

TO MAKE A NATIONAL BASED HISTORICAL SURVEY OF NON-PROLIFERATION OF NUCLEAR WEAPONS. EXPERIENCES FROM THE EXAMPLE OF SWEDEN

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Abstract

This paper presents a project which was initiated by the Swedish Nuclear Power Inspectorate (SKI) and accepted by the Agency as a support program task to increase transparency and support the implementation of the Additional Protocol in Sweden. A general model of how such a historical review of a state's non-proliferation of nuclear weapons policy have been created in order to serve as a guide for other countries strengthening of their safeguards system in the framework of the Additional Protocol. The model contains of four parts, comprising of components such as a state's profile of nuclear activities and role in the non-proliferation policy, nuclear weapons research, and how to evaluate a state's capability to produce nuclear weapons.

1. INTRODUCTION

How is it possible to make a review of a state's nuclear energy activities in the past? And how is it possible to evaluate a state's capability to produce nuclear weapons? The Additional Protocol stipulates that the states in question not only have an obligation to render accounts for current activities, they are also responsible to deliver information about planned future operations. But the Swedish Nuclear Power Inspectorate (SKI) has chosen to go a step further and also include what took place in the past. Although the Additional Protocol does not compel member states to carry out such historical reviews, SKI has decided to report openly on Swedish nuclear weapons research since 1945. As a consequence SKI initiated a project 1998 to carry out this historical survey.¹ The project was accepted by the Agency two years later as a support program task to increase transparency and support the implementation of the Additional Protocol in Sweden. Besides making a survey of the Swedish nuclear energy activities since the mid-forties, the aim is to create a general model of how to conduct historical reviews in order to serve as a guide for other countries strengthening of their safeguards systems within the framework of the Additional Protocol.

In this paper, I will describe how this project was carried out which in turn hopefully can say something generally about how such an investigation can be designed.

2. RESEARCH CONCERNING SWEDISH NUCLEAR WEAPONS: A GENERAL BACKGROUND

To understand the nature of the Swedish nuclear related activities, and especially the Swedish plans to produce nuclear weapons, a short summary is needed. The Swedish plans to produce nuclear weapons, which was abandoned in 1968 when the Swedish government signed the NPT, was based on a dual purpose technology. The production of nuclear weapons should be designed as a part of the civil nuclear energy development. A company, AB Atomenergi (AE), was created in 1947 to deal with the civil industrial development. The company conducted research and built facilities such as reactors and

¹ Jonter, Thomas, *Sverige, USA och kärnenergin. Framväxten av en svensk kärnämneskontroll 1945-1995* (Sweden, USA and nuclear energy. The emergence of Swedish nuclear materials control 1945-1995). SKI Report 99:21; *Försvarets forskningsanstalt och planerna på svenska kärnvapen 1945-1972*, SKI Rapport 01:5 (Sweden and the Bomb. The Swedish Plans to Acquire Nuclear Weapons, 1945-1972. SKI Report 01:33). A Third report is soon to be published, *AB Atomenergi och planerna på svenska kärnvapen 1945-1972*.

a fuel fabrication plant which also in part were designed to suit a possible future production of nuclear weapons. The Swedish National Defence Research Institute (FOA), who was responsible for the military use of nuclear energy, began with nuclear weapons research as early as 1945. Admittedly, the main aim of the research initiated at this time was to find out how Sweden could best protect itself against a nuclear weapon attack. But from the outset FOA was also interested in investigating the possibilities of manufacturing what was then called an atomic bomb. When, in 1954, the Commander-in-Chief of the Swedish Armed Forces advocated Swedish nuclear weapons, this research became the object of political discussions and conflicts.² Resistance to these plans began to emerge among the public, in parliament and even among the government, where Prime Minister Tage Erlander had been in favour of acquiring nuclear weapons well into the 1950s.³ Not only Sweden as a whole, but also the social democracy movement, was divided on the issue. For this reason, a bill was drafted which laid down a period for consideration. This meant that Sweden could postpone a decision on the issue. According to the bill, the reason for the consideration period, or freedom of action as it has also been called, was that research had not reached the technical level at which a decision could be taken on the issue.⁴

The bill laid down that, for the time being only protection research could be done, excluding research aimed directly at producing nuclear weapons. Parliament passed the bill in July 1958.

Did FOA stay within the limits of protection research as regulated by the government? Over the years, this question has been the subject of debate and a government report. A vital task for this project was to analyse whether or not FOA went beyond the defined limits.

