LITHUANIA'S NUCLEAR PAST: A HISTORICAL SURVEY

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CONTENTS

INTRODUCTION

The study of Lithuania's nuclear past consists of three parts. Part one discusses the key directions of the research in nuclear physics, conducted by Lithuanian scientists, and the training of specialists in the field of nuclear engineering. Part two deals with the circumstances of construction of the Ignalina Nuclear Power Plant, Lithuania's most important nuclear facility. The deployment of the Soviet Union's nuclear weaponry in Lithuania is discussed in part three.

The study was performed by the representatives of the Institute of Physics, the Lithuanian Energy Institute, and the Institute of International Relations and Political Sciences of Vilnius University. The work was coordinated by the State Nuclear Power Safety Inspectorate (VATESI) and was financed by the Swedish Nuclear Safety Inspectorate (SKI).

The conclusions presented in the survey and the authors' standpoint in the generalization of data does not represent the official view of VATESI regarding the subject.

DEVELOPMENT OF SCIENCE IN THE AREA OF NUCLEAR PHYSICS

Nuclear physics in Lithuania before World War II

The following words by prof. K. Makariūnas can serve as a suitable beginning for the survey of Lithuania's nuclear past: "Although Lithuania, which did little to develop nuclear research, became a nuclear state fairly late and unexpectedly for herself, interest in nuclear physics was displayed when she was still at the stage of formation[1].”

Before World War II discoveries in nuclear physics took little time to reach Lithuania. New scientific developments were being watched in the country. Besides articles published in the Lithuanian popular science magazines, books written by scientists, such as V. Čepinskis, A. Žvironas, and H. Horodnyčius, appeared in 1920–1940 in the field of man-made radioactivity, newly discovered radioactive elements, nuclear reactions and their energy potential, as well as nuclear apparatus. The material generalizing this period is given in references[2,3]. Before WW II broke out, Vilnius University received several fairly powerful sources of radium from the Cavendish Laboratory at Cambridge. However, the war prevented the beginning of the research, using the powerful sources of radium. Weaker sources were subsequently used in the laboratories for teaching students.

Directions of studies in the Soviet Lithuania

Conditions for starting scientific research in the area of nuclear physics were non-existent in the pre-war Lithuania. Nevertheless, the rudiments of nuclear physics are evident in spectroscopy and the physics of cosmic rays, the closely related branches of physics.

After WW II, more scientists in the field of nuclear physics, such as Boleslovas Styra, Kęstutis Makariūnas, Vladas Vanagas, etc., returned to Lithuania and started working there.

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1 Modern Physics in Lithuania. Šviesa publishers. Kaunas, 1997 (in Lithuanian).
2 Šenavičienė I. Development of Physics in Lithuania in 1920-1940 m. Mokslas publishers, 1982, pp. 82–85 (in Lithuanian).
3 Makariūnienė E., Makariūnas K. Nuclear physics in Lithuanian popular science publications in 1920–1940s. 17th Baltic Conference on History of Science: Baltic Science Between the West and East, Tartu, 4–6 October 1993, pp. 49–52.

The Laboratory of Nuclear Research. On October 1, 1956, when establishing the Institute of Physics and Mathematics, the Radioactive Radiation Sector (RRS) was set up by resolution No. 141 of the Presidium of the Academy of Sciences of the Lithuanian SSR, in which research in experimental nuclear physics was conducted[4,5]. The Sector was created with the initiative of academician Povilas Brazdžiūnas (1897–1986). On May 22, 1959, the Presidium of the Academy of Science of the Lithuanian SSR adopted resolution No. 87 *On Developing Scientific Research in Radioactive Substances at the Institutes of the Academy of Science*, which instructed the beginning at the Academy research in semiconductor structure, changes in properties of semiconductors and dielectrics, resulting from the effects of radioactive and other nuclear radiation, and applying nuclear physics techniques for the research in the field of solids[6]. The first research fellows of RRS used to go to other republics of the USSR for in-service training. The training sessions used to be most useful at Leningrad Institute of Physics and Technology. As higher schools of Lithuania had no departments of nuclear physics, each specialist of RRS was taught individually or started working there after graduating higher education establishments and post-graduate courses in other republics of the former Soviet Union. Prof. K. Makariūnas, one of the most prominent scientists in this field, studied at Leningrad Institute of Physics and Technology and in 1960 defended the thesis *Research into (α, α'), (α, p), (α, d), (α, t) Reactions in Lithium Atoms*. On his return to Vilnius, prof. K. Makariūnas was in charge of the Radioactive Radiation Sector of the Institute of Physics (The Institute of Physics and Mathematics, prior to 1977) of the Lithuanian Academy of Sciences of the Lithuanian SSR, where he worked together with prof. P. Brazdžiūnas, who was especially interested in the physics of semiconductor radiation[7]. Later on, the

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4 Central Archive of the Academy of Sciences, Folio 1, Fund 2, File 412, 1.48.

5 Laboratory of Nuclear Research: Bibliography. Compiled by Makariūnienė E. Vilnius, The Institute of Physics, 1991 (in Lithuanian).

6 Central Archive of the Academy of Sciences, Folio 9, Fund1, File 22,1.1-3, pp. 19-20.

7 Academician Povilas Brazdžiūnas. Prominent Scientists of Lithuania. Vilnius Academia publishers, 1992 (in Lithuanian).

Sector was renamed as the Laboratory of Nuclear Research. Prof. K. Makariūnas, who run it for nearly four decades, is considered to be the initiator of research into experimental nuclear physics in Lithuania[8,9]. At present, prof. K. Makariūnas is the Chairman of the Lithuanian Science Council.

In the profiled science of the Academies of Sciences of the Soviet Republics, development of nuclear physics in Lithuania was not envisaged. Therefore, only research was conducted for which the available technical basis was sufficient. There were these limitations of technical basis or, in other words, inadequate funding that determined the character of nuclear research, which was conducted in Lithuania. As it was clear that the necessary funds for accelerators and research reactors would not be found in Lithuania, therefore, the methods of nuclear spectroscopy were developed instead. These methods were applied for investigating radiation of radioactive atoms, as well as various properties of nuclei and solids. Worth mentioning are works on the effects of chemical environment of the radioactive atom on transformations of internal conversion and electron capture.

In mid-1950s it was planned to build a nuclear reactor for scientific research in Lithuania. However, the plan was then abandoned, and a research reactor was built at Salaspils near Riga, Latvia, for all three Baltic States. The reactor was commissioned in 1961[10].

The radioactive substances, used for research, were produced by irradiating stable isotopes with neutrons at the reactors of the Institute of Physics of the Latvian Academy of Sciences, at the I. Kurchatov Atomic Energy Institute in Moscow and Leningrad Institute of Nuclear Physics. According to prof. K. Makariūnas, the power of the radioactive sources was of mCi order.

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8 Kęstutis Makariūnas: Bibliography. Compiled by Makariūnienė E. The Institute of Physics, 1992 (in Lithuanian).
9 Makariūnas K. Everyday Work. Vilnius, 2002 (in Lithuanian).
10 Modern Physics in Lithuania. Šviesa publishers. Kaunas, 1997 (in Lithuanian).

Nuclear meteorology. In 1947 prof. Boleslovas Styra (1912–1993) started research in the field of atmospheric radioactivity and set the trend for nuclear meteorology research. B. Styra studied at the Radium Institute of the USSR Academy of Sciences in Leningrad, where he defended the thesis *The Application of Nuclear Radiation in Prospecting Uranium and Thorium Deposits*. In 1965–1967 he ran the Division of Application of Nuclear Physics and Radioactive Isotopes of the Academy of Sciences of the Lithuanian SSR. Later on, the Division was joined to the Institute of Physics and Mathematics of the Academy of Sciences of the Lithuanian SSR and was renamed as the Division of Atmospheric Radiation. Radionuclides were studied as tracers of air-mass transfer; the so-called hot α particles were discovered in the atmosphere. The list of scientific publications by B. Styra (from 1939 to 1981) is presented in a book[11]. Prof. B. Styra was one of the few representatives of Lithuania's science community who used to communicate with the staff of the Ignalina NPP as he had a permit for measuring radioactive substances (emitted at Ignalina NPP) and their environmental impact.

Theoretical research was also conducted in Lithuania. The works by prof. V. Vanagas (1930–1990) in the field of nuclear models development[12] are worth mentioning. He developed a group of theory methods, that have an enormous potential for studying the structure of light nuclei, and constructed a mathematical apparatus, convenient for studying and expressing the energy spectra of heavy nuclei. From 1973, he was in charge of the Sector of the Nucleus Theory. At the former Institute of Physics (now known as the Institute of Theoretical Physics and Astronomy), prof. V. Vanagas set up a team of researchers in the field of the nucleus theory. He used to communicate with scientists from the Eastern communist bloc, as well as theoreticians of nuclear physics from Mexico and Brazil.

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11 Boleslovas Styra: Bibliography. Compiled by I. Blažienė. Vilnius, 1983.

12 Vladas Vanagas: Bibliography. Compiled by E. Makariūnienė. The Institute of Physics, The Institute of Theoretical Physics and Astronomy, Physicists' Society of Lithuania, Vilnius, 1996.

Thermal physics research for nuclear reactors. In 1996 in Lithuanian Energy Institute (LEI) the research of thermal physics and hydrodynamics for nuclear reactors was started. Gradually, this subject became dominant in the institute. In 1980–1990 over 50 employees were working in the Laboratory of Nuclear Installations and Heat Transfer. In the laboratory heat transfer and gas (hydro) dynamics was investigated experimentally in the reactors of the following types: gas cooled fast neutron reactors with superheated gas in the core, hydrogen cooled rocket engine reactors, helium cooled high temperature reactors with ball-type fuel elements. All this research was carried out due to the contracts with main Soviet Union construction or scientific centres.

The program of mastering outer space. Data remains on the research in nuclear power installations within the framework in the archive of the Lithuanian Energy Institute of the program of mastering outer space. Work began in 1968 on a contract basis jointly with Russia's research and design centres, such as the Podolsk Research Institute of Technology, Moscow Institute for Research and Design of Energy Installations, and the I. V. Kurchatov Institute of Atomic Energy. The following tasks are:

- Developing efficient engines and nuclear power installations, that would ensure maneuverability of space craft and adjustment of flight trajectory, and long-term power supply to the devices on board the craft.
- Developing sealed nuclear gas turbine installations.
- Developing high-temperature gas-cooled reactors.
- Solving the problem of cooling nuclear reactors.
- Solving the problem of serviceability of different transducers.

