environmental requirements;
- Security and nuclear material accounting requirements;
- Location of the task;
- Responsibility and autonomy;
- Execution and oversight of work;
- Reporting structure (e.g., between the license holder and contractor).

For major project activities or unique/specialist activities, the specification of the contractor work may need to be carried out by a specialist contractor. In this case the responsibility of the NPP organization, as an informed customer, is to ensure that the specification of the work has been carried out to the appropriate standards, the required competence has been identified and the evaluation criteria for the work has been established.

The ultimate objective is to identify the most suitable contractors in the market considering the requirements for the right level of qualifications and competence that will be needed to perform the tasks. A potential contractor organization may need to obtain access to training or knowledge, and this needs to be detailed in the specification. Many NPP organizations will have a tried and tested methodology for contractors to comply with the technical specification requirements for the work to be carried out (e.g. contract Enquiry Technical Specification).

Prior to being assigned work within one of the roles specified within the contract, all personnel need to complete the required training in accordance with established and documented training qualification requirements. The respective roles and responsibilities of NPP personnel and contractors need to be clearly defined, understood and documented (see Table 2).

TABLE 2. TYPICAL EXAMPLES OF THE RELATIONSHIP OF ROLES AND RESPONSIBILITIES BETWEEN THE OPERATOR AND CONTRACTOR ORGANIZATIONS

	Specification	Assurance of qualification	Review of contract performance	Infield observations of performance
Operating organization	In this case the NPP organization	Internal and external verification in line with management system and QA arrangements	Review of KPIs including achievements and areas for improvement, contractor feedback, etc.	Ensuring that safety, quality and service delivery are achieved throughout the contract as per contract specification
Subject matter expert	A person who has an authority/expertise in a particular area or topic	Responsible for defining the type and level of qualification(s) required	Review performance regarding their area of expertise	Provide support and give coaching and feedback as required
Contract manager	A person who oversees projects from the start through to completion ensuring that work is completed on time, to quality and within budget	Maintaining contractor records including qualifications and evidence of competence	Ensure contract close–out and identify areas for improvement in contract process	Carry out some on–site observations during course of contract
Site liaison	A person who liaises between the operating company and contractor organisation to communicate and co–ordinate their activities	Monitor contractor performance, analyse data and feedback on improvements and enhance relationships	Provide comprehensive feedback to the contract manager	Proactively respond and resolve conflicts and address any issues between the Operator and Contractor
Assessor/Auditor (including for quality audits)	A person who will appraise and review financial records, management system, polices, practices and reports	Perform risk assessments and recommend improvements etc.	Assess how well the parties are complying with procedures and contract and make recommendations on issues that need addressing	Prepare reports highlighting any findings, issues or problems and make recommendations

The experience, qualifications and training needed for a contractor and the approach to assure competence will vary according to the duties, assigned tasks, degree of responsibility and autonomy. In order to ensure that competence requirements are correctly defined, and that contractor performance can be monitored the NPP personnel need to ensure that the available contract information includes:

- Definition of competence requirements and assurance arrangements;
- Site access requirements;
- Specification of tasks;
- Gap analysis and training arrangements including general training for contractors who may work on different sites;
- Oversight of contractor supplied training to ensure it meets the agreed standard;
- Oversight/quality plan.

Finally, contractor personnel encounter similar problems and challenges to NPP personnel in providing services. This needs to be considered in the requirements. Typical issues can include:

- Assessment of risk;
- Quality assurance (as per MS);
- Compliance with procedures;
- Communications;
- Teamwork;
- Work in hazardous environments;
- Industrial and fire safety.

5.3. CONTRACTOR IDENTIFICATION AND SELECTION

The selection of contractors is usually based on an assessment of their capability to provide the required services at a reasonable cost level.

Typical criteria for identifying and selecting contractors includes:

- Technical or service capability of the contractor;
- Unique or specialist requirement;
- Performance of previous work;
- Availability of resources or current workload;
- Turnover % (number of people leaving the contractor organization);
- Health and safety performance on previous work.

The process of contractor identification and selection is to fairly and objectively identify acceptable ones against the enquiry and contract specification and in accordance with the contract award criteria. Ideally, the contractor selection should be carried out by the same line managers, procurement specialists and SME's involved in the contract specification. Additional support may be required from specialist disciplines, as appropriate.

The team may consider physical visits to contractor sites/offices during this phase, with the intention of confirming the existence and availability of resources, plant, equipment etc that may be relied upon for the performance of the contract. During this process, it is preferable for subsequent communications with contractors to be through numbered questions through a single point of contact. This will control the exchange of correspondence and ensure that succinct and specific responses are received to the points raised.

The process of evaluation will normally be through presentations and a pre-determined set of questions. It also includes a scoring mechanism with answers clearly documented and with a clear justification for the outcome. The evaluation must be able to withstand any audit and allow feedback to be provided to contractors who have been unsuccessful. There may be several phases in the process depending on the scope/significance of the works and the number of contractors to be evaluated. Often, the contractors passing the evaluation are taken on an approved contractors list showing their eligibility for contracting.

In order to minimize the risk associated with contractor selection, particularly for specialist tasks, an NPP operator may consider long term contractual arrangements and partnerships with contractor organizations to ensure retention of expertise. For any new contracts there may be an invitation to tender (ITT) and relevant information will need to be collected from new contractor organizations as part of the contractor selection process. Annex I provides more information on the basic requirements to be considered for a tender document and the request for information. Moreover, NP-T-3.21 provides additional information on different contracting options [1].

There is a time and cost premium to be paid for mobilising nuclear contractors and consideration needs to be given to whether existing employees and contractors can be used before engaging a new contractor. Extensive efforts and additional costs are involved in 'on–boarding' a new contractor to ensure they are aligned with the standards and expectations of the NPP and, most importantly, that they understand the safety culture.

5.4. ASSURING CONTRACTOR COMPETENCE

A key principle to assuring the competence of contractor personnel is that they must be suitably qualified and experienced before performing the work. It is also important that contractor personnel maintain their qualifications throughout the duration of the contract with retraining as required. The NPP operator needs to ensure that contractor personnel competence is assessed and documented before and throughout their work.

The NPP will need to have adequate personnel possessing the KSA's necessary to supervise and evaluate the work of contractor personnel. Personnel required to supervise contractors need to be clearly identified and roles defined. The necessary QA procedures or guides should be developed by the NPP and this can sometimes be carried out in conjunction with the contractor. It is likely that the NPP will take a graded approach in determining the appropriate level of quality assurance arrangements based on the contract complexity, impact on nuclear safety, security, service failure etc. The IAEA TECDOC-1910 Quality Assurance and Quality Control in Nuclear Facilities and Activities: Good Practices and Lessons Learned [9] provides lessons learned and good practices in this area. Based on the nature of work to be contracted out, the NPP operator may assign in cases a person whose responsibility is to assist in all phases of the work, e.g. supervising performance of work and its evaluation, competence verification, checking work against specification and site access.

The NPP quality assurance programme and/or the management system can include formal procedures and rules to determine qualification and competence requirements for any task that may potentially influence plant safety or the quality of the work to be performed by contractors. Examples include maintenance of the turbine and the generator vital for electricity production.

Regulatory requirements may vary amongst Member States when assigning the responsibility for ensuring the competence of contractor personnel, and in some of them the regulators give licences to contractors. In all cases the final responsibility including ensuring the quality of all work performed at the site rests with the licensee, i.e., the NPP organization. Annex II contains an example concerning details of regulatory compliance activities for ensuring workers competence during the execution of a refurbishment project.

Tasks to be performed by the contractors need to be described in a way that addresses the required competencies to do the task safely and effectively. Both the contractor and the NPP operator are responsible for verifying the competence and qualification of contractor personnel. Annex III includes a checklist for contractors training and qualification programmes to assist in assuring the competence of contractor personnel. Annex IV provides an overview of the key stages in assuring the competence of NPP contractors working on-site. Annex V details an example approach of how contractors carry out assurance of their personnel.

Table 3 presents generic examples of the methods used to assure the competence of contractors.

TABLE 3. EXAMPLES OF METHODS TO ASSURE THE COMPETENCIES OF CONTRACTORS

Aspect of competence	Methods to assure competence
Knowledge, skills and experience	– Task Performance evaluation records of the contractor from previous work done (from other NPPs) – 'In field' observation reports of work performed, if available – Incident and corrective action reports from previous contracts, if available – Review of qualifications and certifications on suppliers training record system – Oversight and assessment of contractors' exam banks, assessment reviews by operating companies and its internal oversight functions – Recent work order card reviews to prove that experience is relevant and 'fresh' – Curriculum vitae checks for workers who may have specialized experience with non–applicable qualification – Technical interview with worker by subject matter experts – Simulated demonstration or mock–up training
Attitudes and behaviours	– Task performance evaluation records of the contractor from previous work done (from other NPPs) – 'In field' observation reports of work performed – Incident and corrective action reports from previous contracts, if available – Instructor feedback from on–site training
Performance and proficiency	– Task Performance evaluation records of the contractor from previous contracts, if available – 'In field' observation reports of work performed – Incident and corrective action reports – Post job debriefs – Review of the current and previous quality plans of the contractor – Trending Reports

Table 4 outlines examples of approaches to assuring competence and how they vary according to the duties and tasks (work scope) being carried for each type of contractor. These examples are not exhaustive and there will be situations where NPPs may have different arrangements depending on their fleet size. For example, some contractors may be involved in outages for multiple sites within a fleet and therefore may be considered a long-term contractor rather than short-term.

