

Safeguards Inspection Regime In Sweden

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ABSTRACT

The presentation will cover a brief overview of the safeguards agreements that Sweden has in place. Sweden has had safeguards agreements with the IAEA since 1975. In 1995, Sweden entered the European Union (EU) and the European Atomic Energy Community (Euratom) and consequently became part of the agreement between Euratom and the IAEA. The Additional protocol entered into force in 2004 for all the EU member states including Sweden. Although Sweden is a part of the EU it has kept its own national authority to handle safeguards, the Swedish Radiation Safety Authority (SSM) performs its own safeguards inspections and always participates in the IAEA inspections even if Euratom is present.

Sweden is a rather small country but has several different types of nuclear facilities, there are nuclear power plants that are in operation but also some shut down reactors, a fuel fabrication plant and an interim storage for spent fuel. Sweden also has research facility, nuclear Locations outside Facilities (LOF) and non-nuclear LOFs of which one is a national Material Balance Area (MBA) with 13 small installations. The LOFs and non-nuclear LOFs are for example universities, hospitals and companies using nuclear material in research or using depleted uranium for shielding radioactive sources in measurement equipment. The challenges regarding safeguards at LOFs and non-nuclear LOFs compared to larger nuclear facilities are clearly noticeable during the inspections. The challenges with the LOFs and non-nuclear LOFs are probably caused by the fact that the nuclear material is not used regularly and sometimes it is only stored or used as shielding for radioactive sources.

The presentation will give an overview of the last 4 years of safeguards field activities, including safeguards inspections and complementary accesses performed by the IAEA, Euratom and SSM. The safeguards activities depend on the type of installation, some activities are only performed by the IAEA while SSM participates as representative from the State, some activities are only performed by Euratom. SSM also perform their own activities preferably at the LOF and non-nuclear LOF.

INTRODUCTION

Sweden has been a member of the European Union (EU) and the European Atomic Energy Community (Euratom) since 1995 and is therefore part of the agreements between Euratom and the IAEA [1] [2]. Before Sweden became a member of the EU, Sweden had its own safeguards agreement with the IAEA [3]. Even though Sweden is a part of the EU it has kept its own

national authority, the Swedish Radiation Safety Authority (SSM), to handle safeguards and SSM always participates in the IAEA inspections even if Euratom is present.

Safeguards inspections are regularly performed by IAEA and Euratom on all the different types of nuclear installations in Sweden, for example nuclear power plants, fuel fabrication plant, interim storage for spent fuel, nuclear Locations outside Facilities (LOF) and non-nuclear LOFs. For the domestic safeguards inspections, SSM has focused on nuclear LOF and non-nuclear LOF for the past four years.

The safeguards field activities, including safeguards inspections and complementary accesses, are performed by the IAEA, Euratom and SSM. The safeguards activities depend on the type of installation, some activities are only performed by the IAEA while SSM participates as representative from the State, some activities are only performed by Euratom or by SSM.

SAFEGUARD AGREEMENTS

Sweden has had safeguards agreements with the IAEA since 1975 [3]. In 1995, Sweden entered EU and Euratom and consequently became part of the agreement between Euratom and the IAEA [1]. The Additional protocol [2] entered into force in 2004 for all the EU member states including Sweden. Although Sweden is part of the EU, it has kept its own national authority (SSM) to handle safeguards and a national register for nuclear material in Sweden.

Since Sweden is a member of the EU and Euratom, the Euratom Treaty also applies. Regulations issued by the EU and Euratom apply directly and must be implemented in the same way as Swedish legislation by parties carrying out an activity (licensees) and government bodies alike. For accountancy of nuclear material the Euratom regulation 302/2005 [4] apply. There are also international agreements and conventions, such as the Non-Proliferation Treaty [5] and the Convention of Nuclear Safety [6] and the Joint Convention [7].

National framework

The main national regulations regarding safeguards, including inspections, are the Act on Nuclear Activities [8] and Ordinance on Nuclear activities [9] and SSM's own regulation regarding Safeguards [10]. There are also the Act on inspections according to international agreements on prevention of proliferation of nuclear weapons [11] and Ordinance on inspections according to international agreements on prevention of proliferation of nuclear weapons [12].

NUCLEAR FACILITIES IN SWEDEN

Sweden is a rather small country but has several different types of nuclear facilities. Sweden has four nuclear power plants with six light water reactors in operation and six shut down light water reactors that are in different stages of decommissioning, a fuel fabrication plant and an interim storage for spent fuel. Sweden also has research facility, nuclear Locations outside Facilities (LOF) and non-nuclear LOFs of which one is a national Material Balance Area (MBA) with 13 small installations. The LOFs and non-nuclear LOFs are for example universities, hospitals, scrap metal recycling companies and companies using nuclear material in research or using depleted uranium for shielding radioactive sources in measurement equipment.

Table 1. Nuclear facilities in Sweden 2020.

Type of nuclear facilities	Number of each type of facility	Number of corresponding material balance areas (MBAs)
Fuel fabrication plant (include conversion)	1	1
Nuclear power plant (NPP)	4	12 (one MBA for each reactor)
Research facility	2	2
Spent fuel storage and disposal	1	1
Nuclear location outside facilities (LOF)	4	4
Non-nuclear location outside facilities (LOF)	7	7

SAFEGUARDS INSPECTIONS IN SWEDEN

Planned safeguards inspections, with physical inventory verification (PIV) and design verification, are performed every year by IAEA and Euratom on all the Nuclear power plants (NPP), the Fuel fabrication plant (FFP), the Spent fuel storage, the Research facility and some of the LOF. The planned inspections are normally performed simultaneously by IAEA and Euratom and SSM also participate. For the NPP there are normally two inspections at each reactor in operation, one before the opening of the core for refueling and one after the closure of the core. For shut down reactors there are normally one inspection each year. For the FFP there is one inspection for the PIV and design verification but there are also several Short Notice Random Inspections (SNRI) with 48 hours' notice initiated by Euratom and at least one SNRI initiated by IAEA each year. IAEA also initiate SNRI with 48 hours' notice at NPP and one unannounced inspection (UI) with 2 hours' notice every year at the spent fuel storage. During 2017-2019, there has also been one Complementary Access (CA) with 24 hours' notice each year at a research facility or a LOF. SSM always participate in the SNRI, UI and CA initiated by IAEA.

The regulatory body, SSM, participate in the inspections performed by IAEA even if Euratom is present. SSM also participate in inspections performed only by Euratom if the inspections are at the LOFs. SSM conducts its own smaller inspection in parallel to the safeguards inspection performed by IAEA and Euratom, except for when a CA is conducted. During this smaller inspection SSM verify that the total amount of nuclear material at the facility or LOF complies with the national nuclear material register. SSM also check compliance with certain national requirements for example that all nuclear material can be verified and that the facility have personnel available so the inspection by IAEA and Euratom can be performed without unnecessary delay.

The field activities performed by IAEA and Euratom are safeguards inspections with review of accounting and amount of material in total and divided by category type, physical inventory verification of the nuclear material using visual identification and non-destructive analysis (NDA), design verification of facilities, sealing of material and equipment and also sealing and

service of surveillance equipment. For verification of nuclear material and NDA the inspectors are using different instruments e.g. Improved Cherenkov Viewing Device (ICVD), Irradiated Item Attribute Tester (IRAT), Spent Fuel Attribute Tester (SFAT), LaBr-detector, and HM-5 type detector of gamma and neutrons.

During 2017-2019, the total number of safeguards inspections performed by IAEA and Euratom have been between 38-43 and the number of person days have been 175-180, but during 2020 there were only 31 inspections and 146 person days due to the Covid-19 pandemic, see table 2.

Table 2. Inspections performed by IAEA and Euratom during 2017-2020

Type of facilities	Type of inspection	2017 Inspections / Person days	2018 Inspections / Person days	2019 Inspections / Person days	2020 Inspections / Person days
FFP (incl. conversion)	IAEA only	0	0	0	1 / 8
	Euratom only	1 / 6	3 / 18	3 / 18	2 / 12
	Both IAEA and Euratom	5 / 89	4 / 80	4 / 82	3 / 63
NPP	IAEA only	0	0	0	2 / 4
	Euratom only	0	0	0	0
	Both IAEA and Euratom	28 / 55	24 / 48	26 / 56	19 / 38
Research facility	IAEA only	1 / 2	0	0	0
	Euratom only	0	1 / 1	0	0
	Both IAEA and Euratom	1 / 11	1 / 9	1 / 9	1 / 6
Spent fuel storage and disposal	IAEA only	1 / 4	1 / 4	1 / 4	1 / 5
	Euratom only	0	0	0	0
	Both IAEA and Euratom	1 / 6	2 / 8	1 / 6	1 / 6
LOF (both nuclear and non nuclear)	IAEA only	0	0	0	0
	Euratom only	0	6 / 6	0	0
	Both IAEA and Euratom	1 / 2	1 / 3	2 / 5	1 / 4
Total number of inspections:		39	43	38	31
Total number of person days:		175	177	180	146

Euratom also perform sealing activities of nuclear material before export from the fuel fabrication plant, these sealing activities has been reduced since 2020 when Euratom had a new policy regarding sealing before export.

Table 3. Sealing activities by Euratom before export of nuclear material

	2017	2018	2019	2020
Sealing activities before export	14	6	5	0

Domestic Inspections

SSM also perform safeguards inspections without the presence of IAEA or Euratom. These domestic inspections are mostly performed at the LOFs because the LOFs is not inspected regularly by IAEA and Euratom.

SSM usually starts a domestic inspection at a LOF with a presentation regarding safeguards and nuclear non-proliferation and the regulations that apply for the holder of nuclear material. The participants from the LOF have appreciated the information, most of the LOF have contact with SSM regarding radiation protection issues but safeguards is a more unknown area for most of the personnel.

During a domestic inspection SSM verify that the total amount of nuclear material at the facility or LOF complies with the national nuclear material register. SSM performs a physical verification by number identification of the material compared to the inventory list. SSM also interviews responsible personnel regarding their safeguards instructions, especially the instructions regarding inventory and inventory changes. SSM always writes a report after the inspections with the findings, both good examples and things to improve, and send the report to the LOF. Depending of the findings SSM decides whether there should be a follow-up inspection or other actions taken due to the findings.

During 2017-2020, both IAEA and Euratom performed several inspections at LOFs and SSM participated and also performed own smaller inspections in parallel to IAEA and Euratom. In 2018, SSM performed two domestic safeguards inspection at LOFs and in 2020, SSM performed six domestic safeguards inspection at LOFs. Due to the Covid-19 pandemic three of the inspections where performed remotely during 2020. In 2020 SSM also decided to gather information via letter regarding handling of the nuclear material at one LOF and four of the small holder of nuclear material in the national MBA.

Table 4. Domestic inspection, without or parallel to IAEA/Euratom

Type of inspection	2017	2018	2019	2020
Domestic, without IAEA/Euratom	-	2	-	6
Small inspection, parallel to IAEA/Euratom	1	7	1	1
Information gathering via letter	-	-	-	5

CONCLUSIONS

The amount of safeguards inspections initiated by IAEA and Euratom were almost constant during the past four years except for last year due to the Covid-19 pandemic. IAEA have conducted one CA with 24 hours' notice each year during 2017-2019, the CA have been on research facility or on a LOF. SSM always participate in the IAEA inspections even if Euratom is present. SSM also performs own smaller inspections parallel to the inspections performed by IAEA and Euratom. The domestic safeguards inspections performed by SSM, without presence of IAEA or Euratom, are mostly performed at the LOFs because the LOFs are not regularly inspected by IAEA or Euratom.

The domestic inspections are an important tool for SSM when it comes to strengthening safeguards and ensuring that all nuclear material in Sweden is under control and registered in

the national nuclear material register. The focus have been on LOFs and the very small holders of nuclear material who belongs to the national MBA. Our experience from the domestic inspections is that in addition to conducting inspections, we also need to spend time on information and follow-ups.

REFERENCES

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