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Mentoring and Coaching for Knowledge Management in Nuclear Organizations

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International Atomic Energy Agency

MENTORING AND COACHING FOR KNOWLEDGE MANAGEMENT IN NUCLEAR ORGANIZATIONS

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MENTORING AND COACHING FOR KNOWLEDGE MANAGEMENT IN NUCLEAR ORGANIZATIONS

INTERNATIONAL ATOMIC ENERGY AGENCY
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FOREWORD

The IAEA continues to work with Member States to identify good practices that support nuclear organizations in introducing new approaches to improve safety and business performance. To support this endeavour, the IAEA has been identifying good practices in the area of knowledge management, particularly practical approaches that can help organizations effectively retain critical knowledge and experience.

Two beneficial practices that support knowledge transfer between personnel in nuclear organizations are mentoring and coaching. Mentoring plays a significant role in the transfer of knowledge and skills from experienced professionals to newcomers or the less experienced. Coaching plays a crucial role in instilling the correct behaviours and values that are essential to promote the safety and performance of personnel working in nuclear organizations.

Changes resulting from the mentoring and coaching of individuals or groups of employees can have a positive effect on the organization through improved styles of leadership, management and communication and by helping to improve specific technical abilities. Mentoring and coaching enable organizational learning by passing on the important attributes of the skills, routines, norms and values associated with various business processes and functions. The most significant aspects of mentoring and coaching are the transfer of ideas and thought processes that foster essential skills, self-confidence and maturity and the teaching of the technical abilities required to perform specific tasks.

This publication aims to provide practical guidance on mentoring and coaching approaches based on the experiences of Member States. It provides guidance for nuclear organizations to initiate suitable mentoring and coaching programmes that support strategic organizational knowledge management activities and programmes.

This publication highlights the importance of mentoring and coaching for knowledge transfer and how they facilitate the transfer of relevant knowledge and skills across the generations within the workforce. It also includes successful case studies from Member State organizations that have used mentoring and coaching as effective tools for knowledge transfer and performance improvement.

The IAEA officers responsible for this publication were A. Ganesan and M. Drace of the Division of Planning, Information and Knowledge Management.

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CONTENTS

1. INTRODUCTION

1.1. BACKGROUND

Throughout the nuclear industry, competence is defined as a combination of knowledge, skills and attitudes. This knowledge component can be categorized into:

- Explicit knowledge, which can be readily articulated, codified, stored and accessed;
- Implicit knowledge, which is the application of this explicit knowledge, that is gained through incidental activities, or without the awareness that learning is occurring;
- Tacit knowledge, which is the knowledge an individual possesses that is gathered from personal experience and context and which is most difficult to express or define.

In some cases, this knowledge may be useful in supporting day to day activities. The more significant knowledge may be essential to maintain the ongoing operational and safety requirements. For the most significant knowledge, where failure to maintain and implement correctly this knowledge would result in a direct and immediate challenge to safety or operational and commercial viability this would be regarded as critical knowledge. Figure 1 below summarizes these typical knowledge categories.

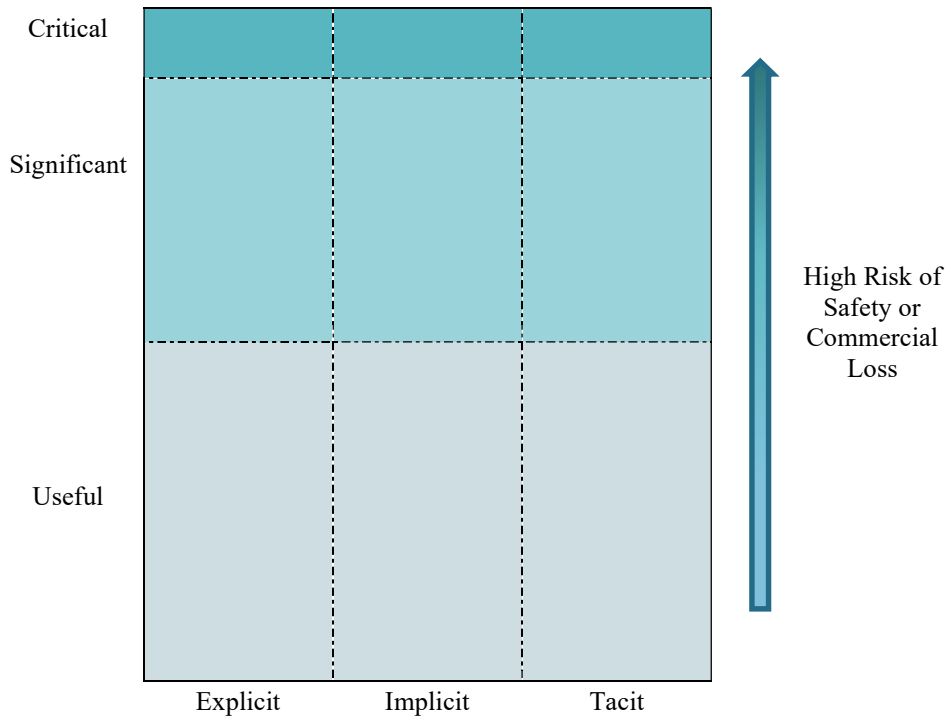

FIG. 1. Knowledge categories

The ability to effectively transfer knowledge, skills, and attributes from more experienced to less experienced personnel often differentiate organizations with excellent knowledge management programmes from the rest. This is particularly true regarding implicit and tacit knowledge that resides in the minds of professionals and is difficult to transfer [1, 2] through formal training.

Nuclear organizations use specialized training programmes [3, 4], including practical training in full scope simulators, dedicated mock-ups and practical aids to help their personnel acquire a level of

proficiency that supports safe and efficient working. As people start working in nuclear organizations, they gain unique skills, knowledge and insights in a particular field as they experience challenges and development opportunities in their professional career.

Personnel working on operation and maintenance activities in nuclear operating organizations gain unique skills and experiences from activities such as the maintenance of control rod drive mechanisms, reactor coolant pumps, steam generators, etc. Most of these experiences, in the form of lessons learned, are captured in experience reports for further use in training and procedural and process improvements. However, some of the experiences are not easy to transfer through a documented process as human-to-human interaction is also required for effective knowledge transfer [1]. Mentoring plays an important role in this type of knowledge transfer.

The IAEA Safety Standard Series No. GSR Part 2, Leadership and Management for Safety [5] requires individuals in nuclear operating organizations to foster a strong safety culture [5]. Coaching helps instil the right behaviours and attitudes for safety. For example, managers in nuclear power plants (NPPs) use field visits as opportunities to coach their employees to use human error prevention tools such as self-check, peer check, procedure use, and three-way communications. Coaching is also extensively used for improving technical, managerial and leadership skills. Personnel identified for senior managerial and leadership positions are coached to improve their managerial competencies as they move up in an organization.

Changes resulting from mentoring and coaching an individual or a group of employees can have a positive effect on the organization through improved styles of leadership, management, and communication besides helping to improve specific technical abilities. They enable organizational learning by passing on the important attributes of the skills, routines, norms and values associated with various business processes and functions. The most significant benefit of mentoring and coaching is to support the transfer of ideas and thought processes that foster skills, self-confidence and maturity as well as teaching physical capabilities to perform specific tasks.

This publication aims to collect the experience of Members States, in the form of case studies and examples of mentoring and coaching and to provide some useful guidance and insights on how to apply them for effective knowledge transfer.

1.2. OBJECTIVE

The objectives of this publication are to:

- Describe the mentoring and coaching techniques and their importance for supporting a strategic knowledge management programme in nuclear organizations;
- Illustrate successful mentoring and coaching approaches that promote effective knowledge transfer and contribute to improved organizational performance in Member States;
- Provide insights and guidance for using mentoring and coaching to develop a successful knowledge management programme.

1.3. SCOPE

This publication is intended for organizations that either directly or indirectly support the use of nuclear energy and other nuclear applications and activities, including:

- Operating organizations of nuclear installations, fuel cycle facilities, as well as waste management, storage and disposal facilities;

— The transport of radioactive material;
— Radiation protection activities;
— Regulatory Bodies;
— Research and Development (R&D) organizations;
— Suppliers or contractors to nuclear facilities;
— Technical support and service organizations (TSOs);
— Education and training organizations.

This publication is designed for personnel involved in the mentoring and coaching programmes within their organizations and for personnel involved in establishing and conducting mentoring and coaching programmes and knowledge management activities. This publication is also meant for senior and mid-level managers in nuclear organizations for their implementation of effective mentoring and coaching practices.

1.4. STRUCTURE

Section 2 introduces the basic concepts through definition, purpose, benefits, common drawbacks and different types of mentoring and coaching. It also explains the desirable characteristics of mentor and mentee and coach and the people being coached.

Section 3 analyzes typical mentoring and coaching approaches applied in nuclear organizations as an individual moves through the employee life cycle.

Section 4 provides step by step guidance for developing and implementing mentoring and coaching activities as part of a strategic knowledge management programme.

Section 5 considers the specifics of implementation of mentoring and coaching activities in different types of nuclear organizations.

Section 6. provides a summary of important takeaway lessons from this publication.

In the Annex, case studies demonstrating practical applications of mentoring and coaching from different types of organizations are included to illustrate the different approaches and their merits.

2. CONCEPTS OF MENTORING AND COACHING

People to people knowledge transfer is a challenging area for many organizations and it often decides the success of a beneficial knowledge management programme. A variety of techniques including mentoring, coaching, shadowing, tutoring, on the job training, and communities of practice are used by organizations to achieve their knowledge transfer goals. In that mentoring and coaching play a significant role.

It can be difficult to differentiate between the concepts of mentoring, coaching, and training. Mentoring and coaching have similarities and differences. A mentor has experience and expertise in a particular field. A mentor transfers specific knowledge and unique experiences by acting as an adviser, counsellor, guide, tutor, or teacher. In contrast, a coach's role is to assist people in uncovering their own knowledge, skills, and abilities and to facilitate them in becoming their own advisers. Coaching requires skills in coaching, mentoring requires technical knowledge and experience in the subject matter. However, coaching can be used as an opportunity for mentoring if appropriate to share knowledge and experience. Training is a formalized period of instruction with defined learning objectives.

Table 1 provides a comparison between mentoring, coaching, and training with reference to their objective, emphasis, relationship, timelines etc.

2.1. MENTORING

2.1.1. Definition

For the purposes of this publication, mentoring is defined as a relationship between a more experienced and/or knowledgeable individual (mentor) and one less experienced and/or knowledgeable (mentee). It is a one-to-one relationship, designed to enhance the mentee's understanding of, and ability to put into practice, knowledge and skills possessed by the mentor. Such relationships are usually established outside any line-management relationship and for extended periods of time. The term mentor is often used interchangeably with terms such as counsellor, sponsor, and guide.

2.1.2. Purpose and benefit

Mentoring offers an opportunity for the mentee to work in parallel with the mentor to get a perspective into the working processes and be able to ask questions. In this relationship the mentor transfers ideas and thought processes to the mentee which will foster their skills, self-confidence and role maturity and enhance their capabilities to perform specific tasks [6]. In the nuclear industry, mentoring is often used to pair more senior personnel with junior personnel to assist with professional and career development. Mentors may be drawn from within or from outside an organization.

Mentoring is an important element of the human resource development process that supports the learning and sharing of knowledge and experience. Mentoring can be used for various purposes in organizations:

- To introduce the organizational expectations, vision, norms, and culture at the time of inducting personnel into the organization;
- To improve the knowledge and skills that support technical development and career progression for the newly employed;
- To introduce organizational expectations and the relevant knowledge and experiences needed for different job roles or positions.

Mentoring is used when an organization seeks to:

- Develop new leaders or a talent pool as part of succession planning;
- Develop knowledgeable employees and to remove barriers that hinder their development;
- Further develop employees in ways that are additional to the acquisition of specific skills and competencies;
- Retain and pass on internal expertise and experience residing in employees for future generations.

Mentoring is an important process for knowledge management as it supports the transferring of tacit knowledge and retaining expertise within the organization. It supports knowledge transfer through the sharing of experiences and helps to internalize this knowledge.

2.1.3. Characteristics of mentors and mentees

Understanding the roles and responsibilities of the mentor and the mentee is important for the success of this relationship. Some of the important characteristics and responsibilities of mentors and mentees are listed below.

Mentor:

- Good understanding of the organization, its principles and values;
- Deep understanding and expertise in relevant professional subject matter topics;
- Motivated to teach and to provide guidance to others as well as a willingness to share knowledge;
- Ability to evaluate and recognize the potential talents and skills of the mentees for achieving effective and efficient knowledge and skills transfer;
- Ability to motivate others as well as to encourage the mentee to ask everything they individually want to know but are reluctant to ask;
- Ability to foster trust and allow the mentee to feel comfortable to ask the same or similar questions again;
- Show interest in learning from others and in connecting with the newcomer generation.

Mentee:

- Eager and open to learn proactively;
- Positive outlook and attitude;
- Patient, responsive and respectful of the mentor's role and time;
- Comfortable receiving objective feedback.

2.1.4. Responsibilities of mentors and mentees

Mentor:

- Meets with mentee on a regular basis and informs how and when the meetings will take place in order to create a commitment to the relationship;
- Encourages mentee to take on tasks that may be outside of their comfort zone;
- Develops the mentees to be capable of taking the mentor's job;
- Assists the mentee in identifying professional and personal growth goals and objectives;
- Assists the mentee in establishing explicit goals and objectives for the relationship;

— Assists the mentee in developing and maintaining the Mentoring Agreement[1];
— Reviews agreements reached in the Mentoring Agreement at regular intervals;
— Completes progress reports and regularly re-assesses needs;
— Maintains the confidentiality of the relationship;
— Gives constructive feedback.

TABLE 1. COMPARISON OF MENTORING, COACHING AND TRAINING

Mentoring	**Coaching**	**Training**
It represents a relationship in which a more experienced or more knowledgeable person (mentor) guides a less experienced or less knowledgeable person (mentee).	The coach facilitates the person being coached to improve their capabilities and performance.	Training is aimed at imparting specific new knowledge and skills. It could be used to meet initial qualifications, or to maintain, upgrade or update knowledge and skills.
In most cases, it is a one-to-one relationship.	It is a one-to-one or group relationship.	Typically, it is a relationship between one person and a group.
The mentor shares his/her own personal experience.	The coach helps the person being coached evaluate his or her own experience.	The trainer teaches and imparts skills to the trainee based on standard training materials.
The mentor is more experienced in the topic or subject than the mentee.	The coach may not be as experienced as the person being coached.	The trainer is usually more knowledgeable and skilled on the topic than the trainee.
The mentor takes a more active role in helping the mentee work successfully through problems.	The coach takes a more passive role during problem solving, helping the person being coached think through the problems on their own.	The trainer delivers standard training packages to several trainees to achieve defined objectives.
Emphasis is on career progression, behaviour, or all-around personal development.	Emphasis is on performance or behaviour transformation.	Emphasis is on knowledge and skills training, upgrading, and advancing skills.
Usually, it is lasting for a long-time period.	Usually, it is lasting for a short time period.	May be lasting for a short or a long time period depending on the purpose.
It is informal, relationship oriented, and development driven.	It is formal, task oriented, and task or performance driven.	It is formal and usually structured with measurable learning outcomes.

[1] A Mentoring Agreement is a document that can be used to capture the objectives of a particular mentoring activity.

Mentee:

- Works as a 'team player';
- Is willing to work outside of his/her comfort zone;
- Identifies the skills, knowledge and goals needed to achieve and communicates them to the mentor;
- Prepares a list of career goals and objectives and shares them with the mentor;
- Works with the mentor to seek resources for learning such as by identifying people and information that might be helpful;
- Assists the mentor in developing the Mentoring Agreement;
- Commits to meeting with mentor on a regular basis and agrees on how and when those meetings will take place;
- Shares with mentor a preferred way to obtain feedback;
- Reviews agreements reached in the Mentoring Agreement at regular intervals;
- Completes progress reports and regularly re-assesses needs;
- Maintains the confidentiality of the relationship;
- Proactively requests feedback;
- Reads and listens to the mentor's comments carefully and is open to different perspectives.

2.1.5. The mentoring life cycle

Each mentoring relationship is unique and tends to find its own rhythm and intensity. There are many models in use to describe mentoring life cycles, from the initial stages of building a mentor and mentee relationship through to the end of it. A typical example is the *Mentoring Life Cycle model* developed by Clutterbuck [6], which uses a five-phase relationship model.

Building rapport

This usually happens during the first meeting between the mentor and mentee that provides the opportunity for both parties to get to know each other and to build the relationship on which future work will be based. At this stage, they determine if they want to work together or not, set common rules for the mentoring practice, clarify their expectations and establish common grounds.

Setting direction

In this phase, the mentor and mentee gain clarity on the expectations and goals of each party, thus giving a sense of purpose to the relationship. They also clarify what kind of help and assistance the mentee is looking for to achieve the learning goals.

Making progress

This is the most productive phase of the relationship where most of the time and effort is invested. The mentor is supporting the mentee with their commitment, whereas the mentee grows more independent and confident.

Winding up

The mentee is becoming more self-reliant, and the relationship becomes mutual in terms of learning and support. The mentee is fully in charge of the relationship and the mentor's role becomes more reactive and supportive.

Moving On

At this stage, both parties feel that most or all of the goals have been achieved and that it is time to move on. It is important to also manage this part of the relationship and to give it a formal closure so that both parties feel "released" from the commitment. It is also useful in this stage to look back on what has been learned so that the learning can be transferred to a future mentoring relationship.

2.1.6. Different types of mentoring

Mentoring relationships can vary in their approach. They differ depending on the people and the type of organization. They can be open, closed, public, private as well as formal and informal.

Informal relationships are typically created spontaneously and initiated by special interests. The benefits of this type of relationship typically include a high degree of trust, mutual compatibility and flexibility in the way mentoring occurs. The most frequent form of learning in this context is informal learning often supported by social networks. Usually, guidelines for informal mentoring are adopted within the organization to facilitate goals setting, structure the mentoring activities and offer the framework for tracking progress.

Formal mentoring though is often applied and facilitated by an organization. In this type of relationship, goals are clearly established from the inception by the organization, as well as from the mentor and the mentee. This also means that there is an awareness about the knowledge and experiences that needs to be transferred, as well as outcomes that are typically measured. Additionally, the mentor and the mentee are paired based on their compatibility and both the organization and the employees benefit directly.

While informal mentoring is useful to instil a culture of knowledge sharing at an organizational level, it does not support achieving specific measurable goals and objectives at an individual level. Therefore, to derive substantial benefits and to use mentoring as a tool for organizational knowledge management, formal mentoring programmes focused on individual mentoring goals and objectives are the most appropriate way forward.

Different types of mentoring include:

One-to-one mentoring

A predominantly used mentoring mode in which a mentor and a mentee form the relationship. The mentor provides individual guidance and support to the mentee and therefore this type of mentoring focusses on activities that would address individual requirements and development. It requires minimal involvement from responsible departments such as human resources for managing the mentoring processes as the schedules are usually agreed between the mentor and the mentee.

Resource-based mentoring

In this type of mentoring, a one-to-one relationship exists between the mentor and the mentee. The main difference lies in the process of pairing the mentor and mentee. A list consisting of names of mentors is prepared and made available to the mentees to choose. Since the mentee, through interaction and discussion, choses the mentor, it helps in good engagement with the mentoring programme. As there are no formal supervisory processes in forming the mentor-mentee pair, there is a risk of a mismatched pairing.

Group mentoring

As the name implies, in group mentoring, one mentor works with several mentees at the same time. The group of mentees regularly meet with the mentor and discuss on selected topics or issues. The senior mentor provides new insights and guidance as the mentees give their opinions and share experience. It is important to ensure that the group mentoring session is scheduled in a way to maximize attendance from across the group, this may be challenging for shift working groups and careful scheduling and flexibility may be needed.

Reverse mentoring

Reverse mentoring schemes can also prove beneficial for the ageing nuclear workforce. Reverse mentoring creates a reciprocal and mutually enriching relationship, based on two-way communication. It entails building new skills and bridging generation gaps. Two generations are brought together to exchange perspectives, knowledge and experience, in a way that allows senior staff to get fresh perspectives and a better understanding on the views of the younger generation.

Training-based mentoring

This type of mentoring is associated with a specific training programme. A mentor is assigned to a mentee in order to enhance and appreciate the knowledge and skills that he/she is learning through a training course. A good example of this type of training-based mentoring is the reactor operator training where the mentoring is limited and focused on very specific operational tasks and activities.

Executive mentoring

This type of mentoring helps to foster a mentoring culture within the organization. Executives who have reached a high level of success and expertise within the organization can share their knowledge and experience with other relevant personnel in the organization. This helps to retain the knowledge and experience gained over the years within the organization. This type of mentoring works well in a one-to-one setting, especially in the cases when the mentor is preparing the mentee to succeed the mentor.

How the mentoring programme is conducted needs to be agreed between the mentor and the mentee or mentees at the outset and be reflected in the mentoring plan. This could take the form of either all face-to-face, all remote (e.g., teleconference.) or a blend of both. The style of operation ought to be driven by what delivers the best outcome rather than the physical availability of the mentor. The type of mentoring relationship depends on the organization's qualifications and business needs.

2.1.7. Success factors and common drawbacks

The success of the formal mentoring relationship within the organization depends on the mentor and mentee having the required skills, desire to participate and the support of their organization. In order

to increase the effectiveness of any mentoring efforts, it's important to first understand the typical characteristics of the younger generation. Methods such as flexible learning with mobile options, personalized, self-paced content and using modern training aids like virtual reality, augmented reality, social media, and networking are good options to enhance the effectiveness of mentoring activities.

In the relationship between mentor and mentee a high degree of trust and mutual respect is important. If possible, it is the best way for this relationship to be voluntary and mutually agreed upon. A mentor helps the mentee to learn through a supportive relationship. This type of relationship benefits both parties and the organization. The mentee develops more confidence and learns faster and with a higher degree of understanding. The following factors are important for success:

— Committed, resourceful, and motivated personnel;
— Effective team members;
— Treat mentoring activities with higher level of importance to achieve business objectives.

Mentoring without defined objectives/clarity of purpose or clear expectations of the participants may result in frustration and a low degree of motivation.

The willingness and commitment of the mentor to share knowledge and experience and the eagerness and commitment of the mentee to learn are crucial for the success of the mentoring activities. The responsibility to act as mentors and share experiences and knowledge often goes beyond the job responsibilities of individuals. Considering the importance of a knowledge sharing culture for nuclear safety, the role of an organization's leadership and line management is fundamental to gain the willingness and commitment of their employees and to motivate them to participate in mentoring activities and share their experiences and knowledge. A mentor needs to understand the learning style of the mentee to know how to plan and structure the mentoring process.

2.2. COACHING

2.2.1. Definition

Coaching is a method that can be used to try and increase performance. A coach, through observation and dialogue, helps those being coached to find an improved way to achieve set expectations and reveal their potential for further improvement of performance. Coaching is a structured relationship in which the coach helps the person being coached by focusing on behaviour that affects performance [7, 8]. The coach facilitates thinking and exploring of possibilities, and when necessary, filling in gaps of knowledge. Coaching may involve a leader interacting with their staff to improve specific behaviour or skills.

2.2.2. Purpose and benefit

A common purpose of coaching is to enhance an individual's capacity and judgment and to encourage independent action. The coach helps those being coached to adopt the right mind-set so that their answers and solutions emerge from their own interest and thought processes.

Benefits of coaching can include enhanced personal and organizational performance, better work–life balance, higher motivation, greater internal collaboration, better self-reflection, and improvements in personal decision making. Coaching methods are primarily concerned with a task, focus on skills, behaviour, and performance. It typically addresses a short-term necessity and the process encourages feedback and reflection from the learner. In an organizational context, coaching helps with employee and leadership development especially with encouraging motivation, confidence building and self-

belief, as well as self-awareness and ownership of responsibilities for one's own actions. Changes resulting from coaching employees can have a positive effect on the organization through improved styles of leadership, management, and communication.

Coaching is used when an organization seeks to:

- Develop specific supervisory and leadership competences in potential employees;
- Develop one or more potential employees to meet the demands of specific tasks or positions;
- Introduce a new system or programme for which employees need to become more proficient;
- Develop a team of individuals that require increased competency in specific areas.

2.2.3. Characteristics of coaches and the persons being coached

Different coaching competencies are required during the different phases of the relationship between the coach and the coached. Coaches need to show these characteristics:

- Demonstrate that they are open, honest, responsible and that they value others;
- Have self-confidence in being able to work with the people they are coaching through different and difficult challenges;
- Maintain an enabling style throughout the relationship, to avoid slipping into a directive approach and to be self-aware;
- Hold a clear methodology, be skilful in applying the method and its associated tools and techniques, throughout the coaching process.

Some of the desired characteristics of the coach and the person being coached that support a positive outcome of the relationship are:

- Self-awareness: Know about strengths and weaknesses;
- Assertiveness: Confident of the methods, goals and outcomes;
- Communicative: Bring specific examples for well-defined issues;
- Prepare effectively: Well-structured coaching sessions with unique ideas and examples;
- Trust and support: Treat those being coached as partners, encourage their input and trust them to carry out assigned tasks;
- Observant: Know the strengths and weaknesses of the those being coached and the ability to tap into their strengths;
- Respectful: Committed to the relationship and respect the time and abilities of those being coached;
- Positive and enthusiastic: Express encouragement and optimism when dealing with both easy and difficult issues;
- Committed: Committed to their own responsibilities as well as asking for commitment to solutions that have been agreed upon;
- Supportive: Provide needed resources, authority and training. Offer support and assistance to implement change and desired results;
- Constructive: Provide constructive feedback, facilitate the thinking of those being coached, ask questions to explore issues more deeply;
- Encouraging: Encourage new ways of thinking, and to explore different possibilities;
- Diligent: Follows up on the progress and results of the coaching sessions in a timely manner.

Those being coached ought to have a very clear view of what they value within a coaching relationship and they need to show these characteristics:

- Desire for improvement: This quality contributes significantly to success;
- Committed: Committed to being coached and engaged in the process and to own whatever agreements or changes the coaching process may result in;
- Openness: Participates with open mind in discussions and provides honest feedback;
- Trusting: Trusts the coach for a mutually beneficial coaching relationship;
- Engaging: Ask questions, trying to understand what the coach is saying, probing and clarifying to make sure what is being heard is what is being said;
- Motivated and willing: Willing to improve and motivated to set personal goals;
- Enthusiasm: Challenging the coach, exploring the issues more deeply, looking at alternatives, to help clarify the thinking of both participants.

2.2.4. Responsibilities of coaches and persons being coached

The persons being coached retain the responsibility and ownership of the outcomes and are the leaders of the entire coaching process, while the coach tailors the coaching to their needs and allows the person being coached to perform the actions required. The relationship is commonly described as an equal one, neither participant being superior nor subordinate to the other. A relationship is more complex where coaching is used within organizations for specific interventions. This is described in more detail in section 3.

The coach is in charge of the processes, such as:

- Timekeeping;
- Ensuring that the person being coached sets clear goals, strategies, and actions;
- Holding the person being coached accountable;
- Keeping the focus on track of the person being coached.

The person being coached takes responsibility in the following areas:

- Selecting the area of the coaching;
- Identifying the specific goals including possible strategies and actions;
- Choosing the right time frame.

Coaches need to be mindful in providing advice or suggestions to the person being coached. They have to identify such advice or suggestions separate from coaching. They support the approach that the person being coached already has a lot of the knowledge he/she needs; the coach is there to help them tap into it.

2.2.5. Different methods of coaching

Coaching is frequently used as an intervention aimed at performance improvement or developing a particular competence and refers to personal development methods that enhance a person's own abilities in order to change conduct or improve behaviour and performance.

Coaching is usually limited and defined in time (short term) and does not require an extensive planning phase. Coaching can be conducted almost immediately on a given matter, for example, in the case of a safety intervention when a safety hazard may exist or be created by an ongoing action. If an organization seeks to provide coaching to a large group of individuals, then certainly some planning is

required in order to determine the competency area, expertise needed, and assessment tools used, but this does not necessarily require a long lead-time to actually implement the coaching programme.

The immediate manager of those being coached is a key partner in coaching. They often provide the coach with feedback on areas in which their employee is in need of coaching. The coach uses this information to guide the coaching process. The manager and the coach can be the same person with the coaching being focused on developing inter-personal or technical skills.

Professional coaches use a number of tools and techniques to encourage reflection, analytical thinking and discussions. Some of these include reflective thinking, probing, brainstorming, challenging and critical thinking, using assumptions, etc. Various task-oriented models are in popular use and deployed across the nuclear industry such as the GROW[2] model which provides a framework to support coaching sessions with questions relating to person's goal, reality, options and will. The STEER[3] model is similar and also task oriented. Another approach uses solution focused coaching, which is somewhat different from the above models. The OSKAR[4] model uses this approach. It is applied to identify what is working well and to reproduce it. In this model, the focus is on solutions to problems rather than on the problems themselves. It centres on highlighting the current skills and abilities of the person in order to grasp their self-defined goals. All models and tools are centred on encouraging discussions and meeting sessions to reach set objectives.