TABLE 4. EXAMPLE OF APPROACHES TO ASSURE COMPETENCE AND HOW THEY VARY ACCORDING TO DUTIES AND TASKS

Type of contractor	Example of work scope	Examples of competencies required	Methods of assuring competence and oversight
– Off–site contractor – Remote working from the nuclear site	– Training instructor – Safety case design engineer	– Nationally recognised qualifications	– Check of source qualifications and certificates – Observation and classroom delivery

TABLE 4. EXAMPLE OF APPROACHES TO ASSURE COMPETENCE AND HOW THEY VARY ACCORDING TO DUTIES AND TASKS

Type of contractor	Example of work scope	Examples of competencies required	Methods of assuring competence and oversight
		– Relevant experience on similar systems	
– On–site embedded contractors – Contractor personnel who perform work at the NPP on core duties	– Waste processing staff	– Trade qualifications, NPP training records – Authorisations for safety permit control	– Pre–contract & regular review meetings to ensure that standards and expectations are understood and changes to operating procedures communicated – Check of supplier LMS system for source qualifications
– Long–term contractor – Contractor personnel who work on a continuing basis at the NPP for more than a year, usually supporting certain job positions at the plant. Also known as contract partners or TSO's	– Maintenance technicians – Catering staff – Scaffolders	– Usually have the same training and competence requirements as permanent NPP employee	– Contractor team leader ensures qualifications before setting to work – Contractor engagement with observation and coaching programmes – Regulator may require proof of competence
– Short–term contractor – Contractor personnel who work at the NPP for a short period of time and are likely to be unescorted, usually, but not exclusively, during outages – Also, without significant risk implications and under direct supervision	– Workers with 'hands on' experience – Heath physics technicians, modification engineers – Knowledge workers, external auditors, administrative personnel	– Trade qualifications – Trade qualifications – Nationally recognised certificates	– Check original qualifications – Check original qualifications
– Qualified/Certified contractor – Contractor personnel who require an official recognition of competence to be able to perform the job, usually from local authorities or other official agencies	– Welders – NDT inspectors	– Nationally recognised certificates	– Original certificates checked as up to date to current standards
– Contractor personnel working in the controlled zone – Contractor personnel who are under a higher risk of exposure to ionising radiations	– Health physics technicians – Steam generator and primary loop inspectors	– NPP training records – Authorisations for safety permit control	– Check original qualifications – Original certificates checked as up to date to current standards – NPP training records checking – Dose records

TABLE 4. EXAMPLE OF APPROACHES TO ASSURE COMPETENCE AND HOW THEY VARY ACCORDING TO DUTIES AND TASKS

Type of contractor	Example of work scope	Examples of competencies required	Methods of assuring competence and oversight
– Nuclear safety related contractor – Contractor personnel whose work affects structures, systems or components important to nuclear safety	– Primary loop workers, safety systems, safeguards, etc.	– Nationally recognised certificates – NPP training records – Authorisations for safety permit control	– Check original qualifications – Original certificates checked as up to date to current standards – NPP training records checking

All the topics detailed above will need to be discussed for a successful contract signing, especially if the contractor is new to the NPP and its organization. In the case of contractors who are already familiar it may be necessary just to go through the main points and issues that may have changed from the last contracting process.

In order to minimize the risk associated with contractor qualification, particularly for specialist tasks, the operator/licensee may consider long term contractual arrangements and partnerships with contractor organizations to ensure retention of expertise. There is a time and cost premium to be paid for mobilising nuclear contractors. Thus, consideration needs to be given to whether existing employees and contractors can be used before engaging a new contractor.

5.5. CONTRACTOR OVERSIGHT AND EVALUATION

The NPP will need to have adequate personnel possessing the knowledge, skills and attitude (KSA's) necessary to supervise and evaluate the work of contractor personnel. Personnel required to supervise contractors need to be clearly identified and roles defined. The necessary management system processes, QA procedures, manuals and plans need to be developed by the NPP organization. This may sometimes be carried out in conjunction with the contractor, and in large projects the main contractor normally takes care of this task.

Extensive efforts and additional costs are involved in onboarding a new contractor to ensure they are aligned with the standards and expectations of the NPP, e.g. understanding the necessary safety culture. With new contractors it is recommended to have a preliminary meeting before beginning the work including to demonstrate the expected ways of working.

Monitoring the performance of contractor personnel is important. The NPP organization needs to be ready to oversee all work tasks to ensure the right level of performance and to quickly respond to non-conformances.

NPP's usually use key performance indicators (KPIs) to achieve the goal of helping with the quantitative assessment of contract and work performance including:

- Contract value variance providing insight into contract changes due to errors, changes of scope, etc.;
- Time deviation from planned time schedule;
- Lost time injury rate;
- Failure rate of works or time spent on reworking/correcting errors.

The role of contractor oversight is equally important and is undertaken by a number of roles/teams and in multiple forms to provide defense in depth when assuring competence and proficiency. FIG. 3 provides some examples of the different roles and oversight methods.

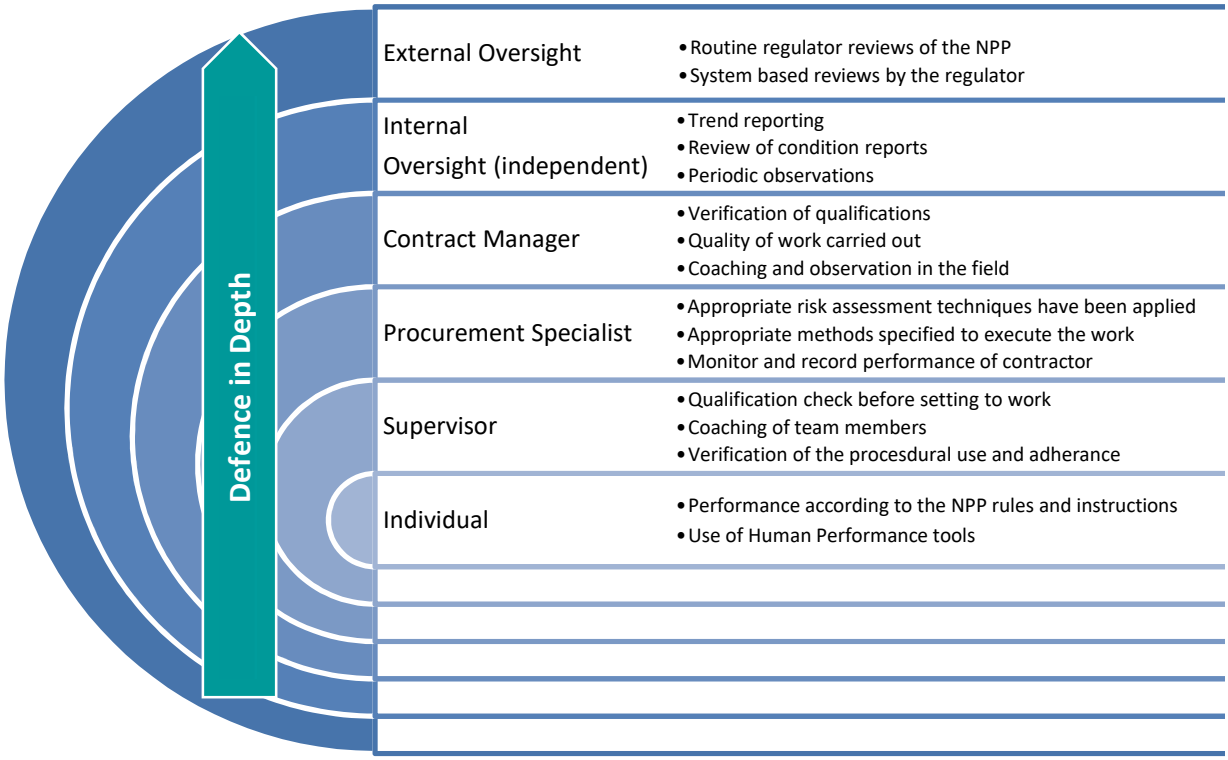

FIG. 3. Multiple forms of oversight.

Internal oversight will typically be undertaken by personnel employed by the NPP and who have the necessary authority to enable assessment and reporting on such activities as operations, activities and processes to be undertaken. External oversight is typically carried out by the national regulatory body.

The IAEA TECDOC-1910 Quality Assurance and Quality Control Activities in Nuclear facilities and Activities [9] and NP-T-3.21 [1] provide lessons learned and good practices in overseeing and evaluating suppliers.

There may be some activities that are ‘overseen’ by the NPP and these can be written into the contract and procedure. Procedures have to be verified and ‘signed–off’ by the NPP operator.

5.5.1. Oversight of the vendor–supplied training

Training provided by personnel from outside the NPP needs to be controlled and evaluated to ensure that it meets the requirements of the task, and that its quality is consistent with NPP training standards. The NPP operator needs to develop and maintain written procedures to monitor and review vendor–supplied training and ensure that detailed roles and accountabilities for oversight of vendor–supplied training are clearly defined.

NPP training personnel would typically oversee the contractor training development and delivery process on an ongoing, predetermined and documented basis to ensure compliance with NPP training procedures. NPP training is usually developed using the Systematic

Approach to Training (SAT), an overview of this approach can be found in Annex VI. Some of the methods to assure that the vendor develops/delivers the training as contracted include:

- Assess quality of training material (e.g., task analyses, learning objectives, lesson plans, exams, manuals, handouts);
- Confirm qualification of trainers;
- Observation of training delivery using observation forms;
- Review of results of completed in training feedback forms;
- Review of 'In–field' observation reports;
- Interviews with trainees, supervisors, managers and trainers;
- Task performance evaluations.

