HoNESt History of Nuclear Energy and Society

Hungary Short Country Report

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Section 2: Narrative of the historical context

Introduction and Abstract

Compiled for the History of Nuclear Energy and Society project, this report is a short summary of the historical developments and decision-making processes that resulted in the production of nuclear energy in Hungary. It is not a unified history propelled by a single argument; rather, it stems from a number of fundamental questions generated by the HoNESt research group and therefore engages several topics. Nevertheless, it can serve as a starting point for anyone interested in the origin of Hungary's operating nuclear reactors.

In Hungary there is one nuclear power station consisting of four reactor blocks. Their particulars according to the World Nuclear Association are as follows:[1]

Reactor	Model	Net Mwe	First power	Scheduled close
Paks 1	VVER-440/V-213	470	1982	2032
Paks 2	VVER-440/V-213	473	1984	2034
Paks 3	VVER-440/V-213	473	1986	2036
Paks 4	VVER-440/V-213	473	1987	2037
Total (4)		**1889 MWe (2000 MWe gross)**		

In 2017, Paks accounted for 16,097.6 GWh of electricity, which represented 50% of all electricity generated in Hungary. Recent decisions since the writing of this short country report have involved extending the lifetimes of the last two of the Paks NPP reactors.

The site of the nuclear station is Paks, a town in southern Hungary on the Danube River.

The study of Hungary's nuclear history offers scholars a fine opportunity to examine how scientific and technocratic decision-making took place in the former socialist states of Eastern Europe. Civil society was highly restricted, under the control of state authorities, and therefore did not have a role in the decision-making process that led to the introduction of nuclear power. Rather, this process took place within the government and bureaucracy of the Socialist State, where influence came not from the building of coalitions of citizens who voiced their opinions in public, but instead from the assembly of constellations of interest and power consisting of important figures in the State government, administration, and bureaucracy. This process was transnational, happening amid and because of the hegemony of the USSR in Eastern Europe.

[1] http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/hungary.aspx

Negotiation between the Hungarian and Soviet governments was vital to this history; in addition, there were exchanges of personnel and technologies between various Eastern European countries, evidenced in the history of nuclear energy in Hungary.

The five events recommended as representative of the process explained above are:

a) decision to construct a research reactor (1955)
b) decision to construction a training reactor (1962)
c) decision to construct nuclear power plant (1966)
d) halt to the planning and construction of the power plant (1969)
e) definitive restart to the construction of the power plant (1973)

More will be said about all below.

Contextual Narrative

Historical periods in Socialist Hungary largely conform to those of the conventional Soviet periodization. Hungary's nuclear energy project began in 1955, during the Khrushchev era (1953-64), yet preserved many features of the preceding Stalinist era (1945-1953). The most decisive years in Hungarian nuclear history came during the Brezhnev era (1964-82).

The periodization of Hungarian nuclear history might be best thought of as follows:

- Period 1 (1955-1959): planning, construction, and use of a research reactor;
- Period 2 (1966-1987): planning and construction of the four reactors of Hungary's nuclear power plant;
- Period 3 (1982-1990): regular operation of the nuclear plant and contribution of its output to the national grid;
- Period 4 (1990-present): continued regular operation of the nuclear plant in a new political regime, ongoing debate and decision-making concerning construction of new reactors.

These regimes bring different contexts to nuclear history. The most radical change came around 1990, when Hungary went from being in the Soviet sphere, to being part of a cluster of newly democratic states as the Soviet Union collapsed. By that time the electricity-generating nuclear plants were built and in operation. In other words, the four Paks reactors were built and began operation during the latter stages of Socialist-era Hungarian history. What has happened after 1990 can best be described as a kind of epilogue with fewer historical sources and only an emerging historical perspective, something more akin to contemporary daily politics than to history.