The program of developing small-size reactor installations. Another important program, in which scientists from LEI participated, was the targeted program of the

Soviet Union *Research into Thermal-Physical Properties of Small-Size Reactor Installations* [13]. At LEI, within the framework of this program, work was carried out in the following directions:

- Intensification of heat exchange in different channels of a reactor.
- Research processes of heat exchange and hydrodynamics in fuel assemblies of rod or ball type in the course of transition processes related to the reduction of reactor capacity or it's cooling (in the program it is referred to as "the gas trend").

Scientists of LEI did not take part in other trends, that are listed in the program (selecting the optimal thermal hydraulic schemes for the reactor core, thermal physics of dynamic processes in reactors, and thermal-hydraulic stability of reactors).

Training specialists in nuclear engineering

When the construction of the Ignalina Nuclear Power Plant began, the concern regarded training specialists in nuclear engineering. In 1978 the Department of Thermal and Atomic Power at Kaunas Polytechnical Institute (now Kaunas University of Technology (KTU)) started training the specialists[14]. The first nuclear engineering majors graduated in 1980. Fifty six engineers were trained to work at the Ignalina NPP until 1986, the year of the Chernobyl accident. Due to all kinds of political, national, economic and social motives, only two KTU graduates of that time are still working at the Ignalina NPP. The training of specialists in the field of nuclear engineering was suspended, after the Chernobyl accident. After Lithuania regained its independence, the government of the Republic of Lithuania passed

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13 Targeted Program of Thermal Physics Research into Small-Size Reactor Installations // Archive of LEI – Inv. No. 366cc. File Nr.18. pp.49–53 (in Russian).

14 Gylys J. Nuclear Engineering Specialists Training in Lithuania // PBNC 2002. Proceedings of the 13th Pacific Basin Nuclear Conference. Shenzhen, China, October 21-25, 2002 (CD-R).

resolutions *On Training Nuclear Energy Specialists for the Ignalina NPP* (No. 195, dated May 14, 1991, and No. 496, dated July 7, 1993) obligating to resume training of specialists in nuclear engineering at Kaunas University of Technology. At that time, bachelors in nuclear engineering, on graduating KTU, used to continue their studies at Obninsk Atomic Energy Institute in Russia.

THE NUCLEAR FACILITY:
THE IGNALINA NUCLEAR POWER PLANT

Nuclear power is the basis of Lithuania's power industry. The Ignalina NPP is a product of the former Soviet Union (Fig. 1). Two reactors of RBMK-1500 type are operational at the Ignalina NPP[15]. This is the most advanced and the most recent version of the RBMK reactor design series (only two reactors of this type have ever been built). The power plant was built as part of the Soviet Union's North-West Unified Power System rather than the one, which meets Lithuania's needs. The first unit of the Ignalina NPP was commissioned in late1983, and the second one in the August of 1987. A total of four units with RBMK-1500 reactors were to be built. However, due to political and safety motives the construction of the third unit was suspended as early as 1989.

15 Almenas A., Kaliatka A., Ušpuras E. Ignalina RBMK-1500. A Source Book. Lithuanian Energy Institute, 1998.

Fig. 1. Ignalina NPP

After Lithuania declared its independence in 1990, the Ignalina NPP was still guarded by the Soviet troops and KGB operatives, and remained under the jurisdiction of the Soviet Union until the August of 1991. Supervision was carried out by that country's regulatory authority, the State Nuclear Power Supervision Inspection (Gosatomnadzor). It was only after the political events of the August of 1991 in Moscow that the Ignalina NPP finally came under the authority of the Lithuanian Republic. It is now controlled administratively by the Lithuanian Ministry of Economy, and its supervision is carried out by the Lithuanian State Nuclear Power Safety Inspectorate (VATESI).

How the Ignalina NPP came into being

The material, regarding the establishment of the Ignalina NPP and problems related to it, is collected at the Special Archive of Lithuania (LYA) and the Central State Archive of Lithuania (LCVA). LYA has been using fund No. 1771 of the Central Committee of the Lithuanian Communist Party (CC LCP)[16] whose documents mostly reflect the activities of the CC LCP in supervising the construction of this all-

[16] Special Archive of Lithuania (LYA). Fund 1771.

union facility. The fund contains, among other things, documents of correspondence with different all-union institutions that reflect Moscow's position on the issue. Resolutions of the Central Committee of the Communist Party of the Soviet Union (CC CPSU) and the Council of Ministers of the Soviet Union (CM USSR), whose second copies are stored in the archive, are also used for the present survey. Only the minutes of the sittings that were held in Moscow were sent to Lithuania; the shorthand records and primary material are absent. Nearly all the quoted documents were marked as top secret, which shows that the Ignalina NPP was a facility of extreme importance to both Moscow and Vilnius, as in the 1970s and 1980s most of the Communist Party's documents were marked simply as secret.

Fund No. R-754[17] of the Managing Department of the Council of Ministers of the Lithuanian SSR was also studied in the LCVA. Unfortunately, very few documents related to the researched subject remain in the LCVA. The files of the 1976–1987 period on construction of the Ignalina NPP and issues related to it are completely absent, although nearly all the resolutions of 1974–1975 remain. The originals of the bulk of the documents are also missing, only their copies have been preserved.
The situation is even worse at the archive of the former State Planning Committee of the LSSR[18], whose documents were not handed over to LCVA after 1963. This archive mostly contains the correspondence with the State Planning Committee of the USSR.

The material collected by Laimonas Gryva for the master thesis at Vilnius University *The Construction of the Ignalina NPP and its Operation in 1971–1988*[19] is also used for the present survey.

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17 Central State Archive of Lithuania. Fund R-754.

18 Archive of the State Planning Committee of the LSSR. Fund 755.

19 Gryva L. The Construction of the Ignalina Nuclear Power Plant and its Operation in 1971–1988. Master thesis. The Department of History of Vilnius University. Vilnius, 1996 (in Lithuanian).

Prerequisites for the construction of the Ignalina NPP. When after World War II Lithuania became part of the North-West Unified Power System of the USSR, which covered the area from Murmansk to Belarus inclusive, as well as the Kaliningrad Region, the power industry was managed in such way as to take into account not only the local needs but also the needs of the Unified System.

On September 16, 1971, the CC CPSU and the CM USSR adopted the resolution *On Constructing a Nuclear Power Plant in the Area of the North-West Unified Power System* in accordance with which a new nuclear power facility of 2 million kW capacity was to be constructed in the area; its' first stage of 1 million kW was to be implemented in 1979. The deadline for preparing the technical design was set for October 1973[20]. The 1979 deadline was unrealistic because it took at least 10 years from designing to commissioning a nuclear power facility.

In 1971, the all-union Institute of Design of Thermal Power Facilities drafted proposals for considering the site of the would-be nuclear power plant. Two alternative sites were proposed, at Snudy in the Belarus SSR, near the town of Breslau, and near Lake Drūkšiai. The issue was coordinated with the Ministry of Energy and the Ministry of Medium-Machine Building of the USSR. The latter actually was a ministry of military industry of the Soviet Union disguised beneath this innocent-looking name, and it supervised, among other things, the construction of the NPPs. It was decided to construct the nuclear power facility on the southern shore of Lake Drūkšiai, as siting the plant at Snudy would have cost 25 million roubles more. Furthermore, geological conditions were extremely adverse at the Belarusian site, where clays of the glacial epoch prevail. Nothing was clear about tectonic faults in the Lake Drūkšiai area at that time. The decision was made to build reactors of the RBMK type, that were very highly valuated by Soviet powermen. It was possible to replace fuel in these reactors without shutting them down. In 1971, a boosted version of the reactor was developed,

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20 Resolution of the CC of the CPSU and the CM of the USSR, dated September 16, 1971, *On Construction of a Nuclear Power Station in the Unified North-West Power System* // LYA. Fund 1771. Folder 247. File 147. Sheet 3.

which had a capacity of 1.5 million kW, therefore, all-union departments decided to increase the capacity of the Ignalina NPP to 6 million kW, i.e. to build four units with such reactors[21].

The attitude of A. Sniečkus, the First Secretary of the Central Committee of the Communist Party of Lithuania, towards the issues of safety of this construction is not clear. The documents remaining in LYA attest that the First Secretary was not indifferent to the issues of construction of the nuclear power plant. M. Pervukhin, a member of the Board of the State Planning Committee of the USSR, on July 14, 1972, sent the conclusions, drawn by all-union institutions *Regarding the Issue Raised by You about Ensuring Safety of the Power Plant* to A. Sniečkus[22]. On November 13, 1972, A. Sniečkus and the Prime Minister of the LSSR J. Maniušis sent an official letter to the State Planning Committee of the Soviet Union[23], in which they noted that they had no objections regarding the construction of the Ignalina NPP, although, simultaneously, they sent remarks regarding the siting of the nuclear facility, which was made by the Geology Administration under the Council of Ministers of the LSSR, and the Lithuanian Scientific Research Institute of Geology[24].

Work on constructing the NPP. The first sluggish operations of the construction began in 1973. Different designs were coordinated at that time; agreements were made for the supply of building material. On November 29, 1974, the Western Building-Erection Directorate was set up at the construction site, conventionally named Enterprise Post-Box A-7109, that became a structural division of Enterprise Post-Box B-2308 (the construction of the Leningrad NPP)[25]. Practically nothing was

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21 Reference of the CC of the LCP and the CM of the LSSR to the CC of the CPSU, dated November 13, 1972 *On the Issue of Construction of the Ignalina NPP* // LYA. Fund 1771. Folder 269. File 263. Sheet 16.

22 Reference by Pervukhin M. to Sniečkus A., dated November 13, 1972 // LYA. Fund 1771. Folder 247. File 145. Sheet 5.

23 Reference by Sniečkus A. and Maniušis J. to the State Planning Committee of the USSR, dated November 13, 1972 // LYA. Fund 1771. Folder 247. File 147. Sheet 10.

24 Remarks by the Geology Administration, dated November 13, 1972, as regards the siting of the Ignalina NPP // LYA. Fund 1771. Folder 247. File 147. Sheet 11.

25 Official letter by Latyy V., Head of enterprise p/b B-2308, to the Chairman of the Council of Ministers of the LSSR, dated December 31, 1974, on establishing enterprise p/b A-7109 in Dūkštas district // LCVA. Fund R-754. Folder 13. File 1232. Sheet 1.

constructed until 1976–1977. Preparatory operations for the construction of the Ignalina NPP began in 1974. In the March of 1978, earth-moving operations started at the construction site of Unit 1. They were completed in September. The block of control equipment was commissioned in April.