Vendor–supplied training might be re–evaluated on a predetermined basis depending on the course delivery, importance and frequency. Some of the reasons for vendor re–evaluation include:

- Performance deficiencies;
- Modification of training content;
- Change of trainers.

In addition, the NPP operator needs to ensure that the procedure for oversight of vendor–supplied training defines the process to address and remediate when the contractors' performance is below the NPP's performance expectations if one of the causes is related to training.

5.5.2. Oversight of the contractors learning management system

The establishment of a training records system is an essential component of a training management process and training system. Trainee records need to be established and maintained for both the NPP employees, and for contractor training received through the facility's or organization's training activities.

Contractors need to provide sufficient information on the required competence records to the NPPs for contracting, including previous training and qualifications, and sometimes before the work starts. Records of contractor personnel qualifications need to be available to ensure competences meet NPP requirements.

Individual training records need to include, where relevant:

- Qualification records and experience records;
- Expiration dates and refreshment frequency;
- Assessment results;
- Curriculum vitae;
- Mentor guides;
- Specialist authorisations;
- Site induction.

For each trainee, data on their individual progress will need to be recorded. This includes an indication of training programmes and their segments completed.

5.5.3. Evaluation of contractor performance

Contractor evaluation involves objective analysis, Contractors are typically evaluated based on the following criteria:

- Knowledge, skills and attitude;
- Quality of work carried out;
- Compliance with requirements;
- Timely performance against contract schedule;
- Compliance with nuclear safety standards (where applicable);
- Effectiveness of management capabilities;
- Cost control.

For contractors to improve and for the NPP organization to also gain feedback, it is essential to provide feedback from such evaluations to the contractors involved. This can take the form of a contractor performance report where ratings or scores are applied against each performance area. This would be completed at the end of the contract with input from key stakeholders, or during the review for long term contracts.

6. SITE ACCESS TRAINING OBJECTIVES

Site access training is required to allow employees, contractors and visitors to safely gain unescorted access to certain areas of the NPP. Training has to be completed before entering the site and is applicable, in a graded manner (i.e., selecting the appropriate training objectives and associated test items), to all personnel accessing the site.

Development of the site access training needs to be systematically done. In the implementation of the site access training programme blended learning methods can be used, such as multimedia, videos and practical parts. Trainee evaluation methods should also be in place. Site access training is recommended to be renewed periodically. Some part of the training can be done as a computer–based training before accessing the plant.

Examples of requirements to gain access to the site include:

- Medical and behavioural fitness reports;
- Security clearance reports;
- Site access training programmes.

6.1. SITE ACCESS TRAINING PROGRAMME CONTENT

A balanced induction programme needs to cover a broad spectrum of areas including expected behaviours, site specific rules and emergency plan arrangements. Figure 4 provides more details.

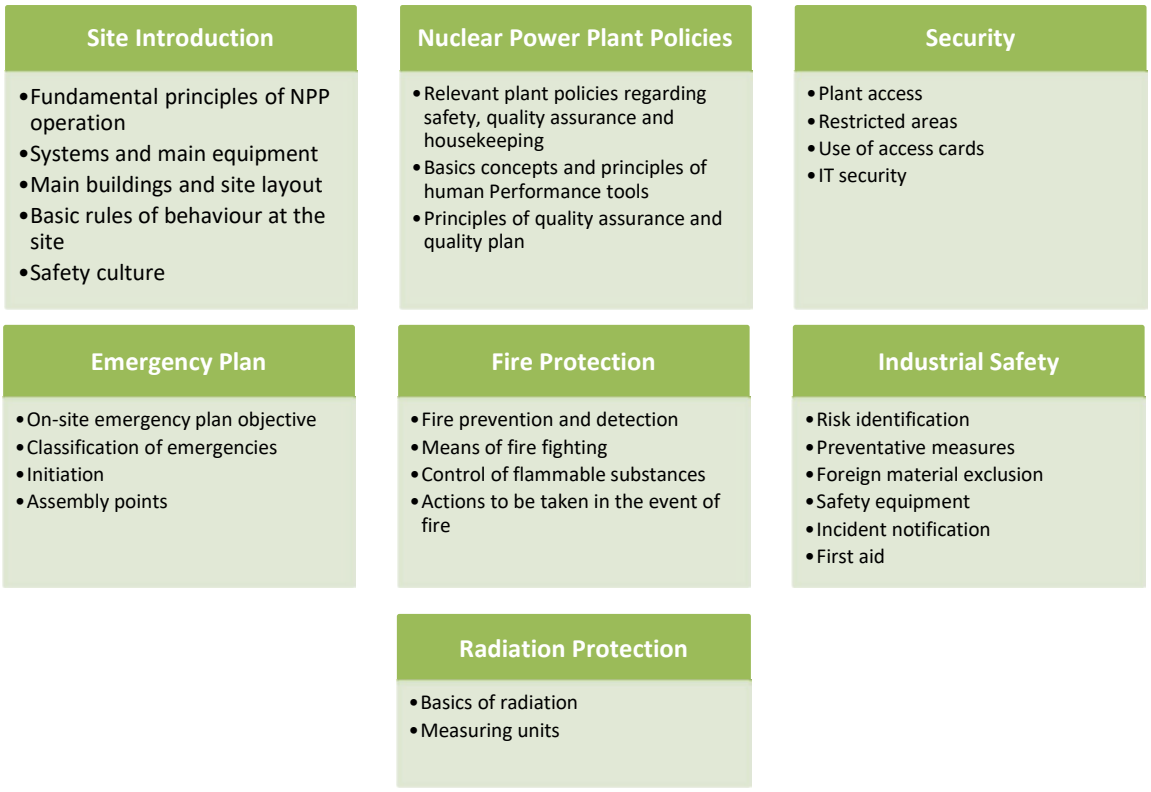

FIG. 4. Example content of site access training.

6.1.1. Controlled area access training programme

Persons assigned to work in the control area are often required to take part in a radiation protection training to get access to the controlled area (see FIG. 5). The objective of the training is to inform personnel about radiological risks and their consequences, and to provide them with the necessary skills to conduct work in a safe manner.

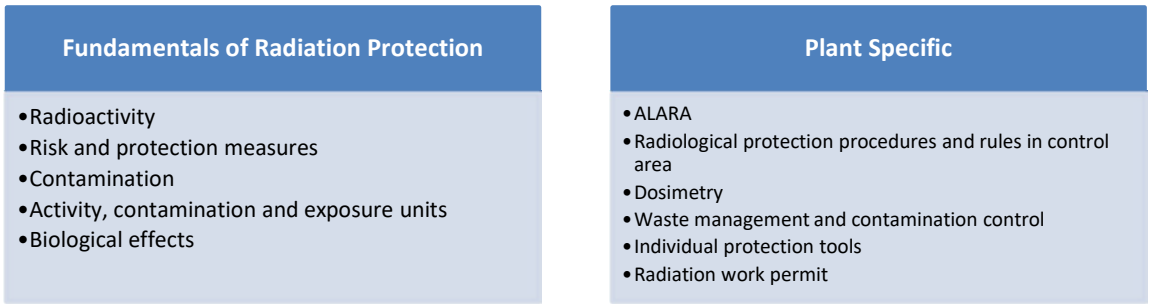

FIG. 5. Example content of control area access training.

Additional training may be required for people working in controlled area, e.g., on safety related systems or in rooms with high radiation or contamination levels. Annex VII provides an example of how contractor site access training takes place at an NPP.

APPENDIX I.
QUESTIONNAIRE SENT TO MEMBER STATES IN 2018

This questionnaire was sent to the IAEA Member States in 2018 (see Table 5).

30 organizations were invited from Member States to participate in the questionnaire, and in total responses were received from 15 different organizations from 11 Member States. Of the total responses, complete responses were received from 12 organizations.

Responses are shown after each question.

TABLE 5. QUESTIONNAIRE SENT TO MEMBER STATES IN 2018

	Questions (in Italics) and Responses	Possible Answers
1.	*What is your country?*	
2.	*What is the name of your organization? (optional)*	
3.	*What is your job position?*	
4.	*What type of reactor (s) do you have in your organization?*	PWR LWGR BWR GCR PHWR Other
5.	*What number of operational units do you have?*	1-3 3-5 >5
6.	*What is the number of permanent employees in business unit?*	<500 for a single or twin unit plant >500-1000< for a single or twin unit plant >1000 for a single or twin unit plant
7.	*Who is responsible for managing/supervising contractors for their daily work activities?* Nine out of twelve survey respondents use a mix of permanent and contractor staff for managing contractors on their daily work activities.	(a) The person responsible for managing the plant contractor organization (b) A mix of permanent staff and contractors (c) Other (please specify)
8.	*How are the contractors trained in your utility/country?* 4 by the NPP, 1 by a third party, 2 by the contractor and 5 is a mix of NPP and contractor	(a) by the NPP (b) by a third party (c) by the contractor (d) other (please specify)
9.	*On average throughout the year what is the % ratio of contractor personnel to permanent personnel?* 0-33% - 5 33-66% - 4	(a) 0-33% (b) 33-66% (c) 66-100%

