



**Finland and nuclear
non-proliferation**

Fifty years of implementing the
Nuclear Non-Proliferation Treaty

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PGET instrument, see page 70
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Summary

The Treaty on the Non-Proliferation of Nuclear Weapons was opened for signature in the UN in 1968 to stem the spread of nuclear weapons and promote nuclear disarmament and peaceful use of nuclear energy. The treaty entered into force in Finland in 1970, the same as in other countries that signed the treaty in the initial phase. For fifty years, the Treaty on the Non-Proliferation of Nuclear Weapons has been a key prerequisite for the peaceful use of nuclear energy in Finland, a country that, as a user of nuclear energy, has had solid grounds for preventing the proliferation of nuclear weapons.

This study asks how and with which motives have the Finns implemented the Non-Proliferation Treaty in different times. Diverse themes, such as the planning of the Nuclear Energy Act and final disposal of spent nuclear fuel, are reviewed from the point of view of the national implementation of the Non-Proliferation Treaty. The study concerns the time from the late 1960s to the 2010s. The study is based on interviews and a diverse choice of literature, including key archive sources. The interviewees were selected so as to cover different points of view of the topic.

Finland was assigned an important role in the final phase of the non-proliferation treaty negotiations when Finland's representative was asked to head the group of countries sponsoring the treaty. The Finns had been preparing for the use of nuclear energy in the confined foreign policy conditions throughout the 1960s, so Finland was both prepared for, and had an interest in, swiftly planning the comprehensive international control of nuclear materials required by the Non-Proliferation Treaty. In accordance with the Treaty, control was implemented by the IAEA. The Agency drafted the control agreement with Finland and, in 1971, Finland became the first country to sign the Comprehensive Safeguards Agreement. This laid the foundation for Finland's identity as a forerunner.

More generally, Finland's cross-cutting activity in non-proliferation issues in the 1970s and 1980s also served to strengthen and signal Finland's neutrality. Starting from the early 1980s, Finland has researched and developed technical solutions for the control of nuclear materials together with the IAEA and other countries and supported the IAEA by, inter alia, providing training opportunities via the Safeguards Support Programme.

Amidst the international changes of the 1990s, Finland was active in developing safeguards of nuclear materials in the former Soviet Union region, for instance. Underlying this was Finland's aim of EU membership and deeper Western integration. The Treaty on the Prohibition of Nuclear Weapons, which Finland has not joined, had a very twofold reception in Finland towards the end of the 2010s.

Relying on the Treaty on the Non-Proliferation of Nuclear Weapons, Finland has been a committed and responsible user of peaceful nuclear energy for decades, and its long-built final disposal facility for spent nuclear fuel, ONKALO, with its safeguards solutions, is the first of its kind in the world.

Foreword

Professor Erkki Laurila, the key designer of Finland's programme to build peaceful nuclear energy, was also a veteran of World War II. As the century was drawing to a close, he considered the nuclear arms race the biggest peacetime tragedy of mankind in the 20th century. From the very beginning of the nuclear energy considerations of Finland, he and his colleagues guided the country to denounce nuclear weapons in every way. Thus, Finland has been a committed state party to the Treaty on the Non-Proliferation of Nuclear Weapons signed in 1968, which entered into force on 5 March 1970.

The starting point of this research report has been the need of the Radiation and Nuclear Safety Authority and other authorities responsible for the non-proliferation obligations of Finland and nuclear actors to better understand the history of their fifty years of activity. At the same time, the research report aims to tell both the Finnish audience and the international expert community about the Non-Proliferation Treaty and its implementation.

The early phases of the research process had a lot of similarities with Arno Aho's paper *Jotta Suomessa voisi huoletta kulkea: ydinaseiden ja ydinpolttoainekysymyksen seuranta Suomessa kylmän sodan aikana* from 2004. Elina Martikka, Head of International Cooperation at STUK, contacted Pauli Kettunen, Professor of political history at the University of Helsinki, and as a result, Martikka ended up coordinating my work in realizing this research report that brought national actors together. There is continuity between the content of the studies as well.

The duration of the research work was defined as four months. The coronavirus pandemic that erupted in mid-March 2020 and related lockdowns also closed down the majority of universities' library services and imposed strict conditions for acquiring information. Fortunately, I had begun to prepare the study before the official launch of the project and the general coronavirus lockdown.

The Radiation and Nuclear Safety Authority in Finland, the Ministry for Foreign Affairs, the Ministry of Economic Affairs and Employment, Fortum Power and Heat Oy, Posiva Oy and Teollisuuden Voima Oyj funded the project and took part in its steering group. The study was commissioned by the Radiation and Nuclear Safety Authority. The support of the steering group and interviewees for the swift research and writing process has been essential to the outcome. I have also received excellent advice from several other Finnish and international researchers. I would like to extend my gratitude to all who helped with the research, and particularly those who were interviewed or shared their memories.

It is difficult to overemphasize the significance of the fifty-year-old Treaty on the Non-Proliferation of Nuclear Weapons. Experienced specialists reminded me of this when I was conducting this research. Without the international Non-Proliferation Treaty, Finland would not, in practice, be able to produce nuclear energy, which covers roughly one-third of the country's electricity consumption and perhaps even more in the future. The energy transformation required by climate change and predicted smaller nuclear power plants do not reduce the importance of the Non-Proliferation Treaty; on the contrary, they increase it. Olli Heinonen, former Deputy Director General of the IAEA, estimated in an interview that

maintaining effective controls requires constant development of the control system. At the same time, the aggravated political development of the world in the 2010s has shown that the dangers of the use and proliferation of nuclear weapons are still real. Therefore, the Non-Proliferation Treaty is at least as important and necessary today as it was fifty years ago.

Petri Paju, Turku, July 2020.

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I Introduction: Finland and nuclear non-proliferation

A somewhat modest-looking group of buildings in a relatively remote island off the Finnish coast hides a complex structure of caves. It will be the world's first final disposal site for spent nuclear fuel. Looking a little farther, one can see the three nuclear reactors of Olkiluoto towering in the vicinity. The cave complex is an essential part of this significant hub of nuclear industry, but its importance is also much more extensive. While other nations are racing for the Moon, the Finns are the world's first nation to place spent nuclear fuel in their bedrock. Many could consider this to be a very Finnish world record. The underground final disposal facility is called ONKALO®,¹ and it is supposed to hide its content for millennia to come. According to plans, nuclear fuel spent in Finland will be placed in the cave complex starting from 2025 for the next one hundred years or so. In accordance with the Non-Proliferation Treaty, the requirements include ensuring that the finally disposed fuel will not be used as material for nuclear weapons even in the distant future.

For fifty years, the Treaty on the Non-Proliferation of Nuclear Weapons has been a key prerequisite for the peaceful use of nuclear energy in Finland, where the Treaty entered into force in March 1970, similarly to other early signatories to the Treaty. The ONKALO construction project is also a very long-term achievement, with its roots dating back to the 1970s. The excavation of the underground final disposal facility proves and symbolizes Finland's deep commitment to the responsible use of nuclear energy. As a user of nuclear energy, Finland has had strong grounds for preventing the proliferation of nuclear weapons. This study reviews the key points of the history of nuclear energy in Finland, especially from the point of view of implementing the Non-Proliferation Treaty.²

This paper asks how and with which motives have the Finns implemented the Non-Proliferation Treaty in different times. From the point of view of the national implementation of the Non-Proliferation Treaty, the research report focuses on outlining the big picture of how Finland and Finnish actors have been involved in the international development of the peaceful use of nuclear energy: when they have been on the receiving end, when as active contributors or perhaps as onlookers, observers in Finland or abroad, which national policies and internal or foreign policy tensions or, on the other hand, synergies, positive opportunities

1 ONKALO® is a registered trademark of Posiva Oy.

2 The clearest common denominator between nuclear weapons and nuclear energy is nuclear fuel, but there is also diverse dual-use technology. Nuclear fuel, its production and particularly its possible enrichment into weapons grade, as well as materials produced from nuclear fuel in a nuclear reactor, such as plutonium, that can be used for making nuclear weapons, have been and are a key object of safeguards. For more details, see Honkamaa et al. 2004.



have been associated with this development, and how Finland has taken part in the development of international non-proliferation policy and in defining safeguard processes.

Finland was the first country to sign a comprehensive nuclear material safeguards agreement with the International Atomic Energy Agency (IAEA), in 1971. Before that, Finland was involved in drafting the IAEA's model safeguards agreement (INFCIRC/153). In particular, Finnish experts remember this well. The study first needs to survey the emergence of this notion and its truthfulness. Based on this and other solutions relating to the enforcement of the Non-Proliferation Treaty, the study examines which factors and changes in Finland and abroad have motivated Finnish actors at different stages. As topical matters, particular attention from the point of view of non-proliferation is paid to the Nuclear Energy Act, which is about to be revised, and the final disposal of spent nuclear fuel. The development of these themes is reviewed as temporal processes, paying particular attention to the development of the international political situation and its role in Finland's decision-making, foreign influences and the roles of key working groups and individuals.

Nuclear industry experts have been asked about what they consider to be good Finnish practices and how these practices have been built and maintained previously in the above-mentioned contexts. This at least has to do with how and when the Finnish distribution of work emerged, and on the other hand, which crises have been experienced and resolved. One could say that the report thereby also borders on the formation of Finnish views of non-proliferation or stemming of the spread of nuclear weapons in the long term.

The study focuses on the main lines of the history of the Non-Proliferation Treaty. Where necessary, they are discussed in the context of arms control and disarmament in general.

The study is limited to the period from the late 1960s to the 2010s. The period includes diverse phases: different phases of the bipolar Cold War world order and the change of that system, i.e. the collapse of the Soviet Union in the early 1990s and the establishment of its successor states, as well as the technology boom in Finland in the 2000s and the age of international terrorism. The identified constants and changes of the nuclear energy sector are reviewed in these changing contexts, as part of which they are discussed.

Background and role of the study

The nuclear energy industry has a long history behind it, also in Finland. Finland began to concretely prepare for the peaceful use of nuclear energy in the late 1960s, at the same time as the Non-Proliferation Treaty was negotiated and signed. An important Finnish starting point underlying these turning points of the 1960s was the Energy Committee established in 1955 – at the same time when the International Atomic Energy Agency was being established.

AERIAL PHOTOGRAPH OF THE OLKILUOTO NUCLEAR FACILITIES ON 22 AUGUST 2019.

The mouth of the entrance tunnel to the spent nuclear fuel final disposal facility Onkalo and other buildings can be seen at the bottom left, with the three nuclear reactors of Olkiluoto in the background.

Photo: TVO.

The Non-Proliferation Treaty is topical in 2020, with the 50th anniversary of its entry into force. At the same time, the Treaty is subject to increasing pressure due to international political tensions. However, hardly anyone will deny the achievements and global importance of the Non-Proliferation Treaty. Finland has aimed to contribute to all three pillars of the Non-Proliferation Treaty: non-proliferation, disarmament, and peaceful use of nuclear energy. Finland emphasizes that all three pillars are equally important and mutually supportive. Being aware of the history of the implementation of the Treaty will assist in continuing and incessantly developing this work.

The starting points of the research report content include questions presented and relayed by the commissioners of the project. On the one hand, a lot has already been written about the history of the use of nuclear energy, and the report aims to combine this information while helping the reader to become even better and more extensively informed of this multifaceted process. So far, the history specifically of non-proliferation policy has not been researched much in Finland, and the topic is not very well known outside small expert circles.³ The study offers up-to-date information and interpretation about the history of the nuclear industry, both to those working with the peaceful use of nuclear energy and the general audience.

Materials and methods

The research data is mostly comprised of information obtained from previous literature, i.e. published sources, and interviews. The author's interviews with experienced nuclear energy experts have been an essential starting point and material for the study. The choice of interviewees has aimed, and been able, to cover the entire time span under review, as well as the points of view of different fields from foreign policy to technical development work. Due to the coronavirus pandemic of spring 2020, none of the interviews could be conducted face-to-face, so they were carried out by telephone and e-mail. Even though there are always limits to the research use of interviews, just like other materials, information obtained on the telephone may have portrayed a slightly different view than could have been created in meetings in person. This has increased the need for supplementing and cross-checking the information even further. Similarly, e-mail interviews have been used for obtaining information and interpretations, as well as for confirming some questions in different phases of the research process. The research method was evidence-based qualitative research, i.e. a careful reading and comparison of the information obtained from different sources to combine and verify it.

The references used were compiled from an extensive sample of memoirs and texts, original sources, such as published lectures and articles, documents of Non-Proliferation Treaty review conferences, journals, such as the *Alara* journal published by the Radiation and Nuclear Safety Authority, and research literature from a variety of fields. The author has also been able to use archive sources found in previous projects. In addition to these, contemporary interpretations and additional information were obtained and key interpretations verified by using the National Library of Finland's digital newspaper and magazine archive and the Helsingin Sanomat newspaper's digital archive. Archive materials of the Ministry for Foreign Affairs and

3 In particular, previous research worth mentioning includes van Dassen 1999 and Aho-Niemi 2004.

the IAEA were also used, albeit to a limited extent. Where possible, the compiled information and interpretations were verified using research literature based on original materials of Finnish or international archives, such as that of the IAEA.

In the study, the role of Finland has been reviewed as part of the primarily international non-proliferation policy and arrangements. The international system based on the Non-Proliferation Treaty includes the nuclear material safeguards, which, according to the Treaty, are implemented by the IAEA, and, e.g., export control of nuclear materials and equipment. Nuclear material safeguards refer to control aiming to stem the spread of nuclear weapons. Finland's non-proliferation policy refers to the country's political choices and policies in matters covered by the Non-Proliferation Treaty in general.

Underlying the presented interpretations is also the author's diverse experience in the fields of history of technology and cultural history, and in particular the in-progress biography of Erkki Laurila (1913–1998), a multidisciplinary scientist and professor of technical physics at the Helsinki University of Technology (TKK), who was a key Finnish influencer in the nuclear energy sector holding several positions from its early days in the mid-1950s to the mid-1970s.⁴ Together with his students and colleagues, he left behind him a legacy that shaped the industry for decades.

Previous research

Little has been written about the history of Finland's non-proliferation policy, but topics touching it have been discussed more, and from several points of view. Various studies have reviewed the development of the Finns' knowledge about nuclear weapons and ties to politics and outlined the peace movement against nuclear war, while studies have been written about topical non-proliferation questions. The most attention has been paid to Finland's best-known initiative in this field, President Urho Kekkonen's 1963 proposal for a nuclear-weapon-free zone in the Nordic countries and later discussion about it. In this study, they are discussed in the framework of Finland's non-proliferation policy and reviewed in conjunction with that big picture.

Finland's preparation for the adoption of nuclear energy in 1955–1970 has been researched in detail by Tuomo Särkikoski in particular. The international control required by the new dual-use technology, for which the later nuclear non-proliferation regime was built, played an essential role in the complicated big picture. Särkikoski's dissertation, combined with Arno Aho's research, lays a good foundation for reviewing the later phases of Finland's non-proliferation policy.

In more recent international research into smaller countries and nuclear disarmament, the history of the implementation and achievements of non-proliferation in Finland are poorly known and rarely if ever mentioned. This is probably attributable to the fact that relatively little has been written about Finland's history in promoting non-proliferation, and time has passed since the scant publications. Finland's case provides the international discussion with

4 See, inter alia, Michelsen & Särkikoski 2004; Paju 2004; Särkikoski 2011; Paju 2015.

additional information about the role and limits of small countries in implementing the Treaty on the Non-Proliferation of Nuclear Weapons.

Different points of view between Finnish perceptions and those of others are most visible in the early history of the IAEA's safeguards agreement. Finnish experts – unlike many others – particularly well remember the pioneering position of Finland in drafting the IAEA's safeguards agreement and as its first signatory.⁵ In Finland, this has been considered such a given thing that no one has confirmed the claim using original sources so far. This report is the first to confirm information handed down using archival documents. It was necessary and essential to the study to ask what explains the fact that Finland was the world's first country to sign the Comprehensive Safeguards Agreement (CSA, INFCIRC/155) with the IAEA, and what all this says about Finland in terms of implementing the Non-Proliferation Treaty.

The topic has customarily been approached mainly in terms of the history of foreign policy or technology, but here, the aim is to bring the points of view of political history and the history of technology together. This will also provide a more comprehensive view into the interaction between these fields.

Non-occurrences, things that never came true, are easily forgotten by people. The threat of a nuclear war and preparing for it also show that events that never took place can be a significant factor in history. A new conflict feared by the contemporaries can have defined an entire era, such as the beginning of the Cold War, the 1950s and 1960s and further the early 1980s. Afterwards, few remember to ask why something feared or expected did not happen. However, it is also history and historic that there has been no nuclear war in the world, even though it has been feared for a long time and repeatedly.⁶ From the point of view of non-occurrence, the prevention of the spread of nuclear weapons has been an unparalleled success story.

5 See, inter alia, Rotkich 2002; Hofmann 2008, 107; Rislakki 2010, 446.

6 See Rislakki 2010, 466 and passim.

2 Treaty on the Non-Proliferation of Nuclear Weapons in brief

The Treaty on the Non-Proliferation of Nuclear Weapons is an international treaty that was signed in 1968 and entered into force on 5 March 1970. Therefore, 2020 was the 50th anniversary of the Treaty.⁷

The Non-Proliferation Treaty has been considered to be the most successful long-term treaty to strengthen international peace and security. On the other hand, there is reason to ask how well it still works in a world that looks very different from when it was first written.

The Non-Proliferation Treaty aims at three goals: non-proliferation of nuclear weapons, nuclear disarmament and promoting the peaceful and safe use of nuclear energy. The goals are mutually supportive. In fact, the Treaty is often referred to as a three-pillar system. However, the text of the Treaty does not refer to pillars; it is a way of condensing and interpreting its core parts.



7 Treaties 10/1970 and 11/1970. Sopimus ydinaseiden leviämisen estämisestä. / Fördrag om förhindrande av spridning av kärnvapen. / Treaty on the Non-Proliferation of Nuclear Weapons. <https://www.finlex.fi/fi/sopimukset/sopsviite/1970/19700010>. Date of international entry into force 5 March 1970. The Treaty is often referred to as the Nuclear Non-Proliferation Treaty, or simply NPT.

The Treaty acknowledges the five states that had detonated a nuclear weapon by 1 January 1967 as legitimate nuclear-weapon states. The United States, the Soviet Union/Russia, the United Kingdom, France and China (in order of nuclear detonation) undertook not to transfer nuclear weapons or related technology to other, non-nuclear-weapon states. Non-nuclear-weapon states, such as Finland, for their part, undertook not to acquire nuclear weapons. The Treaty also guaranteed all these countries that denounced nuclear weapons full rights to the peaceful use of nuclear energy and technical cooperation of other countries in the development of this technology of the future. As a condition for this right and support, the International Atomic Energy Agency (IAEA) was given the right to oversee the use of nuclear energy in non-nuclear-weapon countries. This was to reliably and internationally verify that the fuel of nuclear plants will not be secretly used for producing nuclear weapons.

All countries committed to negotiating on nuclear disarmament in good faith. In practice, this sixth short article of the Treaty was a task for the nuclear-weapon states in particular. The schematic formulation of the article meant that its precise implementation would need to be negotiated at a later stage.

When negotiating on the Treaty in the 1960s, it was foreseen that with the expanding use and commercial deployment of nuclear energy, more and more countries would obtain resources for building nuclear weapon capacity of their own starting from the 1970s. Sweden, for instance, was among the suspects, and its nuclear capacity was monitored by the superpowers.⁸ It was estimated that within a few decades, 20–25 states or even more could have nuclear weapons. Stemming this development that genuinely threatened everyone – including the United States and the Soviet Union, the unparalleled superpowers of their time – was a key motive behind the Non-Proliferation Treaty.

Finland has been a party to the Non-Proliferation Treaty from the very beginning. Finland was among the first countries to sign the Treaty on 1 July 1968, handed over the ratification documents on 5 February 1969, and the Treaty entered into force in Finland and internationally on 5 March 1970.

The implementation of the Treaty is monitored by Review Conferences every five years, reviewing the progress of its implementation and presenting recommendations for follow-up measures. These Review Conferences (RevCon) are prepared by Preparatory Committees (PrepCom) during the three years prior to each Review Conference. The first Review Conference was arranged in 1975. The 1995 Review Conference was particularly significant, as it decided to extend the originally fixed-term Treaty indefinitely. Other conferences have focused on the interpretation and implementation of the Treaty, and in recent years, particularly on discussion about the progress of nuclear disarmament. At the same time, the parties have negotiated on other arrangements built to support the Treaty, such as export control of nuclear commodities.⁹

8 See Hunt 2013, *passim*; Jonter 2016, *passim*.

9 Pasi Patokallio, interview 17 March 2020; Juha Rautjärvi, interviews 21 February and 27 March 2020. The second Review Conference in 1980 did not succeed in achieving a unanimous final document, and this became a kind of an indicator of the success of conferences – did they publish a joint document or did it remain just a dream. As for criticism of this, see, *inter alia*, Cronberg & van der Meer 2017, 2–3.

The Non-Proliferation Treaty described above is the result of historic development, and one could argue that at least the emphases in its implementation could have been different. Next, we will review the history of the Non-Proliferation Treaty and the evolution of its interpretations, especially from the point of view of Finland.

3 From the atomic bomb to the control of nuclear commodities

The world, including Finland, became aware of the invention of the atomic bomb when the new superweapon, already foreseen, was used, for the first time, in obliterating the cities of Hiroshima and Nagasaki in August 1945. The details of the atomic bomb were top secret, but it was not long before considerations arose in the nuclear power United States and elsewhere about how long the atomic secret would remain its exclusive right. Many experts foresaw that it would not last long.¹⁰

The superior weapon interested many from day one, and it was considered to be too dangerous an invention in the hands of most decision-makers. The United States began to develop non-proliferation measures as early as 1945. Negotiations on preventing the spread of nuclear weapons conducted in the United Nations (UN) were reported on by newspapers all over the world in the late 1940s. In Finnish, the measures were referred to as “atomivalvonta”, or “atom control”. Later, in the late 1960s, the word “ydinsulku” (literally “nuclear blockade”) began to mean roughly the same in standard language.¹¹ In 1946, Bernard Baruch’s plan for controlling atomic power in the UN summed up the contradictory nature of the novelty as a source of energy or bombs: “Let us not deceive ourselves: We must elect World Peace or World Destruction.”¹²

Post-war Finland aimed at neutrality in its foreign policy. For a small nation, it was particularly important to avoid conflicts between the superpowers and, whenever possible, support initiatives bringing them together. Finland created friendly relations with both the Soviet Union and the West, and thereby attempted to remain as independent from its neighbouring superpower as possible. However, it was in the interest of the Soviet Union to keep Finland in its sphere of influence. The Soviet Union and Finland signed the Agreement of Friendship, Cooperation, and Mutual Assistance of 1948, also known as the YYA Treaty, in 1948. The “Paasikivi–Kekkonen doctrine”, named after Finnish presidents, emphasized Finland’s good relations with the neighbouring superpower. In Finland, it was hoped that this would make it possible to form even closer ties with the West, on the other hand. The resulting foreign policy balancing and “Finnish paradox” began to work only gradually during the post-

10 See, inter alia, Laurila 1967.

11 The National Library of Finland’s digital newspaper archive. See, inter alia, Roehrllich 2018.

12 The Baruch Plan. Presented to the United Nations Atomic Energy Commission, June 14, 1946.

war decades.¹³ Before that, Finland had to assert its neutrality – the same challenge applied to nuclear energy, a politically sensitive topic.

The Paris Peace Treaty of 1947 prohibited Finland from acquiring nuclear weapons. Article 17 of the Treaty begins this way: “Finland shall not possess, construct or experiment with any atomic weapon.”¹⁴ Therefore, Finland stayed far on the sidelines when the superpowers developed increasingly powerful nuclear bombs in their quest for world domination in the early 1950s. Alleviating fears of a nuclear war was an important factor when the US president encouraged all countries to only develop nuclear energy for peaceful purposes in the UN in 1953. Work began to establish a new organization for this task, and it was given the name International Atomic Energy Agency (IAEA).¹⁵

Winged by the international atom enthusiasm, Energiakomitea (the “Energy Committee”) was established in Finland in spring 1955, intended to pay attention to the use of atomic energy in energy production alongside other alternatives. The Committee denounced nuclear weapons per se – Finland did not want to have anything to do with them, but rather focus on the peaceful use of nuclear energy going forward. The neighbouring country Sweden, however, planned a secret nuclear weapons programme.¹⁶ Yet, it was obvious that in the tensioned international environment, even the political nature of peaceful atomic energy and future atom control caused specific headaches for Finland, which was aiming for neutrality.

According to a later estimate by an early architect of Finnish nuclear energy, “Finland was the first country not to take this atomic power for granted, but instead began to consider whether it suited our energy system in general or not.”¹⁷ Even though there were atom enthusiasts in Finland as well, starting from the Energy Committee of 1955–1956, the country’s key experts and authorities aimed to combine learning lessons from abroad, a high target level and critical thinking to develop the nuclear energy sector in the country.¹⁸

Finland joined the International Atomic Energy Agency in a systematic way that was intended to be noticed. Finland did not want to be one of the least significant founding members of the Agency in 1957, but the first elected member. This also happened in 1958. Strengthening the supranational IAEA controlled by the member states was in the interests of Finland, a country aiming for maximum neutrality, and Finland became an active partner and co-developer for the IAEA.¹⁹

Finland and the IAEA co-operated to establish new solutions, because the co-operation benefitted both of them. In 1960–1962, Finland obtained the Triga research reactor, for education and research purposes, from the United States. The procurement of fuel for the

13 See, inter alia, van Dassen 1999; Visuri 2006.

14 Peace Treaty with Finland, 1947. Finland unilaterally denounced the military regulations of the Peace Treaty in September 1990 – with the exception of Article 17. Finland has thereby proactively committed to being nuclear weapon-free both by joining the Treaty on the Non-Proliferation of Nuclear Weapons and by keeping Article 17 of the Peace Treaty in force.

15 See Fischer 1997.

16 Paju 2004; Jontter 2016.

17 Erkki Laurila’s interview 1983. The Archives of President Urho Kekkonen.

18 Särkikoski 2011, passim.

19 Laurila 1967, 202–203, 206.

research reactor Finland Reactor 1 was organized via the IAEA, and Finland was the second country besides Japan to commit to the Agency's safeguard regulations, at that time known as "safeguards against diversion". Their purpose was to prevent the use of fuel for military purposes.²⁰

The IAEA, on the other hand, needed Finland as a partner, because its position was still weak for the time being. Major powers competed for their influence through it as well. Moreover, the IAEA was capable of control in relatively few countries only.²¹ It is illustrative that when President Urho Kekkonen's speech in 1963 had resulted in many Finns being interested in a Nordic nuclear-weapon-free zone the IAEA's management wanted to be involved in strengthening this disarmament initiative, aiming to enhance their opportunities for influence.²² The matter did not advance in practice.

When Finland needed fuel for its research reactor and wanted to procure it from the United States via the IAEA, another batch for an older atomic pile was requested from the Soviet Union at the same time. The pile was a subcritical reactor built at the Helsinki University of Technology for nuclear engineering education and research purposes in the late 1950s. Finland's representative in the IAEA Board of Governors explained Finland's technological policy upholding the country's neutrality: "Making requests for two batches at the same time was naturally tactical, aiming to prevent Finland from being mixed up in the quarrels between the United States and Soviet Union that were prevalent in the IAEA Board of Governors at the time."²³ The decision was made amicably.

The fuel for the Triga reactor and uranium supplied by the Soviet Union were among the first safeguard tasks of their kind assigned to the IAEA – or that was what the Finns believed. This encouraged building the nuclear energy safeguards on the same foundation later in the 1960s.²⁴ However, Erkki Laurila, who was a key organizer in the early stages of the Finnish nuclear energy sector and later represented the country in the IAEA Board of Governors on several occasions, later characterized the early IAEA control in Finland as playing around, or to put it more nicely, rehearsing.²⁵ There was a lot of room for improvement.

PRESIDENT URHO KEKKONEN starts the Triga research reactor in August 1962.

The research reactor was named Finland Reactor 1, FiR 1. It is also about to become the first nuclear reactor to be decommissioned in Finland.

Photo: Aarre Ekholm, Lehtikuva. Wikipedia.

FINLAND'S FIRST NUCLEAR REACTOR FIR 1 photographed from the upper platform in 1963.

Photo: Helge Heinonen / Finnish Heritage Agency.

20 Särkikoski 2011, esp. 161.

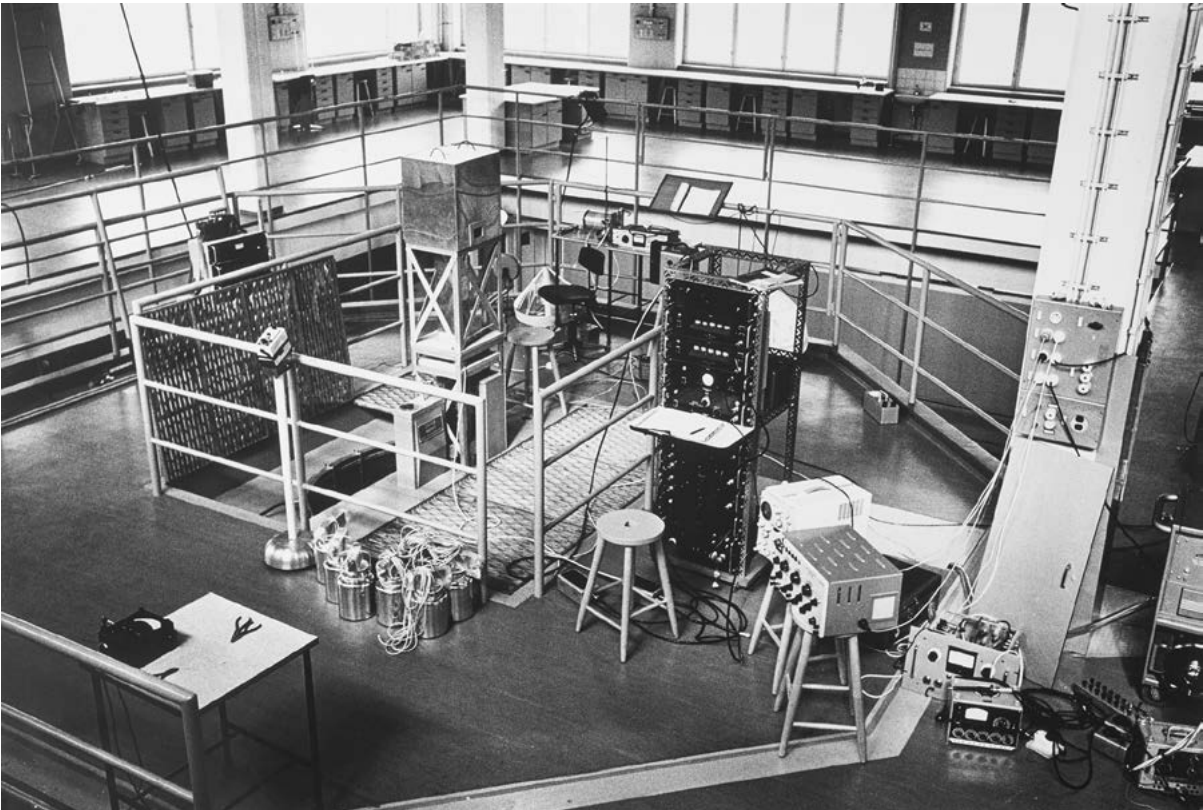
21 Fischer 1997, 307; Särkikoski 2011, 157.

22 Särkikoski 2011, esp. 162.

23 Laurila 1967, 203; Aho 2004, 45–46. See and cf. Aho 2004, 56.

24 Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt 4. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993. The Archives of the Finnish Ministry for Foreign Affairs.

25 Laurila 1977.



The Cuban missile crisis brought the world to the brink of a nuclear war in autumn 1962, as is well known. The increasingly likely threat of a nuclear war fortunately led to the superpowers standing off and talking to each other. After the Cuban missile crisis, the United States and the Soviet Union agreed on a partial Nuclear Test-Ban Treaty in Moscow in 1963.²⁶

Finland, or more precisely Finnish companies, tried to obtain a nuclear power plant through competitive bidding in 1965–1967 and again in 1968. The connection of the procurement of a nuclear power plant with international politics, safeguards and treaties was repeatedly brought up in the atomic energy advisory board in 1965–1966. The advisory board was headed by Erkki Laurila for a long time. Ilkka Mäkipentti, who was a civil servant with the Ministry of Trade and Industry and served as the advisory board's secretary, had been monitoring the development of "atomic safeguards policy" around the world for years. Finland had been avoiding signing bilateral atomic energy-related treaties for a long time so as to not endanger its neutrality. Even though the negotiation rounds were repeatedly interrupted due to political problems, the Finnish buyers also drew important additional information about the leading supplier countries' views of the organization of safeguards from the offers they received. Amidst the frustration of young nuclear power experts, there was time for outlining the safeguards model desired by Finland.²⁷

At the same time with the competitive bidding from 1966 onwards, Finland monitored the progress of disarmament negotiations by posting observers to the Eighteen Nation Committee on Disarmament in Geneva. In 1966, public discussion about the role of small nuclear-weapon-free countries was longed for in Finland as well.²⁸

In February 1967, news from Vienna, the headquarter city of the IAEA, reached Finland. According to the ambassador, the superpowers were about to agree on making the IAEA's safeguards a key tool as part of the superpowers' new strategy aiming at non-proliferation and continuous control of it.²⁹ Information was published in newspapers the same month, and the Finnish word "ydinsulku" (literally "nuclear blockade") apparently debuted in papers.³⁰

Risto Hyvärinen, head of the Political Department of the Finnish Ministry for Foreign Affairs, wrote a secret memorandum on the situation in February 1967. It was also addressed to the country's top political leaders. Aligning with nuclear energy experts, he wrote that "a safeguards agreement required by a nuclear power plant could only be bilateral or trilateral, either between the buyer and suppliers or between them and the IAEA." It appears that Hyvärinen considered it obvious that the neutrality policy adopted by Finland and its support for the IAEA's safeguards system advocated a trilateral procedure.³¹ Risto Hyvärinen, a former

26 See, inter alia, Visuri 2006, 155–158; Aho 2004, 59–60.

27 Särkikoski 2011, passim.

28 Pajunen, Aimo: Voiko sopimus estää ydinaseiden leviämisen? SUOMEN KUVALEHTI 50, 16/1966, 34–35; Aho 2004, 59; Pastinen 2007, 252; Soikkanen 2008.

29 Särkikoski 2011, 270.

30 Kaurinkoski, Jaakko: Ydinsulku esillä Kosyginin ja Thompsonin kohdatessa. UUSI SUOMI, 19 February 1967, p. 10. Search: ydinsul*. Any changes in the terms in Swedish, also an official language of Finland, is ignored here because digitised Swedish-language newspapers do not yet exist in the database for that period.

31 Särkikoski 2011, 279.

officer, had monitored nuclear disarmament and negotiations in Geneva. He had published the first Finnish book on the subject, *Aseidenriisuntaongelma ja ydintaisteluvälineet* (Tammi, Helsinki 1964). In 1967, he was appointed a member of the atomic energy advisory board.³² Later Hyvärinen headed the Finnish delegation to the first NPT Review Conference in 1975.

The elements of the drafted model – with its essential political justifications – were thereby familiar to the Finns from the solutions of the Triga research reactor. The aim was to openly communicate the policies to the general public: Laurila wrote about topical non-proliferation issues in his book *Atomienenergian tekniikkaa ja politiikkaa* published the same year, 1967 – calling for the strong development of the IAEA's safeguard functions.³³ Ilkka Mäkipentti wrote in 1967 that aligned with other independent countries, Finland had proposed international control of nuclear fuel flows instead of the IAEA's previous control system based on inspecting nuclear power plants. Such an efficient safeguard system should be able to warn about the potential misuse of nuclear materials in time.³⁴ The future safeguards system was planned based on this very principle.

Based on these starting points, it is apparent and understandable that the Finns had an opportunity and the information to draft a future international IAEA safeguards agreement and a need for solutions, derived from the national operating environment of the Cold War. The small group of Finnish experts, civil servants and politicians probably had no trouble reaching unanimity on these objectives of Finland. The new Finnish Nuclear Society (Suomen Atomiteknillinen Seura) was tasked with proposing a joint solution.

32 Hyvärinen 2000, passim; Ahošniemi 2004, passim; Poutanen 2014, appendix.

33 Laurila 1967, 232–234.

34 Mäkipentti 1967, 64–65.

4 Agreeing on the prerequisites for producing nuclear energy

Considering the development of the sector in Finland and the situation of the non-proliferation negotiations, it was logical that the Finnish Nuclear Society presented a Finnish solution proposal to the Finnish Government towards the end of 1967. The Finnish Nuclear Society had been established the previous year, 1966. The Society broadly brought together Finnish nuclear experts and parties, still few in number at the time, with the aim of promoting nuclear expertise and production of nuclear energy in Finland. In its active early stages, the Society drafted a brief to the Government in late 1967. The brief was about trading in nuclear fuel, and the Society submitted it to the Finnish Minister of Trade and Industry Olavi Salonen in December 1967. Highlights of the statement were published in newspapers. Underlying the resolution was a presentation given by Kalevi Numminen (Imatran Voima Oy) on the cost factors of nuclear fuel in the society. Numminen, M.Sc. (Eng.), would later become the project manager for Imatran Voima's Loviisa nuclear power plant project. In addition to calculations concerning different energy sources, the presentation particularly discussed how non-proliferation policy-related obstacles distorting the competitive situation could be removed when procuring nuclear fuel for Finland in the future. The proposed solution included bilateral agreements in the field of the peaceful use of nuclear energy made by the Government and the IAEA being responsible for supervising the use of nuclear fuel in Finland. The aim was for the agreements to guarantee "the most economically feasible and unobstructed supply of fuel to Finnish atomic energy producers".³⁵

The Finnish Nuclear Society's brief from 1967 is an important reminder of the key motive of atomic energy producers and the Finnish state underlying the future Non-Proliferation Treaty. From the point of view of energy policy, it was crucial that the previously politically inflammatory nuclear fuel would become a more common object of international trade. Purchases of nuclear fuel should be able to succeed regardless of tensions in world politics.

Judging by the history of Finland's nuclear energy procurement presented above, the measures proposed by the Finnish Nuclear Society represented a plan drafted together by nuclear energy experts – in co-operation with experts in foreign policy. The strategic intent had become clear during the Non-Proliferation Treaty negotiations during 1967, and it was now officially presented to the Government for action.³⁶ These published guidelines support

35 Patrakka et al. 2016, esp. 119 and passim; Ydinpolttoaineesta kirjelmä hallitukselle. Atomiteknillinen Seura esitti kantansa. UUSI SUOMI, 24 December 1967, no 328, p. 17, <https://digi.kansalliskirjasto.fi/sanomalehti/binding/2133384?page=17>

36 See also Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt, 4. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993. The Archives of the Finnish Ministry for Foreign Affairs; Mäkipentti 2000.

the idea that Finland had a stable view of the desirable supranational agreement and control system at an early phase.

The targets had thus been set, but it was another matter whether Finland would be able to negotiate such a complicated package under the pressure of Cold War juxtapositions. Paul Gustafsson, head of the Legal Department of the Finnish Ministry for Foreign Affairs, was given responsibility for the agreements on the whole. He led the Finnish delegation in the initial negotiations on bilateral agreements. The procurement of a nuclear power plant or fuel would not succeed without a state-level agreement. Gustafsson had previously been involved in negotiating on demanding questions between states in the early 1960s.³⁷ The delegations also included Erkki Laurila and Ilkka Mäkipentti, experts who had been monitoring safeguard agreements for years and understood the content of Finland's goals.

In order to prepare for the procurement of a nuclear power plant, the Finnish Ministry for Foreign Affairs made initiatives to sign bilateral agreements on co-operation in nuclear energy with the United Kingdom, the Soviet Union, Sweden and the United States in spring 1968. The first three were still involved in the competition for a power plant order, and the United States was to be involved as a supplier of enriched uranium. The Finns' starting point was for the safeguards required in the concluded bilateral agreements to be transferred to the IAEA at the earliest opportunity. Country-specific bilateral safeguards would have meant the inspectors of the different supplier countries appearing at regular intervals to "inspect the atomic power plants and, in the best case, inspect one another."³⁸ Gustafsson also visited the IAEA secretariat in Vienna, reflecting on the situation while presenting Finland's goals.

At the same time as these negotiations, in summer 1968, the Non-Proliferation Treaty was approved by the UN General Assembly and opened for signature. It paved the road for a considerable dilution of Cold War tensions. Even though 1968 was a year rife with conflicts and tensioned in several ways, the superpowers engaged in negotiations on arms limitations the next year. Superpower meetings that began in Helsinki in late 1969 led to Strategic Arms Limitation Talks, or SALT agreements, in the 1970s.³⁹

Neutral Finland as a figurehead for non-proliferation

Negotiations on a non-proliferation treaty had been underway between the superpowers and in the UN since the mid-1960s. By the beginning of 1968, the superpowers completed the final agreement draft that they aimed to have approved by the UN quickly with minimum amendments. The determined co-operation of the big two also raised objections, so they gathered a group of countries sponsoring the proposal. The superpowers' chief negotiators invited the Finnish UN Ambassador Max Jakobson to be the chairman of the group.⁴⁰

The choice of Finland's representative as a figurehead for the final stage of the non-proliferation negotiations was no coincidence. Max Jakobson told that he had clearly expressed

37 Rotkirch 2002.

38 Gustafsson 1999, 285.

39 Rislakki 2010. See also Aho-Niemi 2004, *passim*. Finland has also later gladly offered the superpowers a meeting venue and aimed to promote stability throughout the world alongside its own national security.

40 Jakobson 1983, 129–147.

Finland's willingness to be active in promoting the Non-Proliferation Treaty in preliminary discussions. In addition to the matter being significant in principle, Jakobson emphasized the fact that Finland considered the Treaty as stabilizing for the European security situation and thereby also directly serving Finland's vital security interests. A non-proliferation treaty would not require that Finland give up anything, because already the Paris Peace Treaty (1947) required the country to be nuclear-weapon-free, so it brought other non-nuclear-weapon states into the same position with Finland.⁴¹

The task given to Finland suited the disarmament policy that had been shaped in a far-reaching way since the mid-1950s under the leadership of Ralph Enckell in the Ministry for Foreign Affairs amidst the hot Cold War arms race. According to the principle, Finland supports all reasonable disarmament proposals supported by both main parties to the Cold War. Without them, no results would be achieved. Finland aimed to strengthen its neutrality while offering to be a mediator and supporting the negotiations.⁴²

The non-proliferation negotiations were not easy, according to Jakobson. The dialogue with the superpowers reminded him of "herding elephants." The difficult West German question was avoided. According to critics, a new Holy Alliance was in the making, just like the (conservative) coalition of superpowers in 1815 to stabilize peace. In his speech, Jakobson justified the Non-Proliferation Treaty to others also as a starting point for future disarmament. He received backing from Finnish observers, who had been monitoring the non-proliferation negotiations from the very beginning.⁴³

In the vote, the resolution recommending that all UN member states sign the Treaty on the Non-Proliferation of Nuclear Weapons was approved with a vast majority. However, not all countries of significance signed the Non-Proliferation Treaty, and some key objects of criticism would be returned to again and again, as the agreement on the implementation of disarmament was obscure. Yet, especially from the European point of view, the Treaty became "the cornerstone of Détente", as Jakobson put it.⁴⁴

With regard to smaller states, particularly Ireland and its Foreign Minister Frank Aiken had been submitting initiatives to commence nuclear disarmament to the UN since 1958. It was specifically these proposals by Ireland that have been considered to be the impetus for the subsequent Non-Proliferation Treaty. The "Irish resolution" was approved by the UN in 1961. Probably on account of the initiatives submitted by its foreign minister to the UN, Ireland had the honour of being the first non-nuclear-weapon state to sign the Non-Proliferation Treaty (NPT) on 1 July 1968. Ireland was also the first country to ratify the Treaty. Finland likewise

41 Jakobson 1983, 140; Pastinen 2007, 257.

42 Hyvärinen 2000, esp. 171; Pastinen 2007, esp. 241 and passim. See also Soikkanen 2003, passim.

43 Jakobson 1983, 146; Pastinen 2007, 257–258. Finnish observers included several civil servants of the Ministry for Foreign Affairs, starting with Risto Hyvärinen. See, inter alia, Hyvärinen 2000, passim; Pastinen 2007, 257–258.

44 Jakobson 1983, 147.

signed the Treaty on the first day, similarly to several other nuclear-weapon-free countries, and was among the early ratifiers of the Treaty, ratifying it on 5 February 1969.⁴⁵

45 Ydinsulkusopimus allekirjoitettiin. ETELÄ-SUOMEN SANOMAT, 2 July 1968, no 175, 1, 8, <https://digi.kansalliskirjasto.fi/sanomalehti/binding/1071076?page=8>; Burr 2018; Disarmament Treaties Database: Treaty on the Non-Proliferation of Nuclear Weapons. United Nations Office for Disarmament Affairs. <http://disarmament.un.org/treaties/t/npt> (retrieved on 2 July 2020). Cf., inter alia, Fischer 1997, 310.

5 Finland and the emergence of the IAEA model agreement

Finland's first bilateral agreement in the field of nuclear energy was signed with the United Kingdom on 25 May 1968, i.e. before the approval of the Non-Proliferation Treaty. Finland's atom negotiations soon continued with Sweden and the United States. Considering safeguard-related matters under Paul Gustafsson at the same time, the Finns had outlined their goals for the content of the safeguards agreement to be concluded with the IAEA. It was already known that each non-nuclear-weapon state to approve the Non-Proliferation Treaty would need to sign a safeguards agreement. Finland wanted to act openly, and therefore its delegation reported on all of its activities to its negotiation partners.⁴⁶

It was considered essential that the agreement would make all regulatory control by the supplier country unnecessary. At the same time, the aim was a simple safeguards agreement whose fulfilment would not cause major detriment to the production plants. Negotiations on a draft agreement between Finland and the IAEA progressed well and received praise from both the East and West, Gustafsson recalled. In spring 1970, the draft was sufficiently finished for the IAEA to already talk about a "model agreement".⁴⁷

The fact that Finland had the procurement process for the country's first nuclear power plant in progress accelerated and added colour to the negotiations. Officially, on the other hand, Finland kept these projects separate.

Negotiations on a bilateral agreement with the Soviet Union had not yet been commenced when the superpower made such an economical offer for the delivery of a nuclear power plant in July 1968 that it was decided to halt the entire previous procurement process and associated competitive bidding. The Soviet Union offered Finland a low-priced nuclear power plant that the country's leadership practically had trouble refusing due to reasons of foreign policy, but to which several changes were negotiated. At the same time, Finland gradually succeeded in selling the main points of its previous trilateral agreement model, in which the IAEA would be responsible for international safeguards, to the Soviet Union in 1968–1970, even to such an extent that Finland was later implied to be advocating for the Soviet Union in the IAEA.⁴⁸ The Soviet Union wanted to start exporting nuclear power plants, and Finland would be important in opening the door to Western markets for it.

Ilkka Mäkipentti from the Finnish Ministry of Trade and Industry presented an account of Finland's negotiations with the IAEA at a seminar in 1993, and it was consistent with Paul

46 Gustafsson 1999, 288.

47 Gustafsson 1999, 288.

48 Gustafsson 1999, 288–291.

Gustafsson's memoirs, although even more detailed. An event for a limited circle of experts at the Königstedt Manor reviewed the previous phases of the IAEA's safeguards from the point of view of Finland. Safeguard-related questions were strikingly relevant at the time due to demands for making them stricter after the Gulf War. Ilkka Mäkipentti confirmed the Finns' point of view at the seminar in 1993: even though international preparation resulted in addenda to the draft, "the key content of the international (safeguards) agreement was formulated in discussions between Finland and the IAEA".⁴⁹

Both the Soviet Union and the United States supported Finland's initiative and its draft safeguards agreement even before the IAEA established an official committee to resolve the control task required of it by the Non-Proliferation Treaty. This Safeguards Committee, also known as the Waldheim Committee after its chairman Kurt Waldheim, launched its work in June 1970, and all member states were allowed to partake. The work began in a situation in which a model agreement compiled by Finland's negotiators existed and had the approval of the superpowers.⁵⁰ This recalled information is finally confirmed by the IAEA's archive source from the first meeting of the committee in 1970. At the meeting, Finland's representative, Ambassador Jussi Mäkinen brought up the fact that the member states' draft agreement offered to the Committee members with a letter from the IAEA's Director General had been negotiated between the Finnish Government and the IAEA secretariat with an eye to Finland's needs.⁵¹

As the negotiations proceeded, Finland was also active in the IAEA General Conferences. In 1968–1971, Finland's representative Erkki Laurila consistently emphasized how central the IAEA was to the safeguards referred to in the Non-Proliferation Treaty and talked about Finland's effort to sign an international safeguards agreement. The highlights of these speeches were covered by Finnish newspapers. In September 1970, when the work of the Waldheim Committee was still at a relatively early phase, he reported to the General Conference that Finland's safeguards agreement with the IAEA has progressed considerably far.⁵² The speeches given by Finland in Vienna provided nuclear energy experts from across the world with information about Finland's goals and state of agreement preparation.

The model paper of the agreement was distributed to the Waldheim Committee at the IAEA without mentioning Finland's role in preparing it. That is the notion that the Finnish experts

49 Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt, 7. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993. The Archives of the Finnish Ministry for Foreign Affairs; Mäkipentti 2000. Gustafsson did not attend the seminar. Ibid.

50 Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt, 6. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993. The Archives of the Finnish Ministry for Foreign Affairs.

51 Safeguards Committee (1970). Official record of the first meeting. Held at Headquarters, Vienna, on Friday, 12 June 1970, at 3.10 p.m. Version 7 December 1970. GOV/COM. 22 /oa.1, page 6. The IAEA's archives.

52 Inter alia, Atomivoimalamme esillä Wienin yleiskokouksessa. UUSI SUOMI, 25 September 1969, no 259, p. 14, <https://digi.kansalliskirjasto.fi/sanomalehti/binding/2134550?page=14>; Loviisan voimalan valvonta IAEA:lle. HELSINGIN SANOMAT 26 September 1970, 20.

had, and anonymity is similarly indicated by the above-mentioned IAEA archive source.⁵³ Nevertheless, the Waldheim Committee was to have ample topics for debate.⁵⁴ Finland's role prior to the work of the committee has been forgotten abroad, but the opposite has been the case in Finland: all Finnish experts know about it. Many of them proactively reported it in interviews with some degree of pride, as perhaps the Finns' finest hour in building the nuclear non-proliferation regime.

Juhani Santaholma, lawyer with Imatran Voima at the time, took part in these negotiations as the youngest member of the Finnish delegation. In an interview, he characterized the head of the delegation, the Ministry for Foreign Affairs representative Paul Gustafsson, as a legendary, incredibly sharp lawyer and astonishing civil servant, who was also charismatic. Santaholma is convinced that Gustafsson's capability played a crucial role in Finland succeeding in its negotiations. Santaholma's interpretation is that Finland got to be the first country to sign the IAEA's comprehensive safeguards agreement specifically as Finland's "reward" for acting as the IAEA's unofficial partner in the rehearsal negotiations.⁵⁵

Fate of a pioneer

Thus, according to the established Finnish view, Finland played a key forerunner role in the emergence of the model IAEA comprehensive safeguards agreement INFCIRC/153 required by the Non-Proliferation Treaty.⁵⁶ Finland's role is hardly known or recalled in foreign literature.⁵⁷ As a significant exception to this, David Fischer, a long-term employee of the IAEA, mentions that the Agency secretariat had a 'dry run' negotiation and early discussions specifically with Finland that eagerly wanted to be the first country to conclude a safeguards agreement pursuant to the Non-Proliferation Treaty. He does not describe Finland's role underlying the agreement model in any more detail, either, but brings up the manifoldness of international negotiations and influences.⁵⁸

The Finnish views of Finland's significant constructive role are supported by Cindy Vestergaard's detailed study based on the IAEA's archive sources. According to her, the Agency's safeguards committee encountered different countries' conflicting views in 1970 of the important question of at which part of the nuclear fuel supply chain safeguards should begin after uranium mining, among other issues. Finland became a mediator in the dispute, and the preliminary study it presented offered a compromise that the Committee approved with a few edits. The Finns' activity and text proposals match exactly with the notion that Finland promoted the achievement of a safeguards agreement with determination.⁵⁹

53 Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt, 6. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993. The Archives of the Finnish Ministry for Foreign Affairs.

54 With regard to the topics of discussion, see, inter alia, Kratzer 1984; Roehrlich 2018.

55 Juhani Santaholma, interview 9 April 2020; Tero Varjoranta, interview 10 June 2020. Santaholma turned 30 years old in 1970.

56 See, inter alia, Mutru 1991; Kilpi 2007.

57 See Shaker 1980; Roehrlich 2018. See also Rentetzi 2017.

58 Fischer 1997, 253–254, 310.

59 Vestergaard 2016, passim; Kratzer 1984, esp. 30. Jussi Manninen recalled that the Finns who took part in the negotiations often talked about this decisive role of theirs. Jussi Manninen, e-mail correspondence 22 February 2020.

It is essential to note that two interpretations or narratives of different scales can be distinguished regarding Finland's role in achieving INFCIRC/153. Those who have heard the narratives later might have mixed them up. In the broader version, the entire model agreement was drafted with Finland and using Finland as the IAEA secretariat's "guinea pig", and in the narrower version, the Finns acted as mediators, especially in the dispute over the starting point of safeguards. Studies on the IAEA's archive sources confirm both narratives, as discussed above. There is no doubt that they are founded. It still remains to be studied in more detail, inter alia, how big were the changes made in Finland's agreement draft by the member states' safeguards committee in 1970–1971. Based on the above-mentioned newspapers, Finland's early agreement negotiations were regularly communicated about to the member states at the IAEA General Conferences. Finland's motives for hastening the negotiations on the safeguards agreement will be investigated in more detail below.

Finland achieved its objective: it was the first state to sign an NPT-based safeguards agreement with the IAEA on 11 June 1971.⁶⁰ The recommendation of the IAEA's safeguards committee was adjusted to match Finland's needs in the final negotiations and published as the IAEA's document INFCIRC/155. The safeguards agreement for Finland entered into force internationally on 9 February 1972, and it was the first NPT-based safeguards agreement to take effect. The agreement remained in force until Finland signed a new safeguards agreement upon becoming a European Union Member State in 1995.⁶¹

Finland's position as the first country to sign the new kind of agreement is undisputable, but the impact of the draft prepared for Finland is a more extensive and complicated question, an object for a separate study. One could also ask whether Finland's special role is connected to later criticisms of the IAEA's safeguards. For example, a new study considers the model safeguards agreement produced by the IAEA safeguards committee to have watered down the safeguards referred to in the Non-Proliferation treaty in a way.⁶² On the other hand, a previous detailed analysis of the history of the negotiations on the model agreement remarks that the original purpose of the agreement text provided the IAEA with more authorizations, such as unannounced inspections, than what ultimately became of the safeguards practice and interpretation of the agreement.⁶³

From the point of view of this study, it is central that the shared view described herein – a correct or mostly correct one, but understandably partial as a national view – of Finland's strong role is, in itself, a fact that has guided and encouraged Finnish parties' activities in and for the implementation of the Non-Proliferation Treaty for a long time. The sort of a small trailblazer's identity shared by Finnish experts was also brought up in the 1993 invitee

60 Government agenda 3 June 1971; Memorandum: Authorizing the signing of the safeguards agreement between Finland and the International Atomic Energy Agency and the protocol associated with its article 15. Eero Yrjölä, Helsinki, 1 June 1971. The Archives of the Finnish Ministry for Foreign Affairs.

61 Honkamaa et al. 2004, 336–337. The date, 9 February 1972, is also the entry into force date pursuant to the Treaty provisions. In Finland, the national entry into force date was prescribed as 10 February 1972 by way of a decree. The information was provided by the Unit for EU and Treaty Law of the Finnish Ministry for Foreign Affairs.

62 Roehrlich 2018.

63 Kratzer 1984, esp. XII.

seminar that discussed both Finland's merits in the early history of the implementation of non-proliferation as well as topical challenges when preparing for the important NPT Review Conference of 1995. At the same time, it seems that the international community of the early 1970s recognized Finland's important role, as the country was given essential tasks in promoting the non-proliferation scheme after that as well.

Why did Finland want to be the first one?

Why did Finland want to be the first country to sign an NPT safeguards agreement? Finland had ordered its first nuclear power plant in 1969, at the same time as the Non-Proliferation Treaty was being ratified – and not from just anywhere. The plant was purchased from the Soviet Union, especially due to reasons of foreign policy. The order was completely new also at the international level. This was the first – and last – nuclear power plant purchased by a neutral Western country from the Soviet Union. Certainly, Finland had a special relationship with its eastern neighbour. Elsewhere in the West, it could seem as if Finland had not been capable of independent decision-making under the pressure of its neighbouring superpower, and most understood that the Soviet Union might attempt to use this nuclear energy leverage to increase its influence on its small western neighbour.

It was feared in Finland, too, what kind of a joint operation the construction of an unforeseen nuclear power plant with the Soviets would be like. On the other hand, the spearhead of Finnish experts had, led by Erkki Laurila, been preparing since the 1950s for ordering the nuclear power plant from the East particularly due to political reasons. The fear of a harmful dependence was a key motivator for Finland building national expertise in the nuclear energy sector since the mid-1950s through various measures – preferably in co-operation with the IAEA. The Finns' key doctrine was that it was necessary to master technology and other matters themselves to guarantee independent decision-making.⁶⁴

The client had to know exactly what they wanted to buy and to be built. Following its doctrine, Finland had negotiated and agreed as part of the power plant purchase with the Soviets to make alterations to the nuclear power plants built in the country, such as a containment structure for the nuclear reactor building modelled after the Western solutions. The nuclear power plant would also incorporate other Western technology to enhance nuclear safety in particular, due to Finnish demands. The modifications were implemented, and they have turned out to be extremely durable and functional solutions.⁶⁵

For a small country, international nuclear fuel controls with the superpowers or either one of them could be an insurmountable task and compromise Finland's position as a neutral country. Furthermore, Soviet and US inspectors might end up in a collision course in the future power plant in Finland and the country might end up as a pawn in a dispute between the superpowers. Therefore, the opportunity provided by the Non-Proliferation Treaty to sign

64 See Laurila 1967; Paju 2015.

65 Michelsen & Särkikoski 2005, *passim*.

a safeguards agreement with a supranational party and transfer future safeguards to the IAEA, an already known international body, was more than necessary for Finland.

Ilkka Mäkipentti from the Finnish Ministry for Foreign Affairs illustrated that, with the IAEA agreement, “we also got rid of difficulties that might have emerged had both the ‘East’ and ‘West’ received control rights to the same plant or fuel in Finland.”⁶⁶ This could have happened at the Loviisa power plant, for instance, that combined both Soviet and Western, even US, solutions and technology according to Finnish plans.

As the 1960s progressed, Finnish experts had come to the conclusion that it was of great benefit to Finland to procure its nuclear power plants from several countries – especially since one of these countries was almost inevitably the Soviet Union. Being neutral, Finland also aimed at a balance in its orders for nuclear power plants. With difficulties, such a balance between the East and West was achieved in the early 1970s, with Finland finally ordering two nuclear reactor units from the Soviet Union (which, however, were enhanced in Finland), and two from Sweden. The treaties and the IAEA’s supervisory role made it possible to achieve such a balance.⁶⁷

On the one hand, Finland, with its power plant procurement in progress, had at least a bit of lucky timing in the negotiations. On the other hand, the plans had been in the making for a long time, and the Finnish negotiators skillfully made use of the opened opportunity for the benefit of both national and international non-proliferation policy.

Alternative courses of action

Did Finland have any alternatives – and if it did, what? One can speculate and guess that if Finland had not joined the Non-Proliferation Treaty, the construction and commissioning of nuclear energy in the 1970s would have been practically impossible – at least based on independent decision-making.

A more passive role in the implementation of the Non-Proliferation Treaty would probably have slowed down the construction and commissioning of nuclear energy. However, the actual aim was economic and industrial growth, and there were plans to further increase the production of nuclear energy after the oil crisis and during the continued depression after the mid-1970s. For example, the “power economy agreement” between Finland and the Soviet Union agreed on the implementation of Loviisa plant units 3 and 4. That plan ultimately did not materialize. Wanting to produce nuclear energy economically, i.e. keeping open the options concerning the countries from which to buy technology, fuel and enrichment services, it was practically mandatory to join the Non-Proliferation Treaty and arrangements in the 1970s.

At the same time, experts were considering diverse implementation methods or solutions to a variety of questions. As alternatives to the IAEA as an international controller of nuclear commodities, Finns remember that there were considerations of Nordic co-operation and

66 Kilpi 2007; Jussi Manninen, e-mail correspondence 22 February 2020.

67 Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt 4. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993. The Archives of the Finnish Ministry for Foreign Affairs; Mäkipentti 2000; Särkikoski 2011, passim.

safeguards by Euratom in the late 1960s.⁶⁸ Supporting them as primary options may have delayed some other countries' solutions, which in part made Finland's trailblazer position as the IAEA's contractual partner possible.

Ilkka Pastinen, who had monitored non-proliferation negotiations already in Geneva, confirmed that the Finns took an active role in achieving and implementing the Treaty on the Non-Proliferation of Nuclear Weapons. Ambassador Pastinen had a long career with both the Finnish Ministry for Foreign Affairs and the UN. In an interview in 2002, he explained Finland's motives as follows: "This was not necessary due to disarmament-related security reasons, but its purpose was to emphasize Finland's neutrality. This also suited the Soviet Union. The Swedes criticized us for being the superpowers' errand boys, as did many others that objected to non-proliferation in one way or another."⁶⁹ Therefore, Finland was not exclusively praised for its actions.

Many factors compounded and encouraged Finland to be active in non-proliferation policy in the late 1960s. In terms of foreign policy, the motive underlying Finland's active role was a new kind of a neutrality policy. According to key parties, arms control supported neutrality



LEFT TO RIGHT: Paul Gustafsson, Juhani Santaholma and Jussi Manninen at the Olkiluoto nuclear power plant construction site in 1976. Photograph probably by Olavi Vapaavuori. Photo: Jussi Manninen's collection.

68 Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt 4. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993. The Archives of the Finnish Ministry for Foreign Affairs.

69 Aho 2004, 83. See also, inter alia, Pastinen 2007.

policy. The aim of activity was to point out even better Finland's capability of independent decision-making.⁷⁰ The motives of the builders of nuclear energy primarily had to do with energy policy: agreements were required to jointly lay out the economic and other rules for the nuclear industry. Atomic energy promised new growth power for industry and economy.

Ambassador Pasi Patokallio, who had a long career in arms control, emphasized in an interview that Finland hardly saw any detriments in the Non-Proliferation Treaty. The Treaty certainly was and is unequal, dividing the world into two classes, but it is easy to understand that for a small neighbouring country of a superpower and nuclear-weapon power, such as Finland, this imbalance was a mundane fact that one had to live with and try to make the most of. Compared to Sweden, for instance, the difference was considerable. Sweden had given up its own nuclear weapon programme. Sweden felt that it had grounds for criticizing the nuclear-weapon states and the Non-Proliferation Treaty negotiated on their terms.⁷¹

70 Pastinen 2007, 252–262; Soikkanen 2008, *passim*.

71 Pasi Patokallio, interview 17 March 2020. See, *inter alia*, Jakobson 1983, 141; Jonter 2016, *passim*.

6 1970s: era of building nuclear power

With the agreement issues resolved, it became apparent that the 1970s would be a hectic era of construction of nuclear energy production in Finland. At the IAEA General Conference in 1971, Finland's representative Erkki Laurila brought up as an achievement the fact that Finland had signed a safeguards agreement with the IAEA as the first country. In particular, Finland wished for key industrial countries to quickly ratify the Non-Proliferation Treaty they had signed. In his speech, Laurila emphasized that these agreements would make trading in the sector significantly easier.⁷²

After the entry into force of the Non-Proliferation Treaty, Finland had acted in several ways to implement its provisions in the early 1970s. In addition to work done for the safeguards agreement, Finland had been requested to take part in the Zangger Committee working on the exports control required by the NPT, and did so. In 1972, Finland proposed a nuclear-weapon-free zone in the Nordic countries in the UN and prepared new openers for the upcoming first NPT Review Conference together with other countries. The conference was also to review nuclear-weapon-free zones.⁷³ In all, Finland made use of the opportunities it got to reinforce its non-proliferation profile, which led to more and more new tasks to grasp.

At the same time, Finland began to strengthen its national expertise in disarmament with the establishment of the Advisory Board for Disarmament (ARNEK) in 1970. Its mandate covered all weapons, both conventional weapons and weapons of mass destruction; in addition to nuclear weapons, it also monitored and controlled chemical and biological warfare. Furthermore, the Scientific Advisory Board For Defence (Matine) had recently established a nuclear engineering section, taking a look at nuclear explosives and examining, inter alia, whether reactor plutonium produced in nuclear power plants was suitable for building nuclear weapons in the same way as military-grade plutonium (isotope 239). The answer was positive in principle, and the results were reported internationally.⁷⁴ Nuclear weapons control was developed as part of the more extensive national arms control expertise and knowledge base motivated by the neutrality policy, whereby Finland aimed to ensure its possibilities of influencing international control and disarmament of weapons of mass destruction.

There were plans to build a significant number of nuclear reactors in Finland in the early 1970s. For these at least six nuclear reactors, experts considered and investigated opportunities

72 "Suomi toivoo ydinsulkusopimuksen pikaista ratifiointia." ETELÄ-SUOMEN SANOMAT, 24 September 1971, no 258, p. 18, <https://digi.kansalliskirjasto.fi/sanomalehti/binding/1072254?page=18>

73 See Pastinen 1975.

74 Ahosniemi 2004, 88, 93–94.

for domestic production of nuclear fuel. Prospecting for uranium was intensified, and a new uranium enrichment method was researched in Finland. When it turned out that considerably fewer nuclear power plants would be built than originally envisioned, it also turned out that domestic fuel production would not be economically feasible. The enrichment of uranium into nuclear fuel would have been a particularly difficult issue in terms of the non-proliferation policy, because nuclear powers closely watched over the capacity for isotope enrichment.⁷⁵

The construction of a total of four nuclear reactors began in Finland during the 1970s. As an essential part of the future nuclear energy production system, work began in Finland in the 1960s to develop an authority responsible for the security of nuclear facilities and safeguards. The task was assigned to the Radiation Safety Institute, originally established in 1958. In 1984, the name was changed to the Radiation and Nuclear Safety Authority (STUK).⁷⁶ The four Finnish nuclear reactors that are still operational in 2020 were commissioned in 1977–1982, and they accounted for a significant share of the country's energy production.

The Stockholm International Peace Research Institute (SIPRI) was active in organizing events to discuss the Treaty on the Non-Proliferation of Nuclear Weapons in the early 1970s. A lot of room for improvement and further specification was seen in it, or particularly in the implementation of the Treaty. At the same time, the debate prepared for the first Review Conference in 1975. Jorma K. Miettinen, a professor of radiochemistry and expert speaker and author on several themes, particularly the new miniature nuclear weapons of the superpowers, was invited to attend. To his mind, their development was completely against the objectives of the Non-Proliferation Treaty. Increasingly small nuclear bombs with more limited areas of impact significantly raised the risk of such nuclear weapons actually being used in warfare.⁷⁷ However, the broader problem was the entire UN's inadequate power, and Miettinen was not too optimistic about the Non-Proliferation Treaty remaining in force in general.

Jorma K. Miettinen was extensively learned in the control of weapons of mass destruction; he took part in national advisory boards as well as scientists' Pugwash movement, and went particularly deep in questions of chemical warfare.⁷⁸ At the same time, he was, even internationally speaking, one of the most active Finnish researchers in nuclear weapons and non-proliferation starting from the 1970s. Professor Miettinen's statements are an important reminder of what the estimates of the implementation of the Non-Proliferation Treaty were as 1975 was nearing, i.e. when preparing for the first NPT Review Conference. The extension of the Treaty was far from certain – according to some, it was at stake. Many countries were simply monitoring the situation and did not hurry over committing to the Treaty.

Similarly to what happened when the Non-Proliferation Treaty was approved, Ireland and Finland were both given a considerable role in the 1975 NPT Review Conference. The extension of the Treaty demanded diplomatic efforts, because many nuclear-weapon-free states presented strong criticism of its implementation. The conference played an integral role in the

75 Jussi Manninen, e-mail correspondence 10 June and 11 June 2020. At some point, the production of heavy water was also examined together with Iceland. *Ibid.* See also Ahosniemi 2004, 42–43.

76 The original name of STUK's predecessor was the Department of Radiation Physics. See Hoffman 2008.

77 Miettinen 1974.

78 Ahosniemi 2004, *passim*; Olli Heinonen, interview 12 June 2020.

establishment of the NPT, so small countries that were tightly committed to the Treaty and had worked for it were in a decisive role.⁷⁹

Ilkka Pastinen, a Finn and Deputy Secretary General of the United Nations in charge of arms control, was appointed as the Secretary General of the 1975 NPT Review Conference.⁸⁰ Pastinen played a crucial role in the success of the conference.⁸¹ His actions helped raise Finland's profile further through international arms control.

Exports control of nuclear commodities and equipment and its enhancement were among the important questions of the first NPT Review Conference in 1975. Finland had been active in the Zangger Committee, whose first Trigger List the IAEA published in 1974, and promoted exports control at the conference. Hectic discussion and measures continued after the Review Conference.

As a new element, the Finnish government, with some other countries, advocated an initiative according to which attention was to be paid correspondingly to imports of nuclear commodities and products. Finland proposed that the parties would similarly commit to not importing nuclear commodities and equipment from countries which are not party to the Non-Proliferation Treaty or which do not approve safeguards covering the entire fuel cycle. Finland submitted a memorandum on the matter to the IAEA.⁸² Finland continued to keep imports control on the agenda in the 1970s and even later.

This active role of Finland in establishing the Non-Proliferation Treaty in 1975 has been almost completely overshadowed by the Conference on Security and Cooperation in Europe (CSCE) held in Helsinki, but they both were factually important milestones and results of détente, allowing Finland to show the best achievements of its neutrality to the world.

Options for the procurement of nuclear fuel

Enthusiasm over atomic energy had resulted in uranium exploration in Finland since the mid-1950s. A few pilot mines were launched due to ore findings, but they turned out to be unprofitable. Still in the early 1970s, Finland was seriously investigating the possibilities of producing nuclear fuel domestically. They included an experiment with a uranium enrichment method (osmosis method), which was kept secret. The primary objective was to increase the local content of the fuel. Finally, a combination of several reasons ranging from economic to technical and political led to the Finns discontinuing the development of a domestic option in the mid-1970s.⁸³ The choice was, without a doubt, influenced by the fact that the Non-Proliferation Treaty with its stabilizing arrangements guaranteed that nuclear fuel could be bought economically from abroad.

The enrichment of uranium into fuel was identified as a service critical to the nuclear power companies already in the late 1960s agreement negotiations.⁸⁴ However, it was not

79 O'Driscoll & Walsh 2014.

80 Pastinen 1975; 1977.

81 Pasi Patokallio, interview 17 March 2020.

82 Pastinen 1977, 59, 66; Soikkanen 2008, 366.

83 Ahosniemi 2004, 41–44.

84 Mäkipentti 1967.

until the 1970s progressed that the entire quagmire of the procurement processes became clear as Teollisuuden Voima (TVO) was preparing for commissioning its nuclear power plant. Eero Patrakka started his career in nuclear energy as a fuel engineer at TVO in 1974. Patrakka reported an example of the complicated nature of international fuel procurement and the sensitivity of safeguards-related matters at the same time. TVO procured natural uranium from Canada for its nuclear reactors. Next, the uranium had to be isotope enriched. “Originally, TVO aimed to purchase the enrichment work from the US, but they closed their order books due to strong demand. TVO was in trouble, but our eastern trade experts (Björn Westerlund) succeeded in agreeing on the procurement from the Soviet Union.”⁸⁵ Purchasing the enrichment service from the Soviet Union and, in general, transporting uranium there, gave rise to suspicions, as it was not permitted to supply Canadian uranium for use by the Soviet Union.

For the safeguards of those nuclear materials, Finland created the fictional Material Balance Area SF-T, that at least looked Finnish and in which international transporters of uranium were closely monitored. The Material Balance Area was, and still is, the base unit of safeguards, and the Radiation and Nuclear Safety Authority (STUK) and the IAEA supervised it in this case as well. Once the natural uranium had been enriched in the Soviet Union, “two components came back: enriched and depleted uranium, still via SF-T. The former went to Sweden for fuel production and the latter was returned to Canada, due to political reasons, even though there was no use for it.”⁸⁶ In the Cold War world, the procedure was exceptional and caused concerns among the Canadians. Finally, the ready-to-use nuclear fuel was shipped from Sweden to TVO’s Olkiluoto nuclear power plant. The agreement system described above secured this relatively complicated cross-border enrichment route of nuclear fuel towards a nuclear reactor on the coast of Finland.

The Nordic countries as a non-nuclear-weapon zone

President Urho Kekkonen presented the idea of a Nordic nuclear-weapon-free zone at a Paasikivi Society meeting in 1963. Internationally, it was far from a unique proposal, but the interest of the President who had become a superior political vanguard made the topic particularly noteworthy in Finland.⁸⁷

Scholar Tapio Juntunen interprets the development of the initiative as four overlapping waves: Kekkonen’s speech, the resulting “shaping of practice in the 1960s, its development and transformation phase in the 1970s and becoming an institution during the 1980s.”⁸⁸

85 Eero Patrakka, e-mail correspondence 26 April and 27 April 2020.

86 Eero Patrakka, e-mail correspondence 26 April and 27 April 2020. See also Mäkipentti 1984. Finland had signed bilateral agreements with Canada and Australia to facilitate raw uranium procurement in the 1970s. See, inter alia, Mäkipentti 1985.

87 See van Dassen 1999; Soikkanen 2003, 175, 252.

88 Juntunen 2016, 40.

The discussion about the initiative came to a halt with the end of the conflict between the superpowers amidst the changes of 1989–1991.

In the history of the Finnish Ministry for Foreign Affairs, Timo Soikkanen explains the background for the work of the Ministry's civil servants to revive the Nordic nuclear-weapon-free zone initiative starting from the early 1970s. To their minds, the initiative should strengthen Finland's neutrality policy.⁸⁹ In the early and mid-1970s, Finland proposed several initiatives in the UN, outlining nuclear-weapon-free zones as an important solution model for nuclear disarmament. The civil servants in charge of arms control managed both these initiatives, and Finland's nuclear non-proliferation policy that was included in the same package. A nuclear-weapon-free zone in the Nordic countries did not materialize, but it is possible that Finland's actions in the UN have somewhat contributed to nuclear-weapon-free zones becoming a reality on many continents.⁹⁰

Launch of research into nuclear waste

As reported above, the construction of a total of four nuclear reactors commenced in Finland by the mid-1970s. The state-owned power company Imatran Voima ordered key components for the two reactor units of the Loviisa nuclear power plant from the Soviet Union, while the manufacturing industry's joint venture Teollisuuden Voima (TVO) ordered the other two nuclear reactors for Olkiluoto from Sweden. The construction projects were not only complicated, but also quite international; however, the looming era of nuclear energy also needed new solutions from national points of view. In the late 1970s, work began in Finland to outline a reform of the Nuclear Energy Act, strengthen the supervision of the safety of nuclear energy and nuclear commodities and investigate the future of nuclear waste management. In all of these tasks, the Non-Proliferation Treaty functioned as an essential foundation.

Nuclear waste became a topic for international discussion in the 1970s, and through publicity, it also gave rise to fears. On the other hand, optimism was also abundant, with the new chairman of the atomic energy advisory board estimating in 1976, when the first Finnish nuclear power plants were still under construction, that stored spent nuclear fuel would be a future energy source once the technology evolves. At the same time, however, he reminded all that the secure storage of spent nuclear fuel was also important to prevent the spread of nuclear weapons.⁹¹

During the same year, 1976, the Finnish Ministry of Trade and Industry established a working group named APO ("Aktiivinen ydinpolttoaine ja jäte"; "Active nuclear fuel and waste") to investigate nuclear waste management, strongly influenced by Sweden. The APO working group, led by VTT Technical Research Centre of Finland's Director President and former

89 Soikkanen 2008, 368–371.

90 See Korhonen 1989; Juntunen 2016. With regard to nuclear-weapon-free zones, see, inter alia, Fanielle 2016; Cronberg 2010.

91 Martti O. Hosia: Ydinjäte kelpaa pian energiaksi. HELSINGIN SANOMAT 3 August 1976, 16.

professor in nuclear energy engineering Pekka Jauho, included an extensive range of nuclear energy experts from scholars to the permit authority and power companies, supervisory authority and diplomatic service. The last was represented by Ilkka Pastinen. His involvement indicates that the fate of spent nuclear fuel was linked to non-proliferation issues. The report of the APO working group was completed in 1978, and the Finnish Government issued its policy on the organization of nuclear waste management in Finland on the basis of it.⁹² There was not much waste in Finland at the time, but at the end of the decade, the state obligated power companies to research the topic and outline solutions.⁹³ Since then, Finns have been involved in developing solutions for nuclear waste.

Spent nuclear fuel was discussed internationally because commercial and international reprocessing of spent nuclear fuel, which was talked about and anticipated a great deal at the time, was to take place in compliance with the requirements of non-proliferation. There was a perceived risk that nuclear fuel would end up in the wrong hands and purposes, such as those pursuing a nuclear bomb. Finland's primary hope was to be able to ship all spent nuclear fuel abroad for reprocessing and be done with it.⁹⁴

Particularly demanding arrangements were also investigated internationally. Paul Gustafsson, a Finn with a good reputation at the IAEA, was requested to assist the IAEA's senior management in 1976. He led a Vienna-based committee on regional nuclear fuel recycling centres.⁹⁵ There were a lot of talk about the centres in subsequent years, but the reports produced mainly led to continuing the research. At the same time, it turned out that the commercial significance of spent nuclear fuel was far more modest than had been estimated.

The International Nuclear Fuel Cycle Evaluation, INFCE, was set up on an initiative of the USA in 1977. The evaluation work ended with the IAEA conference in 1980. According to a Finnish reporter, the outcome was an estimated total of 20,000 pages of diverse materials, and the results could be examined from several different points of view.⁹⁶ At the core was investigating the risk of the spread of nuclear weapons in diverse fuel cycle solutions, especially from the point of view of the potentially increasing international use of plutonium.

The full scope of research was divided between working groups. Finland, the Netherlands and Sweden co-chaired working group 7: Waste management and disposal. This way, Finland got to exert influence on something that was very topical to it in the nuclear waste management working group.⁹⁷

The INFCE evaluation provided options for the management of Finland's nuclear waste, and they were investigated in earnest. The proposal for multinational or international nuclear waste facilities for the processing of spent fuel and its final disposal was estimated to be the most important and promising from Finland's point of view.⁹⁸

92 Raitttila, Hokkanen, Kojo & Litmanen 2002; Poutanen 2014, 38–39.

93 Jauho 1998, 190–192. See, inter alia, ATS YDINTEKNIikka 1/1980.

94 Nikula et al. 2012, esp. 58; Markku Anttila, e-mail 24 February 2020.

95 Gustafsson 1999, 291.

96 Silvennoinen 1980.

97 Silvennoinen 1980.

98 Vuori 1980, 48.

A somewhat similar, albeit relatively closed model was operated by the Soviet Union when it received spent nuclear fuel from its East European Cold War allies. With regard to the two Soviet-made nuclear reactors in Loviisa, Finland got to benefit from the same scheme. Early on, it was agreed that nuclear fuel spent in the Loviisa plant was to be returned to the Soviet Union, so in this respect, Finland was to use a supranational solution in its nuclear waste management all the way until 1996. The system can be considered to also have been part of the Soviet Union's non-proliferation policy. Erkki Laurila brainstormed the same Finnish "Loviisa model" to be recommended more extensively in the 1970s: let the nuclear-weapon powers take care of the waste from the world's nuclear power plants at the same time as they are managing the much more significant detriments of their nuclear weapons development.⁹⁹

However, no such outsourcing of spent nuclear fuel was linked to the two Teollisuuden Voima units constructed in Finland. They were to be the Finns' responsibility. After presenting the waste management options reviewed by the INFCE, VTT's Seppo Vuori, however, left a responsible reservation: "In spite of everything, Finland still has to prepare for the possibility of having to take care of the final disposal of the waste in the bedrock."¹⁰⁰ Efforts were also made in the review of this option to take the risk of the proliferation of nuclear weapons into account. Even though the topic was strange and unknown to the IAEA as well, it was estimated that filling the disposal facility tunnels would make it quite difficult to recommission the buried fuel. Attempts to excavate it would not go unnoticed, the report assumed.¹⁰¹

Finland long considered other alternatives primary, such as transporting spent nuclear fuel abroad for further processing.¹⁰² At the same time, however, preparations were made by commencing research aiming to adopt a back-up plan in the future and implement the option that was technically more difficult in many ways: the final disposal of high-activity nuclear fuel in the Finnish bedrock. The Government's in-principle decision of 1983 laid down the guidelines on the planning and objectives of nuclear waste management until 2000 and also required preparing for final disposal in Finland.¹⁰³

While nuclear power plant projects have encountered many obstacles or impediments in Finland since the 1980s, the work for the final disposal of spent nuclear fuel has progressed on schedule from one decade to another. It has also been called the Finnish "nuclear waste miracle":¹⁰⁴ In many other countries, especially the United States and Sweden, from which the Finns have learned their lessons, final disposal projects have ended up in diverse difficulties. Thus, the Finns have ended up implementing solutions as the first in the world in this field without particularly aiming for it.

99 Laurila 1977; Nikula et al. 2012.

100 Vuori 1980, 48.

101 Vuori 1980, 47.

102 Juhani Santaholma, interview 9 April 2020.

103 Hoffman 2008, 159–160; Nikula et al. 2012, *passim*.

104 See Raittila et. al 2002; Kojo 2014.

7 1980s: a decade of challenges

Following the aggravation of the Cold War, the atmosphere at the 1980 NPT Review Conference was tenser than before. The Three Mile Island accident was still in recent memory, and the nuclear industry suffered from a depression. The perceived slowness of nuclear disarmament became a key question and object of criticism by developing countries in the conference. According to Finnish reports, if nuclear disarmament cannot progress and instead the vertical proliferation of nuclear weapons continues, i.e. the number of weapons increases in countries with nuclear weapons, this would also lead to horizontal proliferation, or forcing threshold states or some non-nuclear-weapon states to develop their nuclear weapon capability.¹⁰⁵

Tightened exports control also caused dissent. The countries that exported nuclear commodities and technology had established the Nuclear Suppliers Group (NSG), also known as the London Club, in 1974. According to critics, trade in nuclear technology was not to be restricted more than required by the Non-Proliferation Treaty. The restrictions were considered to mainly serve industrial countries' supremacy endeavours. These disputes concerning Article IV of the Non-Proliferation Treaty, promoting the peaceful use of nuclear energy, contributed to the conference not being able to achieve a joint final document. Nuclear technology was thereby incorporated into the more general confrontation between the North and South. In practice, the restrictions intentionally targeted the threshold states.¹⁰⁶ Finland was approved as a member of the NSG in early 1980.

The increasing tension between the superpowers had diverse impacts. In 1981, the Ministry for Foreign Affairs began to fund the STYX project aimed at monitoring the development of nuclear weapons and supporting Finland's security and arms control policy. VTT's then-President Pekka Jauho had, already in the early 1970s, established a nuclear technology section in the Scientific Advisory Board For Defence with similar rationale, arising from the obligations of the Agreement of Friendship, Cooperation, and Mutual Assistance between Finland and the Soviet Union.¹⁰⁷ Professor Pekka Jauho recalled: "I feared that if the situation gets tenser and consultation is required, the first consultation group would then certainly include nuclear weapon experts which we would not have had ourselves."¹⁰⁸ The scholars and experts of the STYX project, such as Markku Anttila and Stefan Forss, gave lectures at meetings and seminars to civil servants of the Ministry for Foreign Affairs, among others, and

105 Antola 1980; Lempiäinen 1986, 39, 47.

106 Lempiäinen 1986, 32–33.

107 The agreement included defence against external threats in co-operation. The intent was to prepare for defence through military consultation between the states.

108 Kosonen 1997.

wrote about their research efforts. They were also involved when Finland considered needs for amendments to the IAEA safeguards in the 1990s. The STYX project continued until the early 2000s.¹⁰⁹

Once the fourth nuclear power plant unit was complete, nuclear energy accounted for slightly over 40 per cent of Finland's electricity production in 1983. At the turn of the 1970s/1980s, experts per se assumed that nuclear reactors "V and VI" will be built in the future, at least by 2000.¹¹⁰ These predictions did not materialize, with Finland's fifth nuclear reactor still under construction in spring 2020.¹¹¹ Instead, the final disposal facility for spent nuclear fuel has progressed according to plans prepared during the project. In the 1980s, it was the nuclear waste question that was estimated to become the most socially problematic nuclear power-related matter.¹¹²

In a 1983 interview, Erkki Laurila was critical towards too many nuclear reactors being built in Finland within too short a time. For example, them becoming obsolete, i.e. reaching the end of their service lives, at almost the same time could turn out to be a problem. The situation foreseen by Laurila has resolved almost as if by itself, because the construction of additional nuclear power capacity in Finland has taken – and will take – considerably longer than experts had estimated in spring 1986, just before the Chernobyl disaster. On the other hand, the nuclear reactor units altered by Laurila's students and modernized over the years, have turned out to be longer-lasting than initially estimated.¹¹³

White Angels strengthen nuclear non-proliferation

International non-proliferation policy naturally could not be controlled by a single country, such as Finland. Finland was involved from day one at the 1980 Review Conference in Geneva when the first eight countries decided to join their forces and form a group that would later be called the Vienna Group of Ten. The group has later also been called White Angels and G 11.¹¹⁴

The group was intended to increase the opportunities of small and medium-sized countries to influence the development work on non-proliferation. It is the oldest substance-based alliance at NPT conferences. It was agreed as the purpose of the group to support the nuclear non-proliferation regime with the practical recommendations and co-operation of that system's sponsors of good repute.¹¹⁵

The Group of Ten is thereby comprised of steadfast supporters of the Treaty on the Non-Proliferation of Nuclear Weapons. In addition to Finland, it includes Sweden, Norway,

109 Markku Anttila, e-mail 17 February 2020 and 24 February 2020. See Saarikoski 2019.

110 Paaermaa, Risto: Memorandum (of negotiations). Atomienergiolainsäädännön uudistaminen. Ministry of Trade and Industry 8 October 1976; Laurila's memorandum 1977. Santaholma's archives; Mäkipentti 1984.

111 The decision-in-principle on the sixth and seventh nuclear reactors was made in 2010.

112 Laurila's memorandum 1977, 10. Santaholma's archives; Mäkipentti 1984.

113 Erkki Laurila's interview 1983. The Archives of President Urho Kekkonen; Michelsen & Särkiköski 2005, passim.

114 Aler 1997, 154; Becker 2003, 11–12; Kari Kahiluoto, e-mail correspondence 18 March 2020.

115 Becker 2003, 14; Mukhatzhanova & Potter 2015.

Denmark, Austria, Ireland, the Netherlands, Hungary, Canada, Australia and New Zealand. Hungary took part in the group's work at the 1990 conference.¹¹⁶ These Western developed countries promote, for example, effective safeguards of nuclear commodities and exports control, while some of the Group's members, such as Canada, Sweden, Finland, the Netherlands and Hungary, are significant operators of nuclear energy.

"White Angels" might sound like a mocking name for Western, well-intentioned "small players" from across the world, but according to the Ministry for Foreign Affairs' Pekka Ojanen, the members of the group use it as their pet name themselves. Ojanen worked in several positions for a long time with the Ministry for Foreign Affairs and attended the NPT Review Conferences in 1980 and 1985.¹¹⁷ The name "White Angels" probably expresses a kind of an insider non-proliferation joke that is harder for outsiders to comprehend.

The group has operated both successfully and for a long time, and it is still operational. At the 2017 Preparatory Committee, its chair mentioned that in keeping with a practice dating back 37 years, the Vienna Group of Ten had again convened ahead of the PrepCom to give consideration to opportunities for further advancement of the NPT's "Vienna issues". The group considers these issues to include the peaceful uses of nuclear energy, nuclear safety, security and safeguards and export control.¹¹⁸

The Non-Proliferation Treaty appeared in public in connection with the Review Conferences in particular in the 1980s. In a high-profile summer 1985 *Helsingin Sanomat* interview, Klaus Törnudd, Political Under-Secretary of State at the Finnish Ministry for Foreign Affairs and the vice-chair of the Finnish delegation to the NPT Review Conference, emphasized that the most important objective from Finland's point of view had been reached when the proliferation of nuclear weapons had been brought under control. A contrary critical view was expressed by researcher Anne Eskelinen. She emphasized the shortcomings of the implementation of the treaty, i.e. nuclear disarmament, and alleged that Finland was still too much living in the spirits of the 1960s and 1970s, the détente era when its own interests were emphasized. Eskelinen did not expect much from the upcoming conference, but suggested that Finland should listen to the countries criticizing the Treaty for a change.¹¹⁹ Her statement reminds us that also standpoints criticizing Finland's policy that emphasized the gradual nature of nuclear disarmament were brought up in the nuclear non-proliferation debate already in the Cold War era.

116 Müller 1995, 156. See also Aler 1997.

117 Pekka Ojanen, interview 2 April 2020.

118 Vienna Group of Ten. May 2017 NPT Preparatory Committee: General Debate Statement. Ambassador Dr Brendon Hammer, Permanent Representative of Australia, 4 May 2017. <https://austria.embassy.gov.au/vien/NPT2017VieGroup10Stmnt.html> (retrieved 12 March 2020)

119 Haavisto, Päivi: Ydinsulkusopimus tarkistettavaksi. HELSINGIN SANOMAT 27 August 1985, 21.

Opposition to nuclear power and the peace movement

Organized criticism of, and objection to, nuclear energy emerged in Finland as well in the late 1970s, at the same time when the nuclear power plants built in the country and associated risks became more clearly concrete to people. With the Cold War intensifying again after the détente period in the early 1980s, the fear of a nuclear war returned and increased. The “Euromissile Crisis” between the Soviet Union and NATO again intensified the anti-nuclear-weapon civic activity that had begun in the 1960s, and in the early 1980s it expanded with and as part of the international END movement and other activism. The imperative-form name END stood for European Nuclear Disarmament.¹²⁰

The international peace movement encouraged people threatened by nuclear war to take action on both sides of the Iron Curtain in the 1980s. Finns came up with the idea of organizing an artists’ peace train that quickly turned from a meagre beginning to a national phenomenon and media event. Artists performed for citizens united by the threat of a nuclear war across the country on the peace train in April 1982 – including in cities and towns without rail connections. The slogan for the peace train was non-nuclear-weapon Nordics – the initiative popularized by President Kekkonen. The message of peace was ushered by a large number of well-known artists from diverse fields; actors and actresses, singers, musicians and authors.¹²¹ In addition, the Nordic peace movement marched under the emblems of non-nuclear-weapon Nordics in the early 1980s.

Nordic nuclear-weapon-free zone, a phrase originally coined by President Kekkonen, had become a multi-purpose and internationally disseminated political discussion initiative maintained by the Finns. Interpretations made in recent years have emphasized the fact that in terms of foreign policy, the most important thing about the initiative from the Finns’ point of view was movement; demonstrating initiative and activity, even guiding the discussion, not the goal per se.¹²²

Objection to nuclear weapons and criticism of nuclear energy were naturally two different things, but on the other hand, they did have points of contact and partially the same people in the background. In any case, a generation or generations of civil activists grew up in the

DEMONSTRATION MARCHES

in Tampere in 1980 supported both non-nuclear-weapon Nordics and friendship between Finland and the Soviet Union. Photo: Hämeen yhteistyön kokoelma, Kansan arkisto.

THE FINNISH PEACE COMMITTEE’S

peace march proceeds, apparently in Lappeenranta, in July–August 1982. The slogan at the front is a plea for a Nordic nuclear-weapon-free zone. Photo: Kansan arkisto.

120 Aalto 2018. See also Rislakki 2010.

121 Rinne 2019, 163–168.

122 See, inter alia, Juntunen 2016; Patokallio 2020. See and cf. Pastinen 2007, passim.



middle of parallel objection to nuclear weapons and criticism of nuclear power, and they have subsequently influenced the country's nuclear energy choices through party politics, especially in the green movement, and still work in NGOs, for example.

For the Finnish peace movement, commitment to the Treaty on the Non-Proliferation of Nuclear Weapons has been a given, but many have wished for Finland to take even stronger initiative and further actions to ensure a world free from nuclear weapons.¹²³ Disagreements concerning nuclear disarmament have been visible particularly in the late 2010s in the discussion on Finland's attitude towards a complete ban on nuclear weapons.

Nuclear Energy Act, a product of its time

The atomic energy advisory board set out to review the needs for reforming the Finnish nuclear energy legislation in spring 1976. Erkki Laurila, “the grand old man of the use of nuclear energy for peaceful purposes in Finland”, took on the task of preparing the background work for a comprehensive reform of the legislation. A small group of representatives of different parties from nuclear power producers to supervisors took part in the preparation, but it was Laurila who wrote the actual memorandum that would become the foundation for follow-up work. The memorandum illustrates the view of the leading industry experts on current and future challenges.¹²⁴

In his memorandum in 1977, Laurila started from the purpose of the previous Atomic Energy Act (1957) to think about the need for a legislative reform and how subsequent treaties, such as the Non-Proliferation Treaty, and experiences gained, should be considered in the preparation and formatting of the new Act. He considered two things to be essential goals for nuclear power plant licences: the nuclear power plant was to be required by “the common good” and the nuclear power plant “had to be safe”. He also specifically brought up nuclear waste (which had not been given sufficient attention earlier) and managing it in the long term, which, however, had to be prepared for from the very start of operation. A model taken from the insurance business could be used for the arrangement.¹²⁵ These and other foreseen future issues were not to be forgotten in preparing the legislation.¹²⁶

In his rationale, Laurila considered all parties' joint political will as well as foresaw potential strong opposition to nuclear power in the future. It would help politicians to respond to criticism, for instance, that there was special legislation applicable to the nuclear industry and also reviewed by a neutral expert body, such as the atomic energy advisory board.¹²⁷

Laurila worked on the legislation for almost a year and submitted a memorandum on reforming the legislation on the nuclear energy industry to the advisory board in January

123 See, inter alia, Kytömäki 2014; Taipale 2018.

124 Santaholma 1985; Jussi Manninen, e-mail correspondence 3 May 2020.

125 In his memoirs, Pekka Jauho reported that he invented this or another similar solution with the help of his experience in the insurance industry. Jauho 1998, 192. See also Nikula et al. 2012, passim.

126 Laurila's memorandum 1977. Santaholma's archives

127 Laurila's memorandum 1977. Santaholma's archives.

1977. The memorandum included a draft for the new Act, and according to IVO's counsel Juhani Santaholma, who closely followed up the affair, the underlying thoughts of Laurila's memorandum prevailed throughout the preparation work that took almost the next ten years.¹²⁸

When Ilkka Mäkipentti was presenting a proposal for the Nuclear Energy Act in 1985, he said that the Non-Proliferation Treaty had been an important reason for it. According to Mäkipentti, the NPT quite quickly changed into an international framework agreement on nuclear safety and international trade, joined by more than 120 states. Several amendments had already been made on account of the Treaty to the previous Atomic Energy Act, which was now being replaced with the new Act.¹²⁹

Alongside technological changes, the political development had to be considered in the Act, according to Mäkipentti: the "atomic policy climate change" was a fact in Finland as well. According to many, increasing well-being required additional construction of nuclear power, but there were simultaneously fears in society of a "narrow group of experts" deciding on the matter and the majority becoming very dependent on it. Is that power surely in reliable hands, people asked. Mäkipentti estimated that to the audience he was speaking to, this fear might have felt quite strange, but in any case: "The planned solution to this problem is increasing democracy in nuclear energy decisions."¹³⁰

The change took place in the new Act in the upper-level permit solution on the one hand and at the grassroots level on the other. The nuclear energy question "should be considered by incorporating all of the factors that people want to connect to it or that influence the matter in some way."¹³¹ The concept of "overall good of society" in the new Nuclear Energy Act made such extensive political consideration possible with regard to additional needs for nuclear energy.

Already Laurila had proposed political consideration in his 1977 memorandum. The committee preparing the Nuclear Energy Act had to acknowledge that the concept of "public interest" in the Finnish Atomic Energy Act of 1957 had been guided to binding legal consideration by a decision of the Supreme Administrative Court, so it would not result in political consideration. Therefore, the committee developed the new concept of "overall good of society" to ensure the application of political consideration. This consideration of the "overall good of society" is a kind of a political green light in the licencing system of the Nuclear Energy Act when progressing in a plant project towards implementation decisions and actual nuclear facility licences. The overall good of society is considered specifically in a Government decision-in-principle required by the Act, which, once favourable, must additionally be forwarded to the Parliament for perusal. The actual nuclear facility licences are 1) construction licence, 2) operating licence and 3) decommissioning licence. The last one was not prescribed until 2017. The Government also grants these actual facility licences, applying political expediency consideration. The requirement for the overall good of society must

128 Santaholma 1985.

129 Mäkipentti 1985, 3–4.

130 Mäkipentti 1985, 6.

131 Mäkipentti 1985, 6.

also be met with regard to these permits, in the same way as for the use of nuclear energy in general.¹³²

The Nuclear Energy Act appointed the Radiation and Nuclear Safety Authority as responsible for preparing proposals for general regulations concerning the safety of the use of nuclear energy, security arrangements and emergency response arrangements, which were to be issued by the Government.¹³³ Moreover, STUK was tasked with ensuring “that the control necessary to prevent the proliferation of nuclear weapons has been arranged appropriately”.¹³⁴

A question that turned out to be awkward had been brought up in Finnish public debate in the early 1980s: was it legal or illegal to import a nuclear weapon to Finland? Concerns of this had arisen already long before, especially in conjunction with naval visits by nuclear-weapon states.¹³⁵ In a speech in the UN in 1983, President Mauno Koivisto had emphasized that Finland would not accept nuclear weapons on its territory. Yet, according to scholars of law, importing a nuclear weapon was not prohibited by law. The interpretation caused a scandal in the press. At the initiative of the Ministry for Foreign Affairs, an unequivocal prohibition was devised in the general principles section of the Act: “Import of nuclear explosives as well as their manufacture, possession and detonation in Finland are prohibited.”¹³⁶

132 Juhani Santaholma, e-mail correspondence 20 April and 1 July 2020.

With regard to the concepts and rationale of the Act, see Hallituksen esitys 16, valtiopäivät 1985.

133 Hoffman 2008, 133.

134 Nuclear Energy Act 11.12.1987/990 (original) section 55.

135 See Jauho 1998.

136 Nuclear Energy Act 11.12.1987/990, Chapter 2, section 4; Rislakki 2010, 454–457. See Hallituksen esitys 16, vp. 1985.

8 Non-proliferation and the turmoil of the 1990s

The 1990s brought along a new world in several ways. The old Cold War order gave way when the Soviet Union, the other key negotiating party to the Treaty on the Non-Proliferation of Nuclear Weapons, was dissolved in 1991. The system based on the Non-Proliferation Treaty became even more important to Finland, if that was possible. It was unforeseen that Finland expanded its activity to promote the implementation of the Treaty to outside its borders, to the former Soviet Union.

At the same time, the Gulf War in 1991 led to significant changes in the IAEA's safeguards with the revelation of Iraq's secret nuclear weapons programme. Finland strengthened its technical support for international safeguard activity: Finland's support programme for the IAEA's safeguards, which had commenced in the 1980s and is described more below, was made official in 1988. Amidst the challenges of the 1990s, Finland significantly increased this support and its targets.

In the new international situation, Finland submitted a membership application to the European Union in March 1992 and changed its course more freely towards Western co-operation. In the middle of international turmoil, Finland clung to nuclear power in energy production. This was done in spite of well-known disasters and resulting objection to nuclear power. In the economic depression of the early 1990s, the Government was in favour of constructing a fifth nuclear reactor in Finland, but the Parliament voted otherwise and rejected the proposal in 1993. Nevertheless, Finland remained committed to the use of nuclear energy, and the Non-Proliferation Treaty remained a basic prerequisite for this energy policy.

Around Finland, the most concrete changes took place in the Soviet Union, and the fate of its nuclear weapon legacy concerned the whole world. Jorma K. Miettinen illustrated how the Soviet Union's tactical nuclear weapons could end up in the wrong hands. He said that the former nuclear weapon power was reported to have had approximately 15,000 tactical nuclear weapons, they were "relatively small in size and easily mobile (a 152-mm artillery shell weighs 42 kg and fits in cabin baggage), and because they apparently have less effective safeties than strategic nuclear weapons, the risk of hijacking is the highest in relation to them."¹³⁷

Direct involvement in running down the Soviet Union's nuclear weapon industry was something new to Finland in the early 1990s. Finland took part in dismantling it by, inter alia, funding the Moscow-based International Science and Technology Center that supports the conversion of nuclear weapon industry and provides opportunities for nuclear weapon

137 Miettinen 1993, 100. Tactical nuclear weapons refers to smaller nuclear explosives used on the battlefield, in contrast with large nuclear weapons intended for destroying strategic targets.

experts so that these tens of thousands of highly educated people would not transfer to the service of countries pursuing nuclear weapons. With the EU membership, Finland's national support turned into part of EU funding for this centre.¹³⁸ The centre was established in 1992, and the grant given to it thereby meant for Finland a new kind of an activity for the benefit of non-proliferation.

The Radiation and Nuclear Safety Authority began to publish the *Alara* journal in 1992. In the early 1990s issues of the journal, STUK experts regularly reported on the nuclear power plants of Eastern Europe and the former Soviet Union and the work continuously performed to make them safer. The journal also disseminated awareness of non-proliferation. The topics discussed in 1992 included Iraq's nuclear weapon project, that had raised extensive public interest, and about which nuclear commodities safeguards expert Tero Varjoranta offered detailed information while reporting on the IAEA's robust post-war measures to destroy the nuclear weapon project as completely as possible. In spring 1995, *Alara* published a non-proliferation issue.¹³⁹

At the same time, Finland was centrally involved in other major changes. Its experts convened in seminars to discuss topical themes, such as the development of the IAEA's safeguards, which had turned out to have loopholes, and Finland's objectives during its term on the IAEA Board of Governors. Revealingly, a national seminar in 1993 combined the challenges of the time: the next NPT Review Conference of 1995 and a review of the history of the 1960s and 1970s, considered glorious decades of Finland's influence on the Non-Proliferation Treaty, such as the Finns' role in drafting the IAEA safeguards agreement. Apparently, that golden era of Finland's neutrality and impact and the 1990s shared an important feature: the convener and key note speaker of the seminar deduced that in the right circumstances, small countries can become actors, subjects, in international politics.¹⁴⁰

The national meetings simultaneously functioned as preparations for the 1995 NPT Review Conference that was considered to be crucial to the future of the Non-Proliferation Treaty. The conference was tasked with deciding on whether the Treaty would be made perpetual or something else. The seminar in late 1993 recorded an estimate: "Currently, it unfortunately seems that a follow-up decision on an indefinite time will not be made in 1995."¹⁴¹ Once again, the extension of the Treaty was not a given but felt to be contested.

At the 1995 review and extension conference, Finland had a crystal clear, manifested goal: making the Treaty on the Non-Proliferation of Nuclear Weapons perpetual. According to the conference report, a debate comparable with the former East–West axis now took place

138 Kahiluoto 1995b, 95; Tero Varjoranta, interview 10 June 2020.

139 Varjoranta 1992; ALARA journals 1992–1995.

140 Pekka Ojanen, cover letter to the memorandum Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt, 4. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993, 1. The Archives of the Finnish Ministry for Foreign Affairs; Kari Kahiluoto, e-mail correspondence 11 March 2020.

141 Expert seminar on the extension of the Non-Proliferation Treaty on 17 December 1993, Königstedt 4. Ministry for Foreign Affairs, Political Department. Memorandum no 1252. Rita Vesterinen 21 December 1993, 12. The Archives of the Finnish Ministry for Foreign Affairs.

between northern and southern countries; South Africa, which had recently denounced nuclear weapons and apartheid, played a key role in that debate. Many developing countries aimed to pursue their goals by imposing conditions for the perpetual extension of the Treaty. Finally, however, it was approved. Kari Kahiluoto, who was a member of the Finnish delegation and would later become ambassador, crystallized the country's official view of the outcome: "Permanent non-proliferation will reinforce international stability."¹⁴²

Following the collapse of the Soviet Union, also the environmental disasters left behind by the superpower were revealed. In Finnish politics, the Green party in particular demanded that Finland take responsibility for its nuclear waste in the future. The principle according to which the waste management of nuclear waste produced in Finland had to be managed in Finland was approved in late 1994. In practice, the change meant that Finland had to discontinue the transport of spent fuel from the Loviisa nuclear power plant to the Mayak reprocessing plant in Russia.¹⁴³

At the same time with this proposed amendment to legislation, there was discussion about joining the European Union in Finland. Concerns were raised that a final disposal facility built in Finland ahead of the projects of other countries would be obligated to receive nuclear waste from other EU Member States in the future. Towards the end of 1994, Finland supplemented the Nuclear Energy Act so that it prohibits both the export and import of nuclear waste.

The amendment also meant a crucial policy statement on how energy companies were to proceed with the final disposal of spent nuclear fuel. The Finnish nuclear energy producers TVO and Fortum (then IVO) jointly established Posiva Oy in 1995, tasked with responsibility for the final disposal of the companies' spent nuclear fuel in Finland.¹⁴⁴

Finland joined the European Union in 1995. The membership also meant joining the European Atomic Energy Community (Euratom). From the point of view of non-proliferation, this translated into amendments to agreements and the Commission's inspections in the premises of Finnish nuclear operators. For the purposes of the control of nuclear commodities, Finland joined the safeguards agreement between the IAEA, the European Atomic Energy Community and nuclear-weapon-free Member States of the European Union. The application of the "old" safeguards agreement that had entered into force in the early 1970s was discontinued.¹⁴⁵ Following the transition period, the last shipment of spent nuclear fuel left from Loviisa across the eastern border to Russia in late 1996.¹⁴⁶ On the other hand, deliveries of nuclear fuel from Russia to the Loviisa nuclear power plant continued unchanged.

According to Tero Varjoranta, holder of several safeguards positions through the decades, Finland joining the European Union in the mid-1990s was a major turning point from the

142 Kahiluoto 1995a.

143 Hoffman 2008, 133.

144 See Nikula et al. 2012.

145 The European Atomic Energy Community was established in 1957. The new safeguards agreement between Finland and the IAEA is known as document INFCIRC/193. Some of the new agreements were the Euratom Treaty and the Commission's Safeguards Regulation. Honkamaa et al. 2004, 336–337.

146 Hoffman 2008, 159. Options for the timing of the last transport ranging from October to November were presented in the steering group's discussion.

point of view of those implementing safeguards. Before that, questions concerning nuclear weapons in the UN in particular were the cornerstones of Finnish foreign policy, and the country was active specifically on the basis of the NPT. Ministries had a lot of expertise associated with this. After joining the EU, national activity at the political level has disappeared from sight.¹⁴⁷ According to representatives of the Ministry for Foreign Affairs, the implementation of the Non-Proliferation Treaty has worked well and been coordinated also during Finland's EU membership.

Kari Kahiluoto, nowadays an ambassador, worked in several positions involving arms control and disarmament, mainly with the Ministry for Foreign Affairs, from the early 1990s to the late 2000s. According to Kahiluoto, a key motivation for Finland's disarmament policy and simultaneously the implementation of the Non-Proliferation Treaty in the 1990s was "ensuring the prerequisites for Finland's EU membership and promoting Finland's integration into the West in a world that was changing at a considerable pace."¹⁴⁸ Effective arms control was considered to remove some of the obstacles to membership, and once the EU membership actualized, Finland quickly became involved in e.g. the EU's joint arms control efforts and co-operation on nuclear energy control.

Towards a complete nuclear test ban

Alongside everything else, negotiations on completely discontinuing nuclear tests had continued in the 1990s. This question, too, had been negotiated on for years before the superpowers agreed on a partial nuclear test ban in Moscow in 1963. Finland had hoped for the first NPT Review Conference in 1975 to decide on the cessation of nuclear tests and subsequently promoted the initiative with resilience.¹⁴⁹

THE FIRST NUCLEAR WASTE TRAIN FROM FINLAND TO THE SOVIET UNION

on its way at the Lapinjärvi underpass on 18 August 1981. Spent nuclear fuel was transported from the Loviisa nuclear power plant by rail using special-purpose railway wagons once a year on average for final disposal in the Soviet Union/Russia until late 1996.¹⁵⁰
Photo: Sorvoja Lauri, Press Photo Archive JOKA, Finnish Heritage Agency.

147 Tero Varjoranta, interview 10 June 2020.

148 Kari Kahiluoto, e-mail correspondence 23 June 2020.

149 Karen, Lauri: Suurlähehtiläs Hyvärinen: Ydinsulku on osa liennytystä. HELSINGIN SANOMAT 7 May 1975, 22.

150 See Hoffman 2008, 159.



The negotiations commenced in the 1980s led to the Comprehensive Nuclear-Test-Ban Treaty (CTBT) being approved in the UN and opened for signature in 1996. Finland had provided technical expertise to its preparations and signed the treaty the same year. Finland ratified the nuclear test ban treaty in 1999. The Radiation and Nuclear Safety Authority became the national data centre referred to in the Treaty, and STUK also has a radionuclide laboratory analyzing the particle samples of the nuclear test ban organization. The Department of Seismology of the University of Helsinki has a seismic station that is part of the international monitoring system of the test ban treaty.¹⁵¹ The agreement was still not officially in force in spring 2020, but practically all of the countries in the world except for North Korea have complied with the nuclear test ban.¹⁵²

Enduring post-Cold War themes in Finland included a debate on the benefits and downsides of NATO membership. Experts of the STYX project that monitored the development of nuclear weapons appeared in the MOT investigative journalism TV programme in spring 1997, for instance, considering the problems of Russia at the time in managing its destructive weapon systems, new units prepared for using nuclear weapons brought to the vicinity of Finland and Finland's non-existent possibilities of intercepting short-range nuclear missiles. The original proposer of the STYX project, Professor Pekka Jauho presented a clear opinion on NATO membership, a very popular topic of debate in Finland at the time, based on Russia's nuclear armaments: membership would increase security risks without providing significant benefits to Finland, a geographically marginal country.¹⁵³

In the UN, Finland did not join the New Agenda Coalition (NAC) promoting further nuclear disarmament, which was established in 1998. The NAC submitted resolution proposals concerning commitment to nuclear disarmament in the UN in 1998 and 1999. Finland abstained from voting.¹⁵⁴ Sweden, for example, was originally a party to the New Agenda Coalition, but left it in 2013.

Ambassador Pasi Patokallio, who was involved in Finland's arms control policy from the mid-1970s to the late 1990s, summarized in spring 2020 that Finland's starting point was continuously such that "nuclear disarmament requires the co-operation of nuclear powers in order to materialize, not shouting from the audience. Gradual measures are therefore the only realistic way. The members of the NAC have always disagreed with this notion. This is also proven by the fact that they have either joined or are about to join the UN treaty prohibiting all nuclear weapons at once (Treaty on the Prohibition of Nuclear Weapons, TPNW). No nuclear power is involved in it." He emphasizes that Finland has always seen the Non-Proliferation Treaty as a whole, of which Article VI (disarmament) is only one part.¹⁵⁵

151 Hoffman 2008, 162.

152 The United States has signed the Treaty but not ratified it. In addition, the signatures of some significant threshold states are still missing.

153 Kosonen 1997.

154 Kantola 2000.

155 Pasi Patokallio e-mail correspondence 22 April 2020.

Based on the above, one can also see that the long-term disarmament policy aiming at gradual progress represented and promoted by Finland, as well as practical measures to strengthen non-proliferation, had already succeeded in several ways in the 1990s and were progressing in a promising way. Finland did not want to compromise but rather secure these exceptionally big international successes from the point of view of nuclear disarmament of the 1990s.

9 Boldly entering a new millennium

During the first decade of the 21st century, Finland made important, nationally distinct choices that strengthened its long-term policy as a committed producer and user of nuclear energy and bearer of responsibility. First of all, Finland decided on the final disposal of spent nuclear fuel in its bedrock in 2001. At that time, Finland's final disposal was still following in the wake of trailblazers. Second, the Parliament of Finland approved the Government proposal for the construction of a fifth nuclear reactor in 2002, with Finland deciding on constructing more nuclear power for the first time since the 1970s. On account of this solution, Finland was considered an exception among Western countries. Olkiluoto was decided upon as the location for both the final disposal facility and TVO's new nuclear plant unit. The power plant was initially scheduled for completion in 2009, but the massive project is at least a decade behind the original schedule in spring 2020. The decisions-in-principle of 2010 permitted preparing for two new nuclear reactors (Hanhikivi 1 and Olkiluoto 4). In addition to Finnish companies, the Russian state-owned company Rosatom is strongly involved in Fennovoima Oy's project (Hanhikivi 1). By way of these decisions, Finland remains strongly tied to international trade in nuclear commodities, guaranteed by the NPT system. At the same time, Finnish operators continued technical development work in close co-operation with the IAEA to enhance safeguards, among other things.

Hopes for excavating uranium in Finland had been dormant for a long time. In the 2010s, the Talvivaara mine in Sotkamo began to investigate the recovery of uranium as a by-product. In 2020, the mining company Terrafame was granted a licence referred to in the Nuclear Energy Act for recovery of uranium from ore excavated from the Sotkamo mine. Finland will, therefore, be supervising the fuel cycle of nuclear commodities from mining product to final disposal, "from cradle to grave", for the first time, in the 2020s.¹⁵⁶

From the point of view of NGOs, the New Agenda Coalition of small and medium-sized countries was the star of the 2000 NPT Review Conference. Pressured by it, a sentence on unilateral commitment to nuclear disarmament was recorded in the final document of the Review Conference. According to Malla Kantola, Secretary General of the Committee of 100 in Finland, the European Union and Finland acted in another way and were overshadowed at the conference. According to her, at times Finland seemed to understand the nuclear-weapon states and their reasons for not wanting to commit to concrete disarmament a bit too well. It was "the time for Finland to get out of the trenches of the Cold War" and join the sponsors of the NAC.¹⁵⁷

156 The entire fuel cycle, such as the production of nuclear fuel and an enrichment plant, is not, however, found in Finland.

157 Kantola 2000, 16.

As was customary for it, Finland did take an active part in the 2000 conference, especially in the working group on the use of nuclear energy for peaceful purposes and promoting a reduction in tactical nuclear weapons.¹⁵⁸ The Review Conference at the turn of the millennium also recognized NGOs and their positions better than before. Finland involved NGOs in preparing the NPT Review Conference and its delegations in 2010, at the latest.¹⁵⁹ They have at least diversified the Finnish discussion.

International disarmament in general was in a flux in the early years of the 21st century. The weakening or transformation of previous threat perceptions was also reflected in the discontinuation of the STYX project monitoring the development of nuclear weapons in 2004. At the same time, Finland repositioned itself as a member of the European Union. According to a Finnish study, Finland adapted to the EU's single foreign and security policy in 1995–2005 further than Sweden, for instance, whose more idealistic heritage as a driver of nuclear disarmament has held its ground better than Finland's unique national policy. According to this interpretation, Finland has been an active pragmatist and realist in terms of its nuclear arms policy and made its policy more European and less ambitious than it was during the Cold War.¹⁶⁰ The changes in this era require further research, but it appears that later criticism of Finland's passivity concerns this period or is based specifically on reviewing the start of the 21st century at the expense of the longer-term perspective.¹⁶¹

158 Kantola 2000, 16.

159 2010 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons. Final Document, Volume III, Part IV. Summary records and list of participants. New York, 2010.

160 Nokelainen 2008; Pastinen 2007, 110–122; Saarikoski 2019.

161 Cf. Cronberg 2010.

10 2010s: time of extremes

Come the 2010s, a new era of nuclear disarmament was outlined under the auspices of the United States. President Barack Obama set the elimination of nuclear weapons (global zero) as an objective. This response to the idling of the early 21st century gave rise to optimism in Finland as well. On the other hand, the NPT Review Conference of spring 2010 had to succeed, wrote Juha Rautjärvi, STUK's safeguards specialist and a member of the Finnish delegation, because the previous conference in 2005 failed. The measures finally agreed upon in 2010 were largely the same that had already been negotiated on and written down in the 1995 and 2000 conferences. For example, the Middle East nuclear-weapon-free zone was defined as essential in the spring 2010 conference: all five nuclear-weapon states committed themselves to the implementation of this decision made first by the 1995 Review Conference. The action plan for the project was confirmed.¹⁶²

A host was needed for the planned conference on a Middle East nuclear-weapon-free zone. Finland was requested to head the project, known to be exceptionally difficult, and according to its committed policy, Finland agreed.¹⁶³ According to scholar Tytti Erästö, requests were made by many parties: the UN Secretary General, three permanent members of the United Nations Security Council and Middle Eastern countries requested that Finland host the conference on the Middle East Nuclear-Weapon-Free Zone in 2011. In the best case scenario, the conference was hoped to help the Middle Eastern countries towards resolving the decades-long conflict.¹⁶⁴ Perhaps both Finland and others recalled the dialogue of a Nordic nuclear-weapon-free zone maintained here during the decades of the Cold War. The idea of Nordic countries as a nuclear-weapon-free zone is of the same age, or perhaps a younger idea, as the goal of a nuclear-weapon-free Middle East.

Under the auspices of Jaakko Laajava, Political Under-Secretary of State at the Finnish Ministry for Foreign Affairs, the mediator Finland was drawn to a chronic shock area of international politics, where additionally a wave of uprisings known as the Arab Spring erupted during the preparatory meetings in 2011. After a difficult start, the arch enemies Israel and Iran were successfully involved in the negotiations, which took place with a low profile, away from the public eye. Having been given a significant international role, Finland tried its best, but the conference originally scheduled for 2012 in Helsinki could not ultimately be organized. Instead of governments, NGOs met in the capital of Finland. The mediation task assigned to Laajava turned out to be impossible for the time being. Nevertheless, the initiative has still remained

162 Rautjärvi 2010, 25; Cronberg 2010.

163 Patokallio, interview 17 March 2020.

164 Erästö 2014.

on the agenda of the 2020 Review Conference. Similarly to many others, Finnish experts know that the progress in nuclear disarmament is frequently very slow.¹⁶⁵

Finland's resilient preparatory work for a nuclear-weapon-free Middle East ultimately had to be discontinued with the 2015 NPT Review Conference. The atmosphere of the conference was impacted both by the confusing situation in the Middle East and Russia's attack on the Crimean Peninsula in Ukraine and the acts of war it supported in Eastern Ukraine, which collapsed the relations between the superpowers in 2014.¹⁶⁶

In the middle of conflicts, the Non-Proliferation Treaty system, blamed for being rigid, represents permanence that Finland for its part has actively upheld. In addition to many other commitments, Finland is involved in the GICNT network founded by the United States and Russia in 2006: the Global Initiative to Combat Nuclear Terrorism jointly gathers and develops state-level measures against nuclear terrorism. Finland coordinated the operations of the network with some 90 member states in 2017–2019.¹⁶⁷ Again, Finland supported and reinforced co-operation between the superpowers in an area closely related to nuclear non-proliferation.

Internationally, the key topics of nuclear disarmament in the late 2010s have included the proposal for a complete ban on nuclear weapons. Frustration with the progress of nuclear disarmament led to negotiations on a nuclear-weapon-ban treaty in the UN in 2016–2017. Finland did not take part in the negotiations, but remained outside as planned, unlike other non-allied countries in Europe. The new treaty proposal was widely supported, especially by Latin American and African countries, and the Treaty on the Prohibition of Nuclear Weapons (TPNW) was approved by the UN in 2017. The same year, the Nobel Peace Prize was awarded to the International Campaign to Abolish Nuclear Weapons.¹⁶⁸

The TPNW has met a very two-fold reception in Finland. The Government's statements have emphasized the Non-Proliferation Treaty as the cornerstone of Finland's nuclear disarmament policy and enhancing the implementation of the NPT. The Non-Proliferation Treaty is the only treaty in which also nuclear-weapon powers have committed to nuclear disarmament. In Finland, however, many political parties have decided to support joining the new ban treaty. Whereas all Finnish parties strongly support the Non-Proliferation Treaty, the new treaty is subject to a historically obvious disagreement that has also been debated in public.¹⁶⁹ There has been discussion about which choice better matches Finland's traditional line of action: joining the new treaty or remaining outside it.

According to a report submitted by the Ministry for Foreign Affairs to the Parliament, the ban treaty's provisions on safeguards of nuclear materials are weak, and the treaty could, among other things, weaken the position of the Non-Proliferation Treaty and Nuclear-Test-Ban Treaty and make it more difficult to agree on concrete progress. According to the report,

165 Erästö 2014. See, inter alia, Rislakki 2010, 446.

166 Lindroos, Reijo: Ydinsulkukokous alkaa kireissä tunnelmissa. Yle uutiset 27 April 2015. (retrieved 13 February 2020)

167 Luoto 2018.

168 Simonen 2018. The Treaty is not in force at the time of writing in spring 2020.

169 Erkki Tuomioja, e-mail correspondence 4 May 2020. See also Juntunen 2018.

Finland aims at being constructive in a way that avoids the strengthening of the conflict between the supporters of the Non-Proliferation Treaty and the new ban treaty.¹⁷⁰

The Programme of Prime Minister Sanna Marin's Government of 2019 and its section "Globally influential Finland" underlines Finland's commitment to disarmament and the Nuclear Non-Proliferation Treaty, but it leaves a margin of manoeuvre for Finland to act in accordance with the prevailing diverse points of view in terms of the new nuclear weapon ban treaty. Together with the rest of the world, Finland's expectations were directed at the 2020 NPT Review Conference.¹⁷¹ The conference had to be postponed to spring 2021 at the latest due to the coronavirus pandemic.

170 Finnish Ministry for Foreign Affairs, Unit for Arms Control: Ydinaseet kieltävä sopimus ja Suomen toimintalinja, 13 November 2017. (Memorandum submitted to the Foreign Affairs Committee of the Finnish Parliament.)

171 Programme of Prime Minister Sanna Marin's Government 10 December 2019. Inclusive and competent Finland – a socially, economically and ecologically sustainable society. Publications of the Finnish Government 2019: 31. Helsinki 2019. See Cronberg & van der Meer 2017; Patokallio 2020.

II Finland and the control of nuclear materials

After Finland had signed the bilateral agreements, the Nuclear Non-Proliferation Treaty and the IAEA safeguards agreement, as discussed above, it was time for their implementation.¹⁷²

Initially, the Ministry of Trade and Industry was in charge of the control of nuclear commodities. As of 1975, regulatory control was gradually transferred to the Radiation Safety Institute, the predecessor of the Radiation and Nuclear Safety Authority. Full practical safeguards control began in the Institute's nuclear materials group in 1977 when large-scale imports of nuclear commodities commenced for the Loviisa plant, which was also the first nuclear power plant to be used for energy production in Finland.¹⁷³ The Loviisa plant was started up the same year, 1977.

The basic components of the national safeguards organized by the Radiation and Nuclear Safety Authority were accounting for nuclear fuel transports, transfers and storage and "calculations and measurements indicating changes in the reactor: decay of uranium and generation of plutonium."¹⁷⁴ STUK reported the resulting material balance with changes to the IAEA. The Agency's inspectors verified together with STUK's inspectors that the fuel was found in the reported locations and matched the description provided in terms of composition. In 1989, for instance, STUK carried out 40 nuclear commodity inspections and submitted a total of "190 reports, notifications and opinions" to the IAEA. IAEA inspectors carried out 22 inspections in Finland the same year.¹⁷⁵ In accordance with the safeguards agreement, STUK reported the results of its control and the Agency inspected the reported nuclear commodities. In the late 1980s, STUK also began to publish an annual report on safeguards.

After the contractual safeguard practices had been created in the 1970s, safeguards of nuclear materials were a relatively technical matter at the turn of the 1980s. Finland soon engaged in development work that, according to Tero Varjoranta, included being the world's second country to computerize the processing of control data. Varjoranta took up the position of inspector at STUK in 1981. He subsequently had an international career in safeguards of almost forty years, progressing to become Director General of STUK and ultimately Deputy Director General of the IAEA. In addition to digitization, there was a desire to move from calculation-based methods to actual verification of the content of fuel rod elements in the safeguards of spent nuclear fuel. Because of this, the Finns engaged in developing

172 Hoffman 2008, 158.

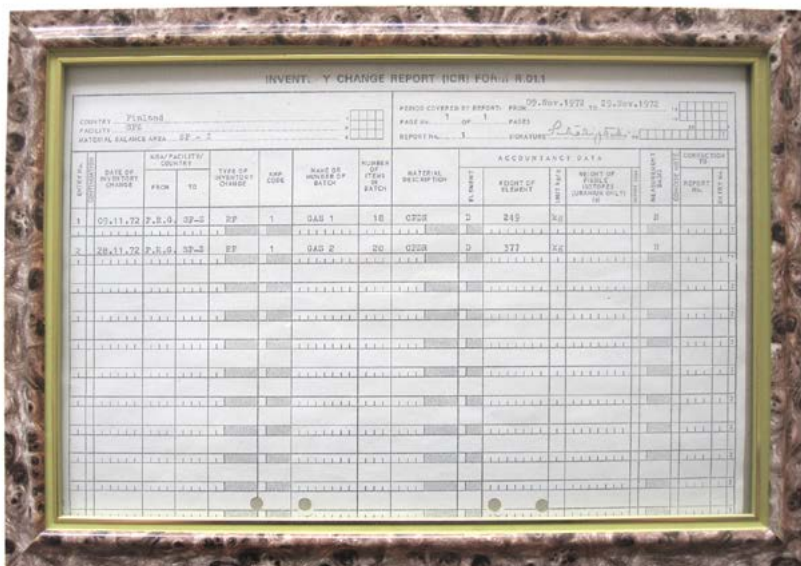
173 Hoffman 2008, 106–107, 158.

174 Hoffman 2008, 158.

175 Hoffman 2008, 158.

measurement methods for spent fuel through international co-operation, which was also significant in terms of strengthening the IAEA's inspection activities. The development work continued throughout the 1980s, until it was made official as Finland's support programme for the IAEA safeguards through funding from the Ministry for Foreign Affairs.¹⁷⁶

The fuel cycle of the Loviisa nuclear power plant was simple to monitor for a long time: the nuclear fuel was purchased ready-to-use from the Soviet Union and the spent nuclear fuel was returned there. In the plant procurement negotiations, Antti Vuorinen, who later became STUK's long-term Director General, had required extending Finnish safeguards of nuclear materials to the entire supply chain of nuclear commodities in the Soviet Union, but ultimately safeguards of nuclear materials could not be implemented across borders.¹⁷⁷ The fuel cycle of Olkiluoto, i.e. the nuclear power plant of the company Teollisuuden Voima (TVO), operated as part of the nuclear energy sector's global trading with its complicated production chains. The enrichment of TVO's uranium mentioned above, mainly sourced from Canada and Australia, into nuclear fuel in the Soviet Union was probably the only exceptional safeguards-related challenge in the 1980s. Supplying either country's uranium to the Soviet Union was absolutely prohibited. A special control system was erected to monitor the international transports of the raw material and interim outcomes of fuel production, ensuring that no uranium exported to the Soviet Union might have ended in the wrong use but that all uranium



A PHOTO OF APPARENTLY THE FIRST inventory change report submitted by Finland to the IAEA pursuant to the comprehensive nuclear material safeguards agreement. It reports receiving a batch of nuclear commodities from West Germany. The report was signed by the Ministry of Trade and Industry's Ilkka Mäkipentti. Photo: Henri Niittymäki / STUK.

176 Tero Varjoranta, interview 10 June 2020.

177 Hoffman 2008, 106.

transported there for enrichment also returned in some, albeit altered, form. The demanding safeguard practice continued until the dissolution of the Soviet Union.¹⁷⁸

The Gulf War as a turning point

The first major amendment to the safeguards took place starting from the early 1990s after and as a consequence of the Gulf War, when the IAEA found out about the nuclear weapon materials hidden by Iraq. Even though the country had signed the Non-Proliferation Treaty and the IAEA had been supervising its nuclear commodities for years, Iraq had been able to additionally develop a separate, secret nuclear weapons programme. The case of Iraq was immediately understood to be a turning point that would lead to a review and tightening of the safeguards system.¹⁷⁹

The Agency officially launched an extensive safeguards development programme with the support of the member states in 1993. It was named the 93+2 programme. The measures to enhance safeguards proposed by the IAEA and their impacts were key matters in the 1995 NPT Review Conference.¹⁸⁰

The overall reform of safeguards was implemented so that the IAEA approved a new Additional Protocol to the international safeguards agreement in 1997. The reform ensured that the Agency would get more accurate information about the nuclear functions of the states that had signed the Additional Protocol as well as new authorizations for verifying it.¹⁸¹

Finland signed the Additional Protocol in 1998 together with the other nuclear-weapon-free EU countries. The amendment to the safeguards agreement required an amendment to the Nuclear Energy Act, which the Parliament and President approved in 2000, but the Additional Protocol did not enter into force before all of the EU Member States had officially ratified it.¹⁸²

The Additional Protocol entered into force in Finland and the entire EU in April 2004. In accordance with the new safeguards system, STUK has had to provide more information to the IAEA. Besides the IAEA collecting a lot of additional data from the state concerned itself, it compiles supplementary and cross-checked information from open sources, such as satellites, diverse publications, commercial databases, the Internet and meetings, such as seminars and other social contacts. The Agency can also monitor environmental concentrations of radioactive substances.¹⁸³

The IAEA requested STUK's Director General Jukka Laaksonen in 2003 to head an international group to assess the success of the improvements to the safeguard system implemented in the 1990s. The group found a lot of room for further improvement, and the observations it reported have been used in follow-up work.¹⁸⁴

178 Tero Varjoranta, interview 10 June 2020.

179 Mutru 1991, 24; Hoffman 2008, 158. See also Rentetzi 2017.

180 Riihonen 1995, 17. With regard to the IAEA's 93+2 programme, see Tarvainen 1997, 17–20.

181 Honkamaa et al. 2004, 339–343; Hoffman 2008, 158.

182 Martikka 2002, 13.

183 Martikka 2002, 13; Honkamaa et al. 2004.

184 Hoffman 2008, 240.

12 Trade and export control of nuclear products

The Non-Proliferation Treaty required export control on nuclear materials. An unofficial committee was initially founded in 1971, and it assumed the task of defining how to interpret Article 3, item 2 of the Non-Proliferation Treaty. The group emerged, in a way, as an extension of the IAEA's safeguards committee work, and it was given the name the Zangger Committee after its Swiss chair, Professor Claude Zangger. Its main task was to consider what the "equipment or material especially designed or prepared for the processing, use or production of special fissionable material" referred to in Article 3 of the Treaty was, and on what terms such products could be exported. Concretely, the Committee worked on the guidelines for exports and prepared a Trigger List of products, which was practically a list of goods to be controlled. The Zangger Committee agreed on its first list in 1974, and the IAEA internationally published the commitments of the countries in the group.¹⁸⁵

Finland has been party to the Zangger Committee since it was founded. Zangger was succeeded as the chair of the Committee by Ilkka Mäkipentti in 1989–1993.¹⁸⁶

The Nuclear Suppliers Group, also known as the "London Club", was also established in 1974. The aim was to further increase export controls. Underlying the tightenings were several motives, starting with a nuclear detonation by India in 1974, and including growing interest in nuclear power as a source of energy due to the oil crisis as well as the predicted transition to a plutonium economy saving uranium and the first agreements on the transfer of sensitive technology to developing countries.¹⁸⁷

Ilkka Mäkipentti later characterized that, in the mid-1970s, nuclear producers were concerned that increasing international trade would raise the risk of nuclear materials, or technology in particular, falling into the wrong hands. The problem was notably with threshold states remaining outside the Non-Proliferation Treaty that were suspected of preparing a nuclear weapons programme or even of building nuclear weapons. In addition, the Non-Proliferation Treaty system was considered to include a lot of "shortcomings – such as the ease of denouncing it – so that being party to it was not a sufficient guarantee of security per se".¹⁸⁸ These factors led the nuclear suppliers to tighten their export conditions; the 15 states of the expanded London Club agreed on and published their joint export principles in 1977.

185 Schmidt 1994, 38; Tanninen 2011, 17.

186 Riihonen 1993; Schmidt 1994.

187 Lempiäinen 1986, 26–27.

188 Mäkipentti 1985, 4.

Finland was not yet involved in the group of 15 states that drafted these guidelines of the London Club, but the country soon joined the supplier countries, in 1980. At the time, Finland was the only country to be approved to join and the first country to join after the two founding waves of the club.¹⁸⁹ Gradually by 1990, a total of eleven West and East Bloc or neutral states were accepted as members of the London Club, of which Finland was, thus, the first.¹⁹⁰

The London Club initially gathered together the seven large exporter countries, even though the United States and the Soviet Union were particularly behind its operations. It was also significant that France joined the supplier club, even though it had not signed the Non-Proliferation Treaty.¹⁹¹ In addition to the solutions of the Zangger Committee, the group emphasized physical safeguards, and the control expanded from the NPT-based activities and, therefore, a separate scheme was created. The London Club was a tensioned group in many ways, and it did not convene once between 1978 and 1990. At the same time, the Zangger Committee was operational and continuously specified its trigger list further along technological development and in changing situations.¹⁹²

Jussi Manninen, a long-term employee of the Finnish Ministry of Trade and Industry, summed up the rationale: “When it comes to the motives of Finland to take part, it certainly helped in identifying with the good boys’ club, as it was a question of strengthening the NPT, which was not against the interests of the superpowers.”¹⁹³

The Gulf War of 1991 was eye-opening in this field as well. The case of Iraq brought the London Club together to consider new, more effective control methods. The United States played a central role in the process. Since the early 1990s, the group has exclusively used the name Nuclear Suppliers Group, NSG.¹⁹⁴

Finland has been active in both control groups. The commercial exports of the Finnish nuclear energy industry have been quite limited, but Finland is a possible country of transit.¹⁹⁵ When Finland chaired the NSG in 1995–1996, ambassador Pasi Patokallio acted as the chairman.

Export control is based on control lists agreed upon in international export control arrangements. The arrangements are legally unofficial. Like many other countries, Finland has additionally undertaken to report on cross-border transit of agreed equipment and products to the IAEA voluntarily. In Finland, the licencing authority responsible for nuclear exports control is the Ministry for Foreign Affairs. The Finnish Customs supervise the exports at borders, and the Radiation and Nuclear Safety Authority maintains a national register of nuclear materials and reports on actual exports to the IAEA.¹⁹⁶

189 INFCIRC/254/Add.2. March 1980. Communication received from certain member states regarding guidelines for the export of nuclear material, equipment and technology. A communication received from Finland. See also the NSG website.

190 Strulak 1993.

191 France, however, had reported that it will comply with the Treaty. France joined the NPT in 1992.

192 Riihonen 1993; Bidgood 2016.

193 Jussi Manninen, e-mail correspondence 11 March 2020.

194 Riihonen 1993.

195 Riihonen 1993.

196 Tanninen 2011, 17.

The Nuclear Suppliers Group continues to be an important and active international operator, whose current topical challenges includes non-state actors with their cross-border connections. The best-known example of such is the smuggling of nuclear technology for a long time led by the Pakistani scientist A. Q. Khan. The network established around the trafficking was traced and dismantled by the IAEA starting from 2003, under the leadership of a Finn, Olli Heinonen, who had a long career in nuclear safeguards at the IAEA. Heinonen held the position of Deputy Director General of the IAEA until 2010.¹⁹⁷

Finnish businesses have occasionally also been caught breaching export regulations of dual-use products, and their products have been confiscated by Customs. It has been estimated that ignorance might have been a partial reason in some of these cases, but it has still been more about neglect.¹⁹⁸

Nuclear export control is based on updated control lists agreed upon in these international export control arrangements. In addition to nuclear materials, the control lists nowadays also include dual-use products and software, i.e. anything that could promote activities prohibited by the Non-Proliferation Treaty.

197 Sillanpää 2008; Pastinen 2007, 115–116; Matti Tarvainen, interview 8 April 2020.

198 Kari Kahiluoto, e-mail correspondence 23 June 2020. See and cf. Rislakki 2010, passim.

13 Finland's support to the IAEA Safeguards

In the late 1970s, the IAEA member states decided that they will not funnel separate R&D funding to the development of safeguards but that the member states will voluntarily participate in it with their own programmes. The Agency created a structure for the support programmes, and the first support programme was established by the United States in 1978.

Finland's actual development support to the IAEA's safeguards began in 1979 when non-destructive control measurements of spent fuel started at the Loviisa nuclear power plant. Between 1982 and 1988, the co-operation was carried out under the name of a technical contract (TC 2950).¹⁹⁹ In it, the main focus was on spent fuel verification methods. In practice, Finland specialized in developing non-destructive verification methods in the 1980s, and the co-operation between the IAEA and the Finns gradually deepened. Training sessions were organized with the IAEA at both the Loviisa and Olkiluoto nuclear power plants.²⁰⁰

The Finnish Support Programme to the IAEA Safeguards (FINSP) was officially established in May 1988. The Finnish Support Programme has provided the IAEA non-budgeted support in development projects relating to safeguards and tasks supporting the controls, such as the training of instructors. The support is aimed to assist the Agency in its main task, i.e. supervising that nuclear materials are not removed from peaceful use.²⁰¹ The number of support programmes has varied over the years. In the early 1990s, 13 member states were involved in them on average. At the end of 2019, 20 member states and the EU had an IAEA support programme in operation.²⁰²

The Finnish Support Programme originally had a fixed term of five years, but it was decided to continue it in 1992 on account of favourable experience and encouraging feedback from the IAEA. Moreover, its extension was supported by several topical challenges of the control of nuclear commodities.²⁰³

During its early years, the Finnish programme focused on the development of measurement and control instruments. The biggest equipment-related project was implemented in 1992–1993. It built a SFAT (Spent Fuel Attribute Tester) instrument for international use. The method was designed so as to be suited more extensively to the IAEA's safeguard activities in different countries, specifically to enhance the control of ageing spent fuel. The new technology was soon tested in Sweden together with the Swedish support

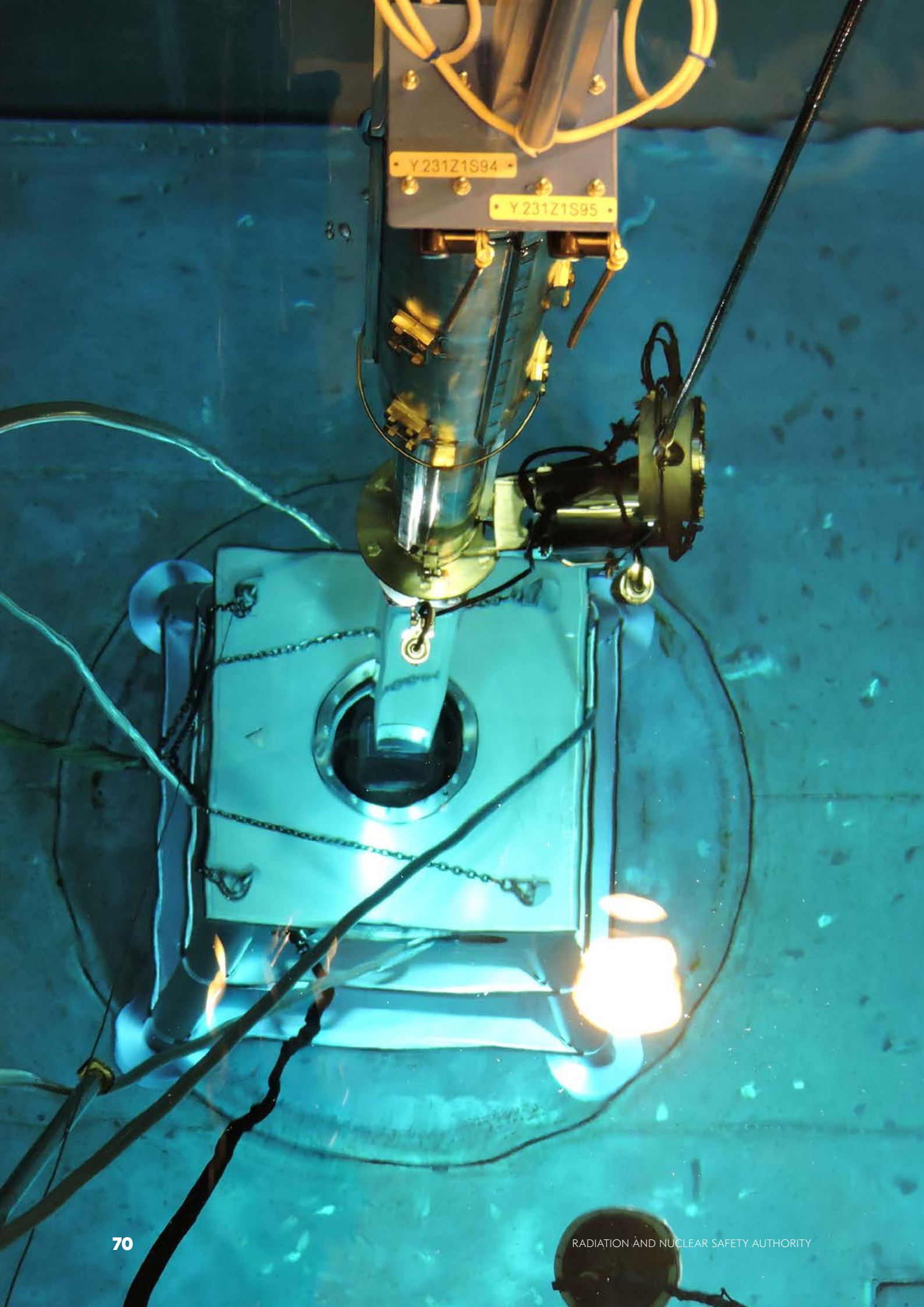
199 IAEA's evaluation letter 1992, appended to reference Tarvainen 1993, 20.

200 Tarvainen 1993, 46; Honkamaa 2020, 2; Matti Tarvainen, interview 8 April 2020.

201 Tarvainen 1995; Rautjärvi and Koponen 2003.

202 Honkamaa 2020, 2.

203 Tikkinen 1990; Tarvainen 1993, passim.



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programme. The Finnish programme, which was estimated to be of an average scale at the time, also co-operated with others, such as the Hungarian safeguards support programme.²⁰⁴

STUK published reports in English on several tasks and projects of the Support Programme, and presentations on them were given in Finland and abroad, especially at events organized by the IAEA. The projects were also introduced in meetings of several parties, so the results were communicated quite extensively to interested audiences.

Matti Tarvainen, who was in charge of the implementation of the Support Programme for a long time in the 1980s and 1990s, summed up that the majority of the projects within the programme had to do with spent nuclear fuel in one way or another. “The active role of nuclear power companies in implementing the support programme is emphasized in this way.”²⁰⁵ Without test materials and facilities offered by the Finnish nuclear industry, the development projects would have remained mere plans and papers. The willingness of power companies to co-operate thereby benefited the IAEA both directly as a practice environment and indirectly through R&D projects.

At the same time with the Cold War conflict weakening in the early 1990s, the operations of the IAEA met several challenges: On the one hand, the revelations in Iraq and resulting criticism, also in the public, and on the other the new situation resulting from the dissolution of the Soviet Union, with several new nuclear-weapon states in the former Soviet Union and nuclear control systems at risk of disintegration. It has been described above how Finland set out to ensure the upkeep of non-proliferation in the former Soviet Union in several ways. In 1992, the Finns organized a national seminar on developing the IAEA's safeguards. The exchange of ideas paved the way for Finland's recently begun term in the Agency's Board of Governors, in which Finland was in favour of reforming the safeguards of nuclear materials.²⁰⁶

The Finnish Support Programme was co-ordinated by a management group. In the hectic early 1990s, for instance, it included representatives of the Ministry for Foreign Affairs and Ministry of Trade and Industry as well as several persons from STUK. It was chaired by Pekka Ojanen, Deputy Head of Department at the Ministry for Foreign Affairs. The Radiation and Nuclear Safety Authority was and is responsible for the implementation of the Support Programme. During the years, the management group did not only review the Support Programme's project-specific activities and funding, but also other matters relating to the implementation of the Non-Proliferation Treaty, such as support to the CIS states'²⁰⁷ safeguards

THE PHOTO DEPICTS A STRONGLY RADIATING SPENT NUCLEAR FUEL ELEMENT

that is lowered to a PGET + PNAR instrument located underwater at a depth of 15 metres on the bottom of the spent nuclear fuel storage basin. PNAR = Passive Neutron Albedo Reactivity (instrument).

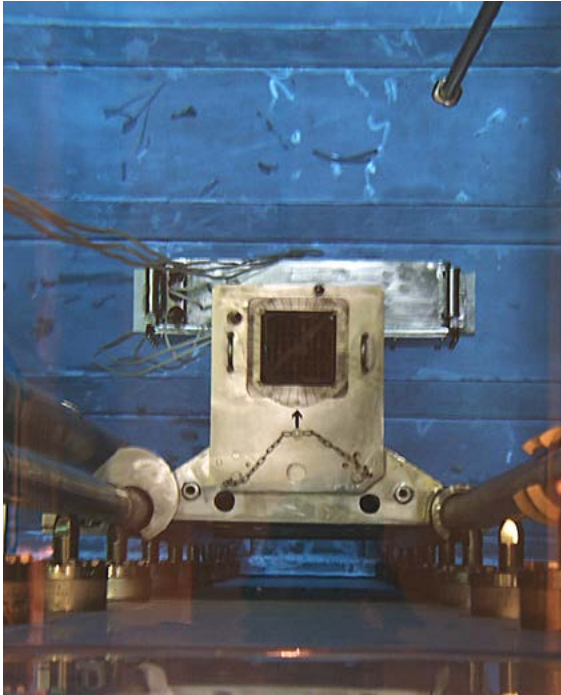
Photo: Tommi Lamminpää / TVO.

204 Tarvainen 1995, 5 and passim.

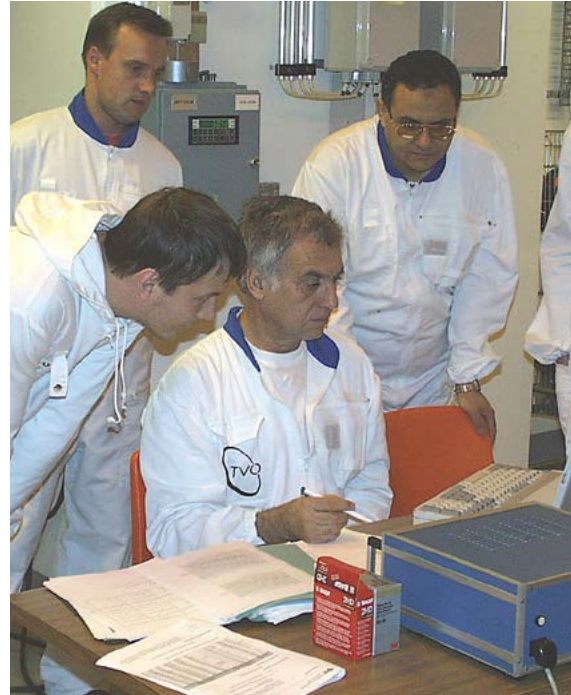
205 Tarvainen 1993, 5.