The main actors were stakeholder groups involved in the construction of a nuclear power station in Hungary. Groups that would prove either for or against nuclear power were formed in the long process of developing nuclear culture in a country where

something like advanced nuclear technoscience, much less a nuclear power station, was virtually nonexistent. Various groups in a rather consistent fashion served as advocates for nuclear energy.

In Period 1 (1955-1959), the supporting group was the political establishment. The Soviets made a recommendation and the Hungarian party complied. This is how decision a) (the decision to build the research reactor) was made. We have no information about any opposition or debates to this decision. This happened at the beginning of the post-Stalin era.

Decision b) (the decision to build the training reactor) was made in 1962, in an entirely different period: the late Khrushchev period, years after the 20th congress of the Soviet Communist Party and the Hungarian revolt in 1956 but before political consolidation and economic reform in Hungary. This latter started in 1966 and led to a gradual softening of the dictatorship. These significant political changes account for why the construction of the training reactor lasted so long. The reactor went critical only in 1971.

To the best of our knowledge, there was no opposition in this case either. Difficulties were due mostly to the complicated bureaucracy that was in confusion during these years of transition. Supporters can, however, be identified. They were leading scientific and engineering professionals belonging partly to the academy and partly to the political leadership and technocracy. In addition, due partly to the research reactor, a small high-level community of nuclear experts was born. Three support groups can easily be discerned, and represented by three particular individuals. These support groups were crucial to the ultimate adoption of nuclear energy in Hungary, and the leading figures who represent these groups merit closer examination.

András Lévai

András Lévai (1908-2003) was an effective mover. He was a mechanical engineer trained in Austria. Lévai settled in Hungary in 1940 after leaving Romania. He became a high expert of energy policy, technology, and economics, occupying high, politically crucial positions in his field. He was director of ERŐTERV, the central office of power plant design. He was professor at the Technical University (where the training reactor was built), a member of the Academy of Sciences, and in an important period (1962-67) he was deputy minister in the Ministry of Heavy Industry, where he worked in various positions before and after. In spite of his high positions, he was not a member of the Party.

Lévai introduced nuclear technology into the curriculum at the Technical University (BME). From 1956, after the First Geneva Conference, with his colleague Károly Simonyi he taught an optional course entitled *Atomic Plants* for regular students and, separately, to postgraduate students. They published lecture notes to help the students and advised on theses related to nuclear technology. Levai wrote a long study on the role of nuclear energy in the future Hungarian economy and sent it to high-level political and party leaders. In so doing, he was likely the first individual to draw the

authorities' attention to the possibility of nuclear energy. He initiated development of the training reactor.

Lévai's students joined him in supporting nuclear energy. He organized a team consisting of six people to study applications of nuclear energy. One of them, Gyula Csom, became the first director of the training reactor, and Gergely Büki also remained active in the field. This was one of the nuclei of the Hungarian nuclear community.
Lévai established an office for designing power stations (called ERŐTERV) in 1950. He was its director until 1962. This company produced designs both for new power stations and for developing the electric network. The small staff at ERŐTERV worked on the preliminary designs that provided the basis for the Soviet-Hungarian negotiations. These experts supported all the steps of the nuclear power project, and overall this small but growing group had a stake in the nuclear future of the country.

Lénárd Pál
Another high ranking supporter of nuclear energy in Hungary was Lénárd Pál (b. 1925), a physicist. He graduated in Budapest and continued his postgraduate studies in Lomonosov University, Moscow. After his return from the USSR in 1953, he became a leading researcher in the Central Research Institute for Physics, the most important center of science then. The research reactor was placed in this institute. In 1956, Pál became head of the organization that operated the reactor and carried out various research programs, produced isotopes, and manufactured instruments for nuclear measurements and experiments. In 1970-1978, he was the director of the entire institute. Meanwhile, Pál became a very influential politician: in 1975-1989 he was a member of the Central Committee of the Party, and from 1985 to 1989 secretary of the Central Committee. In addition, he was member in committee of science of the Council of Ministers in 1978-1989.