	Questions (in Italics) and Responses	Possible Answers
	66-100% - 3	
10.	*Do you have long term partnerships in place with technical support organizations? (TSO's*) *TSO's comprise of competent, long standing experts who deliver technical and scientific services.* Ten out of twelve survey respondents have long–term partnerships in place with TSOs.	(a)Yes (b) No (c) Other (please specify)
11.	*Do you always try and use existing contract partners for work packages?* Five out of ten survey respondents always try and use existing contract partners for work packages, three would consider using new contractors where appropriate, and one only use contractors during outages.	(a) Yes — wherever possible (b) Would always consider using new contractors (c) Would consider using new contractors where appropriate (d) Other (please specify)
12.	*Are roles and responsibilities clearly defined and documented between the NPP and Contractor organization?* Nine out of ten survey respondents have clearly defined and documented roles and responsibilities between the NPP and contractor organization.	(a) Yes (b) No
13.	*How do you go about recruiting new contractor organizations?* Six out of nine survey respondents have a clearly defined process when recruiting new contractor organizations whilst one respondent varies the process for each occasion.	(a) Clearly defined process (b) No clear process (c) A process but varies on each occasion (d) Other (please specify)
14.	*What work do you use contractors for?* Three out of ten survey respondents only use contractors with the NPP whilst the other seven respondents use them on site and off site.	(a) On site only — within the NPP (b) On site and off site (c) Off site only
15.	*Do you use contractors where specialist skills or where specialist technology is required?* Nine out of ten survey respondents use contractors where specialist skills and specialist technology are required.	(a) Yes — specialist skills only (b) No (c) Yes — specialist skills and specialist technology
16.	*Do you ensure that a Quality Assurance Programme/Plan is in place for contractors?* 8 NPP's – always 2 NPP's - sometimes	(a) Yes — always (b) Never (c) Sometimes
17.	*Do you use a systematic approach to training with regard to contractor training?* 7 NPP's Yes and 3 No	(a) Yes (b) No
18.	*Do you have a number of different methods in place to assure the attitudes and behaviours of contractors?* 3 NPP's typically at least one	(a) Yes — typically at least one (b) Yes — typically at least two to three (c) Yes — typically more than three Please provide examples

	Questions (in Italics) and Responses	Possible Answers
	4 NPP's typically at least two to three 3 NPP's typically more than three	
19.	*Do you have a number of different methods in place to assure the performance and proficiency of contractors?* 6 NPP's typically 1-2 methods 3 NPP's typically 3-4 methods 1 NPP typically more than 4 methods	(a) Yes — typically 1-2 methods (b) Yes — typically 3-4 methods (c) Yes — typically more than 4 methods Please provide examples
20.	*Are contractors' performance objectives established and monitored at all levels in the organization?* 3 NPP's – Yes at all levels 4 NPP's – Yes – established but not monitored 3 NPP's – No – not established or monitored	(a) Yes — at all levels (b) No — not established or monitored (c) Yes — established but not monitored
21.	*Are expected critical knowledge and job skills tracked and shared with contractors on an ongoing basis?* 5 NPP's – Yes at all times 3 NPP's – Yes sometimes 1 NPP – Never 1 NPP – No but Curriculum Review Committees and Training Advisory Committees	(a) Yes — at all times (b) Yes — sometimes (c) Never Other (please specify)
22.	*Is training material, used for training of contractors reviewed to ensure it reflects lessons learnt from operating experience and it agrees with plant documentation?* 7 NPP's – Yes always 2 NPP's – Yes sometimes 1 NPP - Never	(a) Yes — always (b) Yes — sometimes (c) Never Other (please specify)
23.	*Do you have a number of different methods in place to assure the knowledge, skills and experience of contractors?* 8 NPP's – Yes – typically 1-3 methods 2 NPP's – Yes – typically 4-6 methods	(a) Yes — typically 1-3 methods (b) Yes — typically 4-6 methods (c) Yes — typically more than 6 methods Please provide examples of methods
24.	*Do you have a training records system in place for permanent and contractor personnel?* Six out of ten survey respondents have a training records system in place for permanent and contractor personnel and four respondents have training records system for permanent staff only (one is in the process of implementing for contractors).	(a) Yes — both (b) Neither (c) Permanent employees only Other (please specify)
25.	*Do you have access to contractor qualification records?*	(a) Yes — always (b) Yes — sometimes

	Questions (in Italics) and Responses	Possible Answers
	Five out of ten survey respondents always have access to contractor qualification records whilst four out of ten sometimes have access to contractor qualification records.	(c) Never Other (please specify)
26.	*Do you have a graded approach for site access training for contractor personnel depending on their assigned activities?* Five survey respondents have a graded approach for site access training whilst four keep it consistent for all contractors.	(a) Yes — a graded approach is used (b) No — site access training is consistent for all contractor personnel Other (please specify)

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[8] INTERNATIONAL ATOMIC ENERGY AGENCY, Workforce Planning for New Nuclear Power Programmes, IAEA Safety Standards Series No. NG-T-3.10, IAEA, Vienna, Austria (2011).

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ANNEX I.
BASIC REQUIREMENTS TO BE CONSIDERED IN TENDER DOCUMENT

This annex presents an example of how to obtain various data (request for information) on a contractor, dealing specifically with personnel competence and qualification, at the ITT stage of the contractor's involvement. The term 'tender' means an invitation to trade under the terms of an offer. More information can also be found in the IAEA publication Ref. [I-1], which outlines the general procurement process.

I-1. PURPOSE

To describe the basic requirements that have to be taken into consideration when awarding tenders, which will be included in the quality plan.

I-2. SCOPE

It is applicable to every contractor's tender to perform services.

I-3. DEVELOPMENT

The sections of the annex outlined below will be filled in for each tender, in order to check that the contractor has taken into consideration the most relevant technical, financial and quality aspects of the service.

The answers to the questions will be developed in the specific quality plan, once the tender is awarded.

The annex, once filled in and signed by the contractor, will be sent together with the tender.

The information will be an absolutely necessary requirement for the assessment of the tender; otherwise the tender could be rejected.

TABLE I-1. BASIC REQUIREMENTS TO BE CONSIDERED IN THE TENDER

General Data		
Name of Contractor	Tender No.	Date
Description of offered services		
No. of personnel		

1. General Information
Has your company been assessed?
Have the agreed actions from the assessing audit been answered?
Have you considered the assessment requirements to perform the services?
If your company has not been assessed do you have available a documented Quality System (e.g. according to ISO 9000)?

Do you have an available quality manual and quality system procedures?
Do you know if the offered service affects to components of nuclear class and/or is it related to nuclear safety?
Has this same service been performed in previous works/outages?
Do you know in detail the scope of the work?
Have you considered some exceptions / variations of the offered scope?
Indicate exceptions / variations of the scope.

2. Organization
For the organization considered in the tender. Do you have available the organization for the NPP with enough autonomy and independence from headquarters, to solve incidents during the service?
Have specific organizational charts been foreseen for the offered service?
The contractor responsible (e.g. contract supervisor) knows the organization of the NPP.
Indicate the persons responsible for each area and the percentage of dedication considered in the tender, e.g.: – Radiological Protection – Logistic and Administrative Management – Quality – Industrial Safety – Housekeeping Indicate any shared functions.
Indicate personnel participating in the tender and their experience: – Contract Supervisor – Foremen – Skilled Workers – Non–skilled workers
Has the following been considered in the tender? – The required access training for the NPP – Specific training about the work to be performed: Technical, Industrial Safety, Radiological Protection and Quality. The continuing training, in case of services for more than one year, e.g. – Certification of Welders – Non–Destructive Tests (NDTs) Others (Indicate)
The persons responsible/s for quality: – Are they trained in quality assurance? – Do they meet the safety guidelines from the National Nuclear Regulatory Body? – Are they certified?

3. Planning of the Works
The duration of the work is into the (initial and final) planning designed by the NPP?
In case of shift working is the organization and proper controls foreseen for a suitable work tracking?

Are there deviations from the specified delivery dates for works? If yes, indicate them.
Have you foreseen the usage of eventual huts?
Is the incorporation of personnel to the NPP foreseen before the beginning of the activity?
Is it foreseen to verify the implementation of the quality system in the works? (e.g., through inspections and internal audits)
It is foreseen the tracking of service indicators
Is the delivery of the final dossier at the end of the service considered?

4. Suppliers and Subcontractors
In case of materials purchasing, is the development of technical specifications foreseen?
Does the service implementation require sub-contractors? If yes, indicate it in the observations
Indicate percentage of sub-Contractors
Indicate percentage of supervision over subcontracted works.

5. Documentation
Are the development and approval of the following documents foreseen before the beginning of the works? – Specific Quality Plan – Specific Industrial Safety Plan
Documents about personnel training and qualification in the technical, industrial safety, quality and radiological protection aspects according to the contracted activities.
Is it foreseen in the works? Inspections Points Programmes (IPPs) and/or route sheets
The procedures to be used in the work: Do they belong to the NPP?
If it is not the case, has the writing of the necessary procedures been considered?
Indicate activities and percentage of inspection by quality personnel in the different works to control: List activities
The tools and measure equipment to be used in the work belong to? NPP or contractor?
It is foreseen that the measure equipment to be used are in force and effect about calibration, with its certificates

The document then has to be signed off and dated.

REFERENCES

[I-1] INTERNATIONAL ATOMIC ENERGY AGENCY, Procurement Engineering and Supply Chain Guidelines in Support of Operation and Maintenance of Nuclear Facilities, IAEA Nuclear Energy Series NP-T-3.21, IAEA, Vienna, Austria (2016).

ANNEX II.
REGULATORY OVERSIGHT OF TRAINING FOR REFURBISHMENT PROJECT

II-1. CANADIAN NUCLEAR SAFETY COMMISSION REGULATORY REQUIREMENTS

The CNSC regulates nuclear activities in order to protect the health, safety, and security of Canadians and the environment, and to implement Canada's international commitments on the peaceful use of nuclear energy; and to disseminate objective scientific, technical and regulatory information to the public.