3. THE SWEDISH NUCLEAR ACTIVITIES PROFILE SINCE MID-FORTIES

The first objective was to make a general inventory of the Swedish nuclear operations since 1945. How can this be done without too much time-consuming archival work? A general overlook was needed. And that general view was not actually reached in Sweden but in a gigantic archive across the Atlantic Ocean, namely the National Archives in Washington DC. The reason for this is that United States global nuclear energy policy since World War II was designed to prevent proliferation of nuclear weapons. The US administration collected extended information about all nations' nuclear energy activities. The United States Atomic Energy Commission (USAEC) who was responsible for the nuclear trade, particularly since the "Atoms for Peace" –programme was launched in the mid-50s, followed every participating nation's developments in this respect. Detailed reports were sent to Washington about the progress of the Swedish nuclear energy operations, especially after the mid-50s when Sweden started to make serious plans for a production of nuclear weapons.

On several occasions the US archives have given detailed information on Swedish issues where the Swedish counterparts have been sparse. The most spectacular example is from the end of the 50s. In the US files I found exhaustive reports about how Swedish military, diplomats and researchers belonging to the military establishment started to explore the possibilities of acquiring nuclear weapons from United States. The Swedish archives contain hardly any information about these talks. There is not enough room here to explain the reason behind this silence, a not too daring guess is that the Swedish non-aligned policy made the officials consciously cautious when documenting sensitive information in foreign policy matters. It is likely that even other states, with which United States co-operated within the nuclear energy research, have similar sensitive fields that have not been objects for documentation in domestic archives.

The reading of reports and analysis by the State Department, CIA and USAEC gave me the general picture I was looking for. Through this archival research I could study organization charts of the

² *Alltjämt starkt försvar. ÖB-förslaget 1954* (ÖB 54). (Strong Defence Preserved. The Commander-in-Chief's proposal 1954 (ÖB 54)). Kontakt med krigsmakten 1954:9-10. (*Contact with the armed forces 1954:9-10*)

³ Erlander, Tage, *1955-1960*, Stockholm 1976, pp 75-101.

⁴ Bill 1958:110.

Swedish nuclear energy projects, identify key persons involved in the activities, and track dates when important meetings were held. This reading gave me useful information to follow up in the Swedish archives and above all, provided me with well-informed summaries and evaluations of the aims and capabilities of the Swedish nuclear developments. In this context, it is important to understand that at this time much of the documentation concerning nuclear weapons related research conducted by FOA was classified.

After this general inventory, I could start the work in the Swedish archives to map-out how the nuclear energy projects were organized since 1945. An important task was to pin-point the government authorities, organizations, private companies, universities and research institutions who were involved in the activities and who had the authoritative power at different times. This part of the survey can be of much help in tracking information and documentation otherwise hard to find.

Another important task was to make a list of Swedish archives which contain documentation about both civil and military nuclear energy activities: to show in general terms what each archive contains, especially in regards to nuclear materials, facilities and equipment which could be used in a production of nuclear weapons. It is also important to investigate whether the archives in question are open or not for the public or the research.

A first review of the Swedish nuclear activities based on Swedish archives as well as a comparison with the US general picture was now possible to make. This archival research was combined with a study of government reports and literature about the emergence of the Swedish nuclear energy and nuclear weapons research.

Now it was possible start to analyzing how the Swedish nuclear materials control system was developed over the years. This includes a list of international inspections of nuclear materials and nuclear facilities in Sweden. An important aim was to show how the early inspection routines were worked out, and how they developed later on, especially in regards to the co-operation with the US and the IAEA. Another important task was to check if there have existed nuclear materials which is not accounted for in the information handed over to the IAEA.

3.1 FOA AND THE PLANS TO MANUFACTURE NUCLEAR WEAPONS

Next step was to analyse FOA's nuclear weapons research, a field that has so far not been analysed by historians, political scientists or other researchers. Admittedly the issue has been touched on in articles and studies, but then in a more general way, describing the main aspects of Swedish official policy. The texts were not based on a thorough review of sources relating to the activities of FOA during the relevant period from 1945 up to 1968, when Sweden signed the NPT.⁵

The first aim of this part of the project was to investigate whether or not FOA went beyond the defined limits of the allowed protection research.

⁵ See for example Agrell, Wilhelm, *Alliansfrihet och atombomber. Kontinuitet och förändring i den svenska försvarsdoktrinen 1945-1982* (Non-alignment and atomic bombs. Continuity and change in the Swedish defence doctrine 1945-1982), Stockholm 1985; Björnerstedt, Rolf, "Sverige i kärnvapenfrågan" (*Sweden in the nuclear weapons issue*). *Försvaret i nutid*, 1965:5; Forssberg, Olof, *Svensk kärnvapenforskning 1945-1972*. (government report) Stockholm 1987; Fröman, Anders, "Kärnvapenforskning" (Nuclear weapons research), in *Försvarets forskningsanstalt (The Swedish National Defence Research Institute) 1945-1995*. Stockholm 1995, and *FOA och kärnvapen – dokumentation från seminarium 16 november 1993* (FOA and nuclear weapons – documentation from a seminar on 16 November 1993), FOA VET om försvarsforskning (FOA knows about defence research) 1995; Garris, Jerome Henry, *Sweden and the Spread of Nuclear Weapons*. University of California, Los Angeles, Ph. D; Jervas, Gunnar, *Sverige, Norden och kärnvapnen* (Sweden, the Nordic countries and nuclear weapons). FOA report C 10189-M3. September 1981; Larsson, Christer, "Historien om en den svenska atombomben". *Ny Teknik*, 1985-86; Lindström, Stefan, *Hela nationens tacksamhet: svensk forskningspolitik på atomenergiområdet 1945-1956* (The entire nations's gratitude: Swedish research policy in the atomic energy field 1945-1956). Stockholm 1991; Larsson K-E, "Kärnkraftens historia i Sverige" (*The history of nuclear power in Sweden*), Kosmos, 1987; Larsson, Tor, "The Swedish Nuclear and Non-nuclear Postures", *Storia delle relazioni internazionali* 1998:1.

The second aim was to place Sweden's nuclear energy research in the context of the international scientific discussion of nuclear weapons proliferation. In this discussion, Sweden has been regarded as an advanced country scientifically and in terms of nuclear technology, a country that refrained from making nuclear weapons even though it was considered technically capable of doing so. It has been generally accepted in the international discussion that Sweden reached a latent capability to begin concrete preparations for nuclear weapons manufacture at the end of the 1950s. But that notion is not based on any review of FOA's nuclear energy activities, but on open sources.⁶

The model used is described in part 4.

The third aim was to follow up the way in which the nuclear weapons activities were phased out after Sweden signed the NPT in 1968 (in other words, how Swedish protection research developed after the agreement had been signed).

The fourth aim was to investigate how much plutonium, uranium (natural and depleted) and heavy water FOA had at its disposal within the framework of the research it conducted.

3.2 THE CIVIL AND MILITARY CO-OPERATION

Even though the FOA study dealt with the co-operation between FOA and AE in order to make technical preparations for a nuclear weapons production the picture was far from clear. I could show what main tasks AE were responsible for within this co-operation and what reactors and other facilities the company had in its possession. But rather little was known about what AE did in detail and what consequences it had for the project as a whole. Another unsolved issue was how much heavy water, plutonium of weapons quality, ²³⁵U and natural and depleted uranium AE used or had in its possession during the period of 1945-1972. Important questions to be answered are: What laboratories, reactors and facilities were used for activities with nuclear material, especially with plutonium, ²³⁵U and heavy water, and where they were located?

In addition to the archival studies, I conducted interviews with former employees at AE and FOA who were involved in this research. This part of the presented model can give new knowledge and perspectives that are hard to find in the archives. This is especially important in cases when documentation is lacking or is scanty. This method was of much help in the study of the co-operation between FOA and AE, where in some cases the documentation was not too exhaustive.

4. THE SWEDISH ROLE AND INTERACTIONS IN THE AREA OF INTERNATIONAL NON-PROLIFERATION

In this part of the project I started to create a profile of the Swedish organisation charts which, of course, changed over the years. A number of essential questions could now be answered such as: Which departments of government have been responsible for different nuclear related matters and at what times? How did the safeguard systems emerge? Which companies, universities and institutions have been involved and to which specific areas of the nuclear related research and development have they contributed?

Then I continued and made a list of national laws that have regulated the use of nuclear materials and heavy water since 1945. Essential questions are: How have the import and export regulations been designed since 1945? Who has had the permission to use sensitive nuclear materials and on what conditions?

In this context, I also made a list of all the international agreements and conventions in the nuclear energy field which were signed and ratified by Sweden since 1945.

⁶ For example, Stephen M Meyer states that this happened in 1957, Meyer, Stephen M, *The Dynamics of Nuclear Proliferation*, Chicago 1987, p 41. Meyer bases this assertion on a dissertation by Jerome Garris, "Sweden's debate on the proliferation of nuclear weapons", see p. 207, footnote 3.

Also a list of bilateral agreements in the nuclear energy field between Sweden and other states was compiled. It is also important to notice that not all co-operation necessarily went through bilateral (government controlled) agreements procedures. If a state used other procedures it is, of course, important to find documentation of this co-operation, in order to make a reliable survey. This part of the project also includes a list of archives that contain documents on the Swedish atomic energy development, both for civil and military use.

5. HOW IS IT POSSIBLE TO EVALUATE A STATE'S CAPABILITY TO PRODUCE NUCLEAR WEAPONS?

The appendix does not demand such an evaluation, but I have used a model which enable me to evaluate the Swedish capability. From my point of view, it is not possible to make an analysis of the nuclear weapons activities at FOA without such a model. I have used a model from the American political scientist Stephen M Meyers study *The Dynamics of Nuclear proliferation*. With his model I can define essential terms such as "nuclear weapons program" and "latent capability".

Why do certain states choose to take the step from latent capability to operational capability? Meyer distinguishes four steps in the process from decision to finished nuclear explosive devices:

1. A state decides to acquire latent capability to manufacture nuclear weapons;
2. A state has reached latent capability;
3. A state decides to manufacture nuclear weapons;
4. A state possesses nuclear weapons.

A state is regarded as having a nuclear weapons programme when the intended programme has been started with an aim to producing at least one nuclear explosive device per year on average for several years. It is immaterial whether the state in question has any plans for a weapon carrier or whether nuclear weapons tests are planned.

In addition, a state is regarded as having achieved latent capability when it has achieved the capability to carry out the above nuclear weapons programme.

But how can the latent capability of a state be measured in a more concrete sense?

A great deal of resources is needed in order to carry out a complete nuclear weapons programme. Firstly, purely material resources such as steel, concrete and obviously nuclear materials are needed. Secondly, scientific expertise is needed. This means more than simply having sufficiently developed nuclear physics and nuclear chemistry available; the scientific knowledge must extend to other areas such as classical mechanical engineering, thermodynamics, kinetic theory and the metallic properties of uranium and plutonium. Thirdly, a state needs technical know how and extensive organisational ability to be able to design and run the programme. It will also need a developed ability to be able to maintain and replace parts in an efficiently functioning nuclear weapons programme.⁷

Meyer divides the possible latent capability of states into three categories.

1. For a state entirely lacking in nuclear infrastructure, and which decides to produce finished nuclear explosive devices, it would take up to six years from the initial experiments to produce the first nuclear weapon.
2. For a state with a modest nuclear infrastructure, the goal of producing the first device could be achieved in two to three years.
3. A state with an advanced nuclear infrastructure would be able to produce a finished nuclear explosive device within at most two years. Such a state possesses practically everything that is needed apart from the actual weapons factory. There are two forms of advanced capability: either the state has both a plutonium-producing reactor and a reprocessing plant (or a "hot cell") or it has a uranium enrichment plant. In either case, the country in question has practically all the resources needed to start a nuclear weapons programme.⁸

⁷ Meyer, Stephen M, *The Dynamics of Nuclear Proliferation*, Chicago 1987.

⁸ Ibid. p 37.

6. CONCLUSIONS

The results of my research can be summarized in mainly six conclusions. The first is dealing with the US nuclear weapons policy towards Sweden. The US policy is analyzed in two periods. In the first period, 1945-1953, the US policy towards Sweden followed the same pattern as toward the rest of Western Europe. The most important aim was to prevent Sweden from acquiring nuclear materials, technical know-how, and advanced equipment that could be used in the production of atomic weapons. During this period the Swedish plans to produce its own nuclear weapons were rather undeveloped. It was, for instance, not a debated issue among political organizations or in the media.

The first priority of the US administration was to discourage the Swedes from exploiting their uranium deposits, especially for military purposes. In the eyes of the Swedish actors, the US policy was considered too restrictive. As a result of this restrictive policy, Swedish researchers developed co-operation with other nations, especially with Great Britain and France. The first Swedish research reactor was actually constructed with assistance and help from Commissariat à l'Énergie Atomique (CEA).

