

# Knowledge management and competence building – Safeguards implementation at STUK

The Radiation and Nuclear Safety Authority (STUK) has a long tradition in maintaining and developing the State System of Accountancy for and Control of nuclear materials (SSAC) and the national safeguards implementation. The building of competences started already in the 1970s and has continued since. In accordance with the legislation, STUK as a state regulatory authority is responsible of taking care that Finland meets its international obligations on peaceful use of nuclear energy and non-proliferation.

At STUK, the Section for Nuclear Materials Safeguards is responsible for national safeguards implementation and has a key role in enabling the effective international safeguards by the IAEA and the European Commission in Finland, as required by the Comprehensive Safeguards Agreement and the Additional Protocol (INFCIRC 193 and INFCIRC 193 add. 8) and the Euratom Treaty. From 2006 onwards the section is also responsible for the national data centre to the CTBT (The Comprehensive Nuclear-Test-Ban Treaty). To be able to fulfil our tasks and duties, we need to have certain skills and expertise.

Recently, we have developed an inspector qualification programme for new staff members at STUK. In safeguards, we can also use the opportunities of international training courses organised by the IAEA and the European Commission. One way to learn and develop our competencies and knowledge is also to share experiences with other states, and in this context, we are actively contributing to the international co-operation and especially to the ESARDA (European Safeguards and Research Development Association) activities. And to ensure that we have adequate and capable resources in our section, we are rotating our staff duties from time to time. This aims to secure the continuity of knowledge and competence, offering also possibilities for personal development to the staff. It is important that we have experts that can back-up each other, if something unexpected happens.

This paper describes how we at STUK and especially in the Safeguards Section are maintaining and developing the skills and expertise necessary for the national safeguards implementation, facilitating also the effective international safeguards implementation in Finland.

## INTRODUCTION

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was opened for signature in the UN in 1968 to prevent the spread of nuclear weapons and to promote nuclear disarmament and peaceful use of nuclear energy. The treaty entered into force in Finland in 1970. Finland was the first country to sign the Comprehensive Safeguards Agreement (CSA) with the IAEA on 9th February 1972. Following Finland's accession to the EU in 1995, the bilateral CSA between Finland and the IAEA was replaced by the trilateral CSA, signed by the non-nuclear weapon member states of the EU, the IAEA and the European Atomic Energy Community, EURATOM. The Additional Protocol to the Safeguards Agreement came into force in the EU on 1st May 2004.

From the beginning, Finland has been active in developing international safeguards and the national safeguards system. The establishing of the State Regulatory Authority for safeguards started in the early 1970s by the Ministry of Trade and Industry, who took care of national safeguards duties at the beginning but soon started to transfer duties to the Radiation Safety Institute (from 1984 the Radiation and Nuclear Safety Authority, STUK) which took the supervisory safeguards control in

Finland finally in 1977. This transition required development of competences to create the national nuclear material accountancy and control system, also enabling the necessary IAEA safeguards in Finland. Already in the 1980s, STUK performed ca. 40 inspections annually, started spent nuclear fuel verification measurements and contributed to the international co-operation in NDA measurements, and developed the necessary safeguards regulations to achieve the objectives of nuclear legislation. I.e. expertise needed and thus developed consisted of understanding of NMAC control, NDA measurements and setting of requirements to fulfil international obligation. At that time, there were specialists who took care of the licensing of nuclear materials and activities, reviewing and submitting the national NM reports, conducting safeguards inspections, and performing the NDA measurements. In practice, staff were divided into two main groups: those who concentrated on special tasks and those who participated in every-day work. This led to an increase in staff members, and in 2007, the safeguards section included 9 inspectors, and we had additional experts who took care of the international co-operation, for example.

In 2013 there were again only 5 inspectors left in the section. Thus, we needed to start considering how to adjust to this new situation when there are more and more nuclear materials and activities in the state and an increasing need for international co-operation.

### NUCLEAR ACTIVITIES IN FINLAND

In 2023, a lot of activities are ongoing in Finland (Figure 1). The main activities include operating the nuclear power plants (5 reactors at two sites), spent nuclear fuel encapsulation and disposal facility under construction, research reactor under decommissioning, uranium recovery plant soon starting to produce UOC and many medium and small size nuclear materials holders in operation. In addition, there are lots of R&D activities ongoing, and considerations of new NPP projects.



Figure 1. Nuclear activities in Finland in 2023.

## RENEWAL OF NATIONAL NUCLEAR LEGISLATION

The Finnish nuclear energy legislation is from the late 1980s and it has been amended almost annually since then. In safeguards, STUK has also issued the YVL Guide D.1 on Regulatory control of nuclear safeguards, where STUK sets detailed requirements for all users of nuclear materials and for actors carrying out nuclear related activities.