The purpose of training in the nuclear industry is to ensure that workers are competent and qualified to perform the duties of their position. 'Worker' means a person who performs work that is referred to in a licence including temporary workers and contractors. The following are relevant CNSC regulatory requirements:

- Licensee shall "ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence" [II-1].
- Licensee shall "train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence" [II-1].
- An application for a licence to operate a Class 1 nuclear facility shall contain the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers [II-2].
- Licensees shall "ensure workers who carry on licensed activities are qualified to do the work assigned to them through the use of a training system to systematically analyse, design, develop, implement, evaluate, document and manage new training and the revision of existing training" [II-3].

  CNSC Regulatory Document Ref. [II-3] sets out requirements and guidance for the analysis, design, development, implementation, evaluation, documentation and management of training at nuclear facilities within Canada, including the essential principles and elements of an effective training system.

II-2. REGULATORY FOCUS DURING NUCLEAR REFURBISHMENT PROJECT

The CNSC provides regulatory oversight of refurbishment projects from the initial planning of the refurbishment project up to and following the return–to–service of the refurbished unit.

Refurbishments at the Canadian Nuclear Power Plants are conducted under 'operating' licences. CNSC does not issue 'refurbishment licences.

Due to the unique requirements associated with a Nuclear Refurbishment (NR) project, some licensees recognized the need to provide a Refurbishment Training Work Plan to address the training requirements and activities related to the following:

- Training for all refurbishment workers including contractors' workers and temporary staff;

- Analysis of all modifications (engineering, design and procedural) to determine impact on training and to define the training needs;
- Training of licensee's workers who already hold qualifications: design, development and conduct of training on each modification;
- Strategy to update the existing training programs for new and future workers to incorporate the refurbishment modifications;
- 'Return to service' training for Licensee's workers including evolutions such as operating with fresh fuel;
- Plan to ensure simulator fidelity;
- Maintenance of operator certifications; and
- Training for Licensee's Project Management Team for the oversight of contractors to ensure that they themselves are competent to conduct oversight of the NR project. For example, the licensee must oversee elements of the contractors training programs to ensure that the contractors' workers are properly trained to perform the work. In addition, when writing the contracts, the licensee must clearly state whom is responsible for the various stages of training (e.g., analysis, design, development, implementation, evaluation).

II-3. COMPLIANCE ACTIVITIES DURING THE REFURBISHMENT PROJECT EXECUTION

CNSC staff review and monitor the refurbishment project activities that enable effective human performance through the development and implementation of processes that ensure that the licensee has enough staff in all relevant job areas with the necessary knowledge, skills, attributes, procedures and tools in place to safely carry out their duties.

Through periodic inspection of licensee training systems, resultant training programs and oversight of contractor training, CNSC staff ensure that workers are receiving the proper, systematically developed training which allows them to fulfil their duties and responsibilities. The licensee's refurbishment training program is linked directly to the hold points in the Licence Conditions Handbook (LCH). The LCH provides specific criteria that CNSC staff use to determine if a licensee is complying with the terms of their licence. The inspections verify that licensee's refurbishment training programs are compliant with the requirements of CNSC Regulatory Document Ref. [II-3] and the licensee's own training system. One inspection is conducted for each refurbishment outage. The following inspections are completed by CNSC staff to verify that the licensee is meeting the applicable regulatory requirements.

II-3.1. Prior to refurbishment execution

Evaluation of the Site Access Training Program and review of the licensee's Project Management Team refurbishment oversight training.

The purpose of this inspection is to verify the use of a training system, as required by CNSC Regulatory Document Ref. [II-3], focusing specifically on the site access training activities, oversight training of management, oversight of worker qualifications, and training records. During the inspection, CNSC staff verify:

- The roles, responsibilities and authority of personnel involved in managing, supervising, developing and implementing site access training and the oversight training are clearly defined;
- NR Site Access Training and the Oversight Training is systematically defined, designed and developed;
- Training documents and training materials are controlled;

- Training records for NR workers are maintained;
- Contractors, temporary personnel or other non–facility personnel are appropriately qualified for the work to which they are assigned;
- Training staff (licensee and vendor) meet and maintain documented qualification requirements (e.g., train–the–trainer qualifications);
- Licensee is confirming the professional and/or trade qualifications and competencies of contractor personnel;
- Training provided by personnel from outside organizations (vendor supplied training) is controlled and evaluated to ensure that its quality is consistent with facility standards.

II-3.2. Mid way through refurbishment execution

Evaluation of the licensee's application of its Training Change Management Process.

This inspection assesses the licensee's application of their training change management process to analyse all refurbishment–related engineering, design and procedural changes for their impact on the training programs for various job families.

This evaluation assesses the licensee's capacity to conduct appropriate analyses, document the results and coordinate the design, development and delivery of the refurbishment modification training packages. Compliance verification activities verify that the licensees' Training Change Control centre is sufficiently staffed and supported such that modification Training Needs Analyses are completed thoroughly and systematically with ample time to design, develop and implement 'delta' training (i.e., training on the differences between pre–refurb and post–refurb plant) prior to return–to–service.

II-3.3. Prior to removal of hold–points

Evaluation of the refurbishment training programs.

This inspection includes training of licensee's staff on all the modifications made to the plant during refurbishment: engineering, procedural, design, etc. CNSC staff evaluates:

- The Return–to–Service training which is linked directly to the Hold Points in LCH;
- The training programs that must be designed, developed, and delivered to prepare site workers to operate and maintain the plant post–refurbishment of the reactors;
- The Training Change Control (TCC) progress for the re–design and re–development of the existing initial and continuing training programs.

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[II-3] Canadian Nuclear Safety Commission (CNSC), Human Performance Management: Personnel Training Regulatory Document: REGDOC-2.2.2, Ver. 2, Ottawa, Canada (2016).

ANNEX III.
EXAMPLE OF CHECK LIST FOR CONTRACTORS TRAINING AND QUALIFICATION PROGRAMMES

III-1. INTRODUCTION

Besides considering the specific technical competence of contractor personnel related to each particular task (such as non–destructive testing or equipment maintenance) to be performed at an NPP, the technical competence requirements that all personnel working on site have to meet are also important.

This annex provides a checklist of how an NPP operator assures contractor personnel competence including means of evaluation of the requirements for contractor personnel qualification, and evaluation of contractor personnel training programmes (see Table III-1).

TABLE III-1. CONTRACTORS TRAINING AND QUALIFICATION PROGRAMMES CHECKLIST

CHECKLIST FOR CONTRACTORS TRAINING AND QUALIFICATION PROGRAMMES		
	1. Organization of training	✓
1.1	Does the required training follow the NPP organised guidelines? For example: – Document by attendance lists – Instructor's records – Content – Period of archiving – Verification of knowledge – Records – Evaluation	
1.2	Are all the certificates and appropriate licences issued?	
1.3	Are the documented licences valid?	
1.4	Are the documents, for obligatory archiving by the customer, submitted for special processes?	
1.5	Documentation of the system of acquiring and maintaining the special qualification of contractor personnel in the form of a written document – QA programme	
1.6	Have job descriptions been developed for the posts that are to be filled by contractor personnel?	
1.7	Has a standard of special training, which must be in accordance with the contractor personnel qualification sheet, been developed for every post (job)? Have lists been developed of required documentation for jobs?	
1.8	How does authorisation for performing the job get issued to personnel by the employing contractor?	
	2. Documented Procedures	
2.1	Have documented procedures, for establishing the requirements for training contractor personnel who perform activities influencing the quality of items relating to nuclear safety and radiation protection, been developed and maintained?	

2.2	Do documented procedures contain qualification criteria for relevant personnel?	
2.3	Do documented procedures contain methods of taking and maintaining the records of training, qualification acquired, and special preparations?	
2.4	Do documented procedures contain methods of documenting training of appropriately qualified personnel to enable them to execute the assigned work and to understand the importance of the work they do with regard to quality?	
3. Training Programmes		
3.1	Are the individual training programmes for contractor personnel developed to enable them to commence their work?	
3.2	Have the training programmes been developed to meet all requirements?	
3.3	Is the training organised according to these training programmes?	
3.4	Have the training programmes for individual work on equipment been developed in co–operation with the customer?	
4. Training Plans		
4.1	Is a special training plan, setting the final targets of the training and qualification criteria of a trained contractor employee for the given work activity, developed on the basis of the analysis of training requirements; and is it used?	
4.2	Is an annual (or other periodic) training plan developed and used?	
4.3	Is the training performed in accordance with the developed training plan?	
4.4	Have the responsibilities for keeping the training plan to time been assigned?	
5. Instructors		
5.1	Have the instructors who will be responsible for contractor personnel training been assigned in writing?	
5.2	Do the instructors have the required qualifications?	
5.3	Do the instructors have practical experience with the activity for which a new employee is being trained?	
5.4	How is it ensured that the instructors possess instructional abilities?	
6. Contractor personnel qualifications		
6.1	In addition to general qualification requirements, have specific qualification requirements connected with QA and safety, been determined?	
6.2	Before contractor personnel begin to perform any tasks, have the employee categories been determined?	
6.3	Before contractor personnel begin to perform any tasks, have the qualification requirements been determined?	
6.4	Are these qualification requirements periodically reviewed, evaluated and revised, if need be?	