In the institute, in particular in the section housing the research reactor, significant expertise in reactor physics was accumulated by a growing staff. They constructed critical assemblies (ZR-1, ZR-2, etc.) to study and prove the experimental and calculation methods of the field. They also designed the training reactor at the Technical University. Among them, nuclear professionals like Ferenc Szabó and Zoltán Gyimesi became important authorities. They expressed their support for nuclear power in various committees and meetings.

Benjamin Szabo
Benjamin Szabo (b. 1932) was the political and organizational manager of the construction of the Paks nuclear plant. He graduated from electric engineering in the Soviet Union in 1958 and in 1961 he became director of an important power plant in Ajka. Two years later he became the referent of electric energy industry in the Party administration. Subsequently, he worked as head of the Atomic Energy Secretariat in the Ministry of Heavy Industry and became a main actor of the nuclear plant construction, first as general manager of Paks Nuclear Power Plant Ltd established in 1976, and then as Government Commissioner of its development.

Szabo was in the arena in which politicians, economic policy makers, and companies fought. He negotiated compromises between participants. He had to look for allies who sometimes changed according the shifting political climate. While he often relied on nuclear experts, it was ministers and deputy ministers, in particular Ferenc Lévárdi (deputy minister and later minister of heavy industry) and Gyula Szekér (also deputy minister and then minister of heavy industry, and later deputy prime minister), who proved incomparably more effective. They had to convince state planners of the importance and inevitability of nuclear energy.

The opposition to nuclear power is more difficult to represent with names. In the 1960s, there was a large, rather undefined group of skeptics who thought that nuclear energy amounted to science fiction. Faced with the undeniable advance of nuclear technology in the Soviet Union, they claimed that construction of nuclear reactors for Hungary was too complicated, the task too big. Unfortunately, we have not as of yet found protocols of the meetings in which they expressed their opinions. In the memoirs we have, we could not identify names or groups because they are mentioned only in general terms.

The National Planning Office opposed nuclear energy as well. It had the task of estimating energy demand and recommending the mix of energy resources (coal, hydrocarbons, hydroelectric, and imports) for the country. The price of a nuclear power plant was undefined but it was guessed to be very high and the price of the energy produced by the plant was also unknown but similarly estimated. Hence, energy planning became uncertain. In addition, Hungary energy mix was undergoing a significant change with the diminishing weight of coal and the increasing weight of hydrocarbons. (The Office planned to increase the ratio of hydrocarbons from 18% in 1958 to 37 % by 1970.) This process required large investments.

Given this situation, the interest groups in opposition to nuclear power can be identified. These were the managers and employers of companies that had every reason to oppose the development of a nuclear plant. There were two sorts of such enterprises: energy production enterprises and plant development enterprises. The growing energy demand necessitated the development of new power stations and enlargement of old ones (e.g., the Gagarin and Bánhidai, Tiszapalkonya, and Dunamenti thermal power stations, and the Tiszai oil refinery). The stakeholders of these companies had a vested interest in the enlargement or development of these plants and feared a competing enterprise. They defended their interests in various meetings on state planning. In addition, the construction companies and companies that produced the technological instruments for the energy companies received enough orders, and were simply uninterested in new tasks and, in particular, in such huge and technologically complicated tasks that required unusually high quality products such as the nuclear industry required.

These groups opposing nuclear energy were influential enough to bring the planning and construction of the nuclear plant in Hungary to a halt. But the oil crisis and the limitation of Soviets energy imports left their opposition untenable in the early 1970s.

The actual characteristics of the three Hungarian reactors/reactor complexes are as follows.

The research reactor
The research reactor was a light water moderated 2 MW thermal power VVR-S reactor. Its fuel was low enriched uranium (10%). It was not designed to generate energy but was used for production of isotopes and for research. The reactor was designed by Soviet experts; Hungarians designed only the building housing the reactor.