In the next period, 1953-1960, the US policy was characterized by extended aid to the development of the Swedish energy programme. Through the "Atoms for Peace"-programme, the Swedish actors now received previously classified technical information and nuclear materials. Swedish companies and research centres could now buy enriched uranium and advanced equipment from the United States. This nuclear trade was, however, controlled by the USAEC. The American help was designed to prevent the Swedes from developing nuclear capability. The second Swedish reactor, located in Studsvik and finished 1959, was in fact constructed with American financial help and technology.

From mid-50s Swedish politicians and defence experts realised that a national production of atomic bombs would cost much more than was supposed 4-5 years earlier. As a consequence, Swedish officials started to explore the possibilities of acquiring nuclear weapons from United States. The Swedish defence establishment assumed that event though Sweden was not a member of NATO it would be in the US interest that the Swedish defence was as strong as possible to deter a Soviet attack. The US administration reacted negatively to these Swedish plans. The US jurisdiction made it impossible to sell to Sweden or otherwise let the Swedes have American atomic bombs. The official policy was based on the Atomic Energy Act which only permitted the US government to contribute to other nations nuclear weapons capability if the country in question had a mutual defence agreement with United States. This was not the case with neutral Sweden, American officials claimed.

The Swedish inquiries regarding the acquisition of American nuclear weapons did take place from 1954 to 1960. Although the American administration adopted a negative attitude towards these Swedish ideas from the beginning it, nevertheless, became a dilemma for the US government. It was considered as a better alternative to equip the Swedish defence with US atomic bombs if the other option was that Sweden otherwise would produce its own nuclear weapons. In the first alternative, the US administration had at least control over the use of the atomic bombs. It would be harder if the Swedes produced their own bombs, concluded experts within the State Department.

Albeit running this risk, the National Security Council (NSC) arrived at the decision in April 1960 that United States should not provide Sweden with nuclear warheads. It was of course in theory possible that the Swedes could develop a nuclear weapons programme by themselves, but it was not held likely by the NSC. A Swedish atomic weapons programme would cost too much for a small country like Sweden, the NSC concluded. Furthermore, such Swedish weapons programme would be dependent on American good-will and assistance, i.e. certain materials and advanced equipment had to be imported from United States.

The second finding of this research project considers the extent of international inspections of nuclear materials and reactors in Sweden 1945-1975. From 1960 to 1972 it was only United States, through the Atomic Energy Commission, who carried out inspections of nuclear materials of US origins.⁹

The third conclusion deals with the nuclear weapons research carried out by FOA and AE. FOA performed an extended research until 1968, when the Swedish Government signed the NPT, which meant the end of these production plans. Up to this date, five main investigations about the technical conditions were made, 1948, 1953, 1955, 1957 and 1965, which all together expanded the Swedish know-how to produce a bomb.

Was then protection research the only research that was performed? The conclusion of this report is that FOA went further in its efforts to make technical and economical estimations than the defined programme allowed, at least in a couple of instances. The findings in this analysis support the assumption that it was a political game that made the Swedish Government to introduce the term protection research to escape criticism, while in practical terms construction research was performed in order to obtain technical and economical estimations for a possible production.

The fourth finding of this research project is that Sweden reached latent capability to produce nuclear weapons in 1955. This is at least two years earlier than what is normally claimed in the international literature on nuclear proliferation. For example, in Stephen M Meyer's classic study *The Dynamics of Nuclear Proliferation*, Sweden is said to have reached latent capability in 1957. Meyer's study refers to another study in this respect. An analysis of the declassified documents from FOA concludes that this is at least two years to late.

The fifth result of this project is the review of the de-commissioning of the nuclear weapons research in Sweden after the NPT was signed in 1968.¹⁰

The sixth result is the account for how much plutonium, natural and depleted uranium and heavy water FOA and AE had at their disposal within the research programme. The result of this investigation concerning FOA is presented in the report *Sweden and the Bomb. Swedish Plans to acquire Nuclear Weapons, 1945-1972*.¹¹ In the end of this year, the figures of the nuclear materials AE had at its disposal will be published in a SKI report.¹²

⁹ See Appendix 2, p 52 in Jonter, Thomas, *Sverige, USA och kärnenergin. Framväxten av en svensk kärnämneskontroll 1945-1995* (Sweden, USA and nuclear energy. The emergence of Swedish nuclear materials control 1945-1995). SKI Report 99:21.

¹⁰ *Sweden and the Bomb. Swedish Plans to Acquire Nuclear Weapons, 1945-1972. SKI Report 01:33*

¹¹ *Ibid.*

¹² *AB Atomenergi och planerna på svenska kärnvapen 1945-1972.*