6.5	Does familiarisation with the quality system and quality assurance elements comprise part of the knowledge requirements of a contractor with his work?	
7. Training and Evaluation		
7.1	Are contractor personnel trained consistently with regard to quality?	
7.2	Is the training performed consistently and is it specific for each group of contractor personnel?	
7.3	Is the training assured for all levels of contractor personnel whose activities influence the quality of the supplied items?	
7.4	Are the personnel who ensure operations important with regard to quality trained in practical skills?	
7.5	Is the analysis of evaluation of the effectiveness of contractor personnel training, based on selected criteria, performed continuously?	
7.6	Are the remedial measures for detecting shortcomings taken in such a way that the required improvements take place?	
8. Assuring contractor personnel competence		
8.1	What method is used to prove that contractor personnel have acquired the required theoretical and practical knowledge or skills to be able to work according to the technological procedures on actual equipment on their own, under supervision or to manage the work?	
8.2	Have the system and rules for selection and development of personnel been developed in accordance with the requirements of their qualification and preparation system?	
8.3	How is it ensured that contractor personnel have the medical, psychological and technical qualifications for performing actual activities or jobs?	

ANNEX IV.
EXAMPLE OF OVERVIEW OF THE KEY STAGES IN ASSURING THE COMPETENCE OF NPP CONTRACTORS

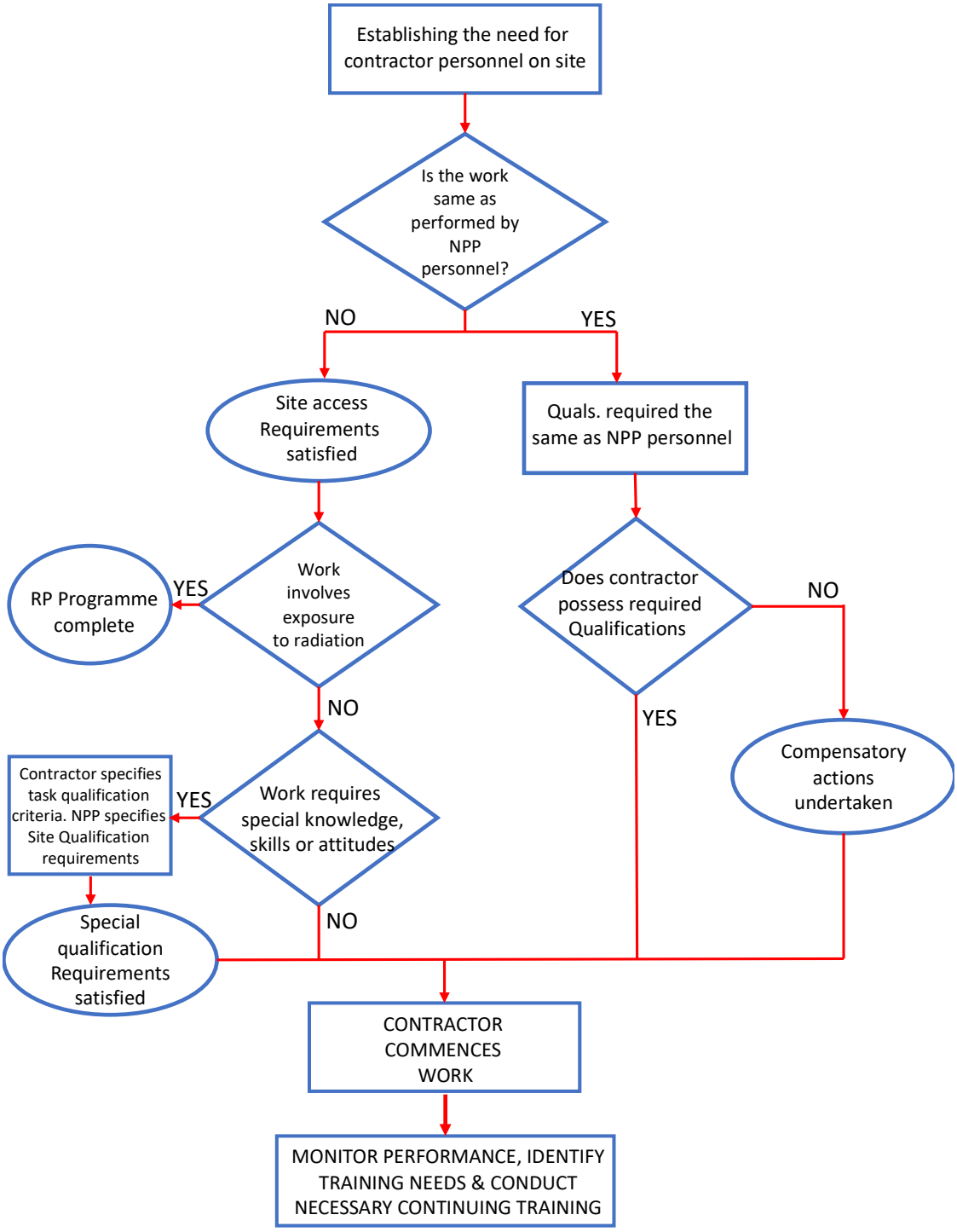

FIG. IV-1. Overview of the key stages in assuring the competence of NPP contractors.

ANNEX V.
EXAMPLE OF HOW CONTRACTORS CARRY OUT ASSURANCE OF THEIR PERSONNEL

This annex describes an example approach, in assuring contractor personnel competence, from the point of view of the contractor. The example includes the different sources of qualification requirements and a QA programme, including the training manual, to assure the competence of its personnel. Some examples of training programmes are included. Finally, this annex describes the typical process of competence assessment and how lessons learned are used to improve personnel competence.

V-1. INTRODUCTION

To supply the type of services for working in an NPP and to ensure quality and safety is maintained it is important that all contractor organizations employ highly trained and qualified personnel.

V-2. QUALIFICATION REQUIREMENTS

Within contractor organizations personnel are normally qualified in accordance with national regulations and international organizations.

National regulations will vary from country to country, but the IAEA and other international organizations provide recommendations; for example, ‘QA for NPP safety’ [V-1].

An NPP will normally have procedures contained in manuals, for example:

- Quality Assurance;
- Radiological Protection;
- Plant Access Procedures;
- General requirements for contractors.

Other contractual documents which may be available from the contractor organization include ‘General conditions for contract specification which typically includes requests for the following information:

- Organization structure;
- Functions and responsibilities;
- Contractor personnel qualification requirements (education, experience, training and certification when required);
- QA Programme and Quality Plan (for those works subjected to quality requirements).

The qualification requirements of contractor personnel are defined by a combination of:

- Education: minimum academic degree for specific job position;
- Experience: for some qualification levels it is necessary to have number of years of experience;
- Training: the initial and continuing training programmes for the different job positions are designed and included as a part of the QA programme;
- Certification: for special job positions (NDT inspectors, QA technicians) is needed a certification by National Authorities.

V-3. QUALITY ASSURANCE PROGRAMME, THE TRAINING MANUAL

QA programme is considered a strategic management tool for the supply of services within the nuclear sector. As a part of the QA programme the training manual is integrated; this is a document that describes the general process for training and qualification, training programmes and define the levels of competence for the different specialists.

V-3.1. Training programmes

The training programmes need to meet more requirements than for conventional businesses. This is the reason why training programmes should deal not only with technical knowledge and skills, but also with quality and safety culture. The training programmes are divided in the following areas:

V-3.1.1. Technical training

Technical training has been designed following the SAT methodology specifically for each job position.

V-3.1.2. QA training programme

The QA programme is considered a management tool. In this respect each employee is introduced to the QA Programme to understand their responsibilities.

Line managers, project managers and team leaders are more intensively training in QA including QA objectives, administrative and QA procedures and, in particular, QA requirements and the development of quality plans.

V-3.1.3. Radiological protection

Contractor organizations are responsible for the training and qualification of their personnel who possibly may be exposed to ionising radiations, in radiological protection including fundamentals of radioactivity, risks and protection measures, regulation and limits, rules in the controlled zone.

NPPs are responsible to assure that contractor personnel have received the general training (this information is included in the 'radiological card') and usually complement with plant specific topics such as: ALARA (as low as reasonably achievable) programme, radiological protection services, dosimetry, reduction of radioactive waste, radiological work permits and contamination control.

V-3.1.4. Industrial safety

In combination with QA and radiological protection, contractor personnel must have a good understanding of safety. Training programme includes theoretical and practical courses on: hazards and protective equipment, working at height, working in confined areas, electrical safety, hazardous chemical and nuclear safety.

For managers responsible for the safety of their personnel, this training is reinforced with the details of the regulatory requirements and the methodology for risk assessment.

V-3.1.5. Continuing training

To maintain and update competence, line managers and training managers cooperate in the preparation of an annual continuing training programme, taking into consideration at least:

- Mandatory refreshing and re–certification;
- Lessons learned for previous works;
- New procedures;

- New technologies and equipment;
- New regulations.

V-3.2. Certification

The certification is the recognition of the personnel qualification by competent organizations or authorities.

V-4. COMPETENCE ASSESSMENT

The competence assessment varies from one utility to other and from country to country, but many contractors have to manage assurance of the competence of its personnel through an assessment of its QA Programme.

Very often the first step in this process is to become a 'Qualified Contractor Company' (member of the approved list of contractors for a specific utility). This contractor qualification process can include an assessment of the company organization, its financial status, QA system, recruitment process, personnel training programmes and its qualification, technical procedures, documentation and records. This accreditation, as a 'Qualified Contractor Company', has to be periodically renewed (usually every 3 years).

In addition to the accreditation as a 'Qualified Contractor Company', the assessment of the contractor personnel competence, for specific works (i.e., outages), usually follows the process described in the scheme below (see Fig. V-1).