In Finland, the Ministry of Economic Affairs and Employment has started a renewal project of the whole nuclear legislation and STUK is heavily involved in this work. The aim is to have a new nuclear legislation ready by 2028. In the future, all binding requirements shall be set in the legislation, which will have three levels:

- 1) Nuclear Energy Act
- 2) Governmental Decree
- 3) STUK Regulations.

The renewed YVL Guides will have no binding requirements, but instead they will be actual guidelines to help in fulfilling the legal requirements.

## STUK SAFEGUARDS

The main objective of STUK's safeguards is set in the Nuclear Energy Decree, section 118: *The Radiation and Nuclear Safety Authority maintains a control system of nuclear materials with the purpose of carrying out the safeguards control of the use of nuclear energy that is necessary for the non-proliferation of nuclear weapons as well as the safeguards control that is related to the international agreements on nuclear energy to which Finland is a party. the Radiation and Nuclear Safety Authority sees to it that the licence holder has the necessary expertise and preparedness to arrange the supervision and that the licence holder for its own part implements the above-mentioned supervision in accordance with the pertinent regulations.*

As we at STUK have a lot of activities which need to be safeguarded and we are maintaining and developing the national safeguards system, we need a wide range of knowledge and expertise, from legislation all the way to the non-destructive assay of spent nuclear fuel. These involve both national and international co-operation as well. To develop the skills and competences of experts and the international safeguards, STUK contributes to the IAEA safeguards support under the Finnish Support Programme (FINSP) and also provides assistance on strengthening safeguards via other international support and co-operation activities.

STUK's safeguards tasks at the office and in the field are diverse. At the office tasks include e.g.:

- Licensing/authorising the use of nuclear materials
- Reviewing, assessing and approving persons responsible for use of nuclear materials (responsible managers, safeguards responsible persons)
- Reviewing, assessing and approving nuclear materials manuals (description of operators safeguards system)
- Reviewing and assessing of all reports, notifications and other provided information
- Central NM bookkeeping (national NM database)
- Reviewing and assessing inspection and safeguards conclusion statements submitted by the IAEA and EC
- Approval of the IAEA and EC inspectors
- Responsible of the Additional Protocol declarations

- Planning of inspections etc.
- Training, competence building and knowledge management

And in the field STUK's tasks include e.g.:

- Design information verifications
- Interim nuclear material inspections and physical inventory verifications (also for nuclear use items)
- Reactor core verifications
- Non-destructive assay (NDA) measurements
- Environmental sampling
- System inspections (operators SG system, management system...)
- Nuclear material security (physical protection) and information security inspections (at nuclear facilities, this is mainly done by the security section)
- Site checks (sites according to the Additional Protocol)
- Verification of the R&D declarations
- Participation to all IAEA and EC inspections and safeguards activities as required by the law

## RECENT HISTORY OF STUK'S SAFEGUARDS SECTION

The development of the safeguards section during the last ca. 20 years can be seen as an example of how the situation may change drastically even in a relatively small country.

In 1999, the safeguards section consisted of a section head and six inspectors: One inspector took care of the licensing of activities, one concentrated on supervision of NM transport, one concentrated on NDA methods and establishing a National Data Center (NDC) for CTBT, one inspector assisted in office work and two inspectors were responsible for nuclear material accountancy and control and performing inspections in the field. At this time, supervision mainly focused on the nuclear power plants in Olkiluoto and in Loviisa, and on the VTT FiR1 research reactor.

In 2003, five full time experts worked in the safeguards section with the section head. The NDC was established as a separate section in the department, but we had a new expert on geology and R&D in the section. All the inspectors in the section were doing at least one field inspection annually. At this point, in addition to the same tasks as in 1999, we were preparing ourselves for the entry into force of the Additional Protocol and for the construction start of the research facility ONKALO for final disposal.

In 2007, there were already eleven persons contributing to the safeguards work in the section, and nine of them were inspectors (see Figure 2). All the inspectors conducted inspections and participated on safeguards supervision. In addition to the tasks in 2003, we now started to concentrate more and more on medium and small-size nuclear material holders and to do more and more field inspections and safeguards activities in ONKALO and also at the new NPP OL3, which was under construction. We were already planning for updating STUK's regulatory guidelines YVL D.1 "Regulatory control of nuclear safeguards" and YVL D.2 "Transport of nuclear materials and nuclear waste". In addition, the security of nuclear materials was highlighted as a part of our duties. The NDC was again part of our section.