Protests of the academic community. Construction of the NPP caused immense concern for Lithuania's scientific community from the very beginning. In the January of 1976 the Presidium of the Lithuanian Academy of Sciences decided to set up a nuclear energy commission, consisting of LAS members, as well as representatives of other scientific institutions and organizations. The commission was to establish and maintain contacts with the State Committee of the Use of Nuclear Energy of the USSR, the Directorate of the Ignalina NPP, the designers and builders, as well as all scientific institutions carrying out research and design operations. Soon the commission had to battle with all-union institutions. At the end of 1978 and the beginning of 1979 the issue of the final disposal of liquid radioactive waste from the NPP became a hot topic. J. Vilemas, Z. Rudzikas, R. Jasiulionis, L. Ašmantas, B. Styro, V. Gudelis, and other scientists from the LAS of the LSSR drew up numerous memos and references, that were submitted to the CC of the CP LSSR and the CM LSSR. It was noted in these documents that the issues of safe disposal of radioactive waste had been given little attention, which resulted in delays in developing methods of safe storage and final disposal of waste. It was also emphasized that the issues of radioactive waste disposal must be addressed at an international level. The CC of the LCP, having acquainted themselves with these documents, sent the relevant data to the Ministry of Medium-Machine Building in Moscow. It was noted in the official letter by A. Brazauskas, the Secretary of the CC of the LCP, that the CC of the LCP shared the scientists' opinion that radioactive waste could not be finally disposed in the country[26].

[26] Official letter by Secretary of the CC of the LCP Brazauskas A., dated January 20, 1976, to the Ministry of Medium-Machine Building of the USSR // LYA. Fund 1771. Folder 255. File 236. Sheet 6.

The crushing tone in which Moscow replied to the documents reminded of the Stalin times. In the reference, sent to the CC of the LCP by A. Semionov, the Deputy Minister of the Ministry of Medium-Machine Building of the USSR and A. Burmazian, the Deputy Minister of Health Care of the USSR, it was emphasized that the underground method of radioactive waste disposal had been successfully used in the Soviet Union since 1963[27]. A 14 page report on the use of this method at the Ignalina NPP (signed by eight Soviet scientists) was attached to the reference. According to the academician J. Vilemas, the Director of the Lithuanian Energy Institute, some Soviet scientists also raised their hesitant voices against the underground method of liquid radioactive waste disposal. The documents, sent by Lithuanian scientists, gave rise to stormy debate, as a result of which, a year later this method of disposal was completely banned in the USSR[28,29].

Speeding up the construction of the Ignalina NPP with an energy crisis imminent. The construction of the NPP went on sluggishly. The problem of the shortage of skilled workers was encountered. On February 28, 1977, the CC of the CPL, and the CM of the LSSR adopted a resolution, instructing the State Vocational-Technical Training Committee to send 100–125 graduates of vocational-technical schools every year at the expense of labour force, intended for other ministries and departments[30,31]. A secret resolution was adopted by the CC of the CPSU and CM of the USSR, banning the construction of any facilities not related directly to servicing the power plant in the area of the NPP; lands in a 10 kilometre zone around the sanitary protection area of the NPPs were to be used exclusively for agricultural needs. Furthermore, setting regional centres in the settlements of

27 Reference by Semionov A. and Burzanian A., dated April 5, 1976, to the CC of the LCP regarding application of the underground method of final disposal of liquid radioactive waste // LYA. Fund 1771. Folder 255. File 236. Sheet 7.

28 Conclusions of academicians of the USSR regarding application of the underground method of final disposal of liquid radioactive waste at the Ignalina NPP, dated March 29, 1976 // LYA. Fund 1771. Folder 255. File 236. Sheet 18.

29 LYA. Fund 1771. Folder 255. File 236. Sheet 21.

30 Minutes of sitting No. 26 of the Bureau of the CC of the LCP, dated February 28, 1972 // LYA. Fund 1771. Folder 254. File 39. Sheet 2.

31 Reference for sitting No. 26 of the Bureau of the CC of the LCP, dated February 28, 1972 // LYA. Fund 1771. Folder 54. File 40. Sheet 21.

the NPPs was banned. The Ministry of Internal Affairs of the USSR was to draft proposals regarding restrictions on registering population in the NPP settlements and locations within the boundaries of such zones, and to coordinate these with other departments[32].

It was stated in the resolution of the CC of the LCP and the CM of the LSSR, dated February 15, 1980, that building and erection works (service buildings, chemical water treatment facility, and the machine hall), worth 350 million roubles, had been completed till 1980[33]. However, much work had not been done till 1979. The party leadership was mostly concerned about the slow pace of construction of the main building of the NPP and other facilities. There was still a shortage of skilled workers.

The secret resolution of the CC of the CPSU and the CM of the USSR, dated June 26, 1980, also dealt with nuclear power. It criticized the Ministry of Energy and Electrification of the USSR, and the Ministry of Medium-Machine Building of the USSR for considerable delays in building and commissioning the NPPs in the period of 1971–1980s[34]. The supply of equipment for the NPPs envisaged in the resolution No. 684-200, dated September 16, 1971, by the CC of the CPSU and the CM of the USSR was stated to be inadequate. Therefore, the two above mentioned ministries were obligated to ensure that power units (with a total capacity of 66.9 million kW) became operational in the Soviet Union in 1981–1990; the total capacity was to grow up to 100 million kW till 1993[35]. In accordance with this resolution, Unit 1, Unit 2, and Unit 3 at the Ignalina NPP were to be commissioned till 1983, 1986 and 1990, respectively[36].

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32 Resolution No. 371-125 of the CC of the CPSU and the CM of the USSR, dated May 17, 1978, On Banning Construction on the Sites of Nuclear Power Stations that Are Not Directly Related to Servicing of the Nuclear Power Industry, and on Registration of Population // LYA. Fund 1771. Folder 255. File 234. Sheets 22–23.

33 Resolution No. 65-5 of the CC of the LCP and the CM of the LSSR dated February 19, 1980, On Measures Aimed at Speeding up the Construction of the Ignalina NPP // LYA. Fund 1771. Folder 257. File 14. Sheet 49.

34 Resolution No. 539-175 of the CC of the CPSU and the CM of the USSR dated June 26, 1980 // LYA. Fund 1771. Folder 257. File 192. Sheet 29.

35 Ibid // Sheet 30.

36 Ibid // Sheet 33.

In the *Key Directions of Economic and Social Development of the USSR in 1981–1985, and until 1990*, adopted at the 26th congress of the CPSU in 1981, it was also noted that Unit 1 at the Ignalina NPP is to begin its operation in 1983[37].

The Bureau of the CP of the LSSR established the National Construction Headquarters (the head of which was A. Brazauskas, the Secretary of the CP of the LSSR) on the 16th of September, 1981 in order to please Moscow. Its members were to prepare a plan of actions to ensure that Unit 1 at the Ignalina NPP becomes operational in time[38].

Despite of all the difficulties, construction of Unit 1 at the Ignalina NPP was continued. By the end of 1982, construction work, worth 800 million roubles, was done: the main building of the NPP was completed, the control panel and the first turbo-generator were installed[39]. The year 1983 was at hand, the deadline of the envisaged commissioning. In late 1983 it was officially announced that Unit 1 had been put into operation. The fact that due to deficiencies in construction work the Unit would have to be stopped after a few days was hushed up.

Information about slipshod workmanship in the construction of Unit 1 at the Ignalina NPP reached the highest circles in Moscow. When the winds of Gorbachev's publicity started blowing in the energy industry, the Party Control Committee under the CC of the CPSU conducted an inspection in the early 1987, whose results shocked even the Moscow's officials.

Two top secret documents were submitted in the April of 1987, the resolution of Party Control Committee under the CC of the CPSU, minutes No. 145, dated April 17, signed by the Committee Chairman M. Solomentsev[40], and the report

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[37] Outlines of the Program of the 26th Congress of the CPSU // LYA. Fund 1771. Folder 259. File 14. Sheet 12–13.

[38] Resolution of the Bureau of the CC of the LCP dated September 16, 1981, regarding establishment of the National Construction headquarters // LYA. Fund 1771. Folder 259. File 78. Sheet 13.

[39] Information by Griškevičius P. dated August 19, 1988, to the CC of the CPSU on the progress of construction of the Ignalina NPP // LYA. Fund 1771. Folder 260. File 179. Sheet 88.

[40] Resolution No. 145 by the Party Control Committee under the CC of the CPSU // LYA. Fund 1771. Folder 260. File 79. Sheet 88.

prepared by Chief Controller Sevastyanov and instructor Astafyev[41]. The two documents had the identical title: *On Flagrant Violations of the Resolutions by the Party and the Government Regarding Enhancing Safety of Atomic Energy Industry Committed by the Heads of the Ministry of Medium-Machine Building and the Ministry of Atomic Energy of the USSR, and on Deceptions in Decommissioning the Ignalina NPP*. It can be seen from the report that the Ministry of Medium-Machine Building started operating Unit 1 at the Ignalina NPP despite gross violations of safety and energy facilities commissioning regulations (when many construction operations had not been completed). According to the inspectors "it was allowed to misinform the Party organs, to deceive and throw dust in their eyes"[42].

It can be seen from the report[43] that before the Unit 1 commissioning deadline (December 1983), more than a third of its facilities had not been built, and erection work had not been completed. The systems, whose operation was directly related to the safety of the NPP, had not been built or completed. In all, some 2200 items of construction, erection and technological work, worth 55 million roubles, had not been accomplished[44]. Owing to these deficiencies (the uncompleted work) in 1984–1986 the reactor had to be shut down for 48 times; its capacity was reduced 67 times, 12 fires started. As a result, the consumers were not supplied 3 million kWh of electricity[45]. In 1986, 50 leaks of radioactive substances, exceeding permissible daily levels, occurred[46].

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41 Report of the Party Control Committee under the CC of the CPSU, dated April 17, 1987, *On Flagrant Violations of the Resolutions by the Party and the Government Regarding Enhancing Safety of Atomic Energy Industry Committed by the Heads of the Ministry of Medium-Machine Building and the Ministry of Atomic Energy of the USSR, and on Deceptions in Decommissioning the Ignalina NPP* // LYA. Fund 1771. Folder 270. File 177. Sheet 141.

42 Ibid // Sheet 142.

43 Report of the Party Control Committee under the CC of the CPSU, dated April 17, 1987, *On Flagrant Violations of the Resolutions by the Party and the Government Regarding Enhancing Safety of Atomic Energy Industry Committed by the Heads of the Ministry of Medium-Machine Building and the Ministry of Atomic Energy of the USSR, and on Deceptions in Decommissioning the Ignalina NPP* // LYA. Fund 1771. Folder 270. File 177. Sheet 141.

44 Ibid // Sheet 142.

45 Ibid // Sheet 144.

46 Ibid // Sheet 145.

Numerous violations were recorded in the report regarding the preparation for the commissioning of Unit 2. It was decided to limit the commissioning of Unit 2, like in the case of Unit 1, only with the facilities that had been completed by that time[47]. The report also criticized the CC of the LCP, and the Party Committee of Ignalina district for tolerating violations of labor and military discipline in military and other construction units, and for unfair reporting of Unit 1 commissioning[48].