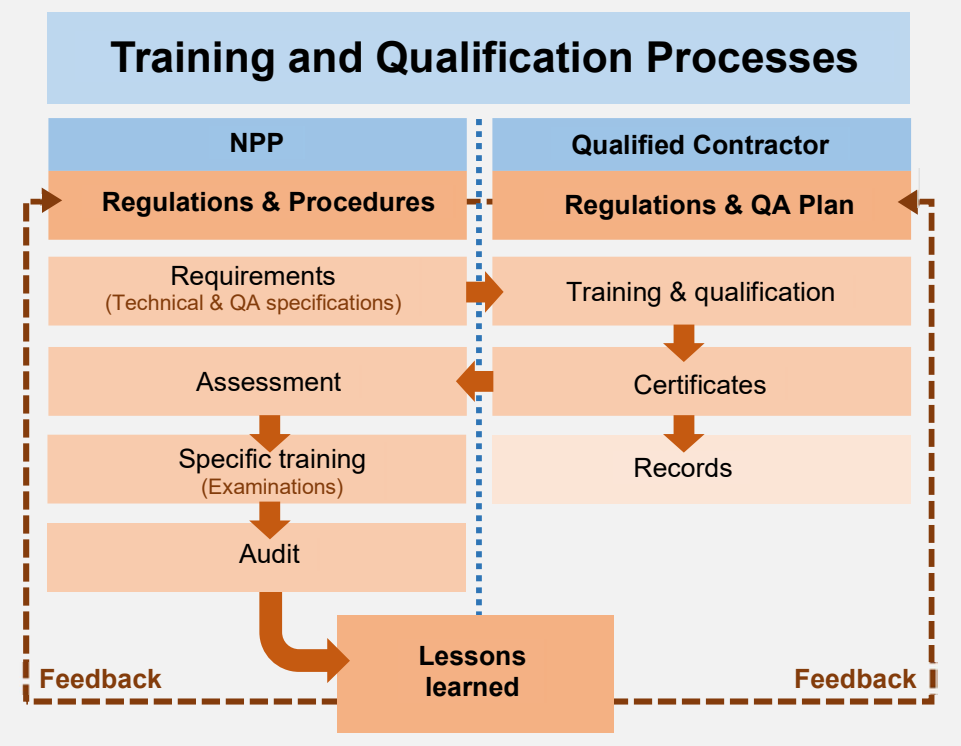

FIG. V-2. Training and qualification process example.

Contractor personnel are trained in accordance with the Training Manual included in the QA programme considering the qualification requirements.

Special requirements can be made by an NPP operator for specific tasks, usually through the contractual documents (technical and QA specifications). Such additional requirements must be analysed and if any qualification gap is identified, compensatory actions are taken such as:

- Experience, i.e., some NPPs ask for certain years of experience of similar work for team managers;
- Additional training, i.e., Quality and Safety Programme (QSP);
- The level and number of personnel certified, i.e. the number of in–service inspectors of level I, II and III in certain NDT techniques.

One of the most important principles of personnel qualification is that the qualification must be auditable and traceable. This means that when somebody is qualified, a certificate submitted by a competent organization must exist, and the results of the examinations and the duration, location and training programme must be available. All qualification records, including official certificates, should be stored in a database. Those which are requested for a specific activity are submitted to the NPP for formal assessment.

Very often the NPP provides additional training before the commencement of the work. This training can include the plant–specific part of the radiological protection course, on–site emergency plan, fire protection and specific QA and safety considerations. At the end of this training there is an examination that the trainees have to pass.

In summary before undertaking work the assessment of competence is performed through:

- Contractor company qualification;
- Contractor documentation assessment;
- Contractor personnel evaluation (optional).

Also, during the work, the qualification assessment may indirectly continue through the NPP QA programme and the quality plans, that include:

- Programme of inspections points, that means milestones in the work, checked by NPP and contractor inspectors that the tasks are performed according to the NPP QA Programme and the submitted Quality Plan;
- Audits during the work by NPP and contractor QA auditors.

V-5. LESSONS LEARNED

Figure V-2 below shows how lessons learned are taken into consideration in the feedback of the qualification process.

Section 3 described the continuing training programme including those lessons learned from previous work and that have been considered important for training purposes.

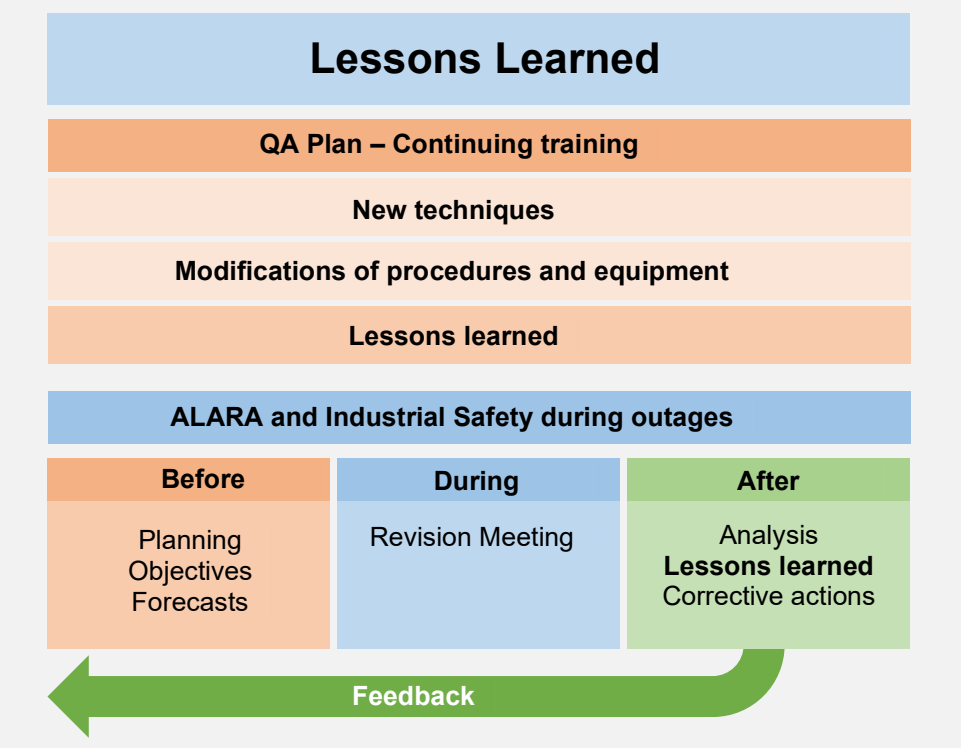

FIG. V-3. Overview of how lessons learned are incorporated into assuring the competence of NPP contractor personnel.

In addition to this, and specifically related to the NPPs ALARA programme and industrial safety during outages, a pre–job brief meeting between NPP and contractor managers, is held to plan the tasks and communicate the NPP objectives in terms of dose and work incidents.

During the outage there is a daily meeting to review the planning and objectives; and at the conclusion there is a closure meeting to analyse deviations and their root causes, lessons learned and corrective measures.

Often corrective measures are related to training and feedback into the qualification process.

V-6. CONCLUSIONS

Many contractors with experience in the nuclear field, have felt the necessity to develop a comprehensive QA programme in order to assure the competence of its personnel. A sound relationship between the contractor QA programme and the assessment of competences made by the NPP, in accordance with its own QA programme, is the cornerstone to assure meeting the NPP qualification requirements.

Finally, the implementation, in cooperation with the NPP, of lessons learned from previous work, offers continuing challenges for improvement.

REFERENCES

[V-1] INTERNATIONAL ATOMIC ENERGY AGENCY, Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations: Code and Safety Guides Q1-Q14, IAEA Safety Series No. 50-C/SG-Q, IAEA, Vienna, Austria (1996).

ANNEX VI.
OVERVIEW OF SYSTEMATIC APPROACH TO TRAINING

SAT consists of five interrelated phases (see Fig. VI-1), which are [VI-1]:

- *Analysis*: this phase comprises the identification of training needs, tasks or competencies selected for training, and KSAs required to perform a particular job;
- *Design*: in this phase, training objectives derived from the training requirements identified during the analysis phase are developed; test items to assess achievement of training objectives are developed; and training objectives are organized into a training programme;
- *Development*: in this phase, training materials are prepared so that the training objectives can be achieved;
- *Implementation*: in this phase, training is delivered by using the training materials developed;
- *Evaluation*: during this phase all aspects of training effectiveness of both training programme and training system are evaluated, followed by feedback leading to training and facility performance improvements.