Most of the processes and approaches involve a series of focused discussions or joint working sessions, directed by agreed and specific goals for each session. Both parties need to willingly participate with clear expectations, the agreements set out and with an understanding of the process. Between sessions the people being coached will reflect on the former session and practice new methods and working styles which are reflected on and discussed in the following sessions. In connection to knowledge transfer and learning, a coach works with an employee in process problem solving, root cause analysis and collaborative problem-solving skills or other work-related issues.

2.2.6. Success factors and common drawbacks

Success factors:

- The coaching relationship needs to be built on trust and respect and this needs to be maintained throughout the process;
- The person being coached needs to be committed to change;
- The choice of the right coach ought to be a decision made between the employer, the coach and the person being coached;
- Both coach and the person being coached ought to plan for the coaching (unless immediate on the job coaching is required due to the observation of performance shortfalls);
- Coaching ought to be seen as a fundamental activity and part of an ongoing development process and not as an add-on activity;
- Organizations and managers need to provide support for the process, as well as appropriate funds and time;
- Patience is imperative from both the coach and the person being coached.

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[2] GROW: Goal, Current Reality, Options (or obstacles) and Will (or way forward).

[3] STEER Model of Coaching: S – Spot training needs, T – Tailor training content to meet the needs of individuals, E – Explain and demonstrate how the task should be done, E – Encourage the individual while he/she is learning, R – Review progress during and on completion of learning.

[4] OSKAR: Outcome, Scaling, Know-How, Affirm & Action and Review.

Common drawbacks:

- Failing to clearly define the coaching objectives and adjusting the requirements to meet them (e.g., an oral discussion might not be an optimal tool to assure that the person being coached obtains the skill of replacing a pump);
- Failing to follow up on the coaching sessions and to monitor that the desired outcomes were achieved. It is important to be aware that sometimes the person being coached also does things to challenge the relationship through a lack of commitment, having unrealistic expectations, being passive, not willing to take risks, being too dependent on the coach or blaming others.

3. GUIDANCE FOR MENTORING AND COACHING ACROSS EMPLOYEE LIFE CYCLE

Mentoring and coaching activities are centred around people. Beneficial mentoring and coaching programmes may be systematically implemented across an employee life cycle by following the guidance provided in this Section.

3.1. IMPORTANCE OF MENTORING AND COACHING FOR THE NUCLEAR INDUSTRY

It involves significant time and effort for personnel working in nuclear organizations to acquire the high level of technical knowledge and skills required for the different engineering and science disciplines [9]. For example, it takes about 5 to 7 years to develop a reactor operator, 7 to 10 years for a shift supervisor and more than 10 years for a senior safety engineer that engineers and evaluates safety upgrades of a nuclear system. In addition to their initial training and educational qualifications, nuclear professionals acquire the skills and experiences through working and interacting with more experienced personnel in their area of work and exposure to the unique opportunities of working with nuclear technologies. It is, therefore, important to institute structured mentoring programmes in nuclear organizations to develop individual and team competencies as career development occurs within nuclear organizations.

Nuclear organization such as NPPs need to ensure they maintain the correct number of qualified individuals in all technical roles to ensure safety and to meet the challenges of the business [3]. Achieving this ensures technical resilience. A focus on the technical resilience of an organization ensures that adequate arrangements are put in place to develop and maintain key technical managerial positions.

Some of the factors that influence the need for mentoring activities in a nuclear organization are:

- The significance of the safety requirements;
- The time and effort needed to transfer knowledge and skills;
- The economic and business sustainability considerations;
- The number of people in an organization possessing such knowledge and their time to retirement or separation from their current position;
- The regulatory and legal requirements to maintain organizational knowledge.

Within nuclear organizations the behaviour demonstrated by individuals while performing their duties is a key driver in maintaining the safety and in improving the performance of the industry. Coaching helps to develop, grow, and maintain the right behaviour and attitudes for safety. For example, managers and supervisors in NPPs use field visits as opportunities to coach and reinforce the right behaviours that support safety and performance. Some examples are:

- Use of error prevention tools [10] such as self-check, STAR (stop, think, act, and review), peer check, independent verification and effective communication techniques like three-way communication;
- Demonstrate behaviours such as a questioning attitude, critical thinking, use of personal protective equipment, foreign material exclusion practices that support safe and reliable performance;
- Use and adhere to the procedures for performing critical tasks;
- Conduct effective pre-job briefs that ensure all personnel involved in an activity are aware of the task including past experiences and potential consequences;
- Conduct effective post job debriefs to capture the lessons learned accurately.

3.2. MENTORING ACROSS THE EMPLOYEE LIFE CYCLE

The application of mentoring techniques starts as soon as new recruits start their training phase. The focus, objective and scope of mentoring varies in different employee life cycles. Figure 2 highlights five employee life cycle phases and the focus of mentoring in those phases.

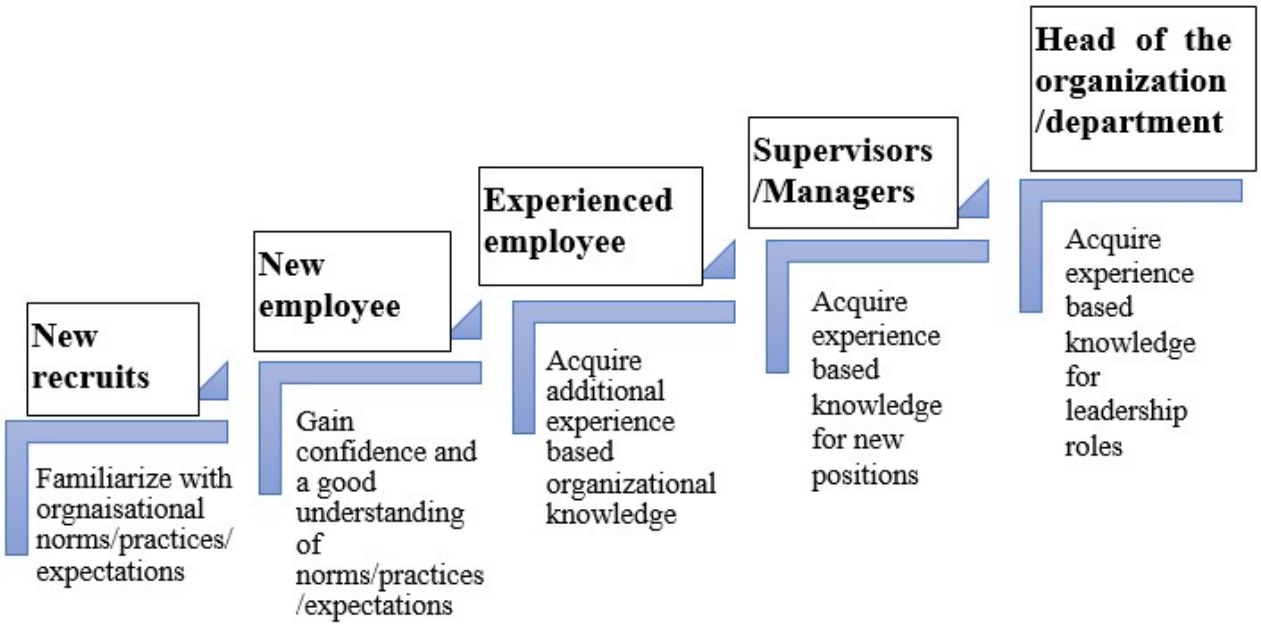

FIG. 2. Mentoring techniques as the employee moves through an organization

Table 2 provides examples of the purposes for mentoring to occur and possible tools and methods that could be adopted for the mentoring in the five different life cycle phases. This serves as a guide for deploying mentoring activities at different levels of an organization. The following sub-sections describe the use of mentoring in each of these five phases.

3.2.1. New recruits

After new employee recruitment, nuclear organizations usually provide structured training to introduce nuclear specific skills and knowledge. The content and duration of this training depends upon the nature of the job to be performed by the new recruits and their level of previous education. The training period provides a good opportunity to mentor the new recruits and familiarize them with organizational routines, culture, norms and values. Experienced staff from the training section or from technical departments act as mentors. Although it is preferable to have one-to-one mentoring, in some cases where there are significant numbers of trainees, group mentoring can also be considered. Well-defined mentoring programmes with identified activities, objectives and adequate time allowances for implementing the programmes are essential for success.

TABLE 2. MENTORING ACROSS THE EMPLOYEE LIFE CYCLE

Job role or position	Purpose of mentoring (types of mentoring are selected considering future assignments)	Tools and aids
New recruits	— To become familiar with the organizational culture, context, and adapt to the new working environment; — To enhance appreciation for the knowledge/skill related to their work.	— Involvement of experienced training department and facility personnel as mentors; — Understandable job specifications and description or demonstration of the activities. A pocketbook containing the expectations of the organization.
New employees	— To gain confidence and good understanding of the norms, practices and expectations; — To learn practical tips and experiences.	— Involvement of experienced colleagues as mentors; — Technical and Human Resource (HR) procedures/policies; — Involving the new employee as an observer or support staff in critical activities or jobs.
Experienced employees	— To acquire additional experience based organizational knowledge.	— Experienced personnel possessing critical organizational skills and knowledge act as mentors; — Involvement of mentors from external organizations may be useful in some cases.
Supervisors and Managers	— To acquire experience-based skills and knowledge that are necessary for their new leadership role.	— Personnel who served in the same or similar roles act as mentors; — In some cases, HR or financial experts may act as additional mentors to explain the financial and administrative rules and regulations of the organization.
Heads of an organization or department	— To acquire experience-based skills and knowledge that are necessary for their new leadership role.	— Current or retired senior staff of the organization act as mentors; — HR, financial or legal experts as additional mentors.

3.2.2. New employees

Mentors are assigned to new employees to help them assimilate into the organization. The mentor provides guidance through the onboarding (integrating a new employee into an organization) by answering questions and sharing experiences.

In the case of knowledge workers who work predominately in engineering, research, and development organizations, most of the technical jobs performed do not have discrete tasks but involve application of extensive education and experience. For this category of workers, mentoring is used in the following ways:

— After meeting the initial qualification and training requirements, newly hired individuals are assigned with mentors who guide them through applying the various technical processes unique to their assignments;

— This working relationship lasts until the newly hired individual has demonstrated that he or she can correctly apply the processes without direct supervision. For example, at an NPP, a newly hired engineer assigned to design plant modifications [11] may work closely with a more experienced colleague until the new engineer can implement the process independently.

In case of task-based workers, mentoring is helpful in transferring task-related operating experience from more to less experienced workers. For example, an experienced plant operator may help a newer plant operator start up a boiler by revealing techniques that are consistent with but not included in written procedures. In another example, an experienced project manager may be helpful to a newer project manager by sharing experiences related to pouring concrete under harsh environmental conditions.

3.2.3. Experienced employees

The process of mentoring experienced employees needs to be driven by the knowledge management objectives of the organization. The identification of useful, significant, and critical knowledge as well as personnel possessing such knowledge is an important first step to start a structured mentoring programme for experienced employees.

As part of knowledge management initiatives or otherwise, organizations can perform knowledge loss risk assessments [12] to identify personnel and competencies at risk of loss. The mentoring programme for experienced employees, therefore, needs to be derived as a mitigation action to address the knowledge loss issues identified during such initiatives. In some cases, the personnel possessing significant and critical knowledge, who are on the verge of retirement or transfer to another job position, are selected as mentors. Talent management and succession planning programmes also provide inputs to mentoring activities for experienced employees. They help in identifying suitable mentees.

The mentoring programmes for experienced employees are usually one-to-one with well-defined objectives and activities and are time framed, focusing on enhancing the technical proficiency of the mentee. In some cases, mentoring is used to prepare the mentee for greater levels of responsibility including management and leadership positions.

3.2.4. Supervisors and managers

Individuals who demonstrate the potential for higher levels of responsibility can be assigned with mentors to reinforce organizational norms and to guide their understanding of both the explicit and implicit management expectations.

In the case of task-based workers, this type of mentoring is used to prepare high-potential individuals for greater levels of responsibility such as frontline supervisors.

Organizations with well-designed succession planning and talent management programmes identify potential individuals for supervisory and managerial positions using a systemic process. Experienced supervisors and managers who have worked with similar responsibilities act as mentors.

This type of mentoring is well suited to a one-to-one mode.

3.2.5. Head of the organizations or departments

The head of an organization or a department usually has very strong experience in one or two core functions of the organization or department. It is important for them to acquire a reasonable level of

understanding on other core and support functions as well. In addition, they also need to have administrative, financial and legal knowledge to effectively deliver their duties. For example, the plant manager of a nuclear facility may have a strong experience base in operation or engineering functions, but also needs a good understanding of maintenance functions besides contracts, materials management, and environmental regulations, etc.

The mentoring programmes for personnel occupying such positions, are therefore to be carefully prepared by considering their experience and background. Experienced personnel who have held similar positions, including retirees, act as mentors.

3.3. MENTORING FOR SPECIFIC SITUATIONS

In addition to regular mentoring programmes explained in Section 3.2 above, there may be situations that would demand specific mentoring activities. Table 3 lists three typical activities. The sub-sections below describe them.

3.3.1. At the time of job or position changes

Within an organization, situations may arise that demand personnel to be transferred to another position or acquire further responsibilities. For example, in an NPP, a shift supervisor may be transferred to take the responsibility of a system engineer. In such situations, tailored mentoring programmes with a focus to help the mentee acquire experience-based knowledge needed for the new position or job are to be established. Whenever possible, the predecessor of that position should act as the mentor.

3.3.2. Transfer of significant or critical skills and knowledge from personnel including retirees

Sometimes, processes such as exit interviews may identify some highly experienced individuals possessing specialized or hard-to-obtain knowledge at the time they leave the organization. Before these individuals leave the organization, they are assigned to mentor less experienced colleagues as a means of transferring that knowledge and retaining it within the organization. For example, an experienced nuclear plant system engineer may possess detailed knowledge of component performance history. Before retirement or reassignment, this knowledge needs to be transferred to the successor.

The mentoring programme in such situations needs to be carefully prepared by considering the significant and critical knowledge at risk including the tacit knowledge possessed by the individual. In addition to mentoring, there may be a need to use other knowledge transfer techniques such as elicitation interviews, knowledge mapping or video recording to capture the tacit knowledge effectively.

3.3.3. Chief executives and board members

These high-level decision-making personnel, sometimes, come from outside the organization and need insights and knowledge that provide a good understanding of the various functions and activities of the organization and the inherent risk involved. This type of mentoring programme is typically informal in nature. Experienced senior personnel in the organization including retirees act as mentors.

TABLE 3. MENTORING FOR SPECIFIC SITUATIONS

Job role or position	Purpose of mentoring	Tools and aids
Personnel changing a job or position	— To ensure relevant knowledge and experience are passed on to the successor during job or position changes.	— Person leaving the position acts as mentor; — Job or position handover documentation; — Talent management plan or succession plan; — Time schedule.
Personnel holding significant or critical skills and knowledge including retirees	— To transfer and sustain significant or critical knowledge within the organization; — To transfer knowledge over a longer period of time (selection of right mentees is important).	— Identification of significant or critical knowledge holders as mentors through a structured process [12]; — A systematically developed mentoring programme schedule, considering sustained organizational knowledge management; — Selection of right mentor and mentee pair; — Consider developing documented knowledge such as a book of experience or a knowledge map.
Chief executives and board members	— To acquire knowledge on high level technical, administrative, financial and legal aspects of the business.	— Usually, informal mentoring involving relevant experienced experts.

3.4. COACHING ACROSS THE EMPLOYEE LIFE CYCLE

Coaching is useful to instil the behaviour that support safety and performance improvement [13, 14]. Coaching techniques are predominantly utilized at the later stage of an employee's development to help improve performance on specific tasks or job positions. Figure 3 below highlight four typical life cycle phases in which coaching can be deployed.

Table 4 provides examples of reasons for coaching to occur with the possible tools and methods that could be adopted for the coaching in the four phases of the life cycle. This serves as guide for deploying coaching activities at different levels of an organization. The sub-sections below describe the use of coaching in each of these four phases.

3.4.1. New employees

Effective coaching requires that the individual being coached already has the necessary knowledge but may need help in understanding how that knowledge is to be applied. Coaching during the initial period is therefore limited to helping individuals to apply their previously attained knowledge and skills from their initial training, education, and previous experiences.

Managers and supervisors working in nuclear organizations need to ensure that the behaviours exhibited by their personnel reflect a strong commitment to nuclear safety [5]. The most appropriate time to instil these behaviours effectively through coaching is when an employee joins the organization.

Experienced staff who are trained in coaching skills are typically used as coaches in this phase.

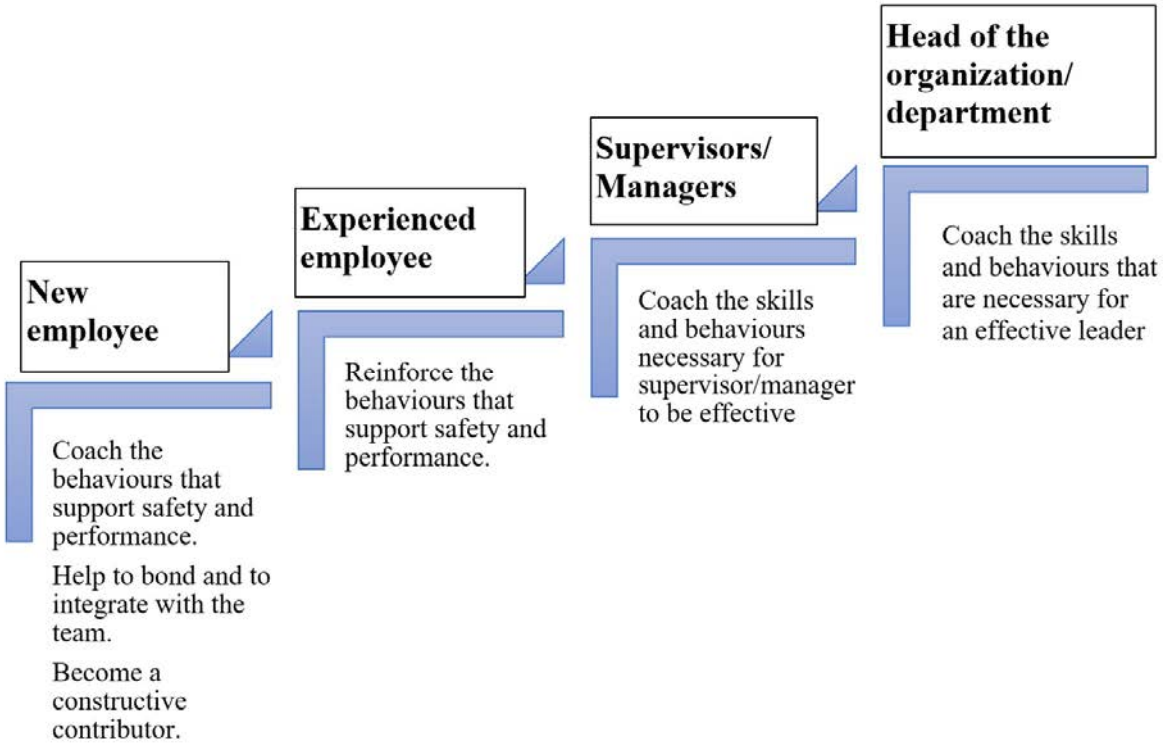

FIG. 3. Coaching techniques as the employee moves through an organization.

3.4.2. Experienced employees

Experienced individuals are coached to reflect on, learn from, and apply the lessons from their own earlier successes and failures. The areas in which the coach can be helpful will likely expand to include forming and retaining effective work habits.

Self-assessment reports and external reviews for nuclear facilities such as from the Operational Safety Review Team (OSART) missions or the peer review from World Association of Nuclear Operators (WANO) often identify behavioural issues responsible for a decrease in safety and performance. These findings form the basis for selecting the right topics for coaching experienced personnel.

The coaching of experienced skill-based workers promotes the behaviour that support the management of safety and performance consistently at high levels. For example, an operator preparing for an important task is observed performing a superficial pre-job briefing. A peer, acting as a coach would ask a series of questions to help the operator understand the importance of thorough briefings. These questions may include:

- Why was the briefing completed so quickly?
- What details were left out of the briefing?
- Why were these details left out?
- What are the potential consequences of missing these details?
- Why are you confident that the purpose, scope, and risks of the job have been understood?

Another example might be related to a project staff member and could include the following questions:

- What factors are causing the project to be behind schedule?
- What are the risks of schedule delays?

— What were the indicators that the schedule would slip?
— How did we respond to those indicators?
— What could we do the next time these indicators appear?
— Did we complete a learning brief to capture the lessons learned for future projects?

TABLE 4. COACHING ACROSS THE EMPLOYEE LIFE CYCLE

Job role or position	Purpose of coaching	Tools and aids
New employee	— To coach the behaviours that support safety and performance in nuclear organizations; — To help bond and integrate with the team; — To become a constructive contributor.	— Experienced organizational staff trained on coaching skills; — Technical and HR procedures and policies.
Experienced employee	— To improve and reinforce the behaviours that support safety and performance in nuclear organizations; — To address behavioural issues identified through self-assessments and external assessments including regulatory inspections.	— Supervisors and managers trained on coaching skills; — Provide coaching at job sites as supervisors and managers observe jobs and activities (e.g., reinforce the correct use of procedures, human error prevention tools, foreign material exclusion practices and safe material handling practices).
Supervisors and managers	— To coach skills and behaviours necessary to be an effective supervisor or manager; — To improve the skills necessary for supervisory and managerial positions such as inter-personal communication, conflict management, decision making and negotiation; — To improve the skills of administrative and financial management that are necessary for such roles; — To improve the skills of inter-sectional or inter-departmental interface.	— Usually done by professional coaches through a structured coaching programme.
Head of an organization or department	— To coach the skills and behaviours necessary to be an effective leader; — To improve the skills necessary for managing an organization's human and financial resources efficiently; — To improve communication skills for dealing with external organizations and entities including the media and public.	— Usually done by professional coaches through a structured coaching programme.

Supervisors and managers trained in coaching skills typically act as coaches in this phase.

3.4.3. Supervisors and managers

In nuclear organizations that deal with state-of-the-art technologies and have the potential risk of consequential accidents, the supervisors and managers play a key role in ensuring that the activities performed by them and their team are done with due diligence in order to ensure the practices followed

promote a culture of safety and improved performance. Coaching for personnel moving to supervisory or frontline managerial positions, therefore, focusses on introducing the skills and attributes that enhances their ability to deal effectively with the responsibilities of their new supervisory and leadership functions.

The coach pays more attention to how the individual acts in team settings, particularly when the individual is assigned to lead the team. Specific topics of interest might include how well the individual recognizes and responds to differing personality and communication styles as well as the individual's ability to provide feedback in a positive, constructive manner. Other topics might include the individual's ability to prioritize and delegate work and to hold others accountable to meet committed deadlines and quality expectations.

Through coaching programmes, supervisors and frontline managers gain the following capacities to support managerial and leadership skills:

- Familiarity with various leadership styles and understanding their impact on the relationship between senior and junior staff;
- Increasing awareness of leadership behaviour with the help of leadership related role plays;
- Communication techniques applicable to leadership;
- Support to understand the critical knowledge on technical challenges;
- Motivating employees: prerequisite for successful cooperation;
- Praise and criticism as a means of leadership;
- Establishing a dense communication network with and among leaders;
- Achieving consent and conflict resolution;
- Getting to know the various types of conflict in order to avoid, resolve or work through the conflict.

Usually, organizations develop tailored coaching programmes that last for a week or two to cater for this type of coaching. It is performed typically by professional coaches hired by the organization.

3.4.4. Head of an organization or department

The coaching programme for the heads of nuclear organizations or departments ought to prepare the individuals to effectively deal with the unique administrative, financial, legal, and regulatory challenges associated with their responsibilities. In many cases, senior management personnel have to deal with the public living near the nuclear facility. The coaching programme for these personnel needs to be carefully developed by considering the demands of their positions.

The focus is to help individuals develop their capacity to deal with change and support them in reaching their organization or work-related goals. It can be viewed as a relationship formed between an employee who has leadership and managerial authority and a qualified coach who uses a range of behavioural techniques. These techniques help the individual to achieve a mutually agreed set of goals with the aim of improving their leadership skills, professional performance, and effectiveness within the organization.

Through coaching programmes, senior managers and leaders may gain the following capacities to support managerial and leadership skills in addition to those listed in section 3.4.3.

- Clarifying the leader's vision, in alignment with their values to add authenticity, job satisfaction and impact;
- Exercise the leader's agility, that brings flexibility and adaptability for change and innovation.

Industry typically uses tailored coaching programmes and professional coaches to suit the needs of specific job positions. Some nuclear operating organizations have specially designed leadership courses for their plant managers that run typically for 3 to 4 weeks.

3.5. COACHING FOR SPECIFIC SITUATIONS

In addition to regular coaching programmes explained under Section 3.4. above, requirements may arise for coaching to enhance the performance of individuals and teams. Table 5 lists some of these situations which are further described in the sections below.

TABLE 5. COACHING FOR SPECIFIC SITUATIONS

Coaching situation	Purpose of coaching	Tools and aids
Team development	— To improve the effectiveness and performance of the team (within and between teams); — To enhance teamwork performance (e.g., the operation crew of NPPs or nuclear facilities)	— Supervisors or managers trained in coaching skills or professional coaches, depending on the nature of the team and the problem to be solved; — Psychometric testing to ensure the team composition supports effective performance; — Team building workshops or sessions to improve skills such as role clarity, communication, team dynamics and trust (exercises are used to demonstrate and reinforce desirable behaviour).
Coaching for specific skills	— To improve specific skills and behaviour for selected activities.	— Personnel who have mastered technical skills in selected areas and coaching skills; — Using specific tasks as examples; — Specially designed mock-ups and practical aids.

3.5.1. Team development

Many activities in nuclear organizations like NPPs are performed in a team setting. The size of the team could range from a few to a few dozen people, depending upon the nature of work. The operational shift crew of an NPP is a good example of a group of people that can benefit from this type of coaching. Synergy within the team and a clear understanding of the roles and responsibilities of the individuals and teams under normal operation, anticipated operational occurrences or abnormal situations are essential requirements for such teams. The skills acquired through coaching are important for team players in a typical NPP operation environment and play a significant role in achieving improvements to plant safety and reliability.

Another important area for using team coaching are plant maintenance activities. Maintenance activities on components important to safety such as steam generators, control rod drives, fuel handling devices and systems, reactor regulation and protection systems are always performed by dedicated teams. Coaching such teams to enhance team working capabilities with a focus on nuclear safety and equipment performance contributes significantly to the overall organizational performance.

Professional coaches are used to provide team coaching, it involves several team building exercises and role playing.

3.5.2. Specific skills

The coaching programmes described in Sections 3.4 and 3.5 focus predominantly on enhancing behavioural skills. Coaching can also be an effective tool for developing and improving technical abilities and skills. There are numerous opportunities for coaching technical skills in the nuclear industry, as it uses uniquely designed and engineered structures, systems and components that require unique skills for their maintenance and management over their life cycle. Designers and manufacturers of such structures, systems and components often provide the coaching to dedicated operating organization personnel with the objective to improve the required technical skills and abilities.

For example, in NPPs, the reactor coolant pumps are safety category 1 nuclear components that are uniquely designed and manufactured. The expertise of manufacturers is used to improve the technical abilities of the personnel that are responsible for the maintenance of the pumps and motors.

4. GUIDANCE FOR DEVELOPING A STRATEGIC MENTORING AND COACHING PROGRAMME

The overall objective of knowledge management is to ensure that valuable and unique insights, experience and lessons learned are identified and that any risk of knowledge loss is mitigated [12] using effective knowledge transfer initiatives. Strategically planned and conceived mentoring and coaching programmes occupy an essential part of such knowledge management initiatives.

The widely used SECI model (Nonaka & Takeuchi 1996) explains the process of knowledge creation and transfer in organizations using a four-stage cyclical process as shown in Fig. 4.

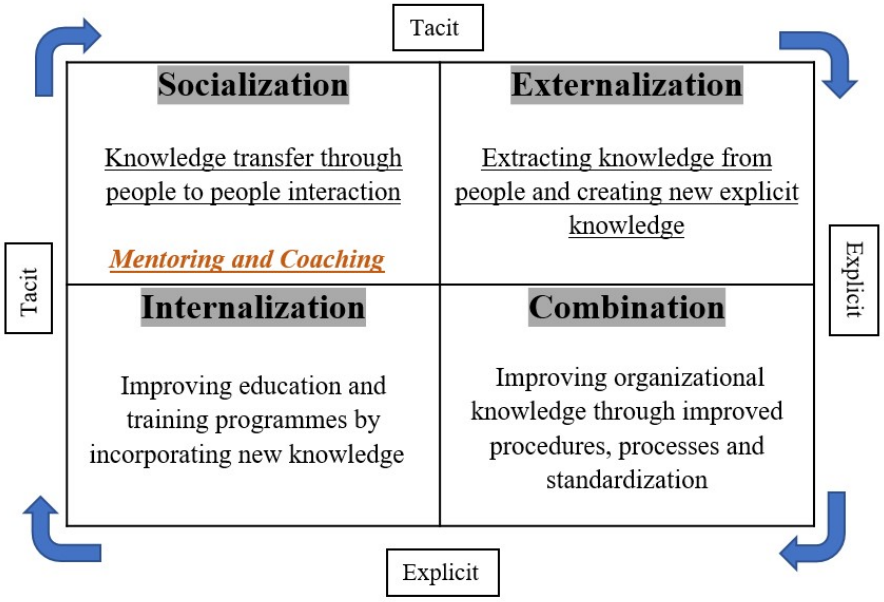

FIG. 4. The use of mentoring and coaching techniques for organizational knowledge transfer using the SECI model.