After the Chernobyl accident of 1986, secret resolution of the CC of the CPSU and the CM of the USSR No. 722-162, dated July 1, 1987, was adopted in Moscow. It was decided to lay up some NPPs being constructed, and to give up construction of a number of the NPPs, including Unit 4 at Ignalina NPP. Construction of Units 3 at the Smolensk and Ignalina NPPs, with RBMK reactors, was to be completed[49]. In accordance with Appendix 3 to the resolution, Unit 2 at the Ignalina NPP was to be commissioned in 1987, and Unit 3 in 1989[50].

Another resolution (No. 722-162) *On Measures Enhancing Safety of Nuclear Power Plants* consisting of 27 items was adopted by the CC of the CPSU and the CM of the USSR on the same day. Among other things, the Ministry of Atomic Energy of the USSR, jointly with the State Security Committee of the USSR (KGB), the Ministry of Medium-Machine Building and the Atomic Energy Supervision Inspection were obligated within 3 months to prepare and submit USSR proposals to the CM regarding a special safety regime at atomic power facilities. In the resolution it was emphasized that construction of spent nuclear fuel storage facilities must be ensured[51].

47 Ibid // Sheet 145.
48 Ibid // Sheet 148.
49 Resolution No. 722-162 of the CC of the CPSU and the CM of the USSR dated July 1, 1987, *On Tasks in Developing Nuclear Power Industry in the 12th Five-year and Additional Measures Ensuring Enhancement of Safety at Nuclear Power Plants* // LYA. Fund 1771. Folder 270. File 175. Sheets 17–22.
50 Ibid. Appendix No. 3. // LYA. Fund 1771. Folder 270. File 175. Sheet 26.
51 Resolution No. 724-163 of the CC of the CPSU and the CM of the USSR dated July 1, 1987, *On Measures Enhancing Safety of Nuclear Power Plants* // LYA. Fund 1771. Folder 270. File 175. Sheet 29.

The debate on the termination of Unit 3 construction. On June 8, 1988, R. Songaila, the First Secretary of the CPL, and V. Sakalauskas, the Chairman of the Council of Ministers of the LSSR, sent a comprehensive report *On Laying up the Construction of Unit 3 at the Ignalina NPP* to N. Ryzhkov, the Chairman of the Council of Ministers of the USSR[52]. In the report it was stated that the CC of the LCP and the CM of the LSSR were concerned with the situation in constructing Unit 3 at the Ignalina NPP. R. Songaila and V. Sakalauskas, due to the conclusions of Lithuanian scientists, noted that the design for constructing the NPP had been made without necessary engineering-geological studies, and that the site chosen for the nuclear power facility did not meet *The Regulations on Siting Nuclear Power Plants*, therefore, the CC of the LCP and the CM of the LSSR believed that the construction of Unit 3 at the Ignalina NPP must be laid up until all the issues, ensuring safety of this facility, were solved. N. Ryzhkov, in his resolution, addressed to B. Shcherbina, N. Lukonin and V. Malyshev, proposed to discuss this issue together with the CM of the LSSR, and speed up the tackling of issues, related to the construction of Unit 3[53].

Numerous references were produced and a score of sittings were held while dealing with the issue of the Unit 3 suspension at the Ignalina NPP. Finally, a sitting took place at the CM of the LSSR on July 19, 1988, in which A. Lapshin, the Minister of Atomic Energy of the USSR, A. Protsenko, a Deputy Minister of the Medium-Machine Building, as well as scientists of the Lithuanian Academy of Sciences and other specialists participated. At the demand of the Lithuanian representatives, the Muscovites promised that the concerned institutions would submit their conclusions regarding safety problems of Unit 3 within a month[54]. However, when no reply came to the given questions, concerning the tackling of

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52 Report to Ryzhkov N., Chairman of the CM of the USSR, by Songaila R. and Sakalauskas V. dated June 8, 1988, *On Laying up the Construction of Unit 3 at the Ignalina NPP* // LYA. Fund 1771. Folder 271. File 184. Sheet 94.

53 Resolution by Ryzhkov N., dated June 12, 1988 // LYA. Fund 1771. Folder 271. File 184. Sheet 96.

54 Proceedings of the sitting at the CM of the LSSR dated July 19, 1988// LCVA. Fund R-754. Folder 13. File 1643. Sheet 8.

safety issues in Unit 3, J. Šėrys, the Deputy Chairman of the CM of the LSSR, sent an official letter to B. Shcherbina, a Deputy Chairman of the CM of the USSR, on August 2, 1988, concerning the problems of Unit 3[55]. B. Shcherbina proposed to the Minister of Atomic Energy of the USSR, N. Lukonin, that these issues should be discussed with the CC of the CPSU and Secretary General, M. Gorbachev. In B. Shcherbina's opinion, the safety design had to be discussed and the construction continued[56].

On August 11, 1988, N. Lukonin, the Minister of Atomic Energy of the USSR, L. Riabev, the Minister of Medium-Machine Building of the USSR, and V. Malyshev, the Head of the State Atomic Energy Supervision Inspection informed the CC of the LCP and the CM of the LSSR that since major part of construction and erection work at Unit 3 of the Ignalina NPP had been completed, they did not assume it to be expedient to suspend further designing and construction operations (information submitted by N. Lukonin, L. Riabev and V. Malyshev on August 11, 1988, to the CC of the LCP and the CM of the LSSR[57]). However, following the negotiations between the CM of the LSSR and the Ministries of Atomic Energy and Medium-Machine Building of the USSR, that were held on August 25, 1988, the decision was taken to discontinue construction of Unit 3. On August 30, 1988, two all-union Ministries published a joint order No. 350 due to which the construction of Unit 3 at the Ignalina NPP was suspended[58].

55 Official letter by Šėrys J., Deputy Chairman of the CM of the LSSR, dated August 2, 1988, to Shcherbina B., Deputy Chairman of the CM of the USSR // LCVA. Fund R-754. Folder 13. File 1643. Sheet 7.

56 Resolution by Shcherbina B. dated August 15, 1988 // LCVA. Fund R-754. Folder 13. File 1643. Sheet 10.

57 Gryva L. The Construction of the Ignalina Nuclear Power Plant and its Operation in 1971–1988. Master thesis. The Department of History of Vilnius University. Vilnius, 1996 (in Lithuanian).

58 Order No. 350 by the Ministries of Atomic Energy and Medium-Machine Building of the USSR dated September 30, 1988, *On Suspending the Construction of Unit 3 at the Ignalina NPP* // LCVA. Fund R-754. Folder 13. File 1643. Sheet 3.

Brief information about the Ignalina NPP

Location of the Plant. The Ignalina nuclear power plant is located in the northeast of Lithuania, close to the borders with Belarus and Latvia (Fig. 2). The plant was built on the southern shores of Lake Drūkšiai, 39 km from the town of Ignalina. The cities nearest to the plant are Vilnius (130 km away with a population of 575,000) and Daugavpils in Latvia (30 km away with 126,000 inhabitants). Six kilometers from the plant is the town of Visaginas with a population of 32,600, the residence of the Ignalina Nuclear Power Plant personnel.

Fig. 2. Location of the Ignalina NPP

The following lakes and rivers are in the vicinity of the Ignalina NPP:

- Lake Visaginas,
- Lake Drūkšiai,

- Lake Apyvardė, 8 km away from the Ignalina NPP, and Lake Alksnas, 13 km away from the Ignalina NPP,
- The River Daugava flows 30 km north of the Ignalina NPP.

Visaginas is part of Ignalina district. The construction of the nuclear power plant has made a crucial impact on the demography in this district. In 1979, the total population of the Ignalina district was 37,800; in 1989 it grew to 59,700, while the rural population decreased from 21,600 to 18,200[59].

Population Distribution (as in 1998). The population distribution in the area of the Ignalina NPP by locations is presented in Table.

Population distribution

Table

Populated area	Distance from the Ignalina NPP, km	Direction with respect to the Ignalina NPP	Number of inhabitants
Villages and farmsteads	within 15 km radius	–	11400
Villages and farmsteads	within 25 km radius	–	30400
Visaginas	6	west	32600
Turmantas	12	northwest	400
Dūkštas	17	southwest	1200
Zarasai	22	northwest	8900
Daugavpils	30	north	126000
Ignalina	39	southwest	7200
Vilnius	130	southwest	575000

The total population within a 30 km radius, excluding the population of Daugavpils, is about 85,000. The population density within a 15 km radius is 14.4 persons/km^2,

59 Population of Lithuania. Mintis publishers, Vilnius, 1990 (in Lithuanian).

without taking into account Visaginas inhabitants, and 63.1 persons/km^2, including inhabitants of Visaginas. Within a 25 km radius the density of population is 18.6 and 35.6 persons/km^2, respectively.

Geology and Seismicity. The Ignalina NPP is located in the area of the East-European platform, at the junction of two large structural elements, the Baltic syncline, and the Mazur-Belarus anticline. Therefore, the bedrock and the sediments are separated by a series of tectonic faults. Some of these were discovered by geophysical methods and determined by data from drilling samples. Data of seismic prospecting and test drilling 10 km northwest from the Ignalina NPP shows that dimensions of tectonic blocks are not large, of the order of 2×2 km. These evident tectonic discontinuities in the region make it believable that such zones are present in the area of the Ignalina NPP.

The terrain in the Ignalina NPP area is rough, with absolute elevations ranging from 150 m to 180 m. Glacial Quaternary sediments occur at a depth of 60 to 200 m. Pre-Quaternary, Devonian, Silurian, Ordovician, Cambrian and Upper-Protozoan deposits underlie them. At a depth of 700–750 m metamorphic sediments and bedrocks of Upper Protozoan and Archean occur.

The site of the Ignalina NPP is located in the area of a Precambrian platform. Nevertheless, the earth’s crust is pulsating and subjected to considerable shocks. The forecast intensity of neotectonic movements in the area of Ignalina NPP is 3.5 mm a year. The district was affected by an earthquake in the Carpathian mountains, and the intensity, according to the Richter scale, was 5 scores.

Plant Layout. The general layout of the Ignalina NPP is shown in Fig. 3. The site of the nuclear power plant covers an area of about 0.75 km^2. The buildings take up about 0.22 km^2.

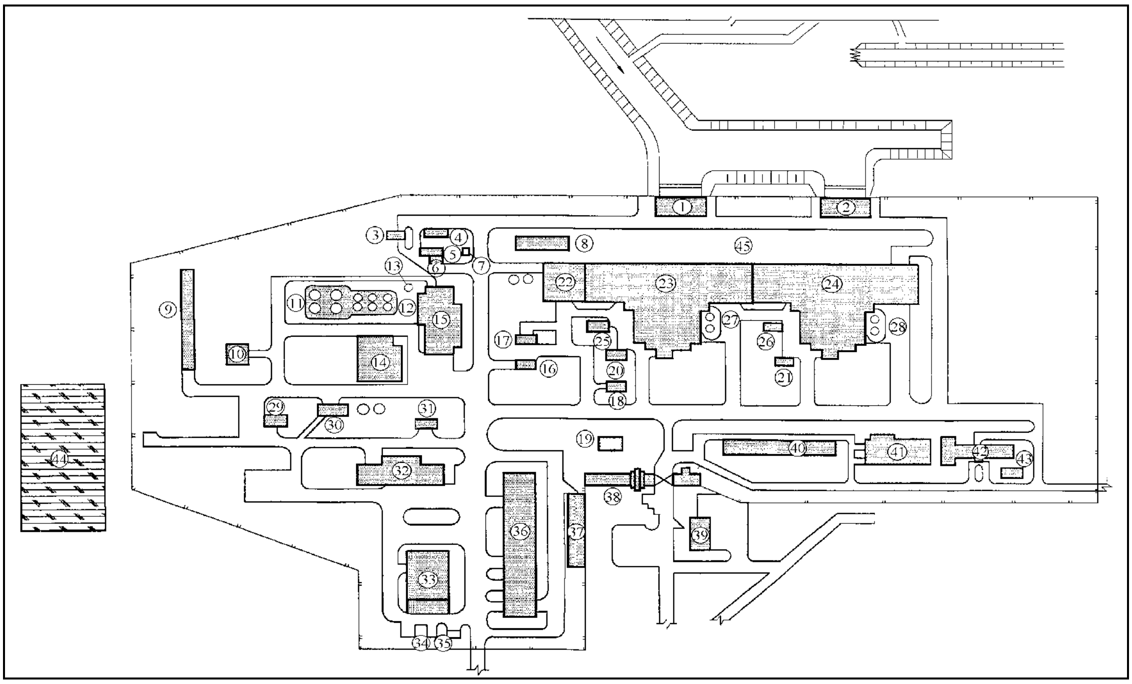

Fig. 3. Layout of the Ignalina NPP[60]

1, 2 – service water pump stations, *3* – acetylene bottle depot, *4* – oil depot, *5* – oil system equipment room, *6* – transformers equipment tower, *7* – pump station for waste and liquid sewerage discharge, *8* – hydrogen- and oxygen-receiving facility, low-activity waste storage, *9* – low-level radwaste repository, *10* – medium- and high-activity waste storage, *11* – operational shower- water reservoir, *12* – drainage water tank, *13* – venting stack of the radwaste reprocessing building, *14* – bitumen storage, *15* – liquid waste storage, *16* – chemical water treatment building, *17* – primary grade water tanks, *18*, *19* – recreational facilities, *20*, *21* – gas purification systems, *22* – heat power station , *23*, *24* – buildings of Units 1 and 2, respectively, *25*, *26* – pressurized tank (accumulator) of the ECCS, *27*, *28* – purified demineralized water tanks, *29* – car-washing facility, *30* – bitumen depot, *31* – special laundry, *32* – chemical reagent depot, *33* – equipment storehouse, *34* – noble-gas reservoir depot, *35* – reservoir facility with artificial evaporation, *36* – repair building, *37*, *38* – administrative buildings, *39* – cafeteria, *40* – diesel generator building, *41* – compressor and refrigeration station, *42* – nitrogen and oxygen manufacture building, *43* – liquid nitrogen reservoir, *44* – 110/330 kV open distribution system

The Ignalina NPP operates two units with RBMK-1500 reactors. Each unit consists of five construction buildings, designated as A, B, V, G and D. Two separate reactor buildings A1 and A2 are adjacent to buildings D1 and D2, housing the main control panels, electric equipment and deaerator rooms. D1 and D2 are connected to

[60] Brief description of Ignalina NPP. Visaginas, 1992.

turbine buildings, e.i. G1 and G2. The main buildings of the plant are situated about 400–500 m away from the shore of Lake Drūkšiai.

Both units have the following common facilities: low-activity waste storage, medium- and high-activity waste storage, an open distribution system, nitrogen and oxygen manufacturing facility, and other auxiliary systems. The building, which houses 12 diesel generators (six diesel generators per unit) for emergency power supply, is physically separated from other buildings. Separate water-pumping stations have also been built on the lake shore for each unit for continuous supply of water.

A layout of the auxiliary services for the Ignalina NPP is shown in Fig. 4. The general area of the Ignalina NPP, the town of Visaginas, the construction organizations and the auxiliary services cover an area of nearly 26 km^2.

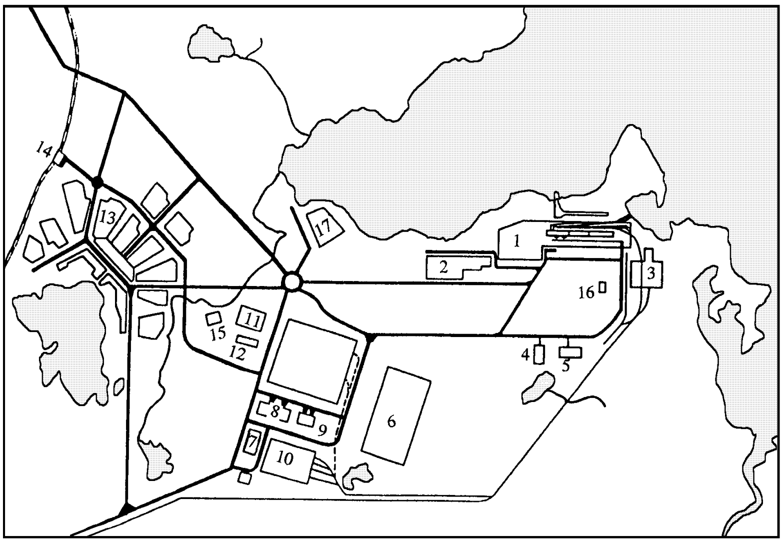

Fig. 4. Layout of auxiliary services[61]

1 – NPP site, *2* – open distribution system, *3* – construction base, *4* – purification plant, *5* – Ignalina NPP vehicle fleet, *6* – supply base, *7* – town vehicle fleet, *8* – vehicle service station, *9* – industrial construction base, *10* – construction base, *11* – military zone, *12* – hospital, *13* – town of Visaginas, *14* – railway station, *15* – town transformer substation, *16* – Ignalina NPP transformers, *17* – recreational area

[61] Brief description of Ignalina NPP. Visaginas, 1992.

Principal parameters of the RBMK-1500 reactor[62]

Coolant	water (steam-water mixture)
Heat cycle configuration	single circuit
Power, MW:	
thermal (design)	4800
thermal (actual)	4200
electrical (design)	1500
Core dimensions, m:	
height	7
diameter	11.8
Thickness of reactor's graphite reflector, m:	
end	0.5
side	0.88
Lattice pitch, m	0.25×0.25
Number of channels:	
fuel	1661
control and protection system	235
reflector-cooling	156
Fuel	uranium dioxide
Initial fuel enrichment for ^{235}U, %	2.0*
Nuclear fuel burnup, Mwday/kg	21.6**
Temperatures, ^{o}C:	
maximum acceptable temperature at center of fuel pellet	2600
maximum acceptable graphite stack temperature	760

62 Almenas A., Kaliatka A., Ušpuras E. Ignalina RBMK-1500. A Source Book. Lithuanian Energy Institute, 1998.

Coolant	water (steam-water mixture)
maximum acceptable fuel channel temperature	650
coolant temperature at fuel channel inlet ***	260–266
feedwater temperature ***	177–190
Pressures, Mpa (kgf/cm^2):	
at separator drum	6.86 (70)
at pressure header	8.5 (86.6)
Coolant flow rate through reactor, m^3/h***	39000–48000
Steam produced in reactor, t/h***	7430–7650
Void fraction at reactor outlet, %	23–29
Maximum fuel channel parameters:	
fuel channel power, kW	4250
coolant flow rate through fuel channel, m^3/h	40
void fraction at fuel channel outlet, %	36.1

* Now the enrichment of fuel in the reactor is 2, 2.4 and 2.6%.
** For fuel enriched to 2%.
*** At 4200 MW (thermal).

Fuel assembly parameters[63]

Fuel pellet	
Fuel	Uranium dioxide
Fuel enrichment for ^{235}U, %	2–2.6
Edge pellet enrichment, %	0.4
Fuel pellet density, kg/m^3	10,400
Fuel pellet diameter, mm	11.5
Fuel pellet length, mm	15

63 Almenas A., Kaliatka A., Ušpuras E. Ignalina RBMK-1500. A Source Book. Lithuanian Energy Institute, 1998.

Fuel pellet	
Pellet central orifice diameter, mm	2
Maximum temperature at the centre of the fuel pellet, ^0C	2100
Fuel element	
Fuel element cladding material	Zr+1% Nb
External diameter of fuel element, mm	13.6
Length of fuel element, m	3.64
Active length of fuel element (height of fuel pellet column in cold state), m	3.4
Cladding wall thickness, mm	0.825
Clearance between fuel pellet and tube, mm	0.22–0.38
Mass of fuel within fuel element, kg	3.5
Helium pressure in the cladding, MPa	0.5
Maximum permissible temperature of fuel element, ^0C	700
Average linear thermal flux, W/cm	218
Maximum linear thermal flux, W/cm	485
Fuel assembly	
Number of segments per fuel assembly	2
Number of fuel elements per segment	18
Total length of fuel assembly, m	10.015
Active length of fuel assembly, m	6.862
Fuel assembly diameter (in the core), mm	79
Mass of fuel assembly without brackets, kg	185
Total mass of fuel assembly with brackets, kg	280
Total steel mass of fuel assembly, kg	2.34
Total mass of zirconium alloy within assembly, kg	40
Mass of uranium in inner fuel pellets, kg	111.2
Mass of uranium in edge fuel pellets, kg	1.016
Maximum permissible power of fuel channel, MW	4.25
Authorized fuel assembly capacity, MWday/assembly	2500
Authorized lifetime of fuel assembly, year	6

Spent nuclear fuel storage. The important area of a nuclear power plant safety is a storage of the spent nuclear fuel. From the beginning of the Ignalina NPP operation the spent nuclear fuel is stored under a layer of water in special pools, that are placed in the same buildings as reactors. It is a temporary way of storage, therefore, the international competition for the spent nuclear fuel storage was announced, the victory in which was gained by the German company GNB.