Due to inspectors moving to another duties inside the STUK, in 2013, the safeguards section staff was reduced to five inspectors and the section head, and the assistant who was responsible for notifications of inspections and inputting data (reports etc.) to the national database. These

inspectors had their main responsibilities: first was responsible of controlling of operator's competencies at facilities and the Additional Protocol declarations; second was responsible of safeguards regulations and coordinating the inspection and the Additional Protocol related matters; third was concentrating to NDA measurements and Finnish safeguards support programme to the IAEA; fourth was maintaining and developing the Finnish National Data Centre for the CTBT and developing the safeguards for final disposal; and fifth was developing the safeguards for geological repository and supervising the construction of ONKALO, and responsible of supervision of R&D activities. All these inspectors also conducted inspections and contributed to the section's common tasks and duties. Whole section staff were participating and contributing to the international co-operation too.

Ms. Elina Martikka	Section Head	
Mr. Marko Hämäläinen	Senior Inspector	Inspection coordination, handbooks, Additional Protocol implementation
Mr. Tapani Honkamaa	Senior Inspector	Non-destructive assay, FINSP to the IAEA safeguards
Mr. Olli Okko	Senior Inspector	Safeguards of research and development, final disposal
Mr. Jaakko Tikkinen	Senior Inspector	Advisor, transport and nuclear security
Ms. Paula Karhu	Inspector	Nuclear security, environmental sampling, internal audit
Ms. Anna Lahkola	Inspector	Transport of nuclear materials, central accountancy
Ms. Miika Holopainen	Inspector	Transport of radioactive materials, international inspectors
Mr. Antero Kuusi	Assistant Inspector	Data bases, non-destructive assay
Mr. Mikael Moring	Senior Inspector	Finnish National Data Centre for the CTBT, non-destructive assay, environmental sampling
Ms. Ritva Kylmälä	Secretary	



Figure 2. The staff of STUK Nuclear Materials Section and Director of Department of Nuclear Waste and Materials Regulation and his Deputy. All section staff participate in the core safeguards tasks. Additionally, each person has some special areas of expertise to focus on (STUK's annual report on Implementing nuclear non-proliferation in Finland. Regulatory control, international cooperation and the Comprehensive Nuclear-Test-Ban Treaty: Annual report 2007, <https://urn.fi/URN:NBN:fi-fe2014120249135>).

Since 2012 we had nominated facility and location responsible inspectors in our section. All inspectors had a back-up person, but these back-ups did not generally contribute to the actual planning of supervision.

Maybe it was just a coincidence or else we were otherwise open to new ideas and thinking, but in 2016 we adopted a practice formerly observed in housing cooperative's caretakers' work. Earlier they were working alone, but now two of those caretakers started to work as a pair. They still had their own areas, but they were working together. The outcome was that they were more effective, and they were chatting all the time. So, not only were they doing things faster and better, but they were evidently enjoying their work doing things together. This led to the idea that also we in the safeguards section could work in pairs or in small groups, and that this approach would make our work not only more effective but also lead to the sharing of expertise and knowledge between the staff. We could for example have a pair, where a newly recruited staff member was working with an experienced inspector. Both could benefit from this mentoring-tutoring approach, the new person learning faster and the experienced person refreshing their thinking. At the same time at STUK, the approach to have qualified staff in-house lead to the establishment of specific qualification programmes, too.

And in 2023, in the current situation, we have now a section head with 7 inspectors and one researcher developing the NDA method necessary for the disposal of spent nuclear fuel, working in pairs and groups in different combinations. The current approach is essential to ensure that we have the necessary knowledge, competence, and preparedness in almost any kind of situations. Now we are more capable to share our expertise to the international service projects as anyone can either contribute to this co-operation or back-up experts contributing to this co-operation. Currently, we have more and more users of nuclear energy to supervise as there are new nuclear projects like Small Modular Reactors starting and our field of activities includes more and more actors that we need to supervise. And what is most resource demanding in the future is that disposal of spent nuclear fuel approaches and is expected to start in 2025, this workload does not get any easier. To answer the demand, we most probably need to recruit new staff members in the coming years. But, in case we need, and we will get new staff appointed, we know how we can efficiently develop their competencies, and that we have persons who can do this and back-up each other's in almost all the tasks we are responsible of. This makes it easier to prepare ourselves for oncoming successor planning too, for example in the case of the retirement of older experts.

## KNOWLEDGE MANAGEMENT AND COMPETENCE BUILDING TODAY

STUK's safeguards section is responsible for developing the competences and expertise we need to fulfil our duties. We have prepared a training programme for our safeguards staff which includes the following main topics:

- 1) International obligations and the roles and functions of the international inspectorates (IAEA, EC)
- 2) National legislation, nuclear safeguards system and STUK's role and duties
- 3) Nuclear fuel cycle
- 4) Peaceful use of nuclear energy in Finland and nuclear non-proliferation
- 5) Licensing of peaceful use of nuclear energy, approvals and main safeguards requirements for users of nuclear energy
- 6) Licensees and other operators, facility and activity specific matters, safeguards measures applied by STUK and international inspectorates
- 7) NMAC at the office: assessing, reviewing and approval of reports and declarations
- 8) NMAC in the field: national inspections and inspections with the international inspectorates
- 9) Security and information security related to safeguards implementation
- 10) Supervision of nuclear waste (especially spent nuclear fuel and nuclear use items considered as a waste)



This programme is repeated every five years and is always conducted when we have new inspectors joining the safeguards section.

In addition, STUK has developed a general staff qualification programme to all staff members working at STUK. This programme familiarises staff to working as a civil servant. It includes lectures, which are obligatory especially for new staff members and encouraged for experienced staff to revise from time to time. This general qualification programme includes e.g. lectures on international obligations and international safeguards applied to the Finnish operators, and STUK's national safeguards implementation. These lectures consider the whole scope of STUK supervision of safeguards, safety and security (3S). The content of this general qualification programme concentrates on STUK's common competences:

- 1) Knowledge of STUK's operation and mission
- 2) STUK's status and jurisdiction
- 3) Understanding the operation of the state administration
- 4) Acting as a civil servant
- 5) Radiation and its effects on people and the environment
- 6) Emergency preparedness at STUK
- 7) Communicating as an official
- 8) Basics of safety culture
- 9) Management system and quality of operations
- 10) Information management, Registry and document management at STUK
- 11) Information and premises security in your own work
- 12) Work well-being
- 13) Project expertise in the work of an expert

In addition, there are lectures on specific topics related to safety, security and/or safeguards, which can be attended when the person themselves or their supervisor finds it appropriate. These lectures include e.g. practical examples of implementation of supervision and lessons learned from international cases, like what happened in Fukushima. These like all other training activities are normally recorded in the personal training history as well.

Considering knowledge management, STUK needs to ensure that the competences and experiences we have developed will be maintained and even further developed. In this work, we are utilising good practices observed in completely other kinds of working environments: those maintenance men of housing societies that used to work alone, but now worked as a pair. This approach was even developed further, with an idea to use expertise already gained and the fresh thinking of new staff members. Thus, we started to work in pairs where old experts and future experts work together. This helps our new staff members to gain necessary basic knowledge faster and also gives the experienced staff members a possibility to mentor and transfer their knowledge to others, and to refresh their own expertise. These pairs are formed in a mixed manner, i.e. pairs are nominated to certain facilities and activities in a way that supports the best knowledge transfer inside the section. These pairs are occasionally switched, and usually rotated as a whole when we get new staff to the safeguards section. In some cases, we have formed small groups, too.

Examples of facilities and activities where staff members are working in pairs or small groups:

- 1) Olkiluoto and Loviisa Nuclear Power Plant
- 2) Posiva Encapsulation Plan and Geological Repository
- 3) Research organisations and universities dealing with nuclear materials

- 4) Research organisations and universities dealing with Research and development activities defined in the AP
- 5) Nuclear information holders
- 6) Small nuclear material holders

And we started to utilise this approach also in certain special tasks, like

- 1) NDA measurements
- 2) AP declarations

An important element of the knowledge management and competence building is international co-operation and contribution to the international service projects. These are included in all safeguards section staff duties from the beginning. Valuable perspective is gained in giving presentations and answering to questions concerned, as well as learning from experiences in other countries, and this perspective helps in the everyday work as a safeguards inspector.

Every second week we have a safeguards section meeting, and once in a month this meeting is organised in-person. In these meetings, pairs inform the others about current topics in their facilities. Sharing experiences between experts is essential in developing the safeguards implementation and enhancing the team spirit.

## CONCLUSIONS

When resources are limited, it is important to use all possible means to utilise expertise gained both nationally and internationally to strengthen the knowledge management and competence building. It is equally important to encourage staff openly from the beginning to participate in all section activities to develop their expertise and to gain experience. This benefits also more experienced experts when they need to share their knowledge and expertise, in practice mentor and teach the future experts who may even ask difficult questions.

At STUK, knowledge management and competence building are organised generally at the house level and more specifically at the safeguards section level. Also, international training courses are included in the new staff development programme. Participation in all trainings is recorded into a personal training registry.

Working in pairs has proved to be a good practice for long term planning and to ensure adequate competence and expertise. Rotating the staff duties from time to time in different tasks and with new pairs, and especially when new staff is recruited, is a practical way to enhance the efficiency of safeguards implementation, and to develop the personal know-how and performance in the safeguards section. This is necessary for the national safeguards implementation and for facilitating the effective international safeguards implementation in Finland also in the future.