The four stages of knowledge transfer are:

- Socialization: Tacit-to-tacit knowledge transfer takes place through social interaction. One effective transfer technique used by organizations in this domain is mentoring and coaching among others such as counselling, observation, shadowing, and forming communities of practice;
- Externalization: Tacit knowledge is converted to explicit knowledge using techniques such as elicitation interviews, concept mapping, process mapping, after action reviews (AAR) and corrective action programmes (CAP);
- Combination: In this stage, improved processes, procedures, and methods are created to exploit the knowledge efficiently and systematically;
- Internalization: In this stage, the new knowledge is internalized through education and training.

The knowledge management strategy of an organization needs to carefully consider the appropriate techniques, tools, and methods to be deployed with their level of use in each of the four quadrants, in order to achieve its knowledge management objectives. The first quadrant activity that promotes socialization is crucial as it promotes the tacit-to-tacit knowledge transfer within the organization and, therefore, it is responsible for the success of the activities in the other three quadrants as well as the overall organizational knowledge creation and sustainability.

Mentoring and coaching are two of the most important techniques to be considered in the first quadrant. Mentoring helps the systematic transfer of tacit knowledge from the more experienced to less experienced personnel. Coaching helps to transfer and sustain correct behaviour and skills.

A systematically developed mentoring and coaching programme uses the five steps shown in Fig. 5.

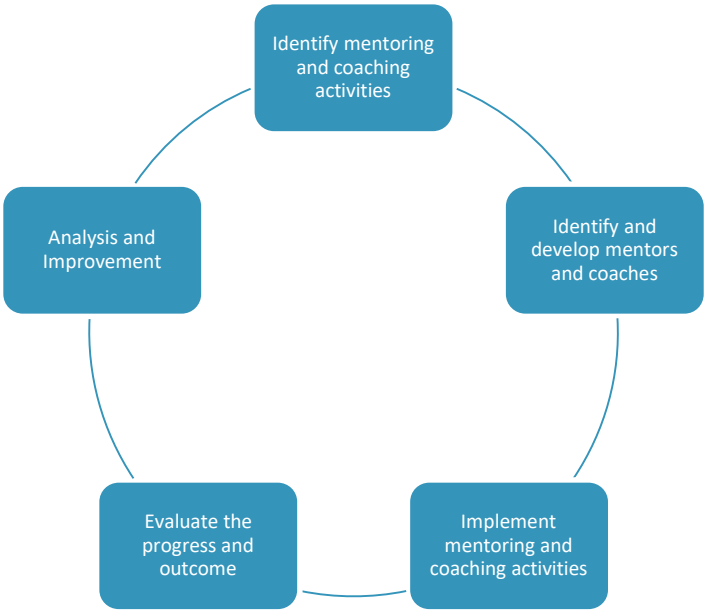

FIG. 5. The five steps of developing a mentoring and coaching programme.

The above steps are elaborated in the following sections.

4.1. IDENTIFICATION OF MENTORING AND COACHING ACTIVITIES

The first step is to identify mentoring and coaching activities for different departments and sections. While the approach described in section 3.2. through 3.5 is useful in systematically developing mentoring and coaching activities starting from new recruits to the head of the organization, it is important to consider the organizational needs for knowledge and skills transfer, based on inputs from several sources including:

- Identified knowledge transfer activities to meet the goals of an organizational knowledge management strategy;
- Mitigation measures identified through knowledge loss risk assessment [12] or similar exercises;
- An organization's talent management and succession planning programme including planned human resource development programmes;
- Performance review, audits and inspections that identify knowledge and skills gaps, etc.

In order to ensure that the mentoring and coaching programmes are optimally utilized, a system that considers all relevant inputs to identify the right mentoring and coaching activities is essential. The identified activities need to focus on the transfer of relevant organizational skills and knowledge and, therefore, need to have well-defined objectives and goals.

This step also should identify a policy and criteria for identifying mentees and those requiring coaching. The organization's policy for development of human resources including succession

planning needs to be considered in this step. Section 2.1.3. and 2.2.3. describe the characteristics for selecting mentees and those requiring coaching.

4.2. IDENTIFICATION AND DEVELOPMENT OF MENTORS AND COACHES

Identifying suitable mentors for each of the identified mentoring activities is the crucial next step. The fundamental requirement to be considered for selecting a mentor is the right level of technical experience. In addition, the characteristics provided in Section 2.1.3. may be used to identify mentors with the right qualities. A short orientation training prior to the mentoring is useful for any potential mentors.

Identifying suitable coaches within the organization is not as straight forward as selecting a mentor. Section 2.2.3. provides the characteristics of a good coach which aids the selection of suitable coaches. It is essential to provide training on coaching techniques for the selected personnel before using them as coaches.

Professional coaches from external organizations that are used in coaching activities need to be experts in their relevant field.

4.3. IMPLEMENTATION OF MENTORING AND COACHING ACTIVITIES

It is essential to identify ownership for the mentoring and coaching programme at the organization, department, or section level before actual implementation. Usually, senior human resource or training department personnel lead the implementation at the organizational level and the heads of departments or sections take the lead in their respective domains. A yearly calendar schedule of mentoring and coaching programmes for organizational, departmental, and sectional level activities is a useful tool to monitor and make adjustments to the programme.

It is always good to start mentoring and coaching as pilot activities. For example, activities may be started in one of the sections or departments or a limited number of activities may be selected based on their importance at organizational level. The evaluation of a pilot activity provides useful insights for improvement before commencement of the full scope implementation.

4.4. EVALUATION OF THE PROGRESS AND OUTCOME

A comprehensive and accurate evaluation of the entire mentoring and coaching programme activities requires the establishment of an appropriate evaluation system and the selection of key indicators. The evaluation can be used to assess the:

- Performance of mentor or coach;
- Performance of mentee or person being coached;
- Knowledge and skills transferred;
- Process and its efficiency.

The key elements against which the mentor or coach would be evaluated include:

- Technical skills;
- Willingness;
- Mentoring or coaching skills.

The key elements against which the mentee or person being coached would be evaluated include:

- Knowledge and skills base that supports the ability and foundation to receive and implement the new knowledge and skills;
- Willingness to learn;
- Personal qualities including the ability to understand, comprehend and communicate.

The key elements for evaluating the knowledge and skills transferred include:

- Efficiency of the knowledge and skills transfer (comparing the desired knowledge and skills transfer with what is actually achieved);
- Level of difficulty encountered to transfer the knowledge and skills;
- Level of the overall appreciation gained for the business functions and activities;
- Level of the personal quality improvements such as ways of thinking, enthusiasm, and persistence.

The key elements against which the process used for the knowledge transfer would be evaluated include:

- The issues affecting the establishment of the relationship between the mentor and mentee or coach and person being coached;
- The issues around planning, scheduling and execution;
- The efficiency of the mentoring or coaching process (time needed for the actual knowledge and skills transfer versus the planned time);
- The use of tools to enhance knowledge and skills transfer.

An evaluation method covering the above four aspects that can serve for different mentoring and coaching activities ought to be developed. Table 6 in the Appendix provides typical questions that can be used for the evaluation of mentoring and coaching activities.

It is also important to consider an evaluation beyond mentor and mentee to understand the impact of mentoring and coaching activities from an organizational perspective. For example, a 180/360 degree feedback is a useful technique in such situations. In a 360-degree feedback, the evaluation is conducted by involving relevant superiors, colleagues and subordinates of the mentee or person being coached. This is typically done after a period of 6 months to one year to measure the changes observed in the performance of mentee or person being coached. In the 180-degree feedback, the evaluation is conducted only with relevant superiors and colleagues.

4.5. ANALYSIS AND IMPROVEMENT

While the evaluation of individual mentoring and coaching activities may reveal specific issues, performing a common cause analysis by aggregating the evaluations of groups of similar activities, will reveal opportunities for improvement for the overall mentoring and coaching programme. The trends of issues identified over a period of time needs to be captured and analyzed to identify the causes and contributors.

Responsible personnel need to be identified at section, department, and organization levels to perform the analysis and identify improvement opportunities. Typically, a team consisting of representatives from technical, human resource, and training departments conduct the analysis at fixed time intervals, for example once every six months.

In addition to improvement opportunities identified through the above analysis, there may be other requirements to make changes to the mentoring and coaching programme. Periodic self-assessments, internal and external reviews including regulatory reviews may call for changes to the ongoing mentoring and coaching programmes as part of continuous improvement.

5. CONSIDERATIONS FOR NUCLEAR ORGANIZATIONS

For different types of nuclear organizations, consideration for developing effective mentoring and coaching can be analyzed by examining the nature of the activities performed.

Case studies from national nuclear organizations, from a range of countries, and from international organizations supporting the nuclear industry can be used as examples of their different approaches for implementing mentoring and coaching programmes.

5.1. NUCLEAR CONSTRUCTION ORGANIZATIONS

The construction phase of NPPs, on average, lasts for about five to eight years, which is a significantly shorter time when compared to the operating phase. However, intense work activities happen during the construction phase with typically more than 5000 people working on the construction. The construction of the nuclear facility is usually not undertaken by the organization that will operate the facility. The construction organization possesses the unique project management and construction skills required for nuclear facilities [15]. The precision and quality requirements for a nuclear facility construction are based on requirements for its high safety and operational performance. The construction of large engineering structures and installation of precision manufactured nuclear components such as reactor pressure vessels including its internal components and reactor coolant pumps provides good experience-based learning to the personnel working on these projects. Focused mentoring activities to young engineers involved in the project on specific techniques applied during the construction are essential to sustain the skills of nuclear facility constructions. With the stagnation in new nuclear plant construction in many Member States, it is more important to establish mentoring programmes and knowledge transfer initiatives with the aim to ensure that construction knowledge and skills are not lost.

When the facility construction reaches the stage of commissioning, an important opportunity arises for the operating organization staff to learn as the testing and commissioning provides valuable experiences which are useful in the operation phase [16]. Planned engagement of the operating organization's staff in commissioning with the aim of learning from commissioning experts provides an excellent opportunity to gain unique commissioning experience and knowledge. Usually, the operation staff learn by shadowing the commissioning experts. Formal mentoring programmes with specific learning objectives to facilitate learning during commissioning are useful to acquire important commissioning experiences systematically.

5.2. NUCLEAR OPERATING ORGANIZATIONS

The operating phase of a nuclear facility such as an NPP ranges from 40 to 80 years and it involves unique challenges to knowledge transfer as two or three generations of workforce are engaged. This phase also uses a range of competencies including many safety significant ones to operate and maintain the facility. The personnel working in operating organizations gain significant experience-based knowledge as they work through their career. It is important to ensure the organization does not lose the critical knowledge gained by its personnel over the years as it is essential for its safety, continued growth, and performance improvement. A well-designed formal mentoring programme that considers the above factors is essential to achieve successful knowledge transfer across generations of staff.

The department responsible for the operation of the facility uses suitably qualified and experienced staff to operate the facility. They gain valuable experience when they encounter challenges arising during operational and outage periods. For example, they gain important experience as they deal with equipment or component failures, transients and abnormal or emergency operational conditions [14].

Systematically derived and implemented mentoring and coaching programmes are essential to transfer experience based critical knowledge gained by the senior plant operation staff to more junior staff.

For example, Bruce Power, Canada, have three types of formal mentoring programmes for plant operation personnel:

— A senior manager is assigned to oversee the development of new shift managers during their training in non-technical areas prior to assuming the role as shift manager. This mentoring programme typically lasts for four months;
— Candidates on a training programme for control room positions are assigned a mentor. The mentor holds a dedicated position called the Assistant Operations Manager for Training. One mentor is assigned for each station with the purpose to increase the number of people qualified to work in the control room;
— A mentoring team helps non-licensed field operators to improve operator fundamentals.

In addition, they have an informal mentoring programme during which the operation leaders including control room supervisors and shift managers are periodically assigned an external mentor to monitor and coach on leadership.

Maintenance departments in operating organizations deal with unique mechanical, electrical and instrumentation components. The experienced maintenance staff gain new knowledge and skills related to nuclear equipment and components as they work in radiologically controlled areas which pose unique challenges. They also gain significant experience in equipment and component troubleshooting. Some of these experiences are related to specialized skills and hence difficult to transfer through training or improved procedures and processes. Mentoring, therefore, plays an important role in transferring maintenance skills from senior to junior personnel.

The transfer of knowledge and skills acquired by engineering department personnel of operating organizations require careful consideration and planning due to the ‘knowledge-based’ work activities. The experience gained from the organization coupled with general engineering and facility design and technical knowledge provides new insights into the engineering requirements of the facility. The interpretation and understanding of such experiences and knowledge need to be systematically planned and disseminated to new staff to ensure important components of the significant and critical knowledge requirements are properly transferred and understood. An example is the knowledge gained by an experienced reactor physicist who performs core reactivity calculations and interpretations and who is responsible for mentoring junior physicists in these activities.

The chemistry department and radiation protection department deal with unique instruments, procedures and processes to monitor, measure and analyze several nuclear safety related parameters needed for safe and efficient operation. A formal mentoring programme, considering the unique requirements of these departments is essential to ensure systematic knowledge transfer.

The training department of a nuclear operating organization is another important area where mentoring can be effectively applied. The training uses several practical training facilities including full scope simulators. For example, experienced simulator trainers gain significant experience as they train personnel to deal with various normal, abnormal, and emergency scenarios. A formal mentoring programme to transfer such experience-based knowledge from senior instructors is useful.

Operating organizations benefit significantly through coaching programmes. For example, senior personnel and managers at NPPs conduct scheduled field observations to coach their staff on correct behaviour that support nuclear safety and improved plant performance. Systematically organized

coaching programmes, using external professional coaches, help operating organizations to improve the skills of technical and leadership capability for selected positions.

Annexes I, II, III and IV provide case studies highlighting the mentoring and coaching activities from Chashma Nuclear Power Generating Station in Pakistan, Nuclear Operating Group in Czech Republic, Kozlouduy NPP in Bulgaria, and Bruce Power in Canada.

5.3. TECHNICAL SUPPORT AND SERVICE ORGANIZATIONS

A technical support and service organization (TSO) [17, 18] provides technical support to nuclear organizations such as NPPs, radioactive waste management organizations, nuclear construction projects and regulatory bodies. They support their clients in their decision-making, assessment and evaluation of technical matters. An example could be supporting decision makers on the preparation for a nuclear project (e.g., establishing the case for the project, solicitation and selection of technology and design, site survey and selection), and afterwards, on the design, licensing, construction, commissioning, operation, maintenance and decommissioning of the nuclear project.

A TSO provides technical support in various areas, such as engineering and scientific services, development of technical improvements or the exploration of specific research and technology, whenever needed for decision making for a nuclear organization. This organization could be placed within or outside the decision-making entity that needs technical support [17, 18].

In some cases, TSOs are involved in supporting non-technical matters (e.g., legal, financial, commercial, scheduling, planning or communication with the public and other interested parties) through the provision of evidence, based on special technical knowledge and expertise, for example as a subject matter expert or expert witness.

A significant number of knowledge-based workers are employed by the TSOs. The knowledge-based workers gain significant experience as they implement new design or perform changes to existing design for improvement. They also gain significant experience as the design standards, codes, and technology change to reflect improvements in scientific and technical domains. The mentoring programmes to transfer experience-based knowledge from senior designers to young design professionals involves significant time. Careful planning and identifying suitable mentors and mentees are important to success.

For example, the Korea Institute of Nuclear Safety (KINS) is the TSO that supports the regulatory body in the Republic of Korea. KINS has developed a competency based human resource development programme that includes a mentoring programme. KINS divided the employees into three groups based on the work experience and age of the mentor and mentee classification as follows:

New employees (≤ seven years of experience)

The focus here is early cultivation of expertise and competency using established plans for self-oriented development. It involves self-study and transfer of knowledge and experience using techniques including mentoring and coaching

Experienced employees (aged under 55)

The focus here is on core competency development through organizational learning and by providing opportunities for participation in relevant seminars, workshops and training courses.

Senior employees (aged above 56)

The focus here is on organizational competency management through the transfer of knowledge and experiences gained by these senior employees. The senior staff act as mentors for new and experienced employees, contribute to the department's core competency learning as lecturers, write and publish teaching materials on their professional area of expertise, compile regulatory experience in related professional fields.

Annexes VI and VII provide case studies highlighting the mentoring and coaching activities from Institute of Nuclear Research (RATEN-ICN) Romania and Nuclear Design Organization, People's Republic of China.

Annexes VIII and XII provide case studies from national nuclear organizations from Indonesia and Argentina.

Annexes X and XI provide case studies from international nuclear organizations OECD-NEA and EC-JRC.

5.4. REGULATORY ORGANIZATIONS

Personnel working in regulatory organizations possess knowledge and skills that support their core activities which includes development and/or provisions of regulations and guides, notification and authorization, including registration and licensing, regulatory review and assessment, regulatory inspections, enforcement, emergency preparedness and response and communication and consultation with interested parties. [17, 19]. For example, regulatory personnel involved in the inspection of NPPs possess sound technical knowledge of NPP functions and the applicable codes, standards, norms, and regulations. Experienced regulatory inspectors gain significant knowledge as they perform inspections and assessments at nuclear facilities. The mentoring programme for regulatory staff ought to consider the systematic transfer of experience-based knowledge gained by senior personnel to junior staff. Annex V provides a case study highlighting the mentoring and coaching activities from the Regulatory Organization, Romanian National Commission for Nuclear Activities Control (CNCAN), Romania.

5.5. NUCLEAR ENERGY ORGANIZATIONS IN NEWCOMER COUNTRIES

A country embarking on a nuclear energy programme and planning to install new NPPs faces several challenges to acquire the knowledge and skills needed for managing its first NPP safely and reliably. The IAEA has been supporting such countries with a milestone approach. This approach defines milestones in the development of the infrastructure necessary for introducing nuclear power and provides guidance on the activities that need to be carried out before each milestone. One of the important infrastructure issues considered in the approach is the development of competent human resources for a new nuclear power programme [20].

Depending upon the type of agreement and contract modes adopted, several host and supplier country organizations will be involved in the process of design, construction, and operation of the first NPP. Typically, the host country will establish an operating organization, regulatory body, and one or more TSOs. The host country will also create a mechanism called nuclear energy programme implementing organization (NEPIO) to coordinate the work of these organizations and other organizations involved, which includes provisions for knowledge transfer from relevant supplier country organizations. The knowledge transfer to these host country organizations from relevant supplier country organizations ought to consider the needs of the former including their long term needs to manage the NPP.

The host country organization(s) usually enter(s) into several agreements or contracts to expedite the knowledge transfer, which involves both transfer of documented knowledge in the form of large volumes of information and the transfer of practical knowledge through training and mentoring. For example, in order to train the first batch of operators for the new NPP, a systematically derived training programme including practical hands-on training at the supplier country's reference plants and facilities is established. This initial training for operators of the first NPP calls for mentoring and coaching sessions to reinforce operator fundamentals, safety culture practices, and to ingrain the mindset needed for safe and reliable operation. The mentors and coaches for such a programme are carefully selected from experienced and knowledgeable staff of relevant supplier country organizations.

Annex IX provides a case study from the Republic of Korea highlighting the challenges faced in training and mentoring new staff for an Asian country. Annex VII provides a case study from the People's Republic of China, providing their experience of training and mentoring newcomer countries.

6. CONCLUSIONS

In the endeavour to implement successful knowledge management initiatives, a difficult challenge is often the transfer of organizational knowledge, especially the tacit knowledge from more experienced people to their successors.

Member States wishing to implement a strategic knowledge management programme in their nuclear organizations can use:

- The five-step guidance provided in Section 4 for systematically introducing mentoring and coaching activities in their nuclear organizations;
- The typical mentoring and coaching activities provided in Section 3, as employees starts their career as a trainee and passes through different responsible assignments until reaching a high-level senior position;
- The twelve case studies from Member State nuclear organizations provided in the Annexes to select suitable paths for introducing beneficial mentoring and coaching activities with due consideration for differing priorities and needs.

The need for mentoring and coaching activities is significantly different for different type of nuclear organizations. For example, the needs of an NPP are very different from those of a regulatory organization. Section 5 provides useful considerations for selecting mentoring and coaching activities in different types of nuclear organizations.

APPENDIX - EVALUATION OF MENTORING AND COACHING ACTIVITIES

Table 6 provides typical questions for evaluating mentoring and coaching activities. These questions ought to be part of the assessment or feedback forms that are to be filled after each mentoring and coaching activity.

TABLE 6. FORMAT FOR EVALUATING MENTORING AND COACHING ACTIVITIES

Area of evaluation	**What is evaluated?**	**How is it evaluated?**
Performance of mentor or coach	— Technical skills; — Willingness; — Mentoring/coaching skills.	Develop assessment forms for getting feedback from mentee or person being coached. The assessment can be typically in a scale of 1 to 5 and some sample questions are: — Was the level of knowledge and skills of the mentor or coach adequate to achieve the planned knowledge and skills transfer? — Was the mentor willing to share his/her knowledge and skills? — What is your assessment of mentoring or coaching skills of the mentor or coach?
Performance of mentee or person being coached	— Knowledge and skills base that supports the ability and foundation to receive and implement the new knowledge and skills; — Willingness to learn; — Personal qualities including ability to understand, comprehend and communicate.	Develop assessment forms for getting feedback from mentor or coach. The assessment can be typically in a scale of 1 to 5 and some sample questions are: — Was the basic level of knowledge and skills possessed by the mentee or person being coached adequate to achieve the planned knowledge and skills transfer? — Was the mentee or person being coached willing to learn? — Was the mentee or person being coached able to understand and comprehend information or knowledge or skill provided effectively? — Was the mentee or person being coached able to communicate effectively?

TABLE 6. FORMAT FOR EVALUATING MENTORING AND COACHING ACTIVITIES cont.

Area of evaluation	**What is evaluated?**	**How is it evaluated?**
Knowledge and skills transferred	— Efficiency of knowledge and skills transfer; — Level of difficulty encountered; — Level of the overall appreciation gained for business functions and activities; Level of personal quality improvements such as ways of thinking, enthusiasm and persistence.	Assess using feedback from mentor/mentee and coach/person being coached. The assessment can be typically in a scale of 1 to 5 and some sample questions are: — Actual knowledge or skills transferred over planned knowledge or skills transfer; — Was there any difficulty to transfer knowledge and skills? If yes, list them with potential solutions; — Level of satisfaction in terms of overall gain for performing business functions; — Level of satisfaction in terms of improved spirit, optimism and ways of thinking.
Process and its efficiency	— The issues affecting the establishment of the relationship between the mentor and mentee or coach and the person being coached; — The issues around planning, scheduling and execution; — Efficiency of the mentoring or coaching process; — Use of tools to enhance knowledge and skills transfer.	Assess using feedback from mentor/mentee and coach/person being coached. The assessment can be typically in a scale of 1 to 5 and some sample questions are: — Were there issues that affected establishing relationship between the mentor and the mentee or the coach and the person being coached? If yes, list them; — Were there issues in planning and scheduling of the mentoring or coaching activities? If yes, list them; — Were there issues in execution of the mentoring or coaching activities? If yes, list them; — Actual time duration for knowledge and skill transfer over planned time duration — Were the tools and facilities (computer aids, training aids) available for conducting mentoring or coaching activities adequate?

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ANNEX I. MENTORING AND COACHING PRACTICES AT CHASHMA NUCLEAR POWER GENERATING STATION (CNPGS), PAKISTAN

I-1. INTRODUCTION

Chashma Nuclear Power Generating Station (CNPGS) working under Pakistan Atomic Energy Commission (PAEC) is located on the bank of river Indus, 280 km south-west of capital Islamabad, Pakistan and has four units of two-loop pressurized water reactors (PWRs) C-1 (325MWe), C-2 (330MWe), C-3 (340MWe) & C-4 (340MWe) in operation. Chashma Centre of Nuclear Training (CHASCENT) is playing vital role in providing a quality training to fresh graduate engineers, operators, and maintainers to fulfil trained manpower requirements of its fleet of NPPs.

CNPGS formal training and development programmes provide knowledge, skills and abilities required to carry out the duties of a specific position. Chashma Centre of Nuclear Training (CHASCENT) has many effective and well-established formal training programmes in place including:

— Basic training programme for newly recruited engineers and technicians;
— Operation engineers and field operators initial training and retraining programmes;
— Maintenance and technical personnel refresher training programme;
— Management training programmes;
— General employee training;
— Instructor training programme;
— Seminars and workshops.

I-2. MOTIVATION TO START MENTORING AND COACHING

CNPGS unit-1 (C-1) operation and maintenance manpower was trained from reference plant in China who remained directly involved with designer and vendors. Apart from formal training programmes, a knowledge management initiative started in 2015 to identify at risk competencies. As significant number of employees was transferred from unit 1 to fill positions in new units, the preservation and transfer of their plant specific knowledge and expertise was a great challenge for reliable and safe operation of unit 1 as well as for new units. The knowledge loss was identified as a critical issue due to ageing of experienced workforce. Moreover, most of the plant shutdowns and significant events were related to human performance and equipment reliability. Therefore, knowledge management programme was started.

Following were the key motivations for staring the knowledge management initiative, which includes mentoring and coaching activities:

— Retirement/transfer of experts;
— Ageing workforce;
— Risk of plant specific knowledge loss from 1st generation to next;
— Lack of knowledge sharing culture;
— Events due to human performance and equipment reliability issues.

I-3. KNOWLEDGE MANAGEMENT MODEL

The detailed knowledge management model is presented in Fig. I-1. Following are the main stages of the knowledge management model for mentoring and coaching:

— Identify critical knowledge areas;
— Identify experts/mentors possessing critical knowledge;

— Prepare a pool of mentors;
— Perform knowledge loss risk assessment;
— Prepare action plan for knowledge transfer;
— Capture unique and critical knowledge;
— Preserve unique and critical knowledge;
— Utilize unique and critical knowledge;
— Improve organizational knowledge culture for transfer and retention of critical knowledge;
— Improve quality and effectiveness of learning process.

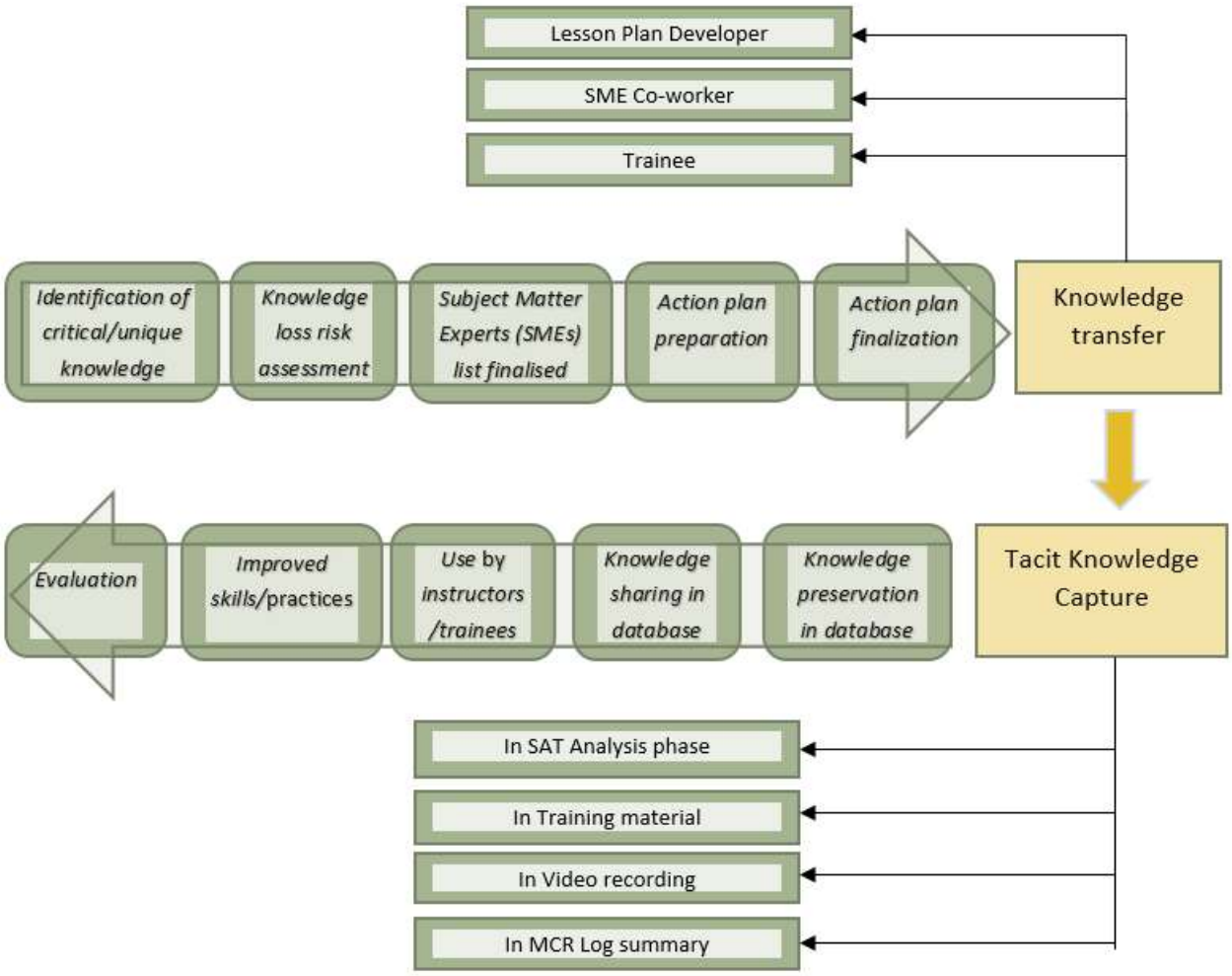


FIG. I-1. Knowledge management model of CNPGS

I-4. DESCRIPTION OF MENTORING AND COACHING PROGRAMMES

I-4.1. Mentoring

At CNPGS two types of mentoring is performed i.e., mentoring for newcomers and advanced level mentoring for young employees. Experts with unique and critical knowledge are identified and their formal mentoring sessions with trainees are scheduled and conducted for tacit knowledge transfer. These sessions are recorded and preserved in the knowledge management portal of the local area network (LAN) for future utilization by trainees. Similarly, young employees are attached to senior employees to work in their shadow to learn new skills. On the job training (OJT) sessions are arranged

under supervision of heads to gain task oriented specific knowledge of the process. Details of the mentoring model are shown in Fig. I-2.

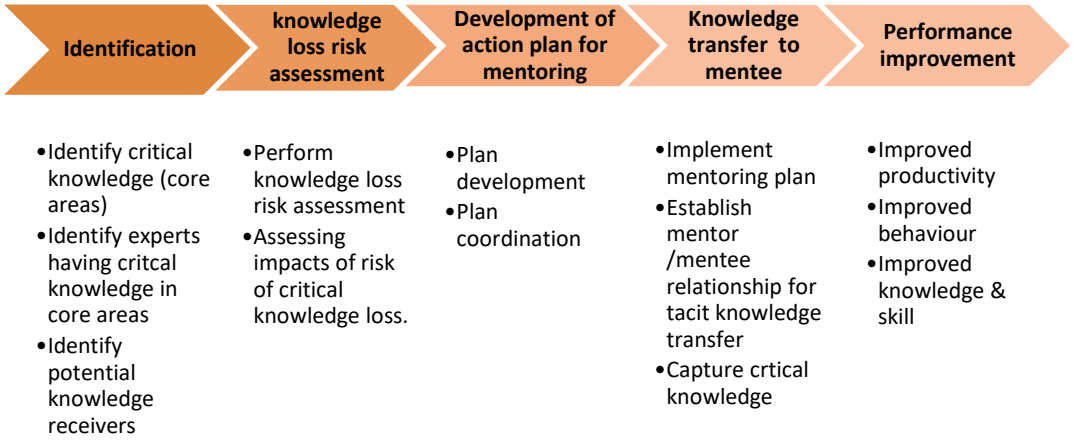


FIG. I-2. Knowledge management model for mentoring in CNPGS

Online modules are also developed by senior experts to foster the knowledge transfer to young employees.

I.1.1.1. Mentoring for newly recruited employee

For newly recruited employee mentoring is focused on:

- Mentor basic skills;
- Provide professional training and social adaptation;
- Increase the retention rate of employment.

I.1.1.2. Advance Mentoring

Advance level mentoring is focused on:

- Increase potential for academic success;
- Provides a structured system for strengthening and assuring the continuity of nuclear professionals;
- Establish relationship between mentor and mentee;
- Create culture of continuous learning;
- Cultivate individual career planning ownership;
- Establish succession planning;
- Ensure the sustainability of the organization through preservation, transfer, and application of core expertise;
- Reduce the risk of inefficient management decisions;
- Enhance leadership development;
- Prepare for more complex and strategic challenges in the future.

I-4.2. Coaching

Coaching of the junior employee is done by respective heads and senior management as per management observation and coaching programmes. Core areas for improvement are identified through observations, action plans for improvement are prepared, and coaching is implemented to improve work practices which in turn results in improved human performance.

Following are some of the important aspects to be considered for management observation and coaching programmes:

- Provide specific guidance for implementing a consistent observation and coaching programme;
- Establish a consistent method for documenting observation results;
- Facilitate timely coaching and providing feedback to individual(s) being coached;
- Provide opportunities to improve human performance by correcting at-risk behaviour and reinforcing desired behaviour;
- Provide guidance for consistent techniques, skills and terminology for conducting observations and assessing the effectiveness of observation.

I-5. LESSONS LEARNED

Following are the lessons learned from this knowledge management initiative:

- Always start from pilot projects;
- Ensure senior management support;
- Ensure resources.

I-6. CONCLUSIONS

Knowledge is the key success factor for all processes. Managing knowledge effectively improves human performance and behaviour. Therefore, it is recommended to promote and support nuclear knowledge management activities.

Following are the major achievements:

- Improvement in plant performance as two CNPGS units have completed more than 300 days continuous operation and significant reduction in plant shutdowns and transients;
- Appreciable improvement in plant safety indicators, capacity and availability factors;
- Appreciation from World Association of Nuclear Operators (WANO) on observation and coaching of human performance improvement during technical support mission (TSM) in 2016;
- Good practice by Operational Safety Review Team (OSART) mission on daily main control room (MCR) log discussion and review in 2015;
- Improvement in human performance and reduction in human errors;
- Improvement in knowledge sharing culture;
- Improvement in equipment reliability.

ANNEX II. MENTORING AND COACHING EXPERIENCE OF CZECH REPUBLIC NUCLEAR OPERATING GROUP

II-1. INTRODUCTION

ČEZ Group is one of the leading economic entities in the Czech Republic. The main objectives of ČEZ business endeavours are generation, distribution, trading and sale of electricity, heat and natural gas, provision of comprehensive energy services from the new energy sector, and coal mining. ČEZ Group is one of the ten largest energy companies in Europe, with more than 8 million customers and over 32,000 employees.

ČEZ operates two NPPs in the Czech Republic: NPP Dukovany and NPP Temelín. They produce around 30 TWh of electricity annually, which is about one third of the Czech total electricity production.

Training and development within ČEZ lead to acquiring the required knowledge, skills and abilities through one's own experience, focused training, and educational programmes. Nuclear sector at ČEZ places great emphasis on the development of leadership, and systematically develop all levels of management.

II-2. MENTORING ACTIVITIES

Mentoring is used to improve individual's knowledge and skill. The experience gained by seniors are transferred to junior personnel to support professional and career development and increase networking. It is also used to promote and transfer of organizational culture. Experiences gained in other companies are also considered for transfer through the mentoring programme. Mentoring is used to develop soft and hard skills.

Basically, two types of mentoring are used:

- Internal mentoring;
- Intercompany mentoring.

Some of the important qualification requirements for mentors are:

- Experience to match with the requirements of mentee;
- Motivation to work with people;
- Matured personality to deal with personnel;
- Respect by fellow colleagues.

Frequently mentored topics are:

- Adaptation to a managerial position acceleration;
- Project management;
- Carrier management;
- Self-motivation;
- Self-enforcement;
- Strategic thinking/management;
- Decision making;
- Networking;
- Problem solving;
- Expertise advice;

— Time management and priority setting;
— Demanding managerial situation.

II-2.1. Internal mentoring

Internal mentoring is focused on transfer of skills and knowledge within the organization. Managers in the rank of B0 – B2 level act as mentors. The mentees are employees in the rank of lower managerial level and technical experts.

II-2.2. Intercompany mentoring

Intercompany mentoring is focused on transfer of skills and knowledge across different organizations. Managers in the rank of B0 – B2 level act as mentors. The mentees are employees in the rank of lower managerial level and technical experts.

II-3. COACHING ACTIVITIES

Coaching is aimed at development of individual capabilities, is designed to support professional and career development and to increase potential of individual. The main aim is to improve soft skills.

Development programmes for managers includes training on leadership styles. Coaching is part of our leadership development programme for all managerial levels.

II-3.1. Internal coaching

Professional internal coaches (part time certified coaches with an international coaching certification) and managers (using coaching style as one of the tools in day-to-day work) provide the coaching needed for the organization. The people being coached are employees in the rank of lower managerial level and technical experts.

Some of the important qualification requirements for coaches are:

— Motivation to work with people;
— Matured personality to deal with personnel;
— Respect by fellow colleagues;
— Certified professional training.

II-3.2. External coaching

Professional certified external coaches are used to coach personnel holding higher managerial level positions.

The qualification and experience of coaches are defined based on the level and experience of employees being coached.

Frequently coached topics are:

— Adaptation to a managerial position;
— Work life balance;
— Motivation;
— Carrier management;
— Self-confidence;

— Time management and priority setting;
— Communication and negotiation skills;
— Self-presentation;
— Self-enforcement;
— Strategic thinking/management;
— Demanding managerial situation;
— Relationship management.

II-4. CONCLUSIONS

For a successful mentoring and coaching process, it is critical to choose managers with required qualities to act as mentors and coaches. Coaches need six months of intensive training, ending with an international certificate (ICF).

Mentors are successful and widely respected managers who are able to inspire. HR staff pay a lot of attention to pairing so that the mentor and the mentee suit each other. This is managed by HR through monitoring of not only the technical area of expertise, but also the personality of the mentor and mentee. HR staff prepare mentors and mentees, for example conducts workshops on goal setting.

The coach is chosen from a pool of coaches (external and internal). In coaching, personality alignment is more important than expertise.

The activity is voluntary, both parties can end the process at any time.

Mentoring and coaching is part of our talent management programme. The outcome of mentoring and coaching activities is very good if the programme has a strong sponsor. Overall satisfaction of employees is monitored through annual surveys in the nuclear power industry. It is recognized that mentoring and coaching activities support loyalty and retention.

To encourage the transfer of knowledge and to support the mutual cooperation between the young and experienced generation in the company, a new knowledge management tool was created called Mentor senior. This tool is focused to those senior knowledge holders who will retire or leave their position within 2 years and where the company needs to be sure that they will transfer as much tacit knowledge and experience as possible. For these Mentor seniors, special positions are created in the organizational structure, which frees up time to transfer knowledge.

As this tool is rather new (launched in 2020), work is in progress to improve it so that it fits to the needs of the company.

In the current situation of Covid-19, we are moving more coaching and mentoring activities to an online form to be able to continue in this area.

ANNEX III. MENTORING PROGRAMME OF KOZLODUY NPP, BULGARIA

III-1. INTRODUCTION

The main goal of the knowledge management processes at Kozloduy NPP is to provide our personnel an intuitive, user-friendly, and efficient environment, accelerating the internal decision-making process where access to information, knowledge, and expertise is made easy, and where the organizational culture promotes transparency, sharing, and collaboration.

The contemporary business environment involves various types of training used for personnel preparation and adaption in the organization, with particular focus on mentoring and coaching. This case study describes in detail the Kozloduy NPP's mentoring process, which is widely recognized as an efficient technique for tacit knowledge sharing from person to person, while gradually investing in means to capture the tacit knowledge and converting it into more tangible and explicit knowledge to serve the future generations.

A structured and functioning mentoring process enables Kozloduy NPP to achieve the following results:

- Minimizing the time required to achieve optimal level of work performance and alignment with corporate standards;
- Enhancing the professional skills and abilities of all participants in the programme, including the mentors;
- Reducing the personnel turnover and providing opportunities for professional development;
- Optimal use of techniques for knowledge transfer from unique knowledge/skills holders;
- Professional development of the experienced workers, both horizontally and vertically.

The mentor intends not only to explain the technical aspects, teach on operation/maintenance of equipment and systems, but also to support newly employed to join the team and to adopt the organizational culture. The main role of the mentor is to create a collaborative environment that would benefit the mentee's abilities to better handle and resolve the tasks assigned.

III-2. EXPLANATION OF THE MENTORING PROGRAMME

In Kozloduy NPP, there are four main types of mentoring in use:

- Mentoring for job position preparation;
- Mentoring for performance improvement;
- Mentoring for students and interns;
- Mentoring during planned workplace observations.

The four main mentoring types in use at the plant are conducted:

- At the mentee's workplace (laboratory, office, workshop etc) in the form of consultations via self-directed learning on theoretical aspects of the particular job, fulfilment of drills and/or case studies, or in the form of demonstrations, observations and control of the conduct of practical tasks;
- On the job at Kozloduy NPP site as a supplement to on-the-job training (practical training) related to introduction, maintenance, diagnostics, and repair carried on equipment and systems;
- As consultations, discussions and applying or proposing corrective measures, during or after concluding observed task.

III-2.1. Mentoring for job position preparation

This type of mentoring combines aspects of one-to-one mentoring with training-based mentoring. The main goal is to prepare the mentee for a job position. The main responsibility of the mentor here is to provide an oversight, and to assess and improve the knowledge and skills obtained by the mentee while progressing with a specific training programme and at the same time, providing guidance and consultations on particular topics/issues contained. This type of mentoring is applicable for:

- New employees taking specified positions;
- Employees taking new positions within the company;
- Employees who need to develop their potential within the current positions;
- Employees to develop their potential to take higher positions in the hierarchy.

Mentoring for job position preparation is conducted based on:

- Individual initial training (for new employees and employees moving to new positions); or
- Individual training programme for continuous training (for specified positions); or
- Mentoring programme (for promotion of new/current employees, beyond the scope of the items above).

III-2.2. Mentoring for performance improvement

The type of mentoring intended for performance improvement is directly related to the performance appraisal of the company's employees. It applies when:

- An employee's performance assessed is partially meeting the expectations and/or performance below expected;
- An employee needs support to improve a particular performance indicator (low score of at least two criteria corresponds to an indicator).

The mentoring for performance improvement is initiated with an individual development plan and is conducted based on the mentoring programme. Programme duration and content depend on specific needs and capabilities of the employee to obtain the required knowledge, skills and behaviour models.

III-2.3. Mentoring for students and interns

The mentoring for students and interns is intended to provide guidance and support to the students in the process of obtaining new knowledge, introduction to the location, features and maintenance of real equipment and systems, as well as the operation processes in the plant. Usually, it is conducted in short terms – from several days to up to one month – and is guided by several mentors, depending on the programme content.

This type for mentoring is applicable for:

- Concluded labour contract with internship conditions, with a person of up to 29 years of age, according to the Bulgarian labour code;
- Internships and apprenticeships for high school/university students;
- Internship contracts concluded under European/national employment programmes.

This type of mentoring is conducted based on:

- Training programme; or

— Mentoring programme or another document, required by a contract.

The mentors under this type of mentoring are selected by the line managers in the departments where the mentees work.

III-2.4. Mentoring during planned workplace observations

This type of mentoring is informal, aimed at imparting informal training and transferring knowledge and experience to enhance staff performance and affirmation of good practices, and in this sense is closer to coaching, rather than mentoring.

The application of this type of mentoring has the following main benefits:

— Improving the psychological climate through positive behaviour reinforcement;
— Identification and avoidance of obstacles to achieve the desired behaviours;
— Improving staff capability and accountability;
— Identification and correction of errors;
— Prevention of operating events through early detection of root causes/preconditions;
— Opportunities for the management to discover new approaches that would make the work safer, faster, and easier.

Mentoring during planned workplace observations aims at materialization of direct, immediate contact between the plant personnel and management of all levels and applies:

— When deviations from approved standards for safe performance are observed;
— When there are identified opportunities to timely prevention of human errors;
— During workplace walk downs.

The mentor's tasks within this type of mentoring include:

— Informing the staff about the observed deviations from plant expectations and policies and reinforcing the need to follow the same;
— Continuous, informal and direct staff training to enhance safety, safety culture and quality assurance;
— Discovering 'hidden opportunities' to improve work arrangements and efficiency.

During the observation the mentor needs to:

— Explain why he/she is present and predispose the personnel to work as usual;
— Serve as a role model;
— Clarify that his/her presence is not due to mistrust but an occasion for comments and dialogue, intended for performance improvement;
— Intervene and act only in case of situations that could endanger the safety of the performers or the equipment;
— Take note of (without intervening) shortfalls in performance as the workers perform and clarify them via dialogue with the performers after conclusion of the work;
— Involve all team members in the after-action review;
— Use the review of particular shortfalls or deviations and emphasize on the importance of correct methods or behaviours, recurrent issues and distribute the positive results and good practices during the after-action review.

This type of mentoring is accomplished according to the guides for management walk downs/observations in force in each of the plant's units.

The persons performing mentoring during scheduled workplace walk downs/observations are the line managers of the task/activity performers, managers of higher level in the hierarchy or specially assigned persons with oversight functions.

III-2.5. Roles and responsibilities in the process

III-2.5.1. Mentor

- Advises the mentee with respect to fulfilment of his duties and responsibilities;
- Encourages critical thinking and a conservative attitude towards safety while resolving issues;
- Analyzes strengths and areas for improvement in the mentee's performance and proposes measures for development;
- Holds regular meetings with the mentee to share work performance and provide additional assistance, if needed;
- Gives and seeks proactively feedback to/from the mentee;
- Analyzes mentee's training needs in line with the results shown and draws proposals for additional training in certain areas;
- Participates in the evaluation of mentoring programme results and efficiency.

III-2.5.2. Mentee

- Complies with mentor's guidance and advise;
- Seeks mentor's support in case needed;
- Works to accomplish goals set and tasks assigned in the programme;
- Participates in the evaluation of mentoring programme results and efficiency.

III-2.6. Mentor's database

The mentor's identification process is based on the personnel performance appraisals.

After concluding performance appraisals, each line manager provides the Personnel and Training Centre department a list of potential mentors and areas in which they could support other employee's professional development.

The individuals contained in the list, are further analyzed in respect of results achieved from the initial and continuous training processes. In addition, the information is matched with the training needs identified in particular areas and finally a list with persons eligible to become mentors is published together with the potential functional areas. Later, agreement to the list from all the concerned units within the organization is obtained and is approved by the CEO.

Currently, the plant mentor database has 251 mentors.

Once enrolled in the database they need to obtain/maintain mentoring qualification. The training itself contains particular topics from the following courses:

- Human factor;
- Training and qualification basics;
- Safety culture;
- Error prevention tools and techniques.

III-2.6.1. Mentor's selection criteria

In order to become a mentor, each individual needs to possess certain professional and psychological features, which include:

- Ability to lead and guide;
- Creativity;
- Patience and willingness to work with people;
- Tact and diplomacy while working with people of different ages;
- Willingness to take more responsibilities including to support the mentee in the process of defining and achieving goals set.

III-2.7. Activity reports, evaluation, and analysis

Mentoring is a systematic process and is subjected to the same principles as other business processes.

It is most efficient when there is feedback between input task and the output results. To reach highest efficiency, all stages need to form a closed loop as shown in Fig. III-1.

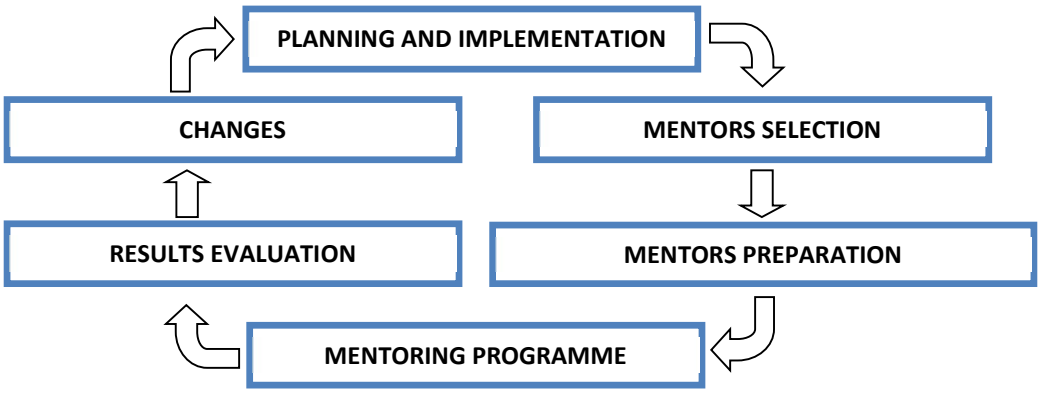


FIG. III-1. Mentoring process followed in Kozloduy NPP.

After conducting the mentoring programme, an evaluation is performed to assess its efficiency. The strengths and areas for improvement are assessed and subsequently corrective measures are prescribed.

Subject to the evaluation are:

- Mentoring scope and topics;
- Knowledge and skills obtained by the mentee;
- Mentor's approach;
- Practical applicability of the new knowledge and skills.

Mentoring metrics:

- Work performance enhancement;
- Error reduction;
- Degree of participant's satisfaction.

The mentee's performance results are the main indicator for the mentor's efficiency.

Evaluation tools:

- Analysis of initial and continuous examinations;
- Mentee's feedback;
- Mentor's feedback;
- Line manager's feedback.

III-2.8. Mentor's motivation

The proper choice of stimuli is the core of the mentor's motivation.

The stimuli need to correspond to the individual's needs and need to combine material and non-material (social) incentives. An individual approach is applied to stimulate plant staff for becoming mentors. Some of the tools used include:

- Experience exchange with foreign counterparts;
- Ensure participation in national and international events;
- Spread mentor's achievements through the plant information system;
- While selecting individuals for higher position in the hierarchy, participation in mentoring programme is considered advantageous;
- Financial bonuses.

III-2.9. Main challenges

One of the main challenges for the mentor is the necessity to perform dual roles. Often, subject matter experts identified for potential mentors, also play a critical role in the day-to-day operations of the NPP and, therefore, their time is valuable and limited. Therefore, it is important to find the right balance so that the mentoring programme does not interfere with the daily duties of the mentor.

Another challenge is to find appropriate stimuli that motivate the individual to become a mentor.

III-3. CONCLUSIONS

FIG. III-2 explains the overall mentoring programme of Kozloduy NPP, activities involved, and their connections.

The programme efficiency is directly linked to the successful establishment of interactions between mentors, mentees, managers, and other stakeholders. The highest efficiency is achieved when the mentor-mentee relationship is based on collaboration, transparency, trust, and ambition for mutual benefit.

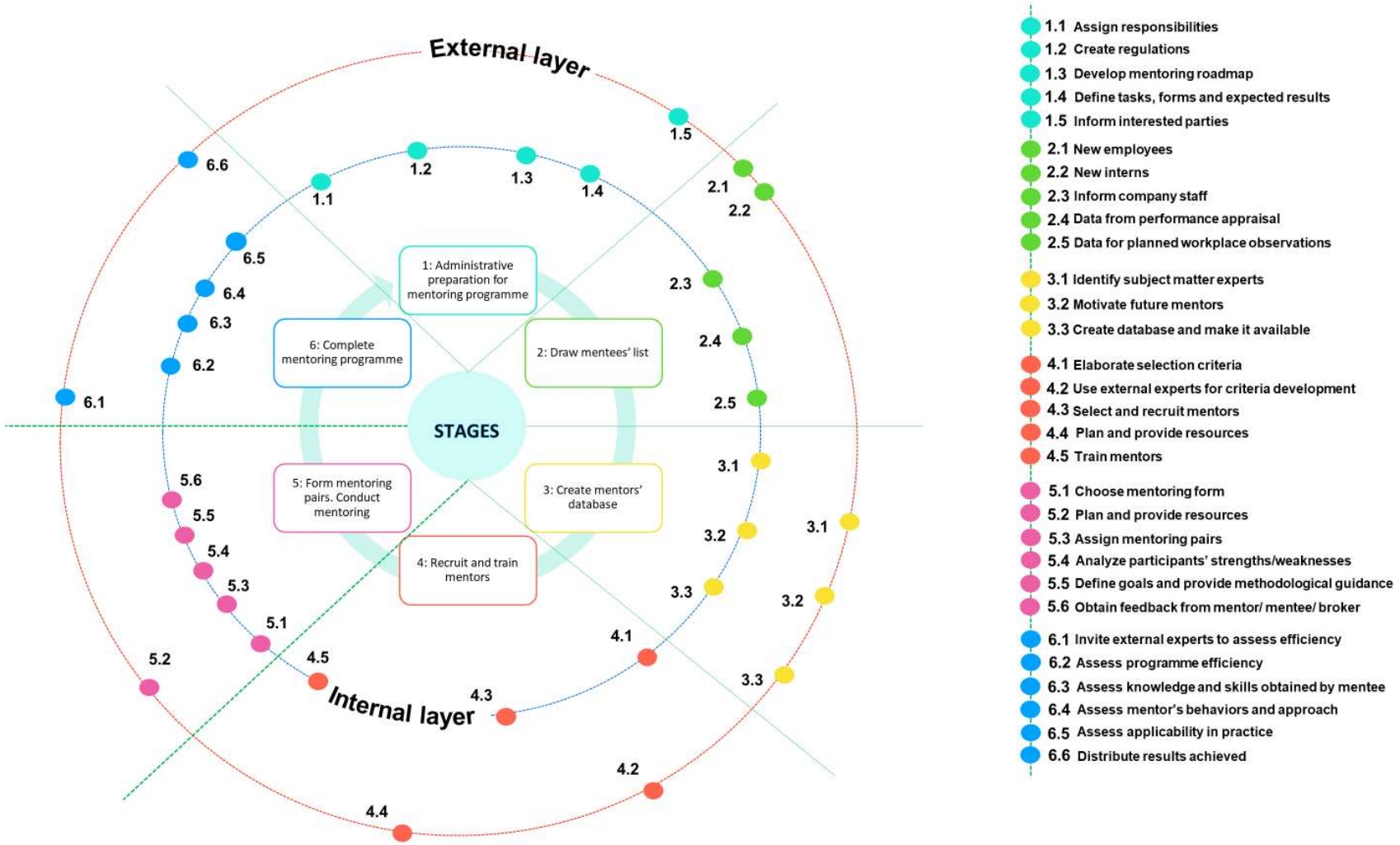


FIG. III-2. Functional model of Kozloduy NPP Mentoring Programme

ANNEX IV. LEADER KNOWLEDGE TRANSFER AND MENTORING AT BRUCE POWER, CANADA

IV-1. INTRODUCTION

Bruce Power is implementing a programme to improve leader knowledge transfer. A solid leadership succession plan and pipeline at Bruce Power has allowed us to fill key leadership roles with ready-to-go talent. However, following a transition of a new leader, we often see a stall in performance and in some cases have seen a short-term decline in functional area performance. This has resulted in overall cyclic performance and has slowed performance improvement.

New incumbents to a senior leadership position were often unaware of critical operating experience in the functional area, not aware of the present state of performance and actions that have been taken in the past to improve. Over time they acquire the knowledge through experience, however, it is during this time that performance stalls or sometimes declines.

Mentoring and coaching are key techniques to ensure a smooth transition. Customized learning packages prepared specifically for the senior leadership position is key to ensuring the mentoring and coaching opportunity is maximized. This is a significant step forward from a standard position turnover or transition checklist.

IV-2. EXPLANATION OF THE MENTORING AND COACHING PROGRAMME

Bruce Power has a mentoring and coaching programme and most senior leaders are participants in the programme. This programme is focused on professional development and getting ready for the next level to support our succession plans.

More than 40 senior leadership positions at Bruce Power were identified as critical to the continuous improvement of site performance. The Learning and Performance Division, responsible for corporate training and knowledge management, formed a team in collaboration with Human Resources to pre-prepare a learning package specific to each position which includes common information on the conduct of business applicable to all positions. A key feature of the learning development is the involvement of the present position holder and previous position holders in knowledge capture.

Knowledge management governance belongs to the Learning and Performance programme. A programme Job Aid was developed to describe the Leadership Transition project. The intention of the programme is to maintain momentum, which is particularly helpful when individuals have not worked in the functional area before or are new to Bruce Power. While many utilities have transition or turnover processes, the benefit of this programme is the advanced preparation of transition information to assist the new incumbent and the mentor.

Human resources business partners flag when a transition is to occur and the Learning and Performance Division begins updating the package and prepares for the transition with the incumbents as soon as they are identified. The business partner monitors the transition of the senior leader by ensuring completion of the learning package and assignment of a mentor if the incumbent does not already have one. This mentor will work with the leader through the completion of the custom learning package. Target completion is three months following assignment.

Learning contents include:

- Detailed job description;
- Site key contacts and stakeholders;
- Procedures and Documents applicable for the position;
- External interfaces;
- Improvement initiatives;
- Meetings;
- Outstanding actions/audits/inspections;
- Staffing;
- Station walkdown/tour of responsible areas;
- Training and qualifications;
- Critical duties and tasks performed by the role;
- Procedure/equipment ownership;
- Mentorship and monitoring;
- Supervisory assessment.