In 1993 the Ignalina NPP and the German company GNB signed the contract on the delivery of 20 CASTOR (Fig. 5) and 40 CONSTOR steel containers[64] for the storage of the spent nuclear fuel.

Fig. 5. Containers of the spent nuclear fuel storage

The first container CASTOR was sent to the storage site, which was constructed nearby the Ignalina NPP on May 12, 1999. Some part of the spent nuclear fuel had already been placed in all available containers of CASTOR type (20 containers) and was taken to the spent nuclear fuel storage site. The weight of the empty

[64] Penkov V., Poškas P. INPP experience with CASTOR and CONSTOR casks loading. Proc. of IAEA Technical Meeting/Workshop, St. Petersburg, Russian Federation, June 10–14, 2002. (CD-R).

container is about 70 tons, with spent nuclear fuel it will be about 84 tons. One of the most important works, connected with the future decommissioning of the Ignalina NPP Unit 1, is the unloading and location of the spent nuclear fuel in the storages.

The Ignalina NPP experts affirm that the available number of the containers will not solve the problem of the spent nuclear fuel, due to the evaluation that in the case of Unit 1 shutdown at the end of the year 2004, and Unit 2 shutdown in the year 2009, in addition 350 containers would be required. The spent nuclear fuel can be stored in containers CASTOR and CONSTOR for 50 years, then it is necessary to take it out to the final burial place but in Lithuania such place is not stipulated yet.

Operation indicators of the Ignalina NPP

From the beginning of operation until January 1, 2004, the two Units produced 242.45 TWh of electricity. The amount of electricity, which was sold during the same period, was 220.21 TWh.

The annual distribution of electricity generated at the two Units as shown in Fig. 6.

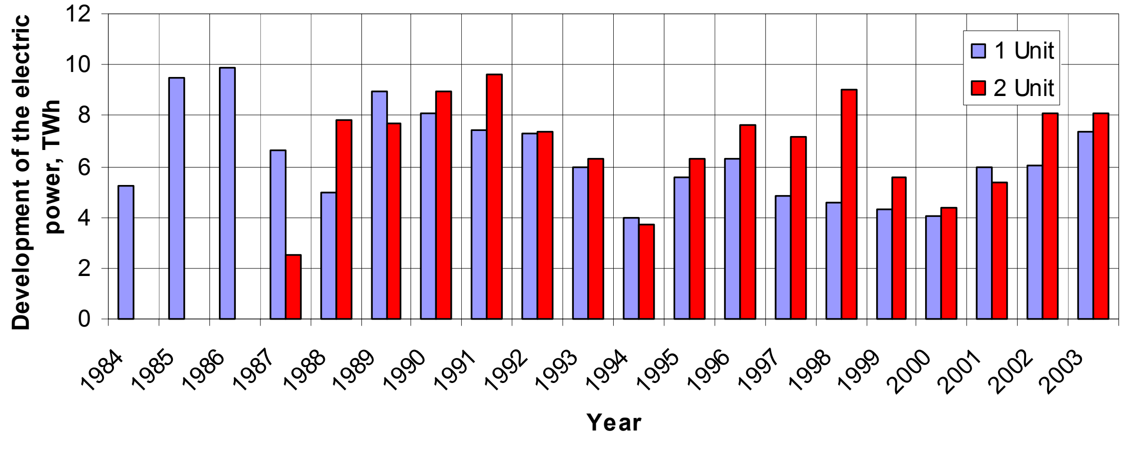

Fig. 6. Electricity generated at IGNALINA NPP from the beginning of the operation

NUCLEAR WEAPONS IN LITHUANIA

Deployment of nuclear weapons in Lithuania is a known although little publicized and studied fact. Theoretically, nuclear weapons could have been in Lithuania since 1949, when the Soviet Union conducted the first nuclear test, until the September of 1993, when the last divisions of the former Soviet Army left Lithuania. Based on the information, given below this period, could be shortened to the years 1963–1988; however, this and other circumstances of the deployment of nuclear weapons in the country are rather hypothetical.

The Soviet nuclear arsenal has been a state secret that is not readily disclosed even today. The documents declassified in Russia so far cover only the program of development of nuclear weapons prior to 1954. However, only a special commission, consisting of Russian scientists and representatives of secret services, are allowed to study them[65]. Local authorities of the Lithuanian SSR had not the slightest influence on the military, therefore, no documents have been found in Lithuania up to this day that would make it possible to determine the sites of deployment of Soviet nuclear weapons and their amounts.

After Lithuania regained independence in 1990, the Soviet Army remained the only institution under complete control of central authorities of the Soviet Union, and, later on, of Russia. In 1993, the military took away everything, the weapons, documentation, and equipment, leaving behind only the devastated buildings of military bases. The Lithuanian Army was created quite independently; it did not inherit either Soviet nuclear ambitions or its nuclear potential. Needless to say, many officers of the former Soviet Army are serving in the Lithuanian Army now, but there are none among them who once served in nuclear divisions of the Soviet Union.

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65 Goncharov G. A., Komov N. I., Stepanov A. S. The Russian Nuclear Declassification Project: Setting up the A-Bomb Effort, 1946 // Cold War International History Project Electronic Bulletin 8–9. Winter 1996/1997. http://www.gwu.edu/~nsarchiv/CWIHP/BULLETINS/b8-9a38.htm

We will attempt to reconstruct the facts, related to the existence of the Soviet nuclear weapons in Lithuania, from the former military bases left by the Soviet Army. The main source of this study is the inventory of Soviet military bases made in 1994–1995 by Krüger Consult in cooperation with Baltic Consulting Group[66,67]. It is the most systematic study of the former Soviet military bases in Lithuania that also contains the data collected by other institutions, such as the Institute of Geography, the Institute of Forests, the Department (now the Ministry) of Environment, and the Ministry of Defense. However, several circumstances must be taken into consideration when assessing this information, most importantly, the number of military bases. In 1993, there were 295 military units in Lithuania. Presumably there were as many as 400 of them in the mid-1970s[68]. Detailed information about them, however, is sparse. Secondly, the main objective of the above mentioned studies was to assess the damage, done by the Soviet Army, therefore, little attention had been given to the activities and history of the Soviet military units. Basically, only assumptions regarding the sites of deployment of nuclear weapons and their types can be made, based on this information.

Accurate information on some of the weaponry, deployed in Lithuania, can only be found in the appendices of the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (INF treaty), in which three bases in Lithuania are listed and the nuclear weaponry and plant are available[69].

As has been mentioned above, local sources are virtually absent. Even the Museum of Militarism, established in a former Soviet rocket base, has only the most

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66 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Phase I Report. Krüger Consult in cooperation with Baltic Consulting Group, July 1994.

67 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Final Report. Krüger Consult in cooperation with Baltic Consulting Group, December 1995.

68 Kazakevičius M., Kutanovas A. Report at the Defence Environmental Conference, Garmisch-Partenkirchen, Germany, May 7–13, 1995.

69 Memorandum of Understanding Regarding the Establishment of the Data Base for the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles. December 1987.

general information on the activities of the base, that is not supported by any documents.

All this data has been assessed against the information, published in the Western countries and Russia on nuclear weaponry of the former Soviet Union. However, there is little information on Lithuania.

Nuclear weapons that were deployed in Lithuania

The available data allows us to claim that intermediate-range ballistic missiles, capable of carrying nuclear warheads, were deployed in Lithuania. The deployment sites and times of these missiles are known approximately (Fig. 7). It can be inferred from this information that the scenario of the deployment of certain components of nuclear weaponry in Lithuania was similar to that in the rest of the Soviet Union.

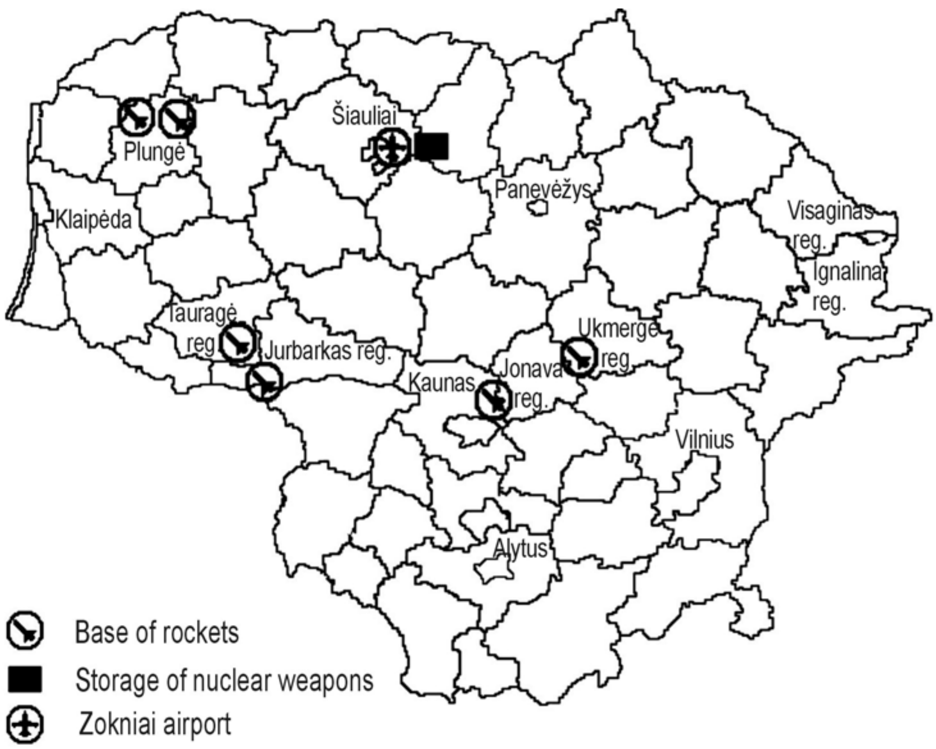

Fig. 7. Sites of deployment of Soviet nuclear weapons in Lithuania

Two most important types of strategic nuclear weapons, i.e. intercontinental ballistic missiles and nuclear submarines, undoubtedly were not deployed in Lithuania, as there were not suitable bases. Only more or less credible assumptions can be made regarding other types of nuclear weaponry.

Intermediate-range missiles. The nuclear weapon undoubtedly was in Lithuania since 1963, when 4 stationary intermediate-range missiles SS-4 were deployed at the newly built Plokščiai base[70]. Deployment of rockets of this type (Fig. 8) in the Soviet Union began in the same year, and construction of the Plokščiai base began before the tests of these rockets had been completed. In the 1960s, SS-4 missiles were the most important element of strategic nuclear forces, intended for attacking Western Europe. Most of them were deployed in Central Europe and the western part of the Soviet Union.

Fig. 8. SS-4 missiles (not in Lithuania)

[70] Information supplied by the Museum of Militarism.

In 1978 replacement of SS-4, with more advanced rockets, began throughout the Soviet Union[71]. The Plokščiai base was closed in the same year.

Some 20 km west from the Plokščiai base is a very similar Šateikiai base, also with 4 silos. No other bases of this type are known in Lithuania; however, more mobile rockets of the same or similar types could have been deployed there at the same time.

The more advanced SS-20 missiles (Fig. 9) were deployed at the Karmėlava rocket base in 1976[72]. The deployment of the rockets of this type in the Soviet Union also began in 1976. In 1987 there were another two SS-20 bases in Lithuania, where a total of 15 missiles were deployed. In all, there were 48 bases of SS-20 missiles throughout the USSR, with 405 rockets deployed there[73]].

Fig. 9. SS-20 missile (not in Lithuania)

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71 World Special Weapons Guide, www.globalsecurity.org.

72 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Final Report. Krüger Consult in cooperation with Baltic Consulting Group, December 1995.

73 Memorandum of Understanding Regarding the Establishment of the Data Base for the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles. December 1987.

The territory of Lithuania played only a secondary role in the Soviet Union's nuclear strategy. Nevertheless, it should be noted that the intermediate-range missiles, that were deployed, were quite suitable for hitting targets throughout Europe and the Middle East. Some sources in the West claimed that SS-20 could be transformed into intercontinental ballistic missiles and used for hitting targets in mainland USA[74].

All the intermediate-range missiles were removed from Lithuania after the USA and the USSR signed the INF treaty in late 1987[75]. As to the number of rockets deployed in Lithuania, there had probably been many more deployed ones, and part of them could have been removed before 1987. There were at least another two bases of a similar type in Lithuania, that are not mentioned in the appendices of the INF treaty. By the way, there was no mentioning of missile repair and storage facilities in the treaty. Most probably, there never were any in Lithuania.

The intermediate-range missiles could have been the last nuclear weapons to be removed from Lithuania. There is no data to prove that the Soviet Army transported nuclear weapons through Lithuania's territory after 1988. This was the time when Lithuania was struggling for independence, and the movement of Soviet Army was being watched.

Airforce. Numerous Soviet airforce units were deployed in Lithuania. Several large military airfields could receive even strategic bombers capable of carrying powerful nuclear charges. However, no data is available on the deployment of such bombers in Lithuania, at least after the year 1984, when the Soviet strategic airforce was restructured. The sites at which strategic bombers were deployed (beginning with the mid-1970s) are known well enough as their number was controlled by the SALT and START treaties between the USA and the Soviet Union[76]. However, the possibility cannot be ruled out that strategic bombers had been deployed in

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74 Soviet Military Power: An Assessment Of The Threat // Defence Intelligence Agency. 1988.

75 W. Walker. Nuclear Weapons and the Former Soviet Republics // International Affairs. Vol. 68, Issue 2. April 1992. pp. 55–277.

76 Soviet Military Power. Defence Intelligence Agency, 1984.

Lithuania earlier. Besides, the Soviet airforce had considerable tactical nuclear arms that could be carried by aircraft usually armed with conventional weapons.

It should be noted that the only one special storage facility of nuclear arms (which probably belonged to the Soviet airforce) was nearby the largest military airport Zokniai in Lithuania. However, it is impossible to say today when or for what purposes it was used.

Tactical nuclear weapons. In general, even less is known about tactical nuclear weapons, used directly in a scene of military actions in comparison with strategic ones. The former are not controlled by any international treaties, and the INF treaty banned only the weapons, whose radius of action was in excess of 500 km. The Soviet Union, however, possessed a rather diverse arsenal of nuclear missiles and artillery shells used within 8–400 km range, as well as antiaircraft and antimissile weapons with nuclear charges. It is very difficult to control the deployment of these weapons as some can even be launched manually. Westerners had no doubts that the tactical nuclear weaponry was deployed in the Baltic States. It was stated, among other things, that SS-12 tactical intermediate-range missiles (with the range of action of up to 800 km) were deployed there, although the deployment sites admittedly were not known[77]. These weapons must have been deployed in Lithuania as a potential scene of military actions; however, it is impossible to ascertain this. There were 43 missile military units in Lithuania before the withdrawal of the Soviet army, most of them antiaircraft[78].

It can be noted that following the withdrawal of the Soviet troops, the increase of natural background radiation was recorded in a former artillery store (at Linkaičiai in Radviliškis district), in a unit of heavy artillery (in Plungė district), and in a missile unit (in Vilnius district). However, it cannot be claimed that it resulted from the

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77 Taagepera R. Inclusion of the Baltic Republics in the Nordic Nuclear Free Zone// Journal of Baltic Studies. Vol. XVI, No. 1. Spring 1985. pp. 33–51.

78 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Final Report. Krüger Consult in cooperation with Baltic Consulting Group, December 1995.

storage of nuclear weapons. Radioactive contamination at these sites was negligible, whereas when more intense sources of radioactive contamination were discovered, say, in the so-called Northern Town in Vilnius and the Zokniai airport, radioactive substances were found to have been used in electronic devices[79]. Nevertheless, the possibility cannot be ruled out that the increased natural background radiation resulted from the storage of nuclear weapons.

Major military bases

Plokščiai (Plateliai) base. The construction of the base in the village of Plokščiai, Plungė district, began in the September of 1960 and was completed on December 31, 1962. Four silos of a 27 m depth were installed (Fig. 10) for SS-4 (R-12 according to the Russian classification) intermediate-range ballistic missiles[80].

Fig. 10. Silos for SS-4 missiles in the Museum of Militarism
(the former Plokščiai rocket base).

79 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Final Report. Krüger Consult in cooperation with Baltic Consulting Group, December 1995.
80 Information supplied by the Museum of Militarism.

The Plokščiai base was to become one of the first underground launch pads for missiles capable of carrying nuclear weapons. Development of R-12U, the modified R-12, missiles, launched from underground pads, began only in 1960, and the first R-12U missiles were ready for action on January 1, 1963[81]. R-12 could carry a single 1–2.3 megaton warhead; its range of action was under 2000 km.

In 1978, systematic replacement began in the Soviet Union of R-12 missile systems with the mobile rockets of SS-20 type. The Plokščiai base was closed on June 18, 1978 but remained at the disposal of the Soviet Army. A museum of militarism was set up in 1995 in the former missile base. Visitors are given an opportunity to see the silos of missiles' launching.

Šateikiai base. The Šateikiai rocket base, very similar to the one at Plokščiai, with 4 silos, was constructed in Plungė district, some 20 km away from the latter. There is no information on its construction and operation; however, it can be assumed that it was operational at the same time as the Plokščiai base. Later on, a store of artillery shells was established on its site, that was in use until 1993, when the Soviet troops withdrew from the base.

Karmėlava base. The Karmėlava rocket base in the vicinity of the town of Kaunas was established in 1976[82]. The missile unit occupied an area of 51 hectares; however, the total territory of the base with the surrounding protected zone was 587 hectares. It was indicated in the protocol of the INF treaty of 1987 that there were 5 intermediate-range missiles and 5 launching facilities. However, according to the inventory of Soviet bases, made after the Soviet troops had withdrawn from Lithuania, there were 4 launch pads and 6 underground hangars for missiles.

SS-20 (RSD-10) mobile intermediate-range missiles, capable of carrying 1–3 nuclear warheads to a distance of 600–5000 km, were deployed in Karmėlava.

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81 World Special Weapons Guide, www.globalsecurity.org.

82 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Final Report. Krüger Consult in cooperation with Baltic Consulting Group, December 1995.

After the INF treaty was signed, providing for elimination of intermediate-range missiles, the rockets were removed from Karmėlava in 1988, and the missile unit redeployed. The base was handed over to a helicopter unit of the Soviet Army. The Soviet troops withdrew from the base in the October of 1992. At first, the unit terrain was given to the Kaunas airport (which was nearby) and in 2000 the military Regional Air Space Control Center began to operate there.

Ukmergė base. It was yet another base referred to in the protocol of the INF treaty. It was very similar to the base of Tauragė (it also consisted of two missile operating bases, occupying an area of 100 and 446 hectares). In the protocol of 1987 it was said to have 5 intermediate-range missiles and 6 launch pads.

Jurbarkas base. Another two rocket bases were situated in Jurbarkas district, nearby Tauragė. They were not mentioned in the INF treaty of 1987, however, in many ways it was very much like the latter three. It seems very likely that intermediate-range missiles had been deployed there, but these were removed from Lithuania before 1987.

Tauragė base. According to the protocol of the 1978 INF treaty, there were 5 intermediate-range missiles and 5 launching facilities in the base[83]. In fact, there were two individual bases situated close to each other, occupying an area of 192 and 145 hectares (Fig. 11)[84]. The missiles were removed in 1988, and the base was handed over to a motorized infantry regiment, which was withdrawn from Lithuania in 1992.

Nuclear weapon storage facility at Kairiai. The only specialized military unit in Lithuania, occupying an area of 113 ha, was in Kairiai, near the town of Šiauliai[85].

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83 Memorandum of Understanding Regarding the Establishment of the Data Base for the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles. December 1987.

84 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Final Report. Krüger Consult in cooperation with Baltic Consulting Group, December 1995.

85 Inventory of Damage and Cost Estimate of Remediation of Former Military Sites in Lithuania: Final Report. Krüger Consult in cooperation with Baltic Consulting Group, December 1995.

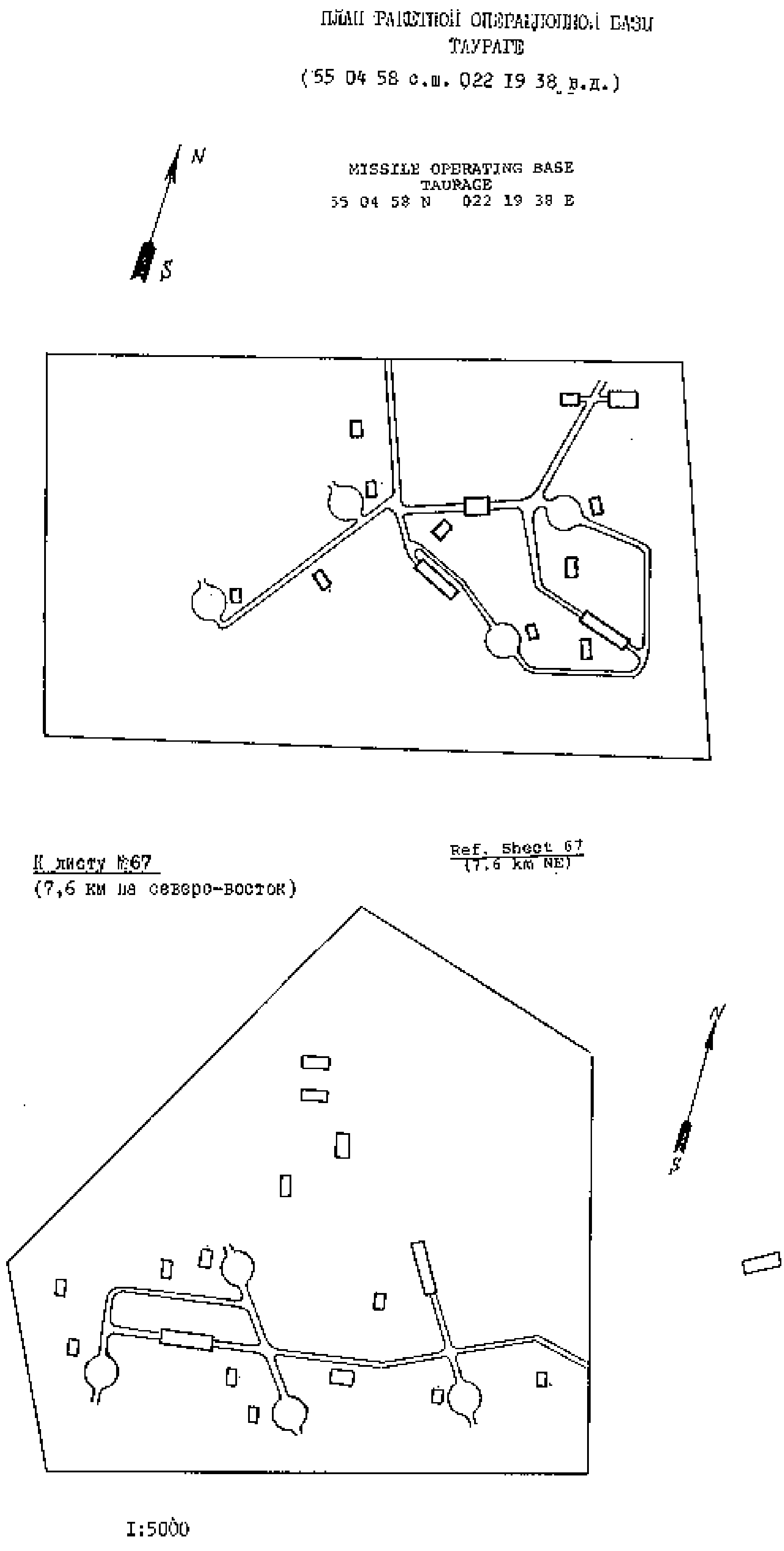

Fig. 11. The plan of rocket bases in vicinities of Tauragė in reports of INF

However, it is very difficult to say, judging from its condition after the withdrawal of the Soviet troops, when the facility had been in operation and what nuclear weapons had been stored there. The storage facility had probably not been used for quite a while during the Soviet times. The store was nearby Zokniai military airport, the largest one in Lithuania, therefore, it is very likely that either it serviced airforce or was used as a temporary storage facility for transporting nuclear weapons.

The issue of the Soviet nuclear weaponry after 1990

Currently available data allows to draw a conclusion that when Lithuania declared independence in 1990, the nuclear weapon was no longer there. The subject was not broached during Lithuania's negotiations (regarding troops withdrawal) with the Soviet Union and, later on, with Russia. Differently from other former Soviet republics, Lithuania did not claimed rights for the part of the Soviet weaponry neither before, nor after the disintegration of the USSR, neither did it assume any rights or duties arising from the Soviet Union's international commitments. Furthermore, Lithuania as early as 1990, before it was recognized internationally, expressed its wish to join the Treaty on the Non-Proliferation of Nuclear Weapons. The treaty was one of the first international documents signed by Lithuania's representatives (on September 23, 1991).

After the withdrawal of Russian troops in 1993, fear was felt that Russia would be willing to transport its nuclear weapons from Central European countries through Lithuanian territory. The rules governing military transit through Lithuania, approved in 1994, banned any transportation of nuclear weapons and Russia has not once applied to Lithuania for a permit of this kind[86].

[86] As Lithuanian and Russian politicians disagree on formalization of military transit, it smoothly goes on in accordance with the permit procedure set by Lithuania. BNS, December 13, 1994.

Lithuania more than once had to worry about the deployment of nuclear arms near its borders, in Kaliningrad Region and Belarus. Only in 1997, when A. Lebed, Russia's former advisor on national security, announced that over 100 Soviet-made nuclear bombs (the size of a suitcase) had disappeared, and that they could be in the Baltic States, did they remember that the Soviet nuclear weapons could be in Lithuania[87]. A. Lebed made his statement soon after two citizens of Lithuania, who allegedly had tried to sell a nuclear weapon to Columbian drug traffickers, were arrested in the USA. However, Russia did not confirm that it had manufactured such bombs and the alleged arms traffickers were only sentenced for fraud[88].

CONCLUSIONS

Lithuanian scientists were not involved in the programs of nuclear weapon development, and did not contribute to the work, being done at the Ignalina NPP (with the exception of scientists from the Lithuanian Energy Institute, who participated when the site for the Ignalina NPP was being selected).

When the boom of nuclear power industry began in the Soviet Union, the idea of constructing the Ignalina NPP occurred to the circles in Moscow's central institutions at the turn of the 1970s. The nuclear power plant remained a facility under all-union jurisdiction, supervised by the Ministries of Atomic Energy and Medium-Machine Building of the USSR from September 16, 1971, when the CC of the CPSU and the CM of the USSR adopted the resolution, regarding the beginning of its construction, until Lithuania regained independence in 1990.

The attitude of the CC of the CPL towards the construction of Ignalina NPP, differently from that of the country's academic circles, is not quite clear. The Atomic

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87 A large number of missiles have disappeared in Russia. ELTA, September 5, 1997.
88 Lithuanians are selling nuclear weapons? ELTA, July 1, 1997.

Energy Supervision Commission, set up under the Academy of Sciences of the LSSR, faced the biggest problems while fighting with the all-union institutions in 1976. The Commission members used to meet with officials of the CC of the LCP, the CM of the LSSR on a regular basis, and they defended Lithuania's interests on their visits to Moscow. They managed to convince Moscow's officials on many aspects of the Ignalina NPP construction in the teeth of fierce hostile reaction. The deeds of the Commission members encouraged Moscow's scientists to openly express their views, which caused a chain reaction throughout the Soviet Union.

After the beginning of construction of stage I of the Ignalina NPP, an idea occurred to officials of central institutions of constructing units 5 and 6 on the same site. This idea was abandoned only due to the protests by scientists from the Lithuanian Academy of Sciences. At that time the problems of construction of units 3 and 4 were the focus of attention. If another two units had been commissioned, their operation would have brought catastrophic consequences for the biological and sanitary regimes of Lake Drūkšiai. A. Drobnys, the Chairman of the State Planning Committee of the LSSR, gave active support to Lithuanian scientists, while other officials did not back them up. It was the time when the deficiencies in the construction of Unit 1 became apparent. Operation of the Unit began before many important pieces of plant had been installed. Furthermore, the construction of the Unit was fraught with disaster. Dozens of soldiers of a construction battalion were killed, fires often broke out in the Unit, and leaks of radioactive substances, exceeding permissible levels, were a usual occurrence.

It was the disaster at the Chernobyl NPP (operating similar reactors of the RBMK type) that helped the government officials to make up their minds. As a result, due to the Chernobyl accident, all the territory of Lithuania, its southern and western regions in particular, was rather heavily contaminated with radioactive nuclides. Over 7 thousand men from Lithuania were sent to carry out decontamination operations in Chernobyl. On return, many of them contracted radiation sickness, with the death exceeding 200. Thus, it was only after 1986 that the CC of the LCP and the CM of the LSSR began coordinating their positions with Lithuanian specialists due to actions of the banning the construction of Units 3 and 4 at the Ignalina NPP. The potential disastrous effects of the tectonic faults on the site of the nuclear power station were accentuated at that time. P. Griškevičius, the First Secretary of the LCP, and V. Sakalauskas, the Chairman of the Council of Ministers of the LSSR, due to the conclusions drawn by Lithuanian scientists and specialists, sent official letters to Moscow, asking to terminate the construction of Unit 4 at the Ignalina NPP. This was done in the July of 1987 through a joint resolution of the CC of the CPSU and the CM of the USSR, signed by their heads M. Gorbachev and N. Ryzhkov.

The situation became extremely vague when R. Songaila became the First Secretary of the LCP. In 1988, two completely different documents were drawn up with a one-month interval. In the first one, the Bureau of the CC of the LCP, stated that all deficiencies of the Ignalina NPP construction had been put right, whereas the second one, addressed to the CM of the USSR, on the contrary, emphasized that the situation was catastrophic and that construction of Unit 3 should be laid up. It seems that R. Songaila tried to walk a tightrope between Moscow's and Lithuania's positions but did not have a definite opinion of his own.

The Council of Ministers of the LSSR expressed a more certain view, based on the conclusions of the country's specialists. It consistently demanded that fewer units should be built at the Ignalina NPP. After lengthy negotiations with all-union institutions, the latter adopted a resolution regarding termination of construction of Unit 3. Members of *Sąjūdis* (the Movement for *Perestroika* in Lithuania), who organized meetings in October 1988, aimed at suspending the construction of Unit 3 and probably did not know about the resolution.

The search for data about the Ignalina NPP in Lithuania's archives produced no evidence to prove that the facility's reactors could have been used for manufacturing nuclear weapons.

Little attention given to the Soviet nuclear weapons in Lithuania should come as no surprise. The existence of nuclear weapons had virtually no effect on the independent status of Lithuania as a nuclear power state, its politics or the environment.

ABBREVIATIONS

CC	Central Committee
CM	Council of Ministers
CP	Communist Party
CPSU	Communist Party of the Soviet Union
INF	Treaty between the USA and USSR on the Elimination of their Intermediate-Range and Shorter-Range Missiles
KTU	Kaunas University of Technology
LAS	Lithuanian Academy of Science
LCP	Lithuanian Communist Party
LCVA	Central State Archive of Lithuania
LSSR	Lithuanian Soviet Socialistic Republic
LYA	Special Archive of Lithuania
NPP	Nuclear Power Plant
RBMK	Russian acronym for "Channelized Large Power Reactor"
RRS	Radioactive Radiation Sector
SKI	Swedish Nuclear Safety Inspectorate
SSR	Soviet Socialistic Republic

USA	United States of America
USSR	Union of Soviet Socialistic Republics
VATESI	Lithuanian acronym for “State Nuclear Power Safety Inspectorate”
WW	World War

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LITHUANIA’S NUCLEAR PAST: A HISTORICAL SURVEY

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