206 Viikinkoski 1993; Tarvainen 1994, passim; Pekka Ojanen, interview 2 April 2020.

207 CIS, or the Commonwealth of Independent States, formed by former-Soviet republics in 1991.



MANY OF the Finnish support programme FINSP projects have been associated with the development of non-destructive measurements (NDA) of spent nuclear fuel. The photo depicts a gamma emission tomography-based underwater measuring instrument fixed in front of a square fuel element in a "gamma cart" at TVO in Olkiluoto on 8 December 1999. Photo: Matti Tarvainen.



TOMOGRAPHY MEASUREMENTS of the Finnish support programme being carried out at TVO on 8 December 1999. Front left: STUK's Tapani Honkamaa and Ferenc Levai from the Technical University of Budapest. The IAEA's representatives often took part in the measurements, with occasional visitors from Euratom and the Swedish SKI. Photo: Matti Tarvainen.



EQUIPMENT DEVELOPMENT began in the early 1990s and has continued. In 2019, the IAEA approved the PGET (Passive Gamma Emission Tomography) instrument for verifying spent fuel at the accuracy of a fuel rod. The PGET instrument is used in Finland before the final disposal of fuel in ONKALO, so the verification done with it is essential to both the IAEA and Finland's safeguards.

Measurement work with a PGET instrument in progress. Sitting at the computer collecting and analysing measurement data, from left to right: Pauli Peura (IAEA), Tapani Honkamaa (STUK) and Peter Dendooven (Helsinki Institute of Physics, Helsinki). Photo: Tommi Lamminpää / TVO.

and Finland's actions in the IAEA General Conference and particularly its Board of Governors. In it, Finland was represented by Pekka Ojanen from the Finnish Ministry for Foreign Affairs.²⁰⁸ The management group thereby offered a practical channel for connections and interaction between Finland's non-proliferation policy and related technical development work.

Finland also took part in training safeguards inspectors for the needs of the IAEA. The multi-year training was organized in co-operation with the Canadian and Swedish support programmes. Training events took place in both TVO's and the Loviisa nuclear power plants in Finland.²⁰⁹ In 1993, two projects included in the Support Programme experimented with a new kind of camera surveillance that the IAEA wanted to improve. The Finnish industry's nuclear facilities co-operated with STUK, and the testing of a new monitoring system based on video cameras was carried out at the Loviisa power plant, for instance.²¹⁰

Finland's support was increased for 1994. The IAEA's support programme was one of the three sub-programmes in the non-proliferation control measures funded by the Finnish Ministry for Foreign Affairs. The other two new programmes concerned assisting Ukraine and the Baltic countries. The Ministry for Foreign Affairs funded the support programmes annually through the state budget.²¹¹ The management group of the support programmes remained unchanged, as did its tasks and the natural link to the IAEA's Board of Governors.

The help of member states became necessary to the IAEA, as several new countries had recently approved its international safeguards. A functional infrastructure, a national safeguards system (State System of Accounting and Control, SSAC) was needed, especially in the former-Soviet states. A few of them had additionally inherited a considerable amount of nuclear weapons from the Soviet Union. As part of international co-operation, the Finns helped establish an authority to implement safeguards in Ukraine. STUK managed the project with funding from the Finnish Ministry for Foreign Affairs.²¹² Ukraine was the first former-Soviet state to give up nuclear weapons in its territory and sign the Non-Proliferation Treaty.

The United States, South Korea and Japan established the international KEDO organization in 1995 to encourage North Korea to only develop peaceful production of nuclear energy. The name was an abbreviation of Korean Peninsula Energy Development Organization. Finland joined KEDO as its first general member the same year, 1995. Later, Finland decided to transfer its membership under the auspices of the EU.²¹³

The majority of the Finnish Support Programme for 1994 was associated with the IAEA safeguards development 93+2 Programme in one way or another. For instance, Finland volunteered as the first pilot country when the IAEA wanted to know how to best utilize a State System of Accounting and Control and co-operate with it in practice. The reform

208 Tarvainen 1994, 6.

209 Tarvainen 1994, 34.

210 Tarvainen 1994, 12 and *passim*.

211 Tarvainen 1995, 6. See also Jonter & van Dassen 2005.

212 Varjoranta & Tanninen 1994; Tarvainen 1995, 5.

213 Patokallio's interview 17 March 2020; Pastinen 2007, 110–113. See also Heinonen 2020, 13–16.

work coordinated by the IAEA was aimed at the NPT Review Conference in spring 1995 for approval.²¹⁴

Finnish impact on safeguards was strong in other ways as well during this period. At the IAEA, the support programmes were coordinated by a Finn, Juha Rautjärvi, with the title of IAEA Support Programme Officer. A former STUK employee, Rautjärvi held key IAEA positions in 1991 supervising the dismantling of South Africa's nuclear weapons programme.²¹⁵

When Finland's official FINSP support programme celebrated its tenth anniversary in 1998, the Finnish Ministry for Foreign Affairs financed a total of four safeguards support programmes. In addition to the original support programme (FINSP), there were bilateral support programmes in operation with Ukraine, the Baltic countries and Russia. The fourth programme was support to the IAEA's Iraq group, the IAEA Iraq Action Team. The discussions of the management group extensively covered Finland's non-proliferation activities. Ideas were exchanged concerning the support programmes as well as the nuclear test-ban treaty, Euratom's safeguards and future questions relating to the safeguards of the final disposal of spent nuclear fuel.²¹⁶

In the early 2000s, the Finnish Ministry for Foreign Affairs continued to finance improving nuclear safety in the regions close to Finland, which also took safeguards of nuclear materials into consideration: "The targets of Finland's bilateral safeguards support programme activities were Russia, Estonia, Latvia, Lithuania and Ukraine. The aim has been to help these countries develop and maintain effective national implementation of nuclear non-proliferation."²¹⁷ National control assisted and strengthened the IAEA's control capability.

RESEARCH REPORTS OF THE IAEA IRAQ ACTION TEAM'S SUPPORT PROGRAMME FROM 2002.

The reports of both the FINSP and the Action Team support programme were public, and they were distributed to the IAEA and other partners. The support programmes were commended by the IAEA on account of the scientific quality and coverage of the reports. According to Matti Tarvainen, in addition to national co-operation, the prerequisites for the success of the support programmes included financing granted by the Finnish Ministry for Foreign Affairs as well as active interest and political support. In part, the success of FINSP was made possible by effective co-operation with the power companies in both Loviisa and Olkiluoto. The management of STUK understood the needs of the support programmes and the internal co-operation worked well. STUK's precision engineering workshop resolved many problems encountered in the experimental work with expertise.

Photo: Ossi Lång / STUK.

214 Tarvainen 1995, passim.

215 Viikinkoski 1993, 3; Tarvainen 1995, passim; Rautjärvi 2014.

216 Tarvainen 1999, esp. 8.

217 Tossavainen 2002, 18.

AEROSOL
METHO
AREA E
SAMPL
Finnish supp
Valmari T. Tarva
Ossintsev A. Le

ANALYT
WIDE A
SAMPL
FILTER
Finnish supp
Riekkinen I. Ja
Ristonmaa S.

GAMMAJET—FIXED-WING
GAMMA SURVEY FOR
THE DETECTION OF
RADIOACTIVE MATERIALS
Finnish support to IAEA
Markku Kettunen, Mika Nikkinen

At the start of the millennium, several Finnish parties ranging from STUK to universities' research organizations jointly developed increasingly sensitive technology for environmental measurements. The programme supported by the Ministry for Foreign Affairs aimed to investigate any unreported nuclear activity from the air. Matti Tarvainen with his colleagues collected such aerosol assays and performed measurements in Iraq on several occasions in the early 2000s. The international community suspected that the country still had a secret nuclear weapons programme in progress. Finnish instruments collected particles indicating gamma radiation, plutonium and enriched uranium, and their detection would have indicated signs of an illegal nuclear weapons programme. The challenging measurements were a success. No signs of a nuclear weapons programme were found based on them, and the results were widely noticed. However, the use of a more advanced environmental measurement method has not been politically approved as part of the IAEA's safeguards toolbox.²¹⁸

One could justifiably ask whether Finland has been an overtly well-intentioned and "easy" sparring partner for the IAEA. This possibility has also been taken into consideration in the training provided by the Finnish Support Programme: If there is reason to do so, the IAEA can nowadays carry out a "supplementary" inspection visit with a short notice period of 24 hours. The purpose of the inspection, aiming for a surprise, is to ensure whether a country has unreported nuclear operations that might be connected to a secret nuclear weapons programme. In the late 2000s, several courses on supplementary inspections were organized in Finland (STUK, Fortum Loviisa, VTT), with the inspectors' operating environment made challenging on purpose with the target state and the operator hiding part of the truth and the inspectors needing to "dig it up". An educational film was also made of the course for international use.²¹⁹

As has been mentioned, one key purpose of the Non-Proliferation Treaty is to offer nuclear-weapon-free countries an opportunity to benefit from the development of the peaceful use of nuclear energy and make use of this technology in energy production.²²⁰ The IAEA's task of promoting the peaceful use of nuclear energy makes it an international "third basket" support pillar to the Non-Proliferation Treaty. This description comes from Martti Mutru, who worked in several positions with the IAEA during three decades from the 1960s to the 1980s. During his time, Finland and industrial countries in general considered safeguarding nuclear materials as the IAEA's most important field of operations.²²¹

Finland, or the Radiation and Nuclear Safety Authority to be more precise, has implemented the Non-Proliferation Treaty during the new millennium by assisting new countries in preparing for the deployment of nuclear energy. The most important task area has been to organize relevant regulatory control in the newcomer countries and develop the safety and the control of nuclear commodities. Assisting the newcomers simultaneously helps the IAEA in its topical safeguard-related challenges. Many of the Agency's new member states in Asia

218 See, inter alia, "Irakin laitonta ydinaseohjelmaa etsitty suomalaislaittein." STT 18 March 2003; Zilliacus, Rosenberg & Tarvainen 2014, 148–150; Matti Tarvainen, e-mail correspondence 24 April 2020.

219 Martikka 2007.

220 Martikka 2002, 12.

221 Mutru 1999, 24.

and Africa are currently building their nuclear energy programmes, and the IAEA's safeguards financing is not keeping up with the same pace. Among others, STUK has been collaborating with Saudi Arabia in the development of the country's national nuclear safety authority since 2014.

The "3S-Concept" covering the safe use of nuclear power developed in the 2000s. Its components are Safety, Security and Safeguards.²²² STUK's 3S activities and the Finnish safeguards system have been considered exemplary, so the IAEA proposed the Finnish model of co-operation between nuclear power producer, regulatory body and the IAEA as a template based on which international training would be organized. Such 3S workshop courses have been organized in STUK and Olkiluoto in 2014 and 2018, and more are planned. The training is part of the still active Finnish Support Programme to the IAEA Safeguards.²²³

222 See Reiman 2010.

223 Honkamaa 2020, 5.

14 Finland at the forefront of final disposal

In accordance with the non-proliferation commitments, the intermediate storages of nuclear facilities must be tended with diligence, because in the wrong hands, they – nuclear materials or radioactive materials in general – can cause harm and destruction, or in the least seriously threaten large numbers of people. Moreover, the danger will not go away in a blink, on the contrary: spent nuclear fuel is potential raw material for nuclear weapons for thousands of years if one knows how to process it in the right way. The risk does not come only, or perhaps even primarily, from hostile states. After the 2001 terrorist attacks in New York, more emphasis was added to the risk of terrorists getting access to nuclear materials in terms of the possible threats of misuse of nuclear waste.²²⁴ In principle, this was not a new thing, as already Erkki Laurila mentioned terrorists as a threat to nuclear safety in his book in 1977, for example. Elina Martikka, Section Head, Nuclear Materials Safeguards at STUK, wrote in 2004 that Finland alone had “almost 10,000 spent fuel rod elements in intermediate storage and the quantity is increasing all the time” at Finnish nuclear power plants.²²⁵

A decision was made in Finland in 2001 to finally dispose of spent nuclear fuel inside the bedrock in Olkiluoto in Eurajoki, at a depth of approximately half a kilometre. The matter was ultimately confirmed by the Parliament following the Government’s decision-in-principle. Because there was no readymade model, Finland ended up shaping the guidelines for the regulatory control of final disposal for the entire world to follow.²²⁶ The new challenges to safeguards had naturally been acknowledged for a long time. Experts have remarked that Finland is now in a similar trailblazing situation with regard to them as it was when drafting the model IAEA agreement in the early 1970s.²²⁷ The final disposal project has later been impressively depicted in the *Into Eternity* documentary film that premiered in 2010, for instance.²²⁸ The film is a gloomy representation of the “eternally” radiating nuclear waste tomb of Olkiluoto and aimed at the general public.

The projects of Sweden and the United States (Yucca Mountain) were technical pioneers of the final disposal of high-activity nuclear waste for a long time, and Finland learned its lessons from them.²²⁹ The order was reversed in the 2010s, when the construction of a final disposal

224 Martikka 2004, 10–11.

225 Martikka 2004, 10; Laurila 1977.

226 Martikka 2004, 10.

227 Tarvainen, interview 8 April 2020. See, inter alia, Tarvainen 1994.

228 INTO ETERNITY: A FILM FOR THE FUTURE. Director Michael Madsen. Denmark, 2010.

229 Nikula et al. 2012, passim.

facility has only continued without problems and interruptions in Finland. In this sense, Finland being a pioneer has half-jokingly been characterized as an accident or coincidence.

The final disposal of spent nuclear fuel underground is globally such a new thing that the IAEA could not provide information about which requirements and methods it would be using for the non-proliferation safeguards of the final disposal facility in advance. Those were requested by Posiva, the company in charge of constructing the final disposal solutions. STUK developed these new underground dimensions of safeguards with the assistance of the Finnish Ministry for Foreign Affairs' support programmes and in co-operation with foreign experts. In practice, the most important thing is that the excavated rock caverns are known, documented and carefully supervised in order to eliminate any secret tunnels or other spaces, for instance (Safeguards by Design), because after the final conventional verification, the spent fuel is sealed, meaning that it will forever disappear from the reach of humans.²³⁰ When the IAEA organized an international safeguards symposium in Vienna at the end of 2018, STUK's representatives reported on these safeguard solutions used in the final disposal facility for spent nuclear fuel developed by the Finns as the first in the world.²³¹



ROCK IS EXAMINED AND MARKINGS are made in it in the central tunnel to be used in the integrated systems test of ONKALO at a depth of 426 metres. The underground final disposal facility Onkalo does not mean that the spent fuel encapsulated there can simply be forgotten. Safeguards continue underground in accordance with the Non-Proliferation Treaty, only implemented in a different way. Photograph taken on 18 September 2019. Photo: Tapani Karjanlahti/TVO.

230 Martikka 2004, 13.

231 Heinonen & Martikka 2018.

There is great interest in the Finnish final disposal facility for nuclear waste across the world and in the IAEA. At the same time, the facility provides an international opportunity and need for re-inventing and testing unforeseen, long-lasting non-proliferation safeguards.²³² As Finnish experts recall what has been reported on their country's role in drafting the IAEA safeguards agreement, Finland has played the demanding role of a pioneer also before, half by accident, while pursuing its goals with full intent.

232 Rockwood, Mayhew, Lazarev & Pfneisl 2019.

15 Conclusions: Finland and non-proliferation

In the international discussion on the proliferation of nuclear weapons, Finland has, in the wildest scenarios, been depicted as a country that could, on account of its relatively extensive nuclear power industry and high level of expertise, develop its own nuclear weapon capability in response to the threat of a hypernationalistic Russia.²³³ Even though such a conclusion flatters Finland's know-how, from the Finnish perspective, this scenario is purely in the domain of science fiction and imagination.

Factually, Finland has been explicitly committed to the use of nuclear power for peaceful purposes from the very beginning and aimed to spread this conviction globally in accordance with, and as a promoter of, the Treaty on the Non-Proliferation of Nuclear Weapons. Similarly, nuclear disarmament and, in particular, preventing nuclear proliferation have been key objectives in Finland's non-proliferation policy. The Non-Proliferation Treaty has been a well-functioning guarantee of international peace and security in accordance with and in regard to Finland's official policy.

The relationship between the Treaty on the Non-Proliferation of Nuclear Weapons and Finland began as active and special, when the superpowers requested Finland to head its sponsors in the UN in 1968 and when Finland soon acted as the first drafter and signatory to the IAEA safeguards agreement. These achievements, documented in this study for the first time, created a pioneer identity for the Finns; this identity was invoked also later and it influenced their performance. Finland's solutions combined the shared goals of global security and peace with Finland's national goals of the country's active and visible neutrality policy and the possibility of starting the production of nuclear energy under international supervision. Similar factors were often combined when Finland later engaged in proactive and diligent activity for the benefit of the Non-Proliferation Treaty, especially in the 1970s and later in the 1990s. At that time, Finland's aspired EU membership and deepening integration into the West were also major contributors.

The non-proliferation policy of the more recent decades has been described above from Finland's point of view, considering the different parties and illustrating their divergent points of view. The aim has been to show the recent times in a longer temporal continuum and thereby shed light on Finland's non-proliferation policy, as well as the repeated critical discussion on it.

Internationally, Finland is an example of a small country's possibilities and limits as a party to the nuclear non-proliferation regime. Even though it was not possible to compare it

233 Tertrais 2006.

to other countries in the framework of this study, in the case of Finland, the relationship with the superpowers and particularly their mutual relationship seems to have been an essential factor in different phases. From the very beginning, the situation of Finland's nuclear-weapon neighbour to the east, whether its name has been the Soviet Union or Russia, has influenced Finland's solutions in safeguards and nuclear arms control in general. In terms of foreign policy, Finland has built peace by aiming to bring the superpowers closer to each other also in nuclear weapon issues. At the same time, the neutral country was able to raise its national profile during the Cold War. At times of tightened relations between the superpowers, Finland has done its best to support the implementation of commitments made and aimed to promote these through practical measures. In general, this step-by-step approach has become the foundation and doctrine of Finland's policy.

Promoting non-proliferation has demanded long-term commitment and resilience from Finland: neither the Non-Proliferation Treaty nor nuclear power waste issues, for instance, are marathons or even ultramarathons, but more a kind of a healthy and active lifestyle passed from one generation to another. The achievements in non-proliferation policy are the results of consistent long-term work, and continuity is important in many kinds of projects. The time span of many developments launched in the era of building nuclear energy in the 1970s crosses generational boundaries, which also increases the need for, and benefits of, historical information to better understand permanence and changes.

The development of the nuclear industry in Finland has been greatly assisted by extensive national co-operation. Especially during the 1970s, Finland launched several far-reaching preparation processes in diverse working groups, the results of which have lasted to this day. Various authorities, power companies and impartial nuclear energy researchers were all involved in discussing them. Finnish actors have also created a close co-operative relationship with the IAEA – the Agency and strengthening its capacity for international action have been considered crucial both for Finland and more broadly. Nevertheless, one should remember that there has been continuous domestic critique in Finland, too, and nuclear energy representatives have occasionally been accused of being deaf to criticism. In the most successful projects, such as with regard to the final disposal facility for nuclear waste, critical feedback has been skillfully taken into consideration for a long time.

According to President Urho Kekkonen, it was Finland's aim during the Cold War to be a doctor, not a judge.²³⁴ With regard to the nuclear non-proliferation regime and arms control in general, Finland's safest bet has been to invest in developing technological expertise. Finland has consistently carried out such engineer-minded work in developing the IAEA safeguard solutions and nuclear exports control and as a forerunner of safeguards for the final disposal of spent nuclear fuel. Finland has also significantly promoted safeguards of nuclear materials especially outside its borders in the former Soviet Union region. One could, in fact, summarize Finland's role as "more of an engineer than a politician." This characterization well matches Finland's profile, especially in the times after the 1990s and in particular as the builder of the world's first underground final disposal facility.

234 Soikkanen 2003, 198–199; Vesa 2012.

Abbreviations

ALARA	As Low As Reasonably Achievable, principle of radiation protection and name of STUK's journal Alara
APO	active nuclear fuel and waste working group
ARNEK	Advisory Board for Disarmament
ATS	Finnish Nuclear Society
CSA	Comprehensive Safeguards Agreement, a comprehensive nuclear material safeguards agreement required of non-nuclear-weapon countries by the Treaty on the Non-Proliferation of Nuclear Weapons
CTBT	Comprehensive Nuclear-Test-Ban Treaty
EURATOM	European Atomic Energy Community
IAEA	International Atomic Energy Agency
INFCIRC	IAEA Information Circulars
IVO	Imatran Voima Oy, later Fortum
FINSP	Finnish Support Programme to the IAEA Safeguards
KTM	Ministry of Trade and Industry, one of the predecessors of TEM
MATINE	Scientific Advisory Board For Defence
MBA	Material Balance Area, the base unit of measurement in nuclear material accounting
NAC	New Agenda Coalition

NPT Nuclear Non-Proliferation Treaty, officially The Treaty on the Non-Proliferation of Nuclear Weapons

NSG Nuclear Suppliers Group

SSAC State System of Accounting for and Control of Nuclear Materials, the foundation of the national nuclear material control system

STUK Radiation and Nuclear Safety Authority

TEM Ministry of Employment and the Economy

TKK Helsinki University of Technology, later part of Aalto University

TPNW Treaty on the Prohibition of Nuclear Weapons

TVO Teollisuuden Voima Oyj

UM Ministry for Foreign Affairs

VTT VTT Technical Research Centre of Finland Ltd



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