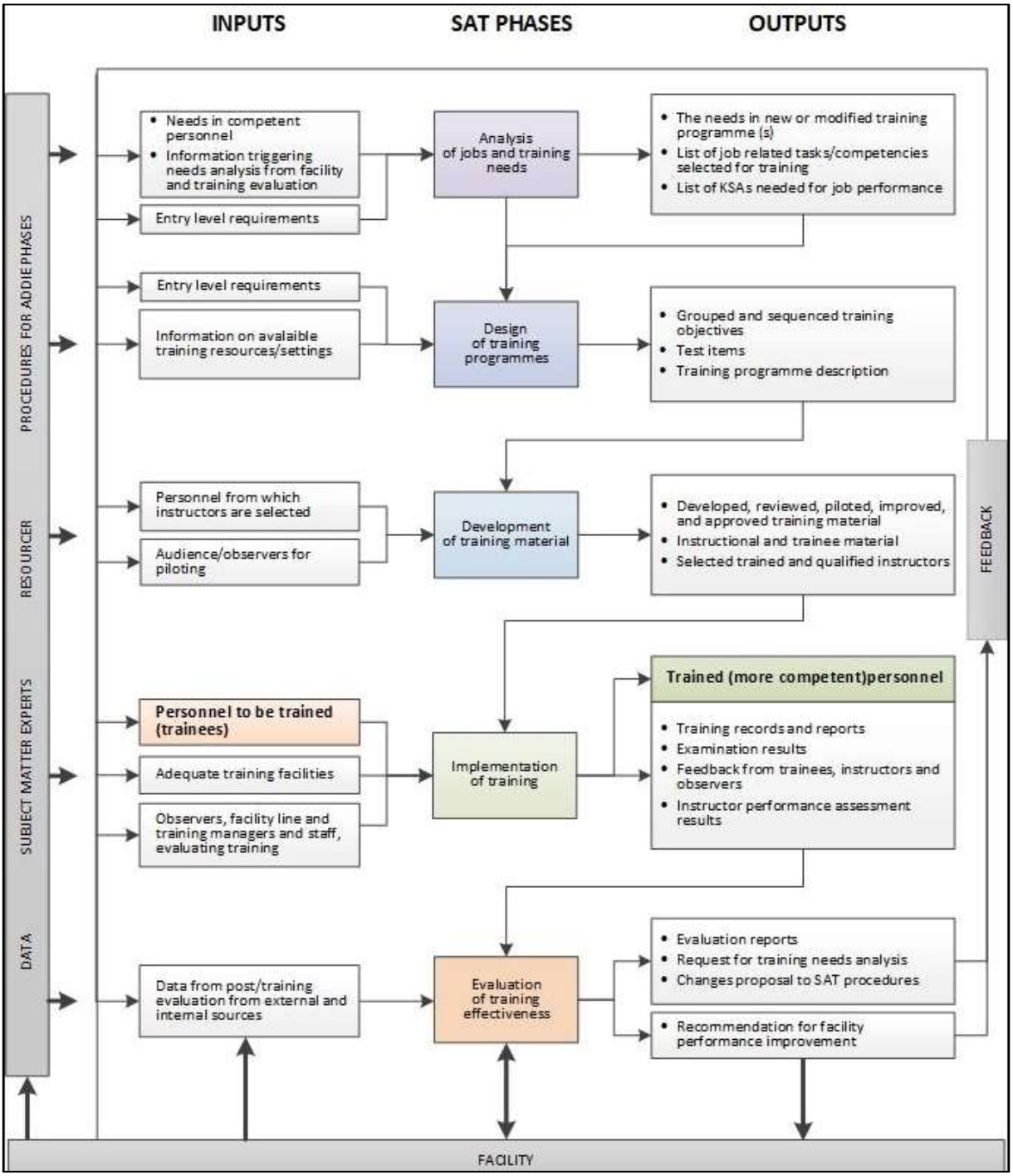

FIG. VI-1. Overview of SAT phases.

REFERENCES

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ANNEX VII.
EXAMPLE OF CONTRACTOR SITE ACCESS TRAINING AT NPP

VII-1. INTRODUCTION

Besides considering the specific technical competence of contractor personnel related to each particular task (such as non–destructive testing or equipment maintenance) to be performed at an NPP, there is a requirement that all personnel working on site undertake training related to site access. An overview of this training is presented in this annex.

VII-2. SITE ACCESS TRAINING

All contractor personnel allocated to an NPP site for the first time, or contractor personnel who have not worked in the NPP restricted area in the past year, are obliged to complete the site access training.

VII-3. PURPOSE OF THE TRAINING

The purpose of the site access training includes the following:

- To enable contractor personnel to acquire basic information about the principles of generation of electrical energy in NPP;
- To obtain an appreciation of the plant layout and organization;
- To ensure they know how to react properly in case of abnormal or unusual events;
- They are familiar with the principles of safe work, fire protection and waste treatment;
- They know where to obtain any further necessary information.

VII-4. ORGANIZATION OF THE TRAINING

The training, inclusive of tests, will normally take place a few times a month at dates fixed in advance, or by arrangement. It is normally the duty of the contractors to organise the training of their personnel in advance, and to submit appropriate paperwork at the same time. A manual may be provided to each contractor before commencing site access training.

VII-5. TRAINING CONTENT

The training content will contain a number of parts and will usually include, but not limited to theoretical instruction, teaching by using models in the Information or Training Centre and a visit to the plant.

VII-6. TEST FOR VERIFICATION OF GENERAL QUALIFICATION

After undertaking the training, contractor personnel have to pass the tests to verify their knowledge. The tests are usually performed on personal computers in the format of pre–set multiple choice questions including a number of possible answers to each question out of which only one is correct.

Successful personnel will receive confirmation that they have completed the site access training and passed the test. The length of training will vary but typically, inclusive of the tests, could

last up to one and a half working days. Assessment of knowledge is undertaken on the second day.

If a contractor does not pass the test to verify their knowledge at the first attempt, the contractor will have to repeat the tests. There may be a time restriction on when repeated tests can be taken, e.g., within a week of the first tests or second, repeated, tests and there may be a limit on the number of times a test can be taken. If a contractor has not worked in the restricted area of an NPP during say the last year, it is the contractor's duty to ensure that their employee will complete the site access training again and pass the tests.

GLOSSARY

Note: all definitions are from the IAEA Glossary of Personnel Competence and Training Related terms dated January 2016 unless otherwise stated and are in alphabetical order.

competence (competency) — (1) The ability to put skills, knowledge and attitudes into practice in order to perform activities or a job in an effective and efficient manner within an occupation or job position to identified standards.

(2) A combination of knowledge, skills and attitudes in a particular field, which, when acquired, allows a person to perform a job or task to identified standards. Competence (Competency) may be developed through a combination of education, experience and training.

(3) A term 'competency' is also used for a generic task or a function.

competences/competencies — The plural forms of competence/competency.

contractor – Also called service supplier, any organization or individual person that provides a service for a licensee under a legally binding contract that is not in the licensee's direct employment or formally seconded to the licensee from the licensee's parent company [7].

DIF (difficulty, importance and frequency) — One of several models available for use in selecting tasks for training. Using this model, tasks are identified as critical, based on the difficulty, importance, and frequency of job task performance.

enabling objectives — A statement of intent, especially the expected outcome of a segment of training. An Enabling Objective must include the expected performance and associated standards, and state or imply the associated conditions. Meeting an Enabling Objective helps a trainee attain one or more terminal objectives or training aims. Enabling objectives describe trainee's competencies that must be mastered before the terminal training objective can be accomplished.

informed customer — As an Informed Customer, in the context of nuclear safety, the management of the facility should know what is required, should fully understand the need for a contractor's services, should specify requirements, should supervise the work and should technically review the output before, during and after implementation. The concept of Informed Customer relates to the attributes of an organization rather than the capabilities of individual post holders [7].

just–in–time (JIT) training — This is the primary means of providing training for infrequently performed tasks. Where appropriate, pre–outage, new equipment, and pre–evolution training is conducted as needed rather than being done on a standard training schedule.

nuclear power plant (NPP) owner/operator — The Nuclear Power Plant Owner is the owner of the entity (registered company, government organization) that owns the asset of the NPP. The Operator (or Operating organization) is the organization applying for authorisation or is authorised to operate a facility.

observation and coaching — Occurs in training and is a method used for observation of task performance.

oversight — The verification that the standards, expectations and goals established through governance of the organization are met. Executives, line managers and oversight organizations identify performance gaps for corrective action, monitor the effectiveness of corrective actions and escalate issues to higher levels of line management where necessary. Oversight, through its fundamental elements of audit, evaluation, monitoring, inspection and investigation, enhances organizational effectiveness, productivity and integrity [8].

proficiency — The ability to perform a specific activity (e.g., a task) to demonstrate mastery of that activity.

Regulator Authority — The authority, body or organization (usually national) that is empowered by legislation to conduct regulatory work, including establishing and publishing regulations, inspecting compliance and issuing relevant certificates, licenses and authorizations for specified activities. Also termed a Regulatory Body.

terminal learning objective (TLO) — In the training context, is a statement on the purpose or goal of a particular training session, course or programme. Also termed a Training Aim or Instructional Aim. A TLO is usually written in behavioural terms, stating the expected outcome in terms of performance, conditions and standards, supported by enabling objectives, which are always written in behavioural terms. However, TLOs are usually directly related to specific tasks/competencies and reflect trainee

performance requirements upon completion of a training programme. TLOs are intended for long–term retention and are reinforced through continuing training as needed.

Technical Support Organization — An organization established (internally and/or externally) to provide support to the NPP operating organization in various areas, including specific research, engineering services, the development of technical improvements, legal advice, analysis and testing to support management decisions. Thus, TSOs are expected to provide expertise, professional output, independent technical or scientific advice, competent judgement, service and assistance to the operating organization [4].

ABBREVIATIONS

ADDIE	analysis, design, develop, implement and evaluate
SAT	systematic approach to training
LMS	learning management system
TSO	technical support organization
NDT	non–destructive test
KPI	key performance indicator
KSA	knowledge, skills and attitudes
NPP	nuclear power plant
IAEA	International Atomic Energy Agency
IMS	integrated management system
ITT	invitation to tender
CNSC	Canadian Nuclear Safety Commission
IPPs	inspections points programmes
NR	nuclear refurbishment
LCH	licence conditions handbook
TCC	training change control
QA	quality assurance
ALARA	as low as reasonably achievable
QSP	quality and safety programme
EDF	Électricité de France
CIN IS	CIN Interactive System
SCN	standard nuclear knowledge
CSQ	safety and quality
RP	radiological protection

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