The training reactor
The training reactor was a light-water moderated 10 kW thermal power reactor, increased to 100 kW in 1980. The experts involved in the construction and use of the research reactor built the training reactor's active zone and control system, while the building and its equipment were designed by ERŐTERV. Notably, a Hungarian company (Kiskunfélegyháza Machine Factory) produced and installed the reactor and its technological appliances.

The nuclear power plant
The nuclear power station's characteristics are found above. The construction was by far the greatest achievement in the history of technology in Hungary. It was built by a number of Hungarian and non-Hungarian companies. They cooperated at several levels. At the top was ERBE (full name: Erőmű Beruházási Vállalat, Power Station Establishing Company) with the task of organizing the construction of power stations. The government entrusted ERBE with developing the nuclear power station described in the Hungarian-Soviet agreement signed after the third decision (1964). ERBE began to organize the project and took important preliminary steps (e.g., finding the most suitable location, securing transportation routes to the site, etc.) With low intensity it continued this activity even after decision four to halt construction.

Following the decision in the early 1970s to resume construction, the Government transferred money into a bank at ERBE's disposal for making contracts with companies. (The Paks Nuclear Power Plant Ltd was responsible for the operation of the would-be-reactor, but not for its construction.) An important principle was to include as many Hungarian firms as possible, because the Hungarian users wanted to understand all of the technological details of the reactor and be assured that they could find experts within easy reach in case of malfunction.

ERBE, like ERŐTERV, was established in 1950. Its task was to provide various services in constructing and operating a wide range of energy stations, including design, quality control, making contracts, etc. ERBE made contracts with ERŐTERV, building companies, service companies and, in 1973, the Soviet foreign trade company, Atomenergoexport. Another crucial partner was the aforementioned ERŐTERV (nickname of Erőmű Tervező Iroda, Power Plant and Network Designing Company). ERŐTERV set up a General Department of Atomic Energy responsible for a considerable part of the nuclear plant's development, including finding a suitable site

and making the general design. ERBE and ERŐTERV had vested interest in developing a nuclear plant throughout the various political periods described above.

Other Hungarian companies were assigned by the Government to particular tasks. An appendix to the government decision (Nr. 3296/1976) lists them, specifying their duties. The list turned out to be incomplete, as in the course of development other companies were also included. The appendix mentions only one Soviet Company, Teploenergoprojekt, as general executor of the assignment. The other Soviet participants remained unknown for obvious secrecy reasons. The list also mentions Intransmas, a Bulgarian-Hungarian company, as a contributor without specified duties.

Despite the lack of details, we know that the development of the nuclear power plant in Hungary was a transnational project. Skoda, the famous Czechoslovak firm, produced the reactor containment vessel. A Polish company, Budostahl, sent workers to carry out special welding and construction jobs that Hungarians were unable to manage. The sole device coming from the West was a French industrial tower-crane. In addition, many exchanges of experts were organized with Soviet, German, Czechoslovak, Bulgarian and Finish colleagues, in different specialties.

It is to be noted that the complexity, quality requirements, the large number of participants, the new technology and the structure of economic and technological administration in State socialism made the construction extremely difficult to achieve. Four blocks were built in sequence and much was learned in the process of their construction. It is a wonder that it was successfully done.

It should be noted that cost was in many respects the most mysterious part of the nuclear plant construction process in Hungary. The basic contracts contained nothing about the costs because the Soviets were not willing to disclose this information. Hence, in their planning the Hungarians relied on an estimated price. This was a fiction, no one took it seriously but they had no choice. The long bargaining procedure could not be based on anything other than qualitative and estimated factors, excepting the power output of the future nuclear station.