Effectiveness is reviewed at six months post transition to capture data on how the transition has gone and determine if there were areas the incumbent would like the learning package to include to further improve the transition in the future. The review includes inputs from the incumbent, their mentor, Human Resources Business Partner, and the incumbent's supervisor.

To fully complete the transition learning package, one of the last steps is to provide feedback to the Learning and Performance division so that changes can be made to the learning package to ensure it is accurate and sustained. The present focus is to move the content of the learning package to our eLearning platform to improve progress tracking and change management of the learning assignment. Total resources required to fully establish the programme is predicted to be 2 person/year and 0.25 person/year to sustain.

IV-3. CONCLUSIONS

To date all transition packages have been developed with involvement by many senior leaders currently in role or with past experience in the position. All have commented that the development activity introduced them to knowledge and information that they were not aware of and which could help them in their present role. The overwhelming response from all senior leader incumbents who have completed the transition is that they valued their participation in the programme, and it has helped the transition. In particular, senior leaders new to Bruce Power or new to the functional areas commented positively on the value of the programme and the pre-preparation of the transition package. Leader transitions have been completed and several active transitions are underway in Maintenance, Outage Management, Chemistry, Operations, and Corporate Oversight. Our challenge will be sustainment of the programme ensuring that the transition packages remain current and are continuously improved.

The programme is relatively new with only 12% of transitions completed and 12% underway. It is too soon to determine effectiveness in preventing performance declines or eliminating cyclic performance, but all participants have indicated that the activity has improved their performance and is considerably more effective than traditional turnover. There is a lot of interest in expanding the programme more broadly. However, this needs to be balanced with sustainability. Mentors remain a critical element of successful knowledge transfer.

ANNEX V. MENTORING AND COACHING APPROACHES IN REGULATORY ORGANIZATION CNCAN, ROMANIA

V-1. INTRODUCTION

Training for Romanian National Commission for Nuclear Activities Control (CNCAN) staff is provided either in-house or through technical cooperation programmes with the IAEA and with other states and organizations. Members of the technical staff frequently attend training courses, workshops, technical meetings, expert meetings, and conferences supported by the IAEA, that are relevant for their professional development in relation to their current and foreseen duties.

CNCAN also receives assistance through the International Regulatory Development Partnership (IRDP), sponsored by the United States Nuclear Regulatory Commission (US NRC). In the period 2014 – 2019, CNCAN staff received training through several activities organized in the framework of the International Regulatory Development Partnership (IRDP). The training events completed to support regulatory oversight activities for nuclear power reactors are presented as follows:

- NPP Site Inspector Benchmarking Workshop for CNCAN (2019);
- Assessment of Events at NPPs and Root Cause Analysis Methods for CNCAN (2019);
- ASME O&M Code for NPPs Workshop (2018);
- Safety Analysis Report Review Training (2018);
- Computer Codes Used in the Regulatory Process Workshop (2017);
- Practical Basics Workshop for CNCAN (2017);
- Fundamentals of Reactor Safety and Regulations (2017);
- Probabilistic Risk Assessment (PRA) and Fukushima Lessons Learned Workshop (2016);
- Research and Test Reactor On-the-Job Inspection Exercise for CNCAN Staff (2017).

Training received through the IAEA technical cooperation programmes and through the United States Nuclear Regulatory Commission's International Regulatory Development Partnership (IRDP) programme are particularly valuable in keeping CNCAN's technical staff up to date with the current international standards and good practices in nuclear safety and regulatory work, as well as with the relevant operating and regulatory experience.

In 2016, CNCAN started to implement a new project regarding qualification of their inspectors in the nuclear field, involving mentoring and coaching approaches. Since then, all inspectors have been qualified using this approach. The goal is to have knowledgeable and skilled inspectors to perform inspections in different areas.

CNCAN has a process to develop and maintain the necessary competence and skills of regulatory staff of the regulatory body, as an element of knowledge management. The required technical education, knowledge, experience, and necessary skills and abilities are documented in the job descriptions for each position with regulatory duties. To maintain an appropriate competence level, an annual plan for staff training is in place and each staff member has an individual training plan, elaborated by their respective line manager.

Acquiring knowledge from the identified sources involves:

- Training, involving mentoring and coaching techniques, of the staff as part of the training process, with input from the knowledge management process and from staff performance appraisals that identifies individual knowledge gaps;

— Acquisition of competences through hiring new personnel with the required knowledge and /or through consultancy services.

V-2. EXPLANATION OF THE MENTORING AND COACHING PROGRAMME

The requirements for the training, qualification and certification of personnel designated by CNCAN to perform inspection and/or control activities are in accordance with the provisions of Law 111/1996 on the safe deployment, regulation, licensing and control of nuclear activities, republished with subsequent modifications and completions.

The objective of the inspector's training, qualification, and certification process (ITQC) is to develop the knowledge, skills, and attitudes (KSA) necessary for inspectors, to enable them to fulfil their inspection responsibilities to the expected standards. This is carried out through the establishment of a uniform system of training, qualification, and certification of inspectors for all installations, sources, materials, and activities, covering all areas of inspection, under direct supervision of the mentors. Mentoring and coaching techniques are used in the qualification and certification process to instil experience-based knowledge and skills.

The mentors and trainers involved have established responsibilities for achieving a good application of the mentoring programme.

Mentor can be an assigned coordinator and/or advisor to the individual training and certification programme of inspector-in-training. The mentor is a qualified inspector with extensive knowledge and experience in the regulatory oversight and/or control of one or more types of installations, sources, materials, and activities, usually covering several inspection areas and topics. The mentors can be the unit coordinators or other senior certified inspectors designated by the director of the technical division in which the inspector-in-training works.

The responsibilities for the mentors include to:

— Perform the competences needs assessment and the training needs assessment related to nuclear activities in the field of inspection, necessary to fulfil the responsibilities of inspectors for the activity for which they were appointed;
— Develop individual training and qualification plans (ITQPs) for the inspectors-in-training under their supervision;
— Guide the implementation of individual training programmes for inspectors;
— Perform the evaluation of the knowledge, skills and attitudes (KSAs) acquired by the inspectors-in-training;
— Propose certification of the inspectors-in-training who meet the qualifications required on completion of the training programme;
— Provide feedback for improving the training programme;
— Provide adequate training to inspector-in-training for the activities for which they were appointed;
— Perform the evaluation of inspectors for the designated areas/topics.

The responsibilities for the mentees include to:

— Under the guidance of direct supervisor/mentor, perform a self-assessment of the training needs for acquiring the competences specific to the inspection job;
— Participate in the development of their individual training and qualification plans (ITQP);
— Update and maintain the individual training and qualification log (ITQL);

— Make effective use of the knowledge, skills and attitudes (KSAs) received through courses and on-the-job training and complete the necessary self-study;
— Participate in periodic evaluations and final confirmation of the knowledge, skills and attitudes (KSAs) acquired through training;
— Provide feedback for improving the training programme.

The mentors guide the mentees through two types of training:

— Core (basic) training;
— Specific training: training for specific installations and activities, including OJT.

Core (basic) training is common for all CNCAN inspectors. This training is based on the fundamentals of performing an inspection, including mandatory training in radiation protection, health and safety, legal, regulatory framework and CNCAN inspection and enforcement processes. Basic training includes:

— CB1 – Legal and regulatory framework, regulatory policies and approaches;
— CB2 – Management system processes and procedures, inspection and enforcement processes and procedures;
— CB3 – Inspection fundamentals;
— CB4 – Radiation protection and instrumentation;
— CB5 – Safety in the workplace (about inspector's personal safety);
— CB6 – Introduction to project management, management and leadership, and teamwork;
— CB7 – Root cause analysis, analytical thinking and problem solving;
— CB8 – Presentation, communication skills, conducting effective meetings;
— CB9 – Interviewing for information;
— CB10 – Writing technical information;
— CB11 – Safety culture.

Specific training is referring to the specific activities and facilities that are inspected by each technical division. The specific training may include training courses, self-study and OJT.

OJT is a one-on-one training conducted at the job site, where someone who knows how to do a task shows another how to perform it.

The OJT is for specific activities and facilities that are regulated by each division and requires an inspector-in-training to:

— Observe an experienced inspector performing inspection;
— Participate in inspections under the direct supervision of an inspector;
— Participate as a team member in an inspection;
— Perform an inspection under supervision;
— Be evaluated by a qualified inspector.

OJT provides the knowledge, skills and attitudes that are required to perform a specific inspection activity/task and is conducted in a working environment which an inspector will experience in his/her job. It uses workplace resources such as personnel, equipment and documents which allow effective learning for an inspector, as well as the experience of senior certified inspectors.

CNCAN has developed a four-quadrant model with minimum competences that needs to be developed at the end of the basic training:

TABLE V-1. FOUR QUADRANT MODEL OF COMPETENCES DEVELOPED BY CNCAN

Competences related to the legal, regulatory and organizational basis: — Legal basis; — Regulatory policies and approaches; — Regulations, license conditions, licensing basis and regulatory guides; — Management system. (These are addressed through the Core Training: CB1, CB2. Specific regulations, license conditions, licensing basis and regulatory guides are different for the 17 inspection areas and for the 8 categories of installations and activities identified in the general inspection process procedure and will be addressed in the specific training)	**Competences related to technical disciplines:** — Basic science & technology; — Applied science & technology; — Specialized science & technology. (Basic and applied science & technology competences are secured mainly through recruitment of staff with adequate education. Some specialized technical issues are addressed through the core training (e.g., CB4 and to some extent CB5, with regard to specific hazards relevant for inspector's work). Other technical aspects will be part of the specific training for inspectors.
Competences related to regulatory body's practices: — Review & assessment; — Authorization; — Inspection; — Enforcement; — Development of regulations and guides. (These are addressed through the Core Training: CB3)	**Competences related to personal and interpersonal effectiveness:** — Analytical thinking and problem solving; — Personal effectiveness and self-management; — Communication; — Teamwork; — Management and leadership; — Safety culture. (These are all addressed through the core training: CB6-CB11)

For a correct guidance CNCAN considers the following attributes for trainers:

— Integrity, honesty and perseverance in relationships with others;
— Respect for the trainee;
— Communication skills;
— Consideration;
— Patience;
— Expertise;
— Exemplary behaviour.

Based on the training programme, a junior employee will start the preparation from the beginning following three important steps.

The first step is to get familiar with the NPP or nuclear research reactor and with all the systems of nuclear installations through all the materials available under the straight supervision and guidance of the mentors. The theoretical part is accompanied by written tests, discussions, and inspections at the nuclear installations. For better preparation, the CNCAN staff can participate in the training courses organized by the NPP which is beneficial because they have a good programme for training.

The second step is to familiarize the new employee with laws, regulations, guides and their applicability. For familiarizing with regulations, the new employees are involved in developing the checklists under the guidance of the mentor. Of course, the theoretical part is accompanied by written tests.

The third step is to involve the new employee in more and more activities like inspections, evaluation of the documents and others under the guidance of the mentors.

Here are some examples of activities in which an inspector participates in training, receiving mentoring and coaching from experienced inspectors:

- Inspection of plant systems;
- Housekeeping inspections;
- Observation of main control room activities;
- Examination of control room operators in the licensing process;
- Inspections of testing and maintenance activities, including during planned outages;
- Observation of shift turn-over;
- Observation of emergency exercises;
- Inspection of measures for response to transients and accident situations (emergency operating procedures and severe accident management guidelines);
- Inspections of the ageing management programme;
- Inspection on fire protection.

V-3. CONCLUSIONS

Mentoring and coaching focus particularly on aspects that an inspector in training cannot learn only from training manuals and procedures and which require knowledge and experience transfer from a senior inspector. The mentoring and coaching activities include experience sharing and practical advice on the following:

- How to prepare for different types of inspections in order to be the most effective;
- How to review and use relevant operating and regulatory experience;
- How to look for potential signs of degrading safety performance;
- How to judge whether corrective actions have resulted in preventing recurrence of problems;
- How to communicate with the licensee personnel during the inspections;
- How to be professional, inspire trust and prevent conflicts;
- How to conduct interviews;
- How to observe plant activities without undue interference and distraction;
- How to communicate the results of the inspections;
- How to deal with differing professional opinions;
- How to recognize what good performance and good condition of systems and equipment looks like;
- How to recognize abnormal conditions in different areas of work, both from technical and organizational perspective;
- How to perform independent verifications and validate the information provided by the licensee, using documentation review, inspections in the field and collaboration with more experienced inspectors that have worked on the same topics;
- How to determine the importance of the inspection findings, in relation to the operational limits and conditions and to compliance with license conditions and regulations;
- How to conduct event investigations;
- How to ask for advice and escalate problems to the upper management to receive advice and support for important matters that may exceed an inspector’s area of expertise;
- How to take enforcement actions, including received legal advice and support.

ANNEX VI. MENTORING AND COACHING APPROACHES AT INSTITUTE OF NUCLEAR RESEARCH (RATEN-ICN), ROMANIA

VI-1. INTRODUCTION

The Institute for Nuclear Research Pitesti is an important organization in the Romanian nuclear sector. It owns and operates important nuclear facilities namely TRIGA SSR-14 MW and TRIGA ACPR Research Reactors, Post Irradiation Examination Laboratory (PIEL) and Radioactive Waste Treatment plant. RATEN-ICN coordinates R&D activities in the nuclear field, provides technical support for the nuclear power activities in Romania, maintains and develops the technical competences for the entire lifetime of the nuclear installations, participates in the development of energy strategies and achieves the scientific and technical objectives of the national nuclear programme.

In 1990, under national economic constraints, a significant restructuring of the institute was carried out. As a result, parts of the institute became independent organizations (e.g., Nuclear Fuel Factory) and new entities were created (Nuclear Waste Agency). Also, the institute lost researchers and skilled personnel due to internal transfer of personnel to newly formed entities and also due to brain drain (especially to Canada due to similar technologies or to U.S.A.). Retirement and the policy to reduce personnel contributed also to the loss of critical knowledge.

Between 1990 and 2005, there were important economic difficulties during which the institute could not hire personnel. As a result, the average age of workforce increased progressively. At that time, the importance of knowledge transfer processes was recognized. However, there was no coherent implementation.

After 2005, new recruitment commenced, but a major gap between skilled personnel and newcomers was already existing. Consequently, the institute's staff considered it important to implement a systematic knowledge management programme. What has been done for this? Under Coordinated Research Project (CRP) "Systematic approach for nuclear knowledge transfer and preservation in Romania", the motivations of our experts to transfer their expertise before retirement were analyzed and an assessment on the knowledge loss risk was performed. Some important results of these analysis are:

- The optimal time interval needed for knowledge transfer;
- The efficiency of methods and tools used for knowledge transfer and knowledge preservation;
- The importance of understanding the barriers of knowledge sharing;
- The efficiency of factors that increase motivation for tacit knowledge transfer;
- A risk map at departmental and organizational level by analysing each position/employee.

The most important outcome was the recommendation offered to the RATEN-ICN management for a systematic knowledge management process.

Significant efforts were made in our institute for the development of the knowledge management strategy. In the field of explicit knowledge, a knowledge portal was created, acting as a repository for scientific and technical documents.

VI-2. MENTORING AND COACHING ACTIVITIES

VI-2.1. Mentoring approaches used in RATEN-ICN

In order to improve the competences of graduates in terms of background and their adaptability to research, mentoring techniques are used as part of the knowledge transfer process. Two types of mentoring are applied in RATEN-ICN for:

— Preparing the newcomers for the jobs;
— Preparing the young students for potential hiring by the institute.

The first type is applied for the employees (mainly new graduates) hired through a competitive process. The mentoring process continues until the employee meets the requirements of the job, usually 3 to 5 years, depending on the complexity of the job, the ability of the mentee to accomplish the tasks received from the mentor, the mentoring relationship, and the availability of the mentor to coordinate and to support the mentee. In Fig. VI-1, the main actors of the mentoring relationship are presented. Apart from the mentors and mentees, other players involved are the RATEN-ICN manager, the deputy directors, the heads of departments and the HR office. An important milestone in the mentoring process is the confirmation report, which is issued after the completion of the trial period, which lasts 6 months.

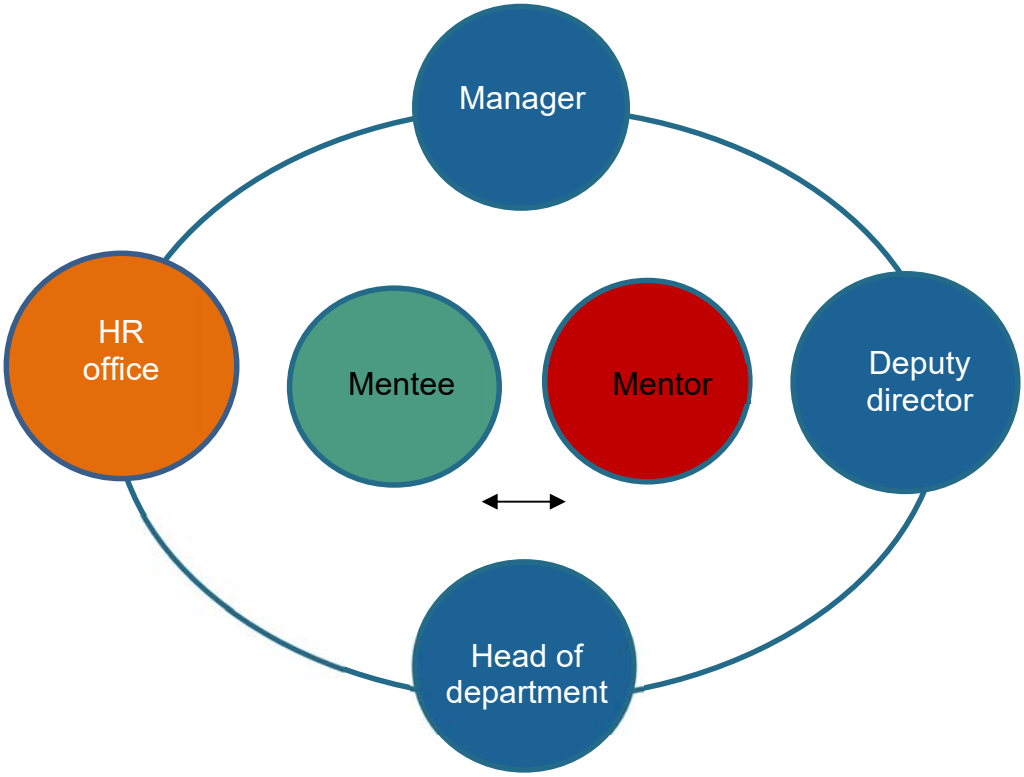


FIG. VI-1. The actors involved in preparing the newcomers for the job requirements after the hiring

During and beyond the trial period, each newcomer is assigned with a mentor by the head of department. The mentor is a person with significant professional experience. At the end of the trial period, in order to be confirmed on the job position, the mentee is required to present a paper in the scientific seminar of the department.

Some responsibilities of the mentors, mentees and heads of departments that are included in an internal procedure called “Confirmation on the job position” and are issued by the Human Resources office, are:

— The head of department, together with the mentor and mentee, establish the topic of the paper for confirmation on the job position;
— The mentor establishes the training programme, coordinates and supports the mentee during the trial period, completes the “Activity appreciation file” and approves the paper produced by the mentee for his/her confirmation on the job position;
— The mentee continuously learns, performs the given tasks and elaborates the paper for confirmation on the job position.

After the trial period, the mentor prepares the annual report on the mentee’s performance. The mentor also facilitates the introduction to the research activity, plans and assigns specific research projects and integrates the mentee into the work team. In the research activities, the mentee participates under the mentor supervision. A favourable annual report on the mentee’s performance is useful for the annual appreciation or reward.

The second type is applied for preparing the students for possible hiring. From our experience, the integration process of the newcomers requires more efforts than preparing the students for hiring.

Some possible motivations for starting mentoring activities to prepare students for hiring are to enhance the quality of background knowledge of students and to prepare them for potential future research activities. This kind of mentoring is realized under the partnership agreement between RATEN-ICN, University from Pitesti (UPIT) and University Polytechnic from Bucharest (UPB).

The adaptability of the students to the research requirements can be enhanced by their involvement in the research activities. The following actions support this endeavour:

— Preparation of the bachelor or master theses;
— Practical training in RATEN-ICN laboratories and departments;
— Involvement in the preparation of scientific papers.

To prepare the papers to obtain the bachelor or master’s degree, each student is assigned with a mentor from RATEN-ICN, who acts as a scientific coordinator (Fig. VI-2). Practically, the students receive mentoring from two sources (from university, for academic objectives and from RATEN-ICN, for research objectives). The mentoring period for this activity lasts for one year.

Last year, 50 papers were produced under this partnership. The mentors supervised the preparation of some of the best scientific papers and their submission to journals or conferences. Most of them are submitted to the Annual International Conference on Sustainable Development through Nuclear Research and Education, organized by RATEN-ICN, under topics on education, continuous learning and knowledge management.

For practical training in our facilities, laboratories and department there is also a mentor for each student.

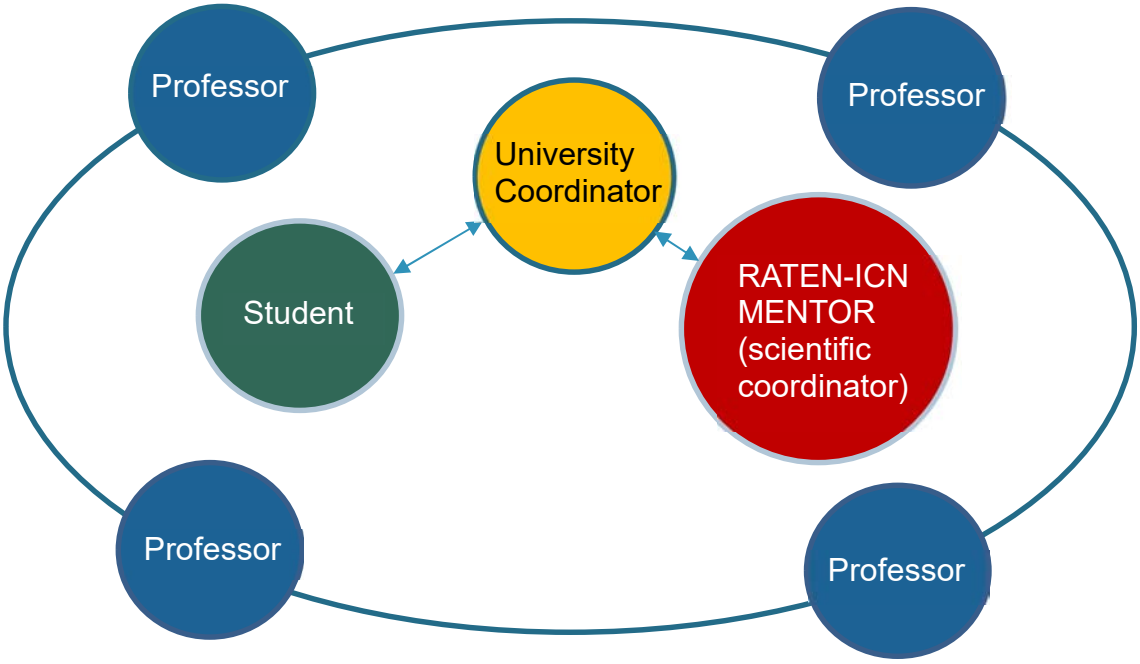


FIG. VI-2. The relationship in preparing the students in the perspective of possible hiring.

VI-2.2. Coaching aspects

In RATEN-ICN, coaching techniques are applied for jobs with common requirements or common background. They are used for enhancing safety of experimental facilities, in radioprotection and for obtaining better efficiency in the use of dedicated computer codes or for obtaining skills for programming.

The duration of coaching can vary from days to weeks.

An experienced expert with technical and educational skills is assigned as coach and a mixture of presentations and practical activities are performed involving groups of 3 to 10 persons.

Table VI-1 presents the mentoring and coaching approaches used in RATEN-ICN.

VI-3. CONCLUSIONS

Mentoring approaches used in RATEN-ICN represent important knowledge transfer techniques. The objective is to alleviate the situation of decrease in competencies in graduates in terms of their background and their adaptability to research.

Mentoring is a time-consuming process and demands significant efforts. However, the results are promising.

RATEN-ICN experience in coaching is limited and it was so far applied for jobs with common requirements or common background. However, it may be increased in future.

TABLE VI-1. MENTORING AND COACHING APPROACHES USED IN RATEN-ICN FOR VARIOUS ACTIVITIES

Activities	Associated skills and knowledge	Knowledge Transfer	
		Mentoring approaches	Coaching approaches
Newcomer's preparation (job position confirmation)	Described by the job position	Mentoring for 6 months	
Integration of newcomers in the groups/teams	Specific methods and tools (for example specific measurements in experimental activities, operation of nuclear installations, working with computer codes, use of the analytical tools, use of the design tools, etc.) according to a specific job position.	Mentoring for 3-5 years	
Preparation of students for the research activities	Understand and apply the methods of RDI (experimental activities, numerical simulations, analysis of data, writing of scientific reports).	Mentoring for 1 year	
Preparation of personnel for team working and projects	The activities include programming in a specific language, radiation protection norms and practices, project management, safety aspects of specific nuclear installations (e.g., research reactor, post irradiation examination laboratory, radioactive waste treatment plant, etc.).		Coaching for some days to some weeks
Transfer of specialized skills from the near retirement expert to a younger member of the same team	Tacit knowledge	Mentoring for 1 – 2 years	

ANNEX VII. MENTORING AND COACHING EXPERIENCE FROM CHINA NUCLEAR INDUSTRY FOCUSING ON TECHNICAL SUPPORT

VII-1. NEW STAFF MENTORING

In order to help new staff, adapt to their jobs as soon as possible and improve their business level, many nuclear power enterprises in China assign experienced senior staff to guide and help new staff. This initiative is called "new staff mentoring".

VII-1.1. Steps involved in new staff mentoring

Enterprises need to develop corresponding safeguard mechanisms to make the new staff mentoring orderly and benign, including determination of the mentor selection criteria, signing of the mentoring agreement, summarizing, and assessing the mentoring process.

Mentor selection

Based on the position and professional background of new staff, the enterprise selects an experienced senior staff as the mentor. The selection of mentors has the following criteria: recognition of the enterprise's corporate culture and core values; rich business experience, proficiency in their disciplines, in-depth analysis and resolution of issues in their disciplines; systematic understanding of management with good management skills and professional qualities with outstanding leadership and influence; as well as a sense of dedication and mission, willing to share knowledge, impart knowledge, and mastering the skills of guidance and answering questions.

Signing of the mentoring agreement

After the mentor is confirmed, the mentor and new staff establish a mentoring relationship and sign the mentoring agreement. The specific contents of the mentoring agreement include determination of the mentoring period, target, and plan. The mentoring period is usually one year. The mentor has to help the new staff to break down work and learning tasks, coach and check the completion of the tasks to promote the new staff to grow.

Summary and assessment of mentoring

After the completion of the mentoring programme, new staff should be assessed and evaluated in the form of oral defence, and the effect of the mentoring should be reflected by the defence. At the same time, the enterprise also has corresponding knowledge output requirements for new staff. After the new staff have accumulated knowledge and inspiration in the learning process, they write a summary and share it within the organization. Outstanding new staff and mentors will receive the honour of “Best Mentor” and “Best Mentee.”

VII-1.2. Incentive mechanism for new staff mentoring

The incentive mechanism for mentors is different from the traditional ex-post remuneration mechanism. An enterprise setting up the ex-ante, in-process and ex-post reward mechanism will achieve outstanding results. Firstly, the mentor needs to be given corresponding allowances as compensation and encouragement. Secondly, the annual Teacher's Day Conference is a tradition of nuclear power enterprises. At this conference, honours will be given to the mentors who have shown outstanding performance. In addition, in the career promotion, the mentors with mentoring experience have more advantages. The combination of financial and non-

financial incentives encourage the mentors to share knowledge. Everyone in the enterprise respect the mentors and the new staff mentoring is becoming a corporate culture.

VII-1.3. Value of new staff mentoring

The new staff mentoring programme has its significance and value. Mentors can revise and improve their knowledge and experience to promote impact and regeneration of knowledge and are encouraged to continuously gain new knowledge to promote their own learning and improvement. New staff can adapt quickly to the new working environment, improve their professional skills, and use less time to learn and master the knowledge and experience accumulated by the mentors for many years. Enterprises can give full play to the capabilities and potential of each person, promote the inheritance of knowledge within the organization, form a corporate culture that is willing to share and disseminate knowledge, and improve the efficiency of knowledge transformation. In addition, the new staff mentoring programme is also an effective way for enterprises to train talents and build talent teams.

VII-2. TRAINING PROGRAMMES FOR NUCLEAR NEWCOMER COUNTRIES

VII-2.1. Introduction to training programmes for nuclear newcomer countries

As an exporter of nuclear power, China signed strategic cooperation agreements with nuclear newcomer countries. The essential elements of these agreements are to provide professional training for nuclear engineers of these countries. Through long-term exploration and practice, Chinese nuclear power enterprises have developed a training system for nuclear newcomer countries. The trainees are technical experts, middle-senior management, and potential nuclear talents. The training system is divided into three stages: basic training courses, specialized training courses and on-the-job training, which are conducted step-by-step, from easy to difficult. The practice has shown that good training effects are achieved.

VII-2.2. On-the-job training

Compared with the previous two stages of theoretical knowledge training, the on-the-job training aims at specific trainees who are normally technical experts and middle-senior management with years of work experience in nuclear power. Therefore, the third stage of training lays emphasis on job practice and knowledge application. For on-the-job training, the Chinese nuclear power enterprises made innovation and improvement on course development, mentor selection and training form and got practical experience as below.

In terms of course customization, the enterprises develop the courses for each trainee based on the discipline and target post and design different course plans according to the requirements of different jobs, which enable the trainees to gain a comprehensive understanding of and experience on the target posts. In order to help the trainees to quickly adapt to the role of the job, the enterprises assign mentors in the form of one-to-one "shadow training" so the trainees will acquire the concrete working contents of the posts and learn relevant skills by observing the work behaviour of the mentors. To improve the training effectiveness, it is also necessary to assign a teaching assistant to follow-up on the learning progress of the trainees and tutor them after the training and to set up a study group. On-the-job training usually lasts over 60 days and therefore, the training forms have to be innovated and diversified. Besides the conventional face-to-face course, case study and discussion, field practice, laboratory teaching, Chinese culture experience and other activities can be involved in the training to increase the trainees' interests in learning. Finally, the enterprises can verify the trainee's learning effectiveness by examination, oral defence and other forms.

The feedback on training evaluation suggested that the trainees can gain a comprehensive understanding of the target post during on-the-job training through one-to-one and many-to-one guidance and mentoring. Both their professional knowledge and management level greatly improved.

VII-2.3. Significance of providing training for nuclear newcomer countries

Providing training for nuclear newcomer countries creates conditions for transnational and cross-cultural knowledge flow. During the training, one can learn from other's strong points to offset weaknesses, which helps to improve knowledge structure and facilitate the development of standardized training contents. The valuable experience will be constantly verified and finalized during the training and be finally incorporated into the training course as a permanent asset of the company.

From a macroscopic perspective, providing nuclear technical training for nuclear newcomer countries can help these countries cultivate nuclear professionalism, promote strategic cooperation on nuclear energy between two countries, improve the international influence of China's nuclear power technology and push the "nuclear power going global" strategy to a new level.

VII-3. MENTORING PROGRAMME OF THE RESEARCH INSTITUTES

VII-3.1. Overview of talent development at higher education in research institutes

In China, the research institutes offer higher education mainly through the graduate development and the postdoctoral working station. The research institutes tend to adopt university–enterprise partnership as the graduate development mode, i.e., the graduates pursue theoretical studies in universities, and participate in work activities and subject practice in the research institutes. In terms of doctoral development, the institutes rely on scientific research working stations to cooperate with the postdoctoral research stations of the universities and scientific research institutions, in the attempt to jointly train and develop the postdoctoral researchers.

VII-3.2. Introduction to the mentoring programme of graduate development

The research institutes attach importance to the mentoring programme and tend to adopt university-enterprise partnerships to jointly train and develop the graduates. They are provided with university mentors for guidance as of their admission, who put more emphasis on the development of graduate's theoretical knowledge learning ability and in-depth study capabilities. If the programme is more directed at training applied or professional talents as opposed to academic researchers, the dual-mentor mechanism will be adopted, i.e., both university and enterprise mentors will be provided, with the latter paying more attention to the development of graduate's scientific research ability and practical ability.

With full consideration to the graduate's academic background and strength, the research institutes have created opportunities for the graduates to participate in the scientific research practice, and helped them determine the research direction, thesis topic and research content by utilizing the enterprise scientific and technological platform and by mobilizing abundant resources of production, study and research. Meanwhile, the research institutes have organized communications and team activities to encourage and support graduates to apply for various scientific research projects and guided them to successfully complete academic thesis and subject research.

VII-3.3. Advantages and disadvantages

Through knowledge transfer from mentors to mentees and mentor-mentee interactions, the mentoring programme can effectively transfer the mentor's experience-based knowledge to the graduates and post doctors. Meanwhile, it is conducive to promoting the knowledge updates and innovation for both mentors and mentees and facilitating the generation of new knowledge under the education mode of production, study, and research. However, the enterprise mentors undertake R&D, design, and other transactional work beside specific teaching activities, which affects the frequency of communication between mentors and mentees. Therefore, it is necessary to further improve relevant systems, so as to create a more favourable institutional environment for the two-way improvement of mentors and mentees as shown in Fig. VII-1.

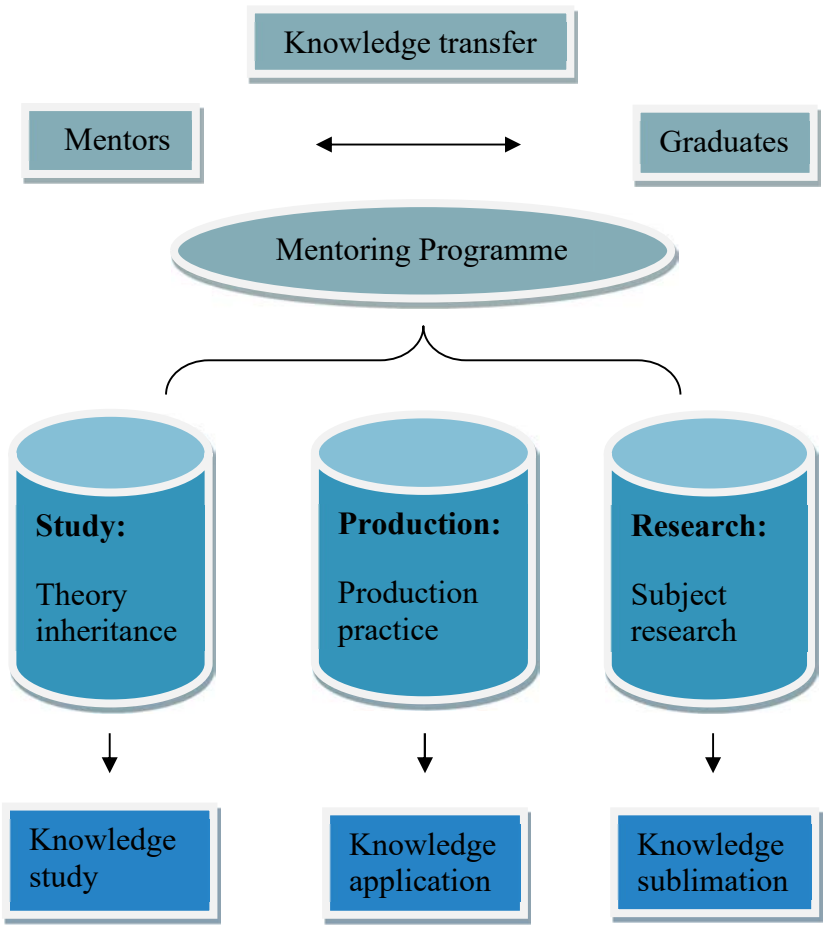


FIG. VII-1. Flow chart of knowledge management under mentoring programme.

ANNEX VIII. MENTORING AND COACHING IN NATIONAL NUCLEAR INSTITUTION OF INDONESIA

VIII-1. INTRODUCTION

The National Nuclear Energy Agency (BATAN) is a governmental agency that holds tasks of research, development and utilization of nuclear science and technology for the welfare of the people of Indonesia. BATAN has accumulated knowledge and holds competent employees in the field of nuclear. For BATAN, knowledge is a very important asset to carry out tasks and functions in safe, secure, and sustainable way.

A few years ago, the government issued a policy on moratorium of civil service recruitment, and this policy posed a new challenge for BATAN, and possibly for other government agencies as well. The challenge that arises from this policy is the existence of a knowledge gap between seniors and juniors, and also a potential of critical knowledge loss. Therefore, BATAN developed a systemic action to overcome this challenge, utilizing a nuclear knowledge management system.

BATAN adopted the concept of capacity building from the IAEA, which consists of 4 elements, namely education and training, human resource development, nuclear knowledge management, and knowledge network. All of these elements are integrated in the management system of BATAN.

This case study discusses the use of coaching/mentoring in knowledge management utilization strategies in BATAN as a national nuclear institution (NNI).

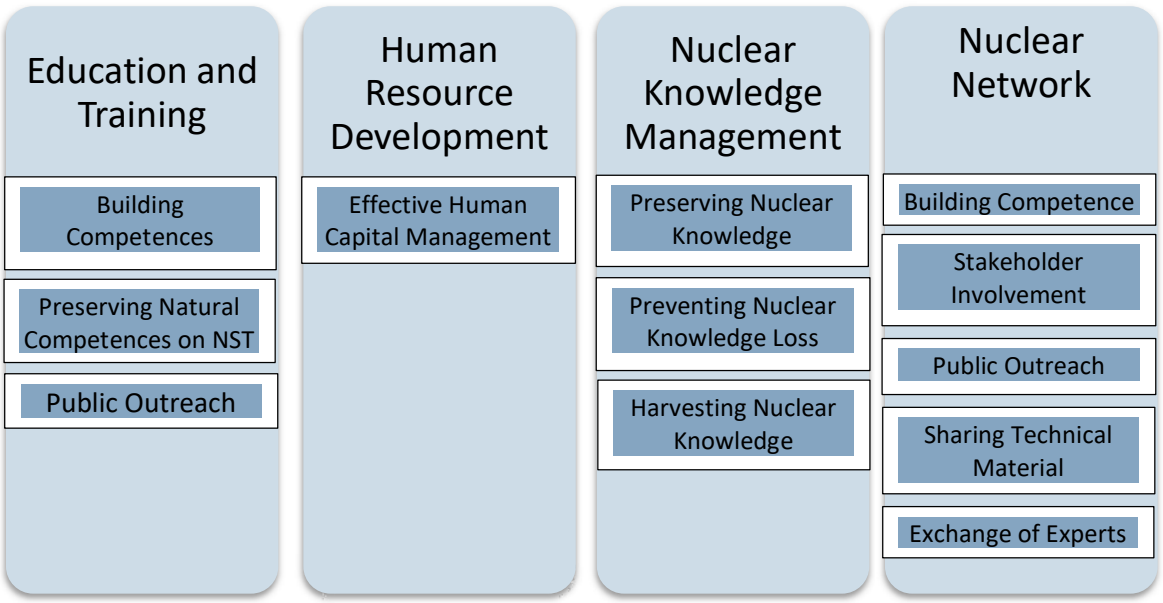
VIII-2. MENTORING AND COACHING PROGRAMME

VIII-2.1. Knowledge management as a part of capacity building

Following the concept of the IAEA, BATAN developed a comprehensive capacity building system. The objectives of the capacity building for each element can be seen in Fig. VIII-1, while the activities are shown in Fig. VIII-2.

Considering the importance of knowledge management in supporting the sustainability of the nuclear programme in Indonesia, BATAN management encourages the use of knowledge management. BATAN has developed a programme in which all officials in structural positions have to carry out knowledge sharing with all employees, and this activity has become one of the points of performance evaluation. Some employees at the middle and upper levels in functional positions are also required to share knowledge. Another programme is knowledge management in the pre-retirement activities. These pre-retirement activities are implemented to pass on knowledge, work attitudes, and values to other employees.

The knowledge management programme for BATAN is managed by the Bureau for Human Resources and Organization (BRHRO), involving Centres that hold responsibility for education and training and information system and technology. As is commonly known, the knowledge management programme covers aspect of people, process, and technology. Bureau for Human Resources and Organization (BRHRO) monitors and provides feedbacks on the knowledge management implementation in BATAN.



*NST: Nuclear Science and Technology

FIG. VIII-1. Objectives of Capacity Building Programme.

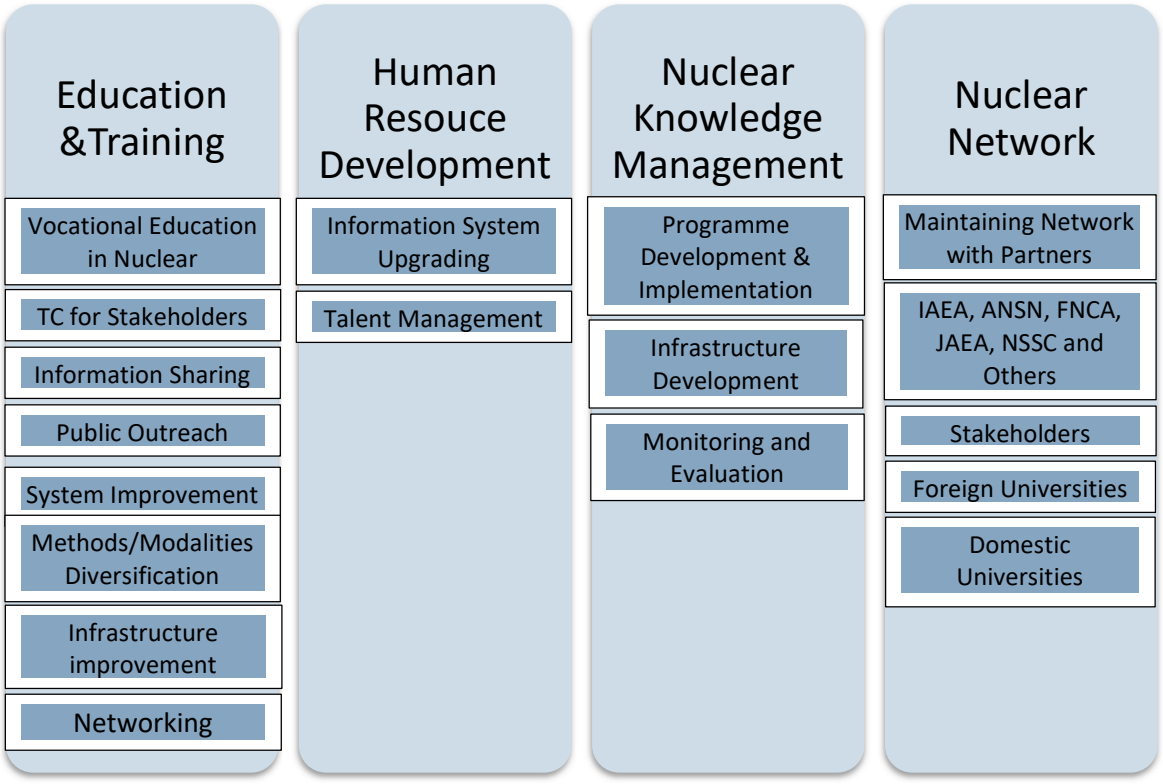


FIG. VIII-2. Activities of Capacity Building Programme.

Another consideration needs to be taken in relation with the specific task of BATAN, i.e., critical knowledge, which includes, among others, knowledge about the nuclear reactor, nuclear

fuel fabrication, radwaste management, radioisotope and radiopharmaceutical production, safety-security-safeguard.

VIII-2.2. Coaching and mentoring in training

Training modalities consist of classical and non-classical, and these modalities are in line with the national policy of the Government for all civil servants. As is shown in Fig. VIII-3, non-classical modalities cover, among others, coaching and mentoring. In this modality, coaching/mentoring may be chosen from one of the following three types:

— One-to-one;
— One-to-many;
— Many-to-many.

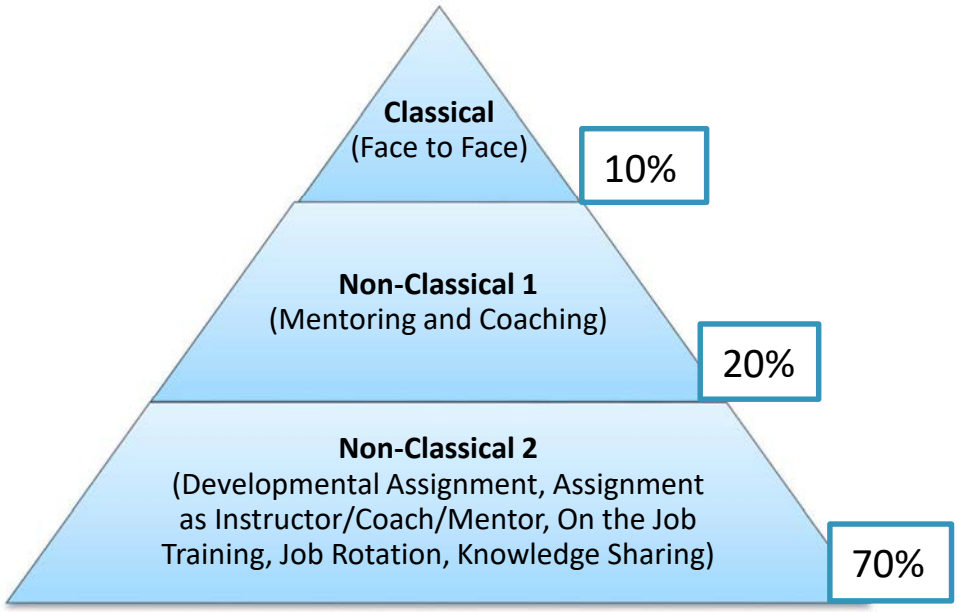


FIG. VIII-3. A typical training modality.

Other non-classical modality includes developmental assignment and other modes of knowledge transfer. Developmental assignments include groups of 3-5 employees. The members of a group are a combination of seniors and juniors to facilitate knowledge transfer both from senior to junior, but also from junior to senior (reverse coaching and mentoring).

VIII-2.3. Coaching and mentoring in knowledge management programme

The knowledge management programme is prepared annually by all working units, and the content of this programme is generic all over BATAN for easy monitoring.

Table VIII-1 shows the generic programme for all working units. One element of this programme is coaching/mentoring in the knowledge preservation section. Other activity is Community of Practice (CoP). In any CoP, coaching/mentoring can occur in a peer-to-peer mode.

TABLE VIII-1. GENERIC KNOWLEDGE MANAGEMENT PROGRAMME

Activities	Tasks
Identification and Mapping of Competence	— Updating employee competences; — Identification of potential list of competence.
Knowledge Identification	— Documentation of knowledge/results of R&D activities: • Journal/paper; • Paper/patent; • Technical/administration standard operating procedure (SOP); • Audio-visual, etc. — Knowledge capturing: • Story telling by employees who will retire; • Books/e-learning modules creation by senior staff.
Knowledge Sharing and Preservation	— Coaching/mentoring; — Shadowing; — On-the-job training.
CoP Development	— CoP formation; — Community activities.

Centre for Education and Training:

Coaching/mentoring at the Centre for Education and Training is done primarily to prepare employees to join as teachers or assistants for practicum. Assignments are given to senior teachers to coach/mentor employees who are prepared to become instructors or assistants. A prospective candidate has to attend 'Train the Trainers' programme on:

— Teaching methodologies;
— Teaching material preparation;
— The thematic 'Train the Trainers' for the material that will be taught in future.

After that the cadres will assist the instructor in the team-teaching system during 2-3 assignments.

A typical example for coaching/mentoring for prospective lecturers/assistants in the Centre for Education and Training in 2019 included:

— Using information system in relation with training activities: 2 senior lecturers, 6 employees;
— Using supplementary application: 6 applications, one-to-one mode;
— Preparatory programme for assistants of radiation protection training course: many-to-many;
— Train the Trainers: Many-to-many teaching technique.

VIII-3. CONCLUSIONS

BATAN is implementing coaching and mentoring as part of capacity building in the areas of education and training and knowledge management. Coaching and mentoring are being implemented with the following modalities:

- E&T: One-to-one, one-to-many, or many-to-many;
- In a developmental assignment modality, transfer of knowledge may take place from senior-to-junior, but also from junior-to-senior (reverse coaching and mentoring);
- Knowledge management: Peer-to-peer (CoP).

ANNEX IX. EXPERIENCE OF REPUBLIC OF KOREA IN MENTORING AND TRAINING FOR A NEW NUCLEAR BUILD

IX-1. OVERVIEW OF TRAINING PROGRAMMES

In a country where NPPs are introduced for the first time, one of the important challenges for the operating company is to secure qualified manpower prior to operation of the NPP. Usually, the operating company does not have the operation experience and, therefore, relies on the supplier for the initial training and qualification of personnel to operate and maintain the NPP.

This case study explains the approaches to knowledge transfer through training/mentoring of a main contractor, Korea Electric Power Company (KEPCO) having a consortium with Korea Hydro & Nuclear Power (KHNP) to train the human resources to operate their first NPP. A contract was signed with the owner company to build the new model APR (Advanced Power Reactor) type NPP developed in Republic of Korea including the design engineering, the construction, the nuclear fuel/equipment supply and as well as the support to build up the qualified owner personnel to operate the new NPP. The main contractor or the company responsible for overall construction of the project had previous experience in operation of NPPs and it supported the human resource development, including the development of qualified instructors/mentors and teaching materials for the operating company. Additionally, the preparation schedule of the training/mentoring was linked with the construction schedule and the hiring process of the operating company. Table IX-1 indicates the timeline of training related activities with reference to construction progress.

TABLE IX-1. MAJOR PROJECT MILESTONES WITH REFERENCE TO ESTABLISHMENT OF TRAINING ACTIVITIES

Schedule	Construction	Training
D - 31m	Signing of the Construction Agreement	—
D - 24m	—	Establishment of training team for the foreign project.
D - 16m	—	Establishment of the build-up plan for the instructors/mentors.
D + 0	Initial Concrete Pouring	—
D + 4m	—	Granting of the instructor JQC
D + 8m	—	Start of the CRT (Operation & maintenance)
D + 14m	—	Start of the CRT (engineering)
D + 19m	—	Delivery of Simulator #1
D + 24m	Reactor Installation	—
D + 30m	FSAR Submittal to Regulatory Body	—
D + 32m	—	Delivery of Simulator #2
D + 33m	Initial Energization	—
D + 45m	—	Acquisition of the MCR Operator License for unit 1
D + 51m	Approval of Operating License & Initial Fuel Loading for unit 1	—

— *m: month*
— *FSAR: Final Safety Analysis Report*
— *JQC: Job Qualification Card*
— *CRT: Classroom Training*
— *MCR: Main Control Room*

IX-2. MILESTONE

The operating company decided to train and qualify the owner's operating personnel 6 months prior to the operation permission by the Regulatory Body in the owner's country and KHNP had the responsibility to build up the owner's employees to meet this requirement and the target schedule.

Therefore, KHNP established a new training organization, which is responsible for securing the instructors/mentors, the development of the detailed training programme and the training/mentoring materials in English. However, the instructors/mentors are required to be professional in the APR type NPP systems and proficient in English language. The instructors/mentors need to be granted a job qualification card (JQC) for the training/mentoring. The timely preparation of training/mentoring materials including the related simulator is essential for training/mentoring the MCR operators.

IX-3. NUMBER OF TRAINEES (BASED ON 2 UNITS)

The training/mentoring programme was prepared to grant the licenses for the MCR operators and job qualification cards (JQCs) for the remaining personnel in each field prior to the fuel loading. The new employees were hired by the operating company according to the training schedule, the academic background, and the field experience for each position. Considering the constraints of available manpower in the owner's country, the operating company had a plan to secure the required manpower through raising new employees corresponding to 2/3 of the total required manpower to operate the NPP as shown in Table IX-2 and the experienced personnel from KHNP corresponding to 1/3 of the required manpower. Additionally, the operating company implemented a strategy to mitigate the lack of owner personnel's operating experience. Through this, experienced foreign expats would support the operation of the NPPs in the initial stage and the expats would gradually be replaced by the operating company's manpower.

TABLE IX-2. NEW EMPLOYEES ON TRAINING

Course	Operator		Maintenance	Engineering	CH/RP & others	Total
	MCR	Local				
No. of Trainees	64	23	70	28	42	227

CH/RP & others: Chemistry/Radiation Protection & QA, Station Engineers; MCR: Main Control Room

IX-4. DIFFICULTIES DURING THE TRAINING/MENTORING

The way to build up the operating manpower can be categorized into classroom training (CRT) and on-the-job training (OJT). Qualified instructors/mentors, training materials including the simulators based on the same design/operation parameters as the new building power plant, and suitable accommodations for the foreign trainees were the essential factors to develop the huge number of the trainees for these challenging tasks.

IX-4.1. Technical difficulties

The reference plant proposed by the bidder was still under construction and, therefore, there were limitations in the development of the instructor/mentor and the teaching materials due to the lack of the operating experience of the reference plant. Moreover, the simulators and the related training materials need to be developed based on the as-built design data of the NPP in

the country, but in so many cases the design process of the plant was equal or a little ahead to the developing schedule of the simulators and the training materials, so it could afford the tight schedule to develop the suitable simulators and training materials, such as, the operation procedure, etc. In case of the nuclear newcomer country, the regulatory body was established just before the start of the NPPs construction and, therefore, the regulatory requirements necessary for the safe operation of the NPP were still under development. Therefore, the training materials had to be revised according to each enactment of the regulation. Finally, the nuclear industry infrastructure of Korea and the nuclear newcomer country were significantly different and, thus, it was necessary to develop different teaching materials.

IX-4.2. Cultural difficulties

In case of the overseas nuclear business, the countries/companies of the instructors/mentors and trainees/mentees were inevitably different, which caused difficulties in the communication in respect to language, climate, behaviour, decision making processes, objectives of the organization, and cultures of the training venue.

IX-5. RESOLUTIONS TO THE DIFFICULTIES

In order to resolve the technical and cultural issues described above, KHNP tried to find the solution by itself and, in some cases, KHNP collaborated with the operating company to find the proper way to overcome the hurdles.

IX-5.1. Technical issues

At the time of developing the training materials necessary for the training/mentoring course, the operating experiences from similar design NPP were not sufficient as the reference plant was also under commissioning. Therefore, the overseas business cooperation team was installed at the reference plant to provide the information of the reference plant's operating procedures and to periodically issue operating experience for the training organization to update the training/mentoring materials on a real-time base. KHNP resolved this issue by dispatching the instructors/mentors to gain experience on the commissioning tests being conducted at the reference plant in order to acquire necessary experience in relevant field.

The development of the training/mentoring materials, as well as the simulator and the MCR operator training schedule was too tight, because the final design parameters of the plant were not available on time. Simulator # 1 had to be manufactured based on the design parameters of the reference power plant because the as-built design data was not available at that time. The simulator was upgraded as soon as the as-built design data became available. In the case of operator training/OJT materials, the instructors resided at the construction site of the plant and acquired the as-built design/operating data through cooperation with the system designers and the newly issued regulatory requirements were reflected in the training materials through collaboration with the professional experts of the operating company.

The operating company hired many foreign expats for the maintenance and engineering areas and for different structures of the nuclear industry in the country. It resulted in different work process compared to the process of KHNP. The changes to the work process were initiated after the completion of training/mentoring course. The revision of the training/mentoring materials to reflect the changes in work processes were made by themselves later.

IX-5.2. Cultural issues

Initially, all training/mentoring courses, except the simulator training, were planned to be carried out in Korea, but the extremely cold winters in Korea as well as cultural differences lead to the decision to conduct CRTs in the trainee's countries. However, the OJT courses were carried out at the Korean NPPs.

In addition, KHNP willingly installed a prayer and foot washing room next to the OJT place for the convenience of the religious activities of the trainees during the OJT period in Korea. KHNP also operated programmes to understand the Korean culture through visiting religious places, the traditional markets, hiking places as a weekend programme, and by visiting nuclear facilities such as, Major Component Manufacturer, Balance of Plant (BOP) Vendors, Nuclear Fuel Supplier and Design Engineering Co., which helped the trainees to enhance the understanding of the nuclear industry.

When the high-level management from operating organization visited Korea, they also visited the Korean NPP and encouraged their trainees/mentees. They also shared their company's goals and the expectations of the management. They, sometimes, identified areas for improvement in the OJT programme, which was communicated to the KHNP management. Such activities of the management level contributed to mitigating the discomfort of the trainees in the Korean NPP and enhanced the training efficiency.

The trainees used their language and the instructor/mentor used Korean language. English was selected as a common language during the CRT/OJT and used for all teaching/mentoring materials. In order to improve the English proficiency of all instructors/mentors, KHNP also commissioned an external professional expert to develop a special programme and dispatched the instructors to a US educational school for several months. KHNP also hired several foreign nuclear experts as instructors for the CRT course. In order to share the understanding of each culture and the language of both countries, the KHNP instructors and trainees also took time to share lectures with each other after the class.

IX-6. CONCLUSIONS

The project to build NPPs in a nuclear newcomer country has to carefully plan and support the human resource development in order to help the owner operate the NPPs independently after completion of the plant construction/commissioning. In this case, the preparation schedule of the training always overlapped with the construction schedule. Therefore, it was very hard to reflect the as-built data in the training material and to secure the experienced instructors/mentors as the reference plant was in many cases still under construction. The differences in language, culture, and regulation requirements were other barriers to be overcome for the successful development of a huge number of inexperienced personnel in the nuclear field. KHNP tried to find the measures by themselves or sometimes in collaboration with the experts of the owner company to develop the operating workforces for the safe operation of the new built NPPs.

ANNEX X. MENTORING APPROACHES IN OECD- NEA IN THEIR TRAINING AND SKILL DEVELOPMENT ACTIVITIES

X-1. INTRODUCTION

The OECD Nuclear Energy Agency (NEA) launched the Nuclear Education, Skills, and Technology (NEST) Framework in February 2019 with the aim to address the concerns of the NEA Member Countries about the potential loss of knowledge due to the retirement of the current workforce and consequently the need to transfer this knowledge to the young generation. The NEST Framework seeks to address in particular the transfer of the *tacit* knowledge, which is more difficult to transfer as it resides in the minds of the practitioners who have gained it through exposure to practical activities.

The NEST Framework is a multilateral initiative which, through international collaborative research projects, trains and facilitates the skills development and training of the next generation of nuclear professionals and is thus nurturing the next generation of nuclear leaders.

NEST helps countries to leverage resources and address short- and long-term educational and research needs through:

- Developing training activities in challenging nuclear projects;
- Building a talent pipeline from universities to industry and regulators by preparing the workforce with the skills and competencies specific to the nuclear sector.

Building long-lasting partnerships between university, industry and with all nuclear stakeholders to create a global nuclear network of fellows, mentors, and organizations.

X-2. EXPLANATION OF THE MENTORING AND COACHING PROGRAMME

The framework is implemented via projects and activities where the NEST fellows carry out hands-on training activities under the supervision of mentors who facilitate the transfer of this knowledge they have accrued and acquisitions of competences.

NEST fellows are graduate or postgraduate students or young professionals engaged in technical and scientific nuclear related activities.

NEST projects are multinational (at least 3 countries) in character, and they need to address concrete and multidisciplinary challenges in the field of nuclear science, technology and applications, including both technical and non-technical aspects. The projects need to offer hands-on training opportunities to NEST fellows as well as skills development and education programmes.

NEST activities are education, training or mentoring activities to broaden the awareness of nuclear science, technology and applications.

X-2.1. NEST working process

NEST is implemented through dedicated projects and activities in any participating country. NEST projects are multi-disciplinary and involve organizations (universities, research centres, industries, TSOs, and regulators) from at least three NEST countries. Master, PhD, Postdoc, and young professionals develop skills and acquire competencies and knowledge in new areas of nuclear science and technology through hands-on activities developed as part of NEST

projects. Each project addresses a specific real-world issue or challenge (safety, decommissioning, nuclear new builds, radioactive waste management, etc.). Each fellow is assigned a NEST mentor to help them acquire knowledge and critical thinking skills that come from working in close contact with experts and leaders in the field. In a second phase, fellows continue working on exploratory research projects related to the challenges and issues faced. This could eventually lead to development of new technologies and greater innovation. Finally, through networking among themselves as well as with a wide range of experts from different countries and disciplines, NEST fellows broaden their knowledge in the nuclear field, which could lead to new opportunities crucial for their career development.

On completion of their fellowships, there is an evaluation of the skills and competences acquired and a fellow's skills passport is issued.

X-2.2. A global network

Universities, research organizations, industries, TSOs and regulators from ten countries are currently participating in the NEST Framework. This global nuclear network of stakeholders helps to:

- Leverage human capacity building and development activities to create the appropriate dynamics for knowledge and expertise to be shared and acquired by NEST fellows;
- Encourage scientists and engineers in various fields to collaborate on a variety of projects and strengthen working relationships;
- Facilitate the development of new technologies and innovation to address real-world challenges and issues.

X-3. CONCLUSIONS

The NEST Framework is still at its early stages of development, hence only a limited number of fellowships took place. The early results are promising, and this has been proven by the positive feedback received by the fellows as reported below:

Through the NEST Fellowship I became connected to other scientists and student researchers from different cultures and different background and each with their own viewpoint. From conversations I learned how others see the world and approach problems, which were always unique and something I simply would not experience at home. Furthermore, the work I engaged in was closely supervised by experts within the field and I was able to dedicate the entire internship time to learning novel techniques to accomplish challenging objectives and was able to apply the knowledge after the internship on new projects. The NEST Fellowship served as one of the significant foundations in my scientific journey and opened the door to many cultures that I never experienced before.

Stephen King, Texas A&M, USA, NEST Fellow at Paul Scherrer Institute, Switzerland, 2019.

ANNEX XI. MENTORING AND COACHING APPROACHES IN EUROPEAN COMMISSION- JOINT RESEARCH CENTRE

XI-1. INTRODUCTION

The Joint Research Centre (JRC) is a Directorate General (DG) of the European Commission (EC) under the responsibility of the Commissioner for Innovation, Research, Culture, Education and Youth. As the EC's science and knowledge service, the JRC provides independent scientific advice and support to EU policymaking. It was established in 1957 under the European Atomic Energy Community (Euratom) Treaty and around 25% of its work continues to be in the nuclear field today, consolidated in the Nuclear Safety and Security Directorate (JRC Directorate G). The Nuclear Directorate is spread across four sites in Germany, Italy, Belgium and the Netherlands, with a total staff of about 500 people. The mission of DG is to create, maintain, and spread independent science with impact on nuclear safety, safeguards and security, as well as to contribute to the prosperity of the European citizens from both nuclear and non-nuclear member states. The Directorate manages and operates nuclear infrastructures from their design (new builds) to their decommissioning. Its research activities are aligned with the EC political priorities and with the European Atomic Energy Community (Euratom) Research and Training Programme, embedded in the EC HORIZON programmes, which facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. Administrative and human resources processes are centralized at European Commission level, where large efforts and means are dedicated to the staff's continuous development of skills and competencies, as well as to talent management programmes.

The transfer of tacit nuclear knowledge in the JRC is assured by a wide range of methods and processes. The current case study is limited to mentoring and coaching schemes and among them, to those interesting from a knowledge management perspective, meaning the ones that serve the purpose of tacit knowledge transfer (know-how and know-why). Some of these schemes are corporate ones managed centrally by DG Human Resources for all General Directorates of the European Commission, whereas others are JRC specific.

XI-2. MENTORING AND COACHING FOR NUCLEAR KNOWLEDGE MANAGEMENT AT THE EUROPEAN COMMISSION'S JOINT RESEARCH CENTRE

The JRC's toolbox on knowledge management relevant mentoring and coaching schemes is illustrated in the Table XI-1.

The following other knowledge transfer tools do not fall under the limitations of this case study and will not be outlined therein, indicatively:

- Externalization (tacit to explicit knowledge) by training or other learning methods, scientific seminars, Open Access to nuclear infrastructures, transparent filing and archiving, hand-over files and exit interviews, as well as people directories;
- Socialization (tacit to tacit knowledge) by means of regular mobility of managers and staff, meetings and missions, office sharing and transparent work on collaborative platforms, team building activities, networking, communities of practise, social events, leisure groups, etc.

TABLE XI-1. MENTORING AND COACHING SCHEME

Employment phase	Knowledge transfer technique	Activity	Tacit knowledge gain
On-boarding of new recruits	Mentoring	EC mentor corporate mentoring scheme for newcomers	Transfer of knowledge and advice from a mentor affiliated to another DG to the newcomer (learning from differences)
		Supervising and mentoring in the frame of collaborative doctoral partnerships	Two-ways knowledge transfer – i) from supervisor/mentor to newcomer and ii) from younger generation to older generation (e.g., technical and scientific advancements)
	Coaching	Coaching as part of the welcoming programme	Knowledge transfer from different profiles to newcomer
		Two weeks overlap with the newcomer	Transfer of know-how from departing job holder to arriving one
Qualification of newcomers	Mentoring	EC mentor corporate mentoring scheme for newcomers	Transfer of knowledge and advice from a mentor affiliated to another DG to the newcomer (learning from differences)
		JRC Research Fellows Mentor and Scientific Supervisor	Knowledge transfer from the mentor or supervisor to JRC scientific and technical staff on different temporary contracts and vice versa
		Supervising and mentoring in the frame of collaborative doctoral partnerships	Two-ways knowledge transfer – i) from supervisor/mentor to newcomer and ii) from younger generation to older generation (e.g., technical and scientific advancements)
	Coaching	Internal individual coaching	Raise awareness of the knowledge detained by each staff member and consequently of the possibility of transferring this knowledge to others
		Team coaching for staff who belong to the same team	Awareness of collective knowledge and knowledge diffusion within the team, collaborative culture and culture of knowledge
		On the job coaching within the Unit	Transfer of knowledge from a peer acting as a coach
Staff development and performance management	Mentoring	Mentoring by Active Senior	Transfer of expertise, information and advice from retired former official to current ones
		JRC Research Fellows Mentor and Scientific Supervisor	Knowledge transfer from the mentor or supervisor to JRC scientific and technical staff on different temporary contracts and vice versa
		Reverse mentoring in the frame of collaborative doctoral partnerships	Two-ways knowledge transfer – i) from supervisor/mentor to newcomer and ii) from younger generation to older generation (e.g., technical and scientific advancements)
		Informal mentoring in the Unit for future managers (e.g., deputising) and other staff (e.g., rotation)	Technical knowledge and skills transferred and put into practice

TABLE XI-1. MENTORING AND COACHING SCHEME, cont.

Employment phase	**Knowledge transfer technique**	**Activity**	**Tacit knowledge gain**
Staff development and performance management	Mentoring	Mentoring/coaching offered in frame of certain networks and communities of practice	Knowledge transfer from more experienced to less experienced members
	Coaching	Internal individual coaching	Raise awareness of the knowledge detained by each staff member and consequently of the possibility of transferring this knowledge to others
		Team coaching for staff who belong to the same team	Awareness of collective knowledge and knowledge diffusion within the team, collaborative culture and culture of knowledge
		Coaching as part of e-learning	Transfer of specific knowledge with coach as facilitator
		On the job coaching within the Unit	Transfer of knowledge from a peer acting as a coach
	Staff exchange	Job shadowing as guest or host	Cross-unit knowledge transfer, collaborative culture, knowledge sharing culture
		Short term staff exchange	Inter-DG knowledge transfer, collaborative culture, knowledge sharing culture

TABLE XI-1. MENTORING AND COACHING SCHEME, cont.

Employment phase	**Knowledge transfer technique**	**Activity**	**Tacit knowledge gain**
First-line supervisors (Team leader, Head of Sector)	Mentoring	Mentoring by active senior	Transfer of expertise, information and advice from retired former official to current ones
		Reverse mentoring in the frame of collaborative doctoral partnerships	Two-ways knowledge transfer – i) from supervisor/mentor to newcomer and ii) from younger generation to older generation (e.g., technical and scientific advancements)
		Informal mentoring in the Unit for future managers (e.g., deputising) and other staff (e.g., rotation)	Technical knowledge and skills transferred and put into practice
		Mentoring/coaching offered in frame of certain networks and communities of practice	Knowledge transfer from more experienced to less experienced members
	Coaching	Internal individual coaching	Raise awareness of the knowledge detained by each staff member and consequently of the possibility of transferring this knowledge to others
		Team coaching for staff who belong to the same team	Awareness of collective knowledge and knowledge diffusion within the team, collaborative culture and culture of knowledge
		Peer support for managers	Transfer of managerial know-how from managers-coaches to other managers
		Coaching as part of e-learning	Transfer of specific knowledge with coach as facilitator

TABLE XI-1. MENTORING AND COACHING SCHEME, cont.

Employment phase	**Knowledge transfer technique**	**Activity**	**Tacit knowledge gain**
First-line Supervisors (Team Leader, Head of Sector)	Staff exchange	Job shadowing as guest or host	Cross-unit knowledge transfer, collaborative culture, knowledge sharing culture
		Short-term staff exchange	Inter-DG knowledge transfer, collaborative culture, knowledge sharing culture
Middle managers (Head of Unit and Head of Department)	Mentoring	Mentoring by Active Senior	Transfer of expertise, information and advice from retired former official to current ones
		Mentoring/coaching offered in frame of certain networks and communities of practice	Knowledge transfer from more experienced to less experienced members
	Coaching	Internal individual coaching	Raise awareness of the knowledge detained by each staff member and consequently of the possibility of transferring this knowledge to others
		External individual coaching for managers	Same as above and additionally to enable them to facilitate the knowledge exchange within their team and among teams
		Team coaching for staff who belong to the same team	Awareness of collective knowledge and knowledge diffusion within the team, collaborative culture and culture of knowledge
		Group coaching for managers	Knowledge exchange between peers on topics of common interest across DGs, building of collective knowledge
		Peer support for managers	Transfer of managerial know-how from managers-coaches to other managers
		Coaching as part of e-learning	Transfer of specific knowledge with coach as facilitator
		Coaching as a component of the 180° and 360° exercise	Knowledge transfer to the participants after receiving their report
	Staff exchange	Short-term staff exchange	Inter-DG knowledge transfer, collaborative culture, knowledge sharing culture
Senior Managers (Director and Director General)	Mentoring	Mentoring by Active Senior	Transfer of expertise, information and advice from retired former official to current ones
	Coaching	External individual coaching for managers	Raise awareness of their knowledge and its transfer and facilitate the knowledge exchange within their team and among teams
		Coaching as a component of the 180° and 360° exercise	Knowledge transfer to the participants after receiving their report

XI-3. MOTIVATION TO START MENTORING AND COACHING

The EC HR Talent Management Strategy, launched in June 2016, complemented, and partially incorporated the learning and development strategy by supporting the existing mentoring/coaching schemes and adding new ones in the EC toolbox. Its implementation aims at creating a knowledgeable, skilled, flexible, and networked organization by means of:

- Focusing on managerial excellence;
- Fostering staff development;
- Strengthening staff performance;
- Contributing to stronger collaborative skills.

In particular, the EC supports mentoring as a developmental and knowledge-transfer tool to create a knowledge-sharing culture, by transferring insights, know-how and experience from more to less experienced colleagues. However, mentors not only help mentees learn, but they also learn from the mentorship relationship. Specifically, for including active seniors in the mentoring scheme, a survey carried out by DG Human Resources in July 2011 revealed that in practice only nine out of 25 Commission DGs had drawn on the expertise of former officials, whereas 24 of the 25 DGs showed interest in making use of it. Therefore, a consolidated framework was put in place to enable retired staff share their know-how and maintain it in the organization after their departure.

The motivation for starting the EC-wide coaching programme was to optimize staff performance and develop staff potential in order to help the organization better achieve its results and strategic goals. In detail, individual coaching supports staff in managing their performance and talent, resilience and development, as well as relationships at work. Team coaching (for people who work together), helps to improve teamwork by exploring team dynamics, team processes, and quality of relationships. Group coaching (for people from different services sharing similar challenges), uses the power of the group for reflection and exchange between peers to support each other's success and development.

The job shadowing programme and the short-term exchange programme (SEP) are part of the JRC mobility package. The corporate job shadowing was tailored to JRC needs in order to encourage knowledge sharing and exchange among different Units and Directorates. It aims to preserve and transfer acquired knowledge and skills as well as to continuously support the acquisition of new ones, to collaborate horizontally when required in teams and networks and hereby create synergies across JRC Units.

XI-4. KNOWLEDGE MANAGEMENT MODEL

The Knowledge Management Unit in the Nuclear Safety and Security Directorate (JRC.G.10-Knowledge for Nuclear Safety, Security and Safeguards) is developing the following conceptual framework on tacit nuclear knowledge transfer:

- Identify and map key functions that detain critical tacit knowledge (know-how and know-why);
- Map knowledge gaps and anticipate knowledge needs;
- Risk assessment of knowledge loss;
- Identify and map knowledge transfer mechanisms and suitable type of communication media for various levels of tacit knowledge;
- Action plan for knowledge transfer: gather, analyze, and codify tacit knowledge to facilitate its reuse and to communicate/diffuse it;

— Develop sharing tools to facilitate knowledge flow;
— Develop targets and indicators to evaluate knowledge transfer efficiency;
— Strengthen the organizational culture for tacit knowledge sharing.

XI-5. EXPLANATION OF THE MENTORING AND COACHING PROGRAMME

XI-5.1. Mentoring

Mentoring in the European Commission is a self-directed knowledge exchange scheme that aims to support the mentee in tackling work-related challenges by sharing information, experience, and views of the mentor. This provides an additional perspective or insight into the way the organization works, which clarifies particular situations and helps the mentee understand the skills and knowledge required for effective performance and taking own decisions.

Mentoring in the JRC is offered under the following schemes:

— EC mentor corporate mentoring scheme for newcomers: transfer of knowledge and advice from a mentor affiliated to another DG to the JRC newcomer (learning from differences);
— Mentoring component of the Active Senior initiative: voluntary transfer of expertise, information and advice from retired official to current ones;
— JRC Research Fellows Mentor and Scientific Supervisor: knowledge transfer from the mentor or supervisor to JRC scientific and technical staff on different temporary contracts and vice versa;
— Supervising, mentoring and reverse mentoring in the frame of collaborative doctoral partnerships: two-ways knowledge transfer) from supervisor/mentor to newcomer; and ii) from younger generation to older generation (e.g., technical and scientific advancements);
— Mentoring/coaching offered in the frame of certain networks and communities of practice both formally and informally (e.g., knowledge transfer from more experienced to less experienced members);
— Informal mentoring to transfer and put into practice technical knowledge and skills in the Unit for future managers (e.g., deputising) and other staff (e.g., rotation of tasks within a team under the coaching of the most experienced team member).

The relationship between mentor and mentee is based on confidentiality, trust, non-judgement, and openness. Both parties accept a shared responsibility for developing the mentoring relationship and commit to putting in the necessary time and effort. However, the driving seat of the process is occupied by the mentee, who is responsible for realistic and achievable goals setting, initiation and maintenance of contact with the mentor, as well as the arrangement of meetings, follow-up on feedback received, and ultimately the decision on the goals and actions to be implemented.

The EC recognizes that there are many intuitive “natural” mentors in the organization since everyday work usually happens in intergenerational teams. Colleagues interested in becoming a mentor formally need to: have extensive experience in the organization (at least 15 years); have a sound understanding of the history, values and role of the organization; know how the organization works; be open to share their experience, knowledge and networks; see the added value of mentoring and have a genuine interest in to help other colleagues in their development; demonstrate patience, respect, discretion, confidentiality, empathy; and in general have a flawless conduct in line with the EC ethical standards.

In particular mentoring offered by active seniors is one of the activities in which former officials, regardless of their level of seniority at their retirement, can provide their assistance on a voluntary basis for both the EC services and the retired staff. The Active Senior initiative launched in February 2014 by the DG Human Resources allows for participation of former officials in unpaid EC activities defined by each DG. Mentoring is particularly encouraged to ensure that their know-how stays in the organization.

At the other end of the age-scale, mentoring of doctoral students and young scientists respectively in the frame of collaborative doctoral partnerships and the JRC Research Fellows initiative, offers JRC experts the chance to connect with the new nuclear generation, pass on their know-how and experience and at the same time benefit from fresh thinking and knowledge.

Each mentoring relationship is unique and tends to find its own rhythm and intensity, upon mutual agreement between mentor and mentee. Even though there are no fixed rules, experience shows that the preferred frequency of meetings is monthly, and the overall duration of mentoring varies between 9 months and 1 year or even beyond. Physical meetings could alternate with other forms of interaction, like telephone contacts or video conferences.

XI-5.2. Coaching

Coaching at the Commission is a structured process that uses specific competencies and techniques through a formal relationship with a professional coach to optimize work-related functioning and create perspectives for higher impact and sustainable change. It helps people to become more self-aware and co-responsible, to make conscious objective-driven choices and put their knowledge and skills in the service of the organization. The following schemes are available:

- Internal individual coaching for all staff: to raise awareness of the knowledge detained by each staff member and consequently of the possibility of transferring this knowledge to others;
- External individual coaching for managers: same as above and additionally to enable them to facilitate the knowledge exchange within their team and among teams;
- Team coaching for staff who belong to the same team: awareness of collective knowledge and knowledge diffusion within the team;
- Group coaching for managers at all levels from different services across the organization, sharing similar challenges: knowledge exchange between peers, building of collective knowledge;
- Peer support for managers: transfer of managerial know-how from managers-coaches to other managers;
- Coaching as part of e-learning, e.g., manager duos for manager and deputy: transfer of specific knowledge with coach as facilitator;
- Coaching as a component of the 180° and 360° exercise: knowledge transfer to the participants after receiving their report;
- On the job coaching within the Unit: transfer of knowledge from a peer acting as a coach;
- Administrative circuits and trainings as part of the welcoming programme also involving coaching: knowledge transfer from different profiles to newcomer;
- Two weeks overlap with the newcomer: transfer of know-how from departing job holder to successor.

Internal coaching is available since 2018 for both managers and staff and is provided either by corporate coaches (Corporate Coaching Service), or accredited internal coaches working in different DGs. External coaching for managers is organized since 2003 only for senior and middle managers and provided by external coaches hired via a coaching framework contract. Individual coaching in general (internal and external) is a focused developmental conversation between the coach and the person being coached, based on organizational and personal objectives. The format is limited in time and duration: usually 3 to 8 sessions of 1 hour over 4 to 6 months.

Team coaching is for people who work together in the same team (from 5 to 12 people). The team undertakes efforts to reflect and work together on its issues in order to deliver a sustainable and high-quality performance. The format is 3 to 3.5 days over 8 months.

Group coaching targets managers who share similar challenges, independent of their management level. A special focus is given to reading and leading group dynamics. The format is 3.5 days over 6 months in closed groups of 6 to 12 people meeting regularly in a confidential protected environment, using different methods e.g., co-development coaching processes, action learning, etc.

Peer support for managers is offered by managers-peer coaches, i.e., managers (Head of Unit to Director General) and other officials with people management responsibilities (Deputy Head of Unit and below) trained to offer support in coaching mode to fellow managers. Peer coaching is run for managers who want to manage in a coaching style, which is proven to be very impactful as a leadership style, and which is also the preferred style of staff. Therefore, this is the encouraged leadership style in the EC currently.

The coaching practice in the EC is formalized. All internal and external coaches in the Commission are fully qualified coaches, i.e., their training has been certified by international certification bodies, and they have also undergone an internal accreditation process.

Within Units “on-the-job coaching” is put in place to assure and accelerate transfer of technical knowledge and skills from a peer acting as a coach to a colleague who has to face a new environment, new procedure, a job-related problem or a new task or programme. On-the-job coaching can be unplanned, informal, and spontaneous. However, services are encouraged to develop a list of internal coaches in specific areas. This scheme applies particularly to newcomers, since it enables them to become rapidly operational, which is usually translated to 6 weeks instead of 6 months. Managers usually appoint an on-the-job coach for each new staff member. In terms of time, typically 5 to 10 working days of an experienced staff member spread over 2 to 6 weeks are invested to facilitate integration, transfer know-how, practices and procedures and make the newcomer efficient.

For newcomers this kind of coaching is also ensured in the frame of the Newcomer’s Programme with the administrative circuit and trainings that are part of it. At the nuclear site of the Joint Research Centre in Karlsruhe for example there is the practice of issuing the “newcomer sheet”: several trainings on laboratory practices, operation of certain devices, radioprotection, etc. are offered by different experts in the field, who sign the sheet upon completion of each training aspect. When the newcomer collects all signatures, he/she is considered “fit for work” in the nuclear laboratories. Usually, this scheme couples the written hand-over file and an overlap of at least 2 working weeks with the previous jobholder, who acts as on-the-job trainer and often also makes use of coaching techniques to transfer know-how.

XI-5.3. Job Shadowing

Job shadowing is a process whereby a JRC staff member (guest) observes (shadows) the work of a colleague in another JRC Unit or Directorate (host) for a given period varying between 3 days and 2 weeks. This short-term experience of "looking over the shoulders" of other colleagues while they are doing their jobs offers insights into a specific working area, improves knowledge, and strengthens competence in different working processes and methods. The job shadowing process is especially useful for staff with expert knowledge in a specific field since it tests and implements specific skills when carrying out concrete tasks in a different organizational environment. It is open since 2018 for participation to all JRC staff and all jobs can be shadowed, except roles that involve confidential work.

During the shadowing period, knowledge is transferred from the host to the guest. However, the transfer of knowledge goes both ways: while the guest learns, he/she can also share their work practices (reciprocal transfer). Job shadowing is a good channel for better mutual understanding and best practice dissemination. It fosters cross-units knowledge transfer within the DG and cultivates a collaborative culture.

XI-5.4. Short Term Staff Exchange

Considered as one of the best ways to develop skills and competences and to transfer knowledge inter DGs, the JRC Short term staff exchange programme (SEP) has been developed since 2015 to allow JRC staff to spend short periods (2 to 4 weeks) working in other DGs or EC services. Knowledge transfer benefits are drawn for both participating services: anticipating emerging issues, understanding complexities, and breaking silos. When back to the service of affiliation, the JRC staff member is encouraged to share the knowledge gained, either by giving a talk to his colleagues or by diffusing the know-how within communities of practice and on collaborative platforms, favouring the transformation of knowledge into organizational memory.

Reciprocity agreements with external organizations can also be sought.

XI-6. PERFORMANCE METRICS

Qualitative and quantitative data on the coaching/mentoring/shadowing/exchange schemes are collected and analyzed by the competent Human Resources services in charge of each programme. All individual participants to the various schemes are encouraged to provide feedback and evidence on the value of the experience and the knowledge gain at any time of the process. Introductory electronic questionnaires before the beginning of the scheme and debriefing meetings at various stages are followed by an end-of-activity evaluation form or interview. Mid-term impact is also evaluated at a later point of time by a follow-up survey or participation in focus groups. Evaluation of mentoring and coaching is based on comparing achievements against initial objectives. Especially for managers, 180°- and 360°-degrees feedback by their hierarchy, peers, and staff offers an additional evaluation source. When it comes to short mobility schemes (job shadowing and short-term exchange programme (SEP)), evaluation is based on the acquired knowledge, which is shared upon return of the job holder to his/her Unit/Directorate of affiliation, by means of informal feedback sessions, like lunchtime seminars, as well as on dedicated specialist communities and on the "back to the office" community on collaborative platforms.

Statistics are taken into account to evaluate the progress of each programme and decide on its extension (especially when it refers to a pilot project) and/or modification for improvement.

The underlying principle is to use a light reporting system to avoid additional administration burden that would outscore the efficiency gain. Evaluation and follow-up are focused on improving the use of the schemes, rather than questioning their utility.

However, all these schemes are not only evaluated individually, but also as parts of the general Talent Management programme, through the periodical staff satisfaction survey and other extraordinary surveys. A scale-on-impact questionnaire is electronically answered in an anonymous way across the EC and follow-up actions are implemented and re-evaluated during the next survey. Occasionally, external companies might be hired to perform an evaluation of a specific programme and propose a report with their findings and recommendations for improvement.

XI-7. LESSONS LEARNED

Following are the lessons learned:

- The organizational memory reflecting the collective knowledge ought to be targeted by mentoring, coaching and other supportive schemes, as part of a larger toolbox for tacit knowledge transfer. Culture, infrastructure, and technology influence knowledge circulation;
- The thematic of coaching and mentoring schemes for tacit knowledge transfer lies at the crossroads between human resources management (people development) and knowledge management (knowledge transfer). Close cooperation between the two services is essential for ensuring optimal results and overall organizational benefits;
- Tacit knowledge transfer in the nuclear field is essential for the legally binding and critical functions (business continuity plan). These critical functions need to be identified, core knowledge (both tacit and explicit) needs to be made accessible and transferable, and priority has to be given to them in case of shortage of resources;
- Through mentoring, coaching, job shadowing and the short-term exchange programme (SEP), tacit knowledge becomes conscious knowledge, and the knowledge holder either becomes aware of the possibilities available to share it or decides to create new knowledge transferring channels. These schemes offer opportunities for tacit knowledge to actually be transferred from one person to another or even within a team and encourage its subsequent dissemination within the organization and beyond. Cross-services knowledge transfer results in more efficient collaboration, transformation and regeneration of knowledge and, subsequently, innovation;
- The above-mentioned schemes facilitate cross-cultural knowledge transfer, meaning especially the flow of knowledge across different professional cultures, such as the scientific culture, the political culture, the regulatory culture, the safety culture, the audit culture, etc. All subcultures together form the organizational culture. Bridging knowledge disparities among them consolidates the organizational memory and, therefore, ensures business continuity, efficiency and development;
- It is difficult to establish one size fits all solution; different types of jobs require different types of tacit knowledge transfer, that can be facilitated by different mentoring/coaching schemes;
- Leading by example and acknowledging the importance of coaching and mentoring activities is crucial for the success of the programmes;
- The creation of communities of practice, networks (like the EC Coaching Network) and/or dedicated virtual spaces for the exchange of information and experience on the mentoring/coaching and other schemes also serves knowledge sharing and maintenance

objectives, since it enables diffusion of the know-how to a larger community and locks it in the corporate memory;
— To tackle the "knowledge is power" culture, efforts ought to be orchestrated towards a collaborative interdependent culture or "culture of knowledge" by infiltrating the belief: "knowledge grows when it is shared";
— Link knowledge to priorities/objectives/needs/functions and not to people to minimize risk of knowledge loss, especially when facing high staff turnover and/or challenges with timely recruitment. Thus, the knowledge will be kept in the organization and transferred to the next jobholder.

XI-8. CONCLUSIONS

XI-8.1. Key Achievements

— Managers "walk the talk" and model the importance of coaching and mentoring by supporting the activities undertaken by their staff and following the schemes themselves: Commission-wide the newly appointed senior managers participating in the development programmes were 70% in 2014 and the target of 80% set for 2020 has already been reached. The 70% target set for managers having performed a 180° or 360° evaluation exercise within the last 3 years has also been reached;
— The JRC staff engagement index has reached the target set for 2020 (EC average) already in 2018, allowing for a positive evaluation of the relevant actions and programmes, among which were coaching and mentoring;
— During the last 3 years the satisfaction rate of the people that received coaching is steadily above 90%, whereas 100% of them state that they would recommend coaching to their peers. Currently, one third of the participants are managers (mostly Heads of Units) whereas the other two thirds are staff. Individual coaching is the most popular coaching scheme, but a raise in team and group coaching is observed, representing about a third of the activities. Transition to new roles and the relevant know-how are addressed by around 40% of the people being coached, with them indicating that their objectives have been met in 80% of the cases at the end of the coaching;
— The evaluation results show a high level of satisfaction with the coaching as well as a positive impact on job-related behaviours, which has led the EC to create a dedicated Unit in DG Human Resources to manage internal coaching and to establish the EC Coaching Accreditation Programme and the Commission Coaching Network;
— On-the-job coaching has reduced the ramp-up time of new hires from approximately 6 months to only 6 weeks, moving newcomers rapidly up their learning curves and making them operational sooner;
— The JRC short term staff exchange is the most popular short mobility programme within JRC. Since 2015, more than 3% of total JRC staff has participated. 20 DGs and services are covered. Its success resulted in a permanent short term exchange programme (SEP) open call. To date 15% of the staff that participated in the short-term exchange programme (SEP) comes from JRC's Nuclear Safety and Security Directorate (JRC.G);
— The transfer of individual tacit knowledge to the JRC's organizational capacity is difficult to measure objectively. However, it creates knowledge assets that influence the organizational performance. Benefits include increased efficiency, collaboration, innovation, as well as the continuous improvement of the knowledge sharing culture. The latter is affirmed by multiplication of networks, communities of practice and collaborative platforms, as well as cross-cutting projects and inter-unit cooperation.

XI-8.2. Recommendations

- Set incentives to share tacit knowledge and follow implementation of mentoring and coaching at Unit level on a yearly/periodical basis, e.g., during the annual appraisal exercise;
- Evaluate the knowledge loss risk on the occasion of every staff member's departure and decide whether it concerns knowledge that needs to be maintained or that JRC can afford losing (eventual re-assessment of knowledge needs). Target recruitment strategy at competency gaps;
- Make use of visualization tools rather than working instructions to transfer technical know-how, e.g., film the user of a machine/device;
- Expand the practise of demand-driven exit interview/video: colleagues and successor assess what knowledge is needed and interview the leaving colleague to share the information. Alternatively, dedicate a coach to interview the staff before leaving and ask them the right questions, so that the tacit knowledge, of which the staff members are sometimes unaware, can be brought out in a form beneficial for the next colleagues;
- Propose the possibility to give a leaver's talk by pensioners: retired colleagues would share their experience with current staff. This would be rewarding for the former colleagues since it would offer them a sense of continuity of their work and thus value. This emotional charge would facilitate transfer of know-how that might have remained tacit until that moment;
- Reinforce job shadowing and short-term exchange schemes and ensure reliable back-up schemes for each function, so that critical knowledge is shared by at least two people who can efficiently replace each other in case of need, e.g., due to sickness or accident. This also enables one of them to coach/mentor other colleagues, whereas the other one is performing;
- Develop more anticipatory tools, like team coaching to build on collective intelligence and create diffused team knowledge, as well as a pool for collective knowledge sharing;
- Develop indicators for evaluation and monitoring of tacit nuclear knowledge transfer or loss, e.g., related to business continuity, number of vacant critical positions or activities discontinued due to departure of staff;
- Grant access to all staff members to the relevant knowledge to aid their work and decision-making. Diffusion and integration of knowledge from several sources would create the self-perception of being "knowledge workers" and allow the organization to prosper.

ANNEX XII. PROMOTING MENTORING AND COACHING THROUGH A SCHOLARSHIP PROGRAMME AT CNEA, ARGENTINA

XII-1. BACKGROUND

The National Atomic Energy Commission (CNEA) is the main Argentine public organization devoted to nuclear R&D activities, expanding the benefits of the peaceful uses of nuclear energy to society. Furthermore, it has been responsible for promoting highly specialized education and training of human resources in the nuclear field.

Since its creation, in 1950, CNEA has promoted a formal programme of scholarships as one of the pillars of its policy of human resources development. The programme encompasses two kinds of scholarships:

— Study scholarships: for studying in the CNEA´s academic Institutes, Balseiro, Dan Beninson and Sabato, founded in association with national universities. All the professors are active researchers at CNEA's facilities. Furthermore, the students have the possibility to perform activities and to be trained at CNEA's laboratories and research reactors in order to acquire practical experience. After getting a degree, graduates might apply for a "Learning by Doing" scholarship to complete their education by being part of institutional ongoing projects;
— "Learning by Doing" scholarships: for training young engineers and technologists as a source for its own staffing needs, but also for providing highly qualified personnel to local industry and R&D organizations. Once trained, it is expected that most of them join the organization. This programme also gives junior researchers the opportunity to undertake PhD studies and allows PhD graduates to continue their training as researchers and gain skills and experience.

The programme is managed by the Intellectual Capital Section of the Academic Area Department which comprises professionals educated in various disciplines from the social sciences.

Given that CNEA is a highly recognized organization, this makes its scholarships programme attractive. In addition, the access to research facilities and laboratories provides a significant added value.

Although CNEA has experienced periods of fluctuating policies, the support to this programme is considered a strategic issue for assuring the next generation nuclear workforce and to continue engaging youth in STEM studies.

The "Learning by Doing" programme has proven to be a successful undertaking to deal with two particularly tough challenges:

— The aging nuclear workforce among which 5,7% are at retirement age and 11,7% will be in the same situation over the next 5 years;
— Replacement of retiring experts possessing critical knowledge faces difficulties due to budget constraints.

This case study focuses on mentoring as core activity involved in "Learning by Doing" scholarships that typically takes place on a one-to-one basis. There are, however, also cases when the mentoring and coaching activities are carried out effectively in a group setting like the RA-10 Research Reactor Project, a successful case presented herein.

XII-2. THE CASE STUDY OF RA-10 RESEARCH REACTOR

Under the Learning by Doing framework, each scholarship is led by a subject matter expert, who assumes the role of a mentor and might be assisted by a co-mentor (Fig. XII-1). Mentor´s responsibilities begin by writing a one-year plan of activities to be developed by the mentee. This plan that fits the topic of the scholarship can be renewed up to a maximum of five years. The mentor and the co-mentor play an active role in providing support, advice, and guidance, fostering a sense of belonging by nurturing an environment that welcomes questions and open communication among mentees and other members of the group.

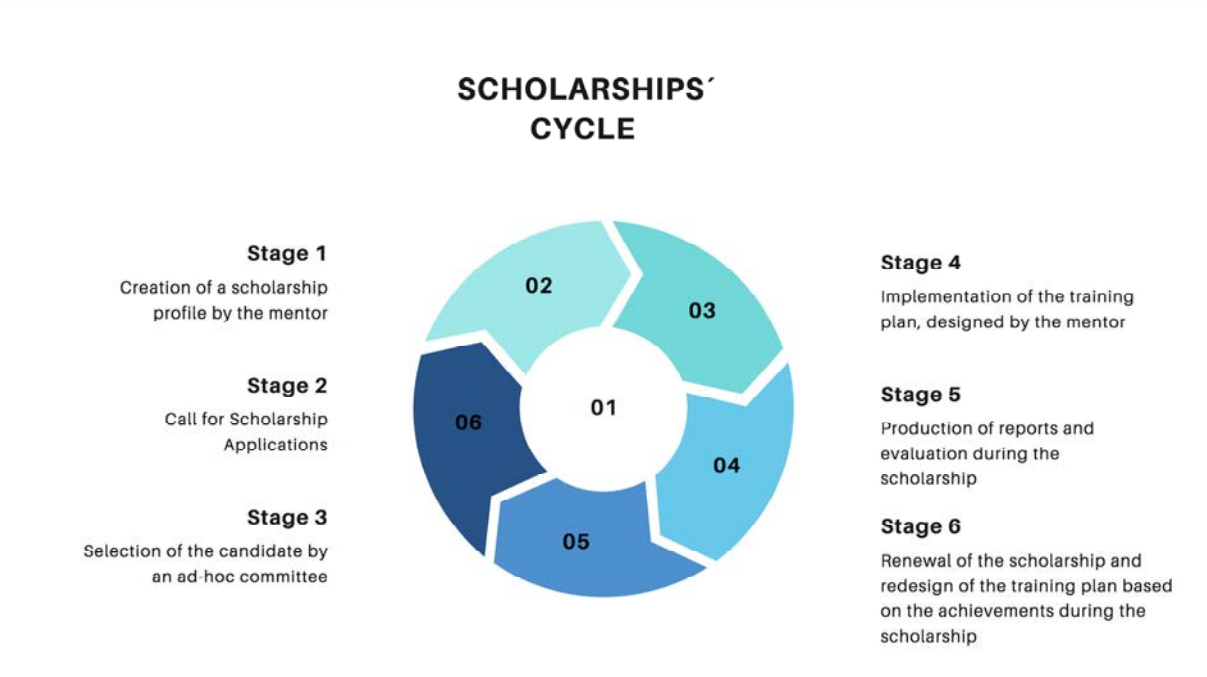


FIG. XII-1. "Learning by Doing" scholarship cycle

The guidance provided by the mentor and the mentor-mentee´s relationship that is woven between them, are crucial for the mentee to incorporate technical knowledge, to assimilate the culture of the group, to identify and get involved in its dynamics, to reproduce its customs, and to promote improvements. This style of interaction is possible due to the framework provided by the scholarship programme.

Many of the mentees under the Learning by Doing framework, where they receive training and develop skills, also study in one of the CNEA´s academic institutes. Thus, mentor-mentee relationships begin during the production of research work (thesis or special projects to get a degree) and extend beyond graduation.

Nowadays, thanks to the Learning by Doing programme, over 220 scholars are being trained with the guidance of a mentor, in areas of institutional interest such as the development and testing of different prototypes for nuclear applications, nuclear materials characterization, energy efficiency issues, ageing management of NPPs, analytical techniques for nuclear laboratories, environmental monitoring, software development for nuclear medicine, medical radioisotopes production, nanotechnology applications, and many others.

Furthermore, the Intellectual Capital Section carries out specific activities in knowledge management, since the transfer, sharing and development of knowledge are very important

processes involved in the mentor-mentee relationship and among mentees themselves. Some examples are presented in Fig. XII-2.

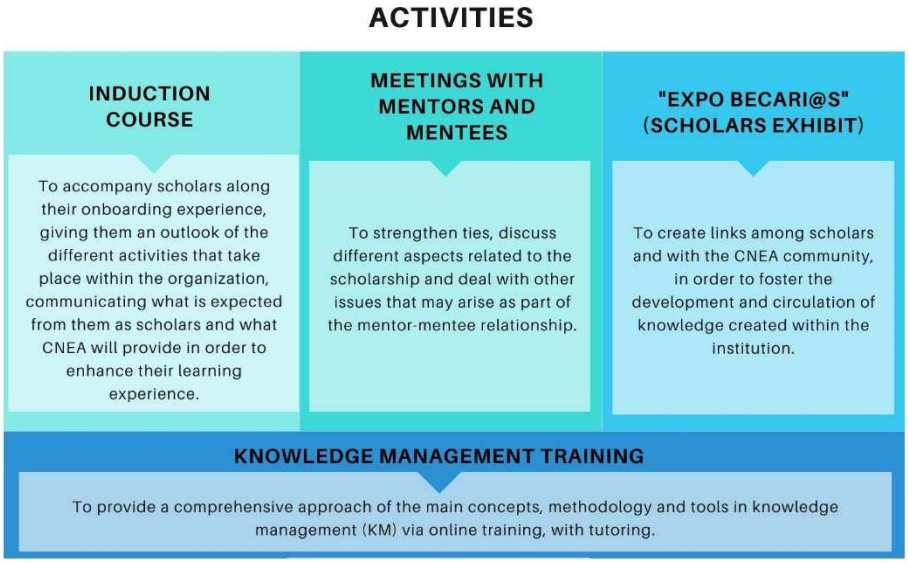


FIG. XII-2. Intellectual Capital Section´s activities

Within the framework of the scholarship programme described above, an experience that is worth highlighting is that of the RA-10 Research Reactor Project.

XII-3. AN EFFECTIVE TRAINING FOR THE RA-10 RESEARCH REACTOR OPERATION TEAM

The RA-10 Project, simultaneously with the construction of the facility, began to form a team of professionals who make up the reactor operations staff (operators for licensed level I and II[5] and level III[6] positions).

To build the team, 50 scholarships were issued between 2016 and 2017with the aim of training professionals in both technical aspects and in soft and management skills.

To achieve this, a general training plan was designed, with the objective of providing the instances to be implemented for the training of the RA-10 reactor operation staff. It was based on the definition of functions, requirements and training programmes for the licensable positions exposed in the organizational structure of the reactor.

The regulatory requirements for obtaining the specific licenses and authorizations necessary to operate the installation were contemplated, as well as the competencies and job profile defined in the document that details the structure, and proposes developing the training in three stages:

— Specialized Training: Provides the contents corresponding to four basic evaluation modules for obtaining the license (Nuclear Reactor Engineering, Radiological Protection, Nuclear Safety and Documentation and Standards);

[5] Plant Manager, Reactor Manager, Operations chief, Shift Manager, Radiological Protection chief, Maintenance chief

[6] Operator, Plant and Utilization Operator, Radiation Protection Officer

— Specific Training: Involves the development of skills and competencies necessary for the adequate performance in each of the specified functions, oriented to obtain the specific authorizations for the specified functions of research reactors;
— Operational Experience.

XII-3.1. Training and qualification process

From the selection process, through the implementation and monitoring of the training plan, the scholarships were developed within a systematized framework, with a strong emphasis on evaluation, monitoring and continuous improvement, training through the transmission of operational experiences and a multidisciplinary vision focused on the elaboration of specific training programmes.

The selection process was conducted by a multidisciplinary committee, which allowed a comprehensive evaluation of the applicants. During this process technical competencies (basic training requirements, by considering the technical and degree career plans presented by the applicants), professional development expectations, and potential for the development of soft skills and management competencies were evaluated.

Once a scholarship was granted, and from the specialized training stage, the work focused not only on complying with the goal defined in the training plan but, as an underlying goal it also aimed at forming a solid work team and develop people/professionals, focusing on values, behaviours, motivation, critical thinking, and work culture as presented in Fig. XII-3.

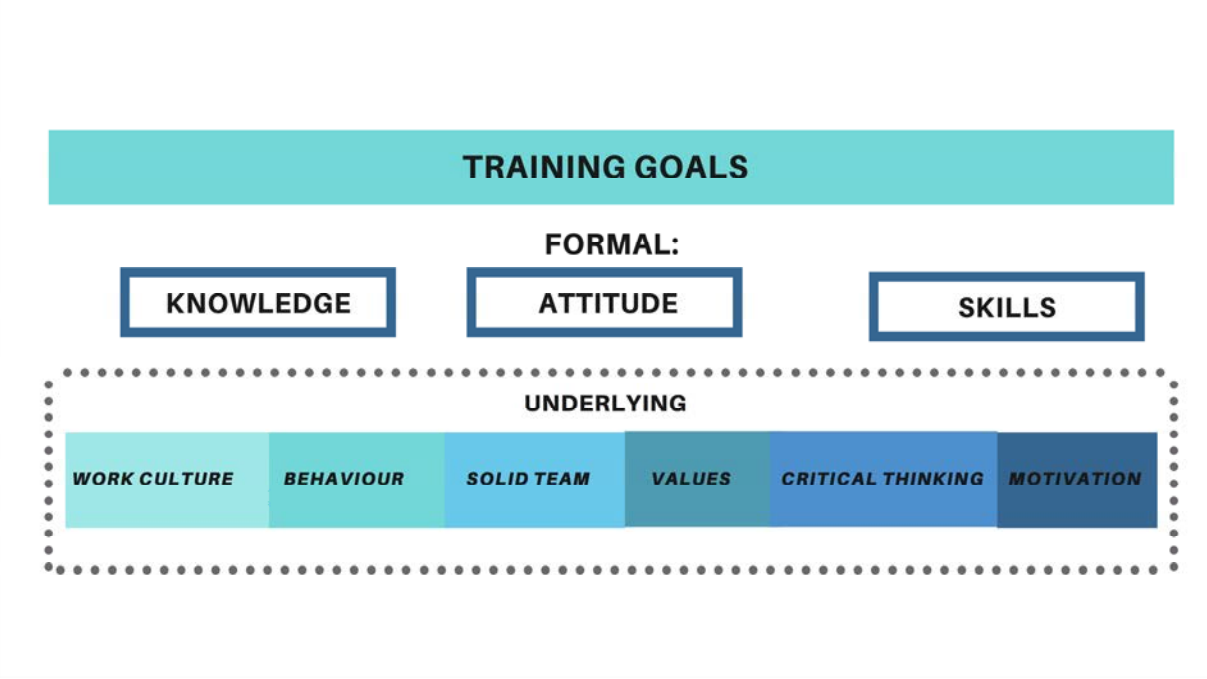


FIG. XII-3. Training goals

For the implementation of the plan, a Training Committee was formed. By doing this, the project brought together professionals from different subject areas, with diverse views and experiences (design engineers, professionals with operational experience, pedagogical experience, professionals with experience in nuclear project management, in human resources management) so as to enriching the training process.

In addition to this multidisciplinary vision, and as an added and distinctive value, this team was involved in the project with a high level of commitment, professionalism and motivation.

The training process was oriented in two lines: learning and training technical skills and develop soft and management skills. To achieve this, specific training instances were designed.

Each instance of the training process was planned and developed constructively, involving stages of analysis, design, development, implementation, and evaluation. This process did not only consider the objectives, but also concentrated on pedagogical tools, implementation methodology, expectations and interests of the professionals in training, transmission of experiences and lessons learned, and instances of feedback related to continuous improvement process as shown in Fig. XII-4.

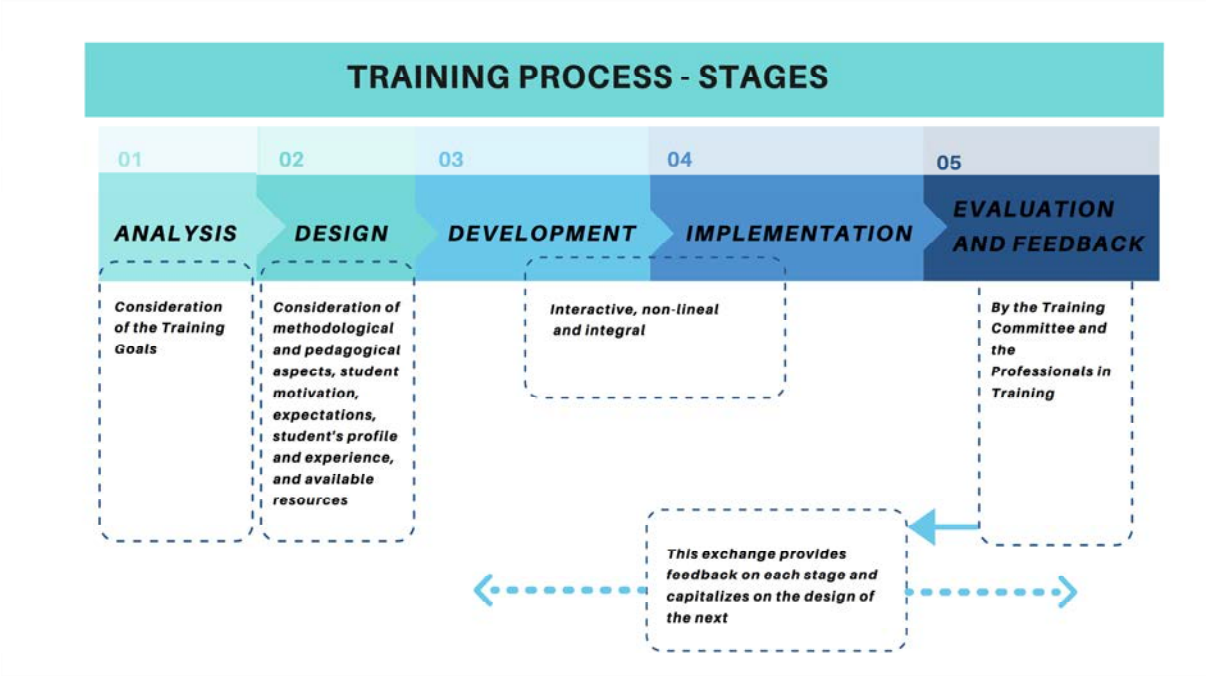


FIG. XII-4. Training stages

Additionally, the process involved various instances of feedback (achievements and results evaluation) and team-building workshops so as to offer development and improvement opportunities.

This allowed to generate a space for communication and listening, as well as achieving integration, openness, work and team learning, adding commitment, developing effective and assertive communication processes, understanding deviations and errors as opportunities for improvement, strengthening cohesion, integration, collaboration and active participation of each of its members, and thus reinforces the sense of trust and belonging.

XII-3.2. Learning by doing - from less to more autonomy

Progressively, and as a result of the internalization of the explicit and implicit training contents, the trainee operation team transitioned from being a team "in training" to a "work team". They went from being content "receivers" (initial stages) to having an active role with greater autonomy.

In this transformation, the committee also redefined its role, focusing on the achievement of specified objectives and on the accompaniment of the team (see Fig. XII-5).

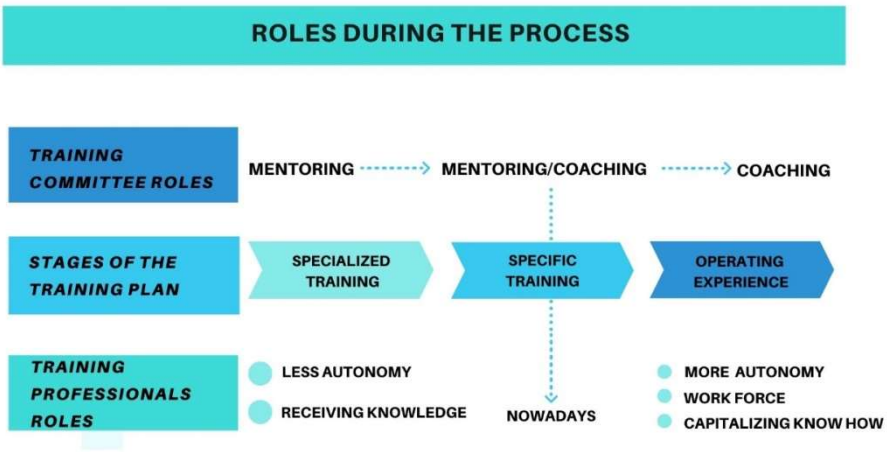


FIG. XII-5. Roles during the training process

This process, in which the team of professionals in training has gradually assumed greater responsibilities, enabled them to get involved in tasks related to the last stages (i.e., construction stage, the pre-operational and commissioning tests stage, and the installation operation stage) of the installation's construction, guaranteeing project continuity.

The key to this new role is 'learning by doing' representing a professional challenge for the team in training.

XII-3.3. Results and challenges

The training process provides solid technical skills7 that allows the professionals in training to obtain the individual licenses issued by the Argentina Nuclear Regulatory Authority (ARN). In the case of Operators in training for Level I and II licensable positions, the highest-level license is that of Reactor Manager, and in the case of Level II Operators, these are the individual licenses for the generic functions of Operator and Radiological Protection Officer. The trainees also acquire soft skills, management skills, and critical thinking, aspects that stand out in the development of their work.

The effectiveness in the implementation of the training plan is observed in the delegation of responsibilities - challenges that the team of professionals in training are now in charge of.

Particularly trainee operators for Level I and II licensable positions were given the responsibility of planning, developing, implementing, and monitoring a specific training programme for Level III operators. The process was developed under the supervision of the

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[7] Level I and II: Specialization in Nuclear Reactors and their Fuel Cycle; Introductory Course to Nuclear Technology: Complementary Training for Personnel of Facilities Class I, Subclass 2, Production and Research Nuclear Reactors and Subclass 3, Critical Sets; Detailed knowledge of the RA-10 engineering detailed of the RA10 Reactor and its Associated Systems, and of the Preliminary Safety Report; Professional Practices in research reactors, training in an Interactive Graphic Simulator.

Level III: Introductory Training Course to Nuclear Technology, Detailed knowledge of RA-10 engineering, detailed RA10 Reactor and its Associated Systems; Professional Practices in research reactors, training in an Interactive Graphic Simulator.

Training Committee. Here it was possible to observe how, in addition to strong technical skills, the team of operators revealed the development of soft skills for team management.

Additionally, the team of professionals in training are preparing the plant documentation required by the Argentina Nuclear Regulatory Authority (ARN) for the licensing of the operation stage. Although the work is supervised by the Training Committee, the staff in training develop this work with a great level of autonomy.

In the same way, professionals in training are participating in different lines of work in the construction stage, with the aim of getting involved in activities related to the pre-operational and commissioning tests stage, ensuring continuity between the project stage and the operation stage.

Another relevant activity is the development of a tool for monitoring the assembly of critical components, which is essential for the operation stage.

These challenges, framed in a systematized training plan, are fundamental instances for the future operation team to gain the skills necessary to obtain provisional specific authorizations.

Looking at the four years in perspective, the 50 trainee operators, most of whom did not have previous work experience, not only acquired solid technical skills (obtaining licenses) and soft and management skills (training through specific courses), but also formed a team of professionals who have appropriated and apprehended a work culture framed in values, behavioural and motivational aspects, self-confidence and professional maturity that in some way reflect the work of the mentors who have been involved in the design and implementation of the training plan.

The definition of a general plan and the specific work in the different training instances, with a multidisciplinary and constructive perspective aimed at continuous improvement; the focus on formal training goals, without forgetting the underlying goals; the personal and professional growth of the operators in training as a result of this process, in tune with a Training Committee that accompanied them and adapted their role throughout the process, were key aspects for an effective implementation of the training plan to build the RA-10 operations team.

XII-4. CONCLUSIONS

Throughout the years, the implementation of the Learning by Doing scholarships programme, which fosters and strengthens mentor-mentee relationships, has been successful, taking into consideration that:

- It promotes the development of highly qualified human resources that make up the current as well as the future staff of CNEA;
- Several former scholars trained under this programme have held important positions in CNEA over the years;
- It provides a formal but flexible enough framework, which can be tailored to the different needs of different areas of the organization;
- It fosters the knowledge transfer between experts and the young generation in nuclear.

ABBREVIATIONS

AAR	After action review
ARN	Argentinian Nuclear Regulatory Authority
BATAN	National Nuclear Energy Agency of Indonesia
BRHRO	Bureau for Human Resources and Organization
C&M	Coaching and Mentoring
CAP	Corrective action programmes
CHASCENT	Chashma Centre of Nuclear Training
CNCAN	Romanian National Commission for Nuclear Activities Control
CNEA	National Atomic Energy Commission, Argentina
CNPGS	Chashma Nuclear Power Generating Station
CoP	Community of practice
CRP	Coordinated research project
CRT	Classroom training
EC	European Commission
Euratom	European Atomic Energy Community
ICF	International certificate
IRDP	International Regulatory Development Partnership
ITQC	Inspectors' training, qualification, and certification process
ITQL	Individual training and qualification log
ITQP	Individual training and qualification plan
JQC	Job qualification card
JRC	Joint Research Centre
KEPCO	Korea Electric Power Company
KHNP	Korea Hydro & Nuclear Power
KINS	Korea Institute of Nuclear Safety
KSA	Knowledge, skills, and attitudes
LAN	Local area network
MCR	Main control room
NEPIO	Nuclear energy programme implementing organization
NEST	Nuclear education, skills, and technology

NKM	Nuclear knowledge management
NNI	National Nuclear Institution
NPP	Nuclear power plant
OJT	On the job training
OSART	Operational Safety Review Team
PAEC	Pakistan Atomic Energy Commission
PIEL	Post Irradiation Examination Laboratory
PRA	Probabilistic risk assessment
PWR	Pressurized water reactor
R&D	Research and development
RATEN-ICN	Romanian Institute of Nuclear Research
SEP	Short-term exchange programme
STAR	Stop, think, act, review
TRIGA	Training, Research, Isotopes, General Atomic
TSM	Technical support mission
TSO	Technical support organization
UPB	University of Bucharest
UPIT	University of Pitesti
US NRC	United States National Regulatory Commission
WANO	World Association of Nuclear Operators

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