None the less, we found an interesting estimate. According to this, in the third decision (1964) the planers calculated 10 billion Forints as the price of the whole project all the while knowing that it was not real. After the final decision (1972), their prognosticated total was 59 billion Forints, plus 10 billion Forints in reserve. In 1986, seeing all the changes in deadlines, organization difficulties, new technologies, changes of the financial system, and so on, a new financial plan was conceived. At that point, the estimated total was 72 billion Forints. When the project was financially closed in 1990, this estimation proved more or less correct, but some elements of the plant were still to be built. (Inflation is disregarded in the sums.)

It is to be noted that the financial account was by then extremely complicated. Hungary needed credit for the construction, and an important agenda in the bargaining process was the sum of credits the Soviets would provide. The account settlements were also

linked to complicated multilateral CMEA agreements. In addition, the prices had little to do with the prices known in Western markets, not to speak of the exchange rates between Forint and Ruble, and Forint and Dollar. These procedures were matters of negotiations.

The fuel cycle

An important part of the history of the Hungarian (and any) reactors involves not the reactors themselves, but the origin of their fuel elements and the fate of the wastes removed from them. In Hungary, the history of fuel cycle problem embraces all indicated periods and the problem of closing the cycle is still present.

The front end, the production of fuel, was carried out in the Soviet Union throughout the periods covered. In Hungary there was in fact a uranium mine in the Mecsek Montains, near the city of Pécs. The associated uranium deposits were discovered in period 1, and the mine opened in 1955 under the name of Bauxitbánya Vállalat (Bauxite Mine Company), near the village of Kővágószőlös. The company was a Soviet-Hungarian one owned originally by the Soviet Union. It had a Hungarian director but all other higher level positions were filled by Soviets. The uranium content of the ore was 0.1%. In 1957 Hungarian state took over the mine, renamed the Pécsi Uránércbánya Vállalat (Pécs Uranium Ore Company) and in 1958 made a contract with the Soviet Union for twenty years, prolonged for another fifteen years in 1979. In this same contract, the Soviet party undertook to provide Hungarian reactors with nuclear fuel.

In 1964 (already period 2) Hungarians started to concentrate to a higher grade the ore in Hungary, making subsequent shipment to Chepetsk Mechanical Works in Glazov City, Udmurt Republic (the Soviet processing company) cheaper. The product of the renamed company (Mecseki Ércbányászati Vállalat, Mecsek Ore Mining Company) contained 50% uranium metal. In exchange, Hungarians received the ready-to-use uranium fuel elements, called ‘cassettes’.

In the new regime following the collapse of communism 1990 (period 4), uranium mining entered a deep crisis in Hungary from which it never recovered. By 1997, the whole uranium industry was shut down.

As for the back end of the nuclear fuel cycle, it was first tackled during period 2, when the first nuclear waste storage was opened in Solymár, near Budapest in 1960. A portion of the waste coming from the research and training reactors was stored there, while another portion was transported to the Soviet Union. As the Solymár site reached the limits of its capacity, and in addition seemed to pose a danger to nearby Budapest, a new repository was built in Püspökszilágy, about fifty kilometers NNW of Budapest. The repository was named the Radioactive Waste Treatment and Disposal Facility (RWTDF), designed in the early 1970s in harmony with the international standards of the time. It was completed in 1976 and the first items of waste arrived in 1977.

The nuclear waste produced by the Paks plant were to be transported back to the Soviet Union, according to the agreements related to decisions 3 and 4. However, by the time

this aspect of the agreements would have come into effect, the Soviet Union asked for its modification. Originally, the burnt cassettes with spent fuel had to be stored for three years in a decay pool before return to the Soviet Union, where they were reprocessed and the residues stored. Later the Soviets asked for a five-year storage in the decay pool in Hungary. In 1986 a contract was signed about handling nuclear waste; it contained a paragraph saying that the Soviets take back spent fuel free of charge. The Hungarians themselves had to store low and intermediate level radioactive wastes. For a while, they again used Püspökszilágy for this.

What happened after this might be considered an epilogue to our history. After the collapse of state socialism all the former agreements and reasoning became entirely invalid. Five year plans, CMEA, Socialist friendship, insulation from the West, ignoring financial aspects—all this disappeared with the dissolution of the Soviet Union. Consequently, the Hungarians found themselves facing a new partner: Russia. Waste handling was one of the subjects that had to be radically rethought in the new regime. Bargaining had to be continued on monetary basis. Indeed Russia charged increasingly high prices for the return of nuclear waste. As a result, the Hungarians searched for less expensive solutions, i.e. storage of high-level nuclear waste in Hungary.

This search resulted in the first and only notable popular anti-nuclear action in Hungary's history, against the plan for a new repository for low and intermediate level radioactive wastes in Ofalu, in southwestern Hungary. In 1990, its population voted against storing radioactive waste in spite of all the efforts of politicians and experts to lobby otherwise. They had to abandon their campaign to create a repository in Ofalu and instead open a storage facility in Bátaapáti, to the east of Ofalu. The National Radiactive Waste Repository (NRWR) in Bátaapáti was opened in October 2008.

The situation grew more confusing in the early 1990s, and not only because of the collapse of the USSR. Domestically, the democratic Hungarian parliament was compelled to pass a law on the handling of nuclear energy issues, including nuclear waste management, in 1996. (1996/CXVI. Law). A financial fund was established (Központi Nukleáris Pénzügyi Alap) in 1998 and the National Commission of Atomic Energy was reorganized under the new name of Országos Atomenergia Hivatal (Hungarian Atomic Energy Authority) with new mandates. The law ordered this institution to establish a Public Agency for Radioactive Waste Management, a non-profit company, which was transformed to the Public Limited Company for Radioactive Waste Management (PURAM) in 2008. PURAM is responsible for all of the steps of the back end of the fuel cycle.

In this institutional framework a group of experts decided to construct a new system for storing, reprocessing and disposing various kinds of nuclear waste in Paks. They opted for Interim Spent Fuel Storage Facility technology (ISFSF). As a consequence, the renamed company, the Paks Nuclear Power Plant (not the Hungarian state) made a contract with British-French GEC Alsthom to construct a Modular Vault Dry Storage System (MVDS) in 1992. In spite of some protest from the local community, since its

completion in 1997 the system has been working and growing in accordance with the requirements.

Siting

Another important context to the development of nuclear energy in Hungary is siting—how sites for reactors were selected, and, just as importantly, what influence those reactors had on the localities. The siting of the research reactor and the training reactor had no real influence on the neighborhood. The research reactor was built in the campus of the large Central Research Institute for Physics, in Csillebérc, located in the Buda Hills, in Budapest far from the city center. The training reactor is located on the campus of Budapest Technical University also in Buda. Both reactors are virtually invisible to the general population of Budapest.

In contrast, Hungary's nuclear plant brought radical changes in the life of the town of Paks. The site of the plant was determined by the Hungarian government in 1967 on the basis of research done by a team of Soviet and Hungarian experts of geology, meteorology, geography, and others, including urban planners. Political aspects were also considered, as the plant provided an important means of development to Tolna County. Bogyiszló, another township, was a competitor to Paks but from the technical point of view Paks appeared more suitable. The local population was not consulted about the decision.

For the construction block apartment houses were built for the workers (instead of barracks as was suggested by some) and new shops and other facilities were established for the fast growing number of workers coming from various parts of the country. Paks, a sleepy town, abruptly doubled in size, with around ten thousand migrants arriving with their urban styles and needs. Hence, Paks developed very fast, received new medical, cultural, sport, commercial, and other facilities as well as well-paid jobs, and career opportunities. As a result, an unprecedented interest in engineering studies took root in the population.

Nevertheless, the integration of the newcomers by the traditional population was very difficult. Fear of atomic energy was present in Paks but was only expressed in private conversation. After 1990, the tension between the old and new inhabitants received political form in the shape of contested local government elections. Anti-nuclear plant groups were organized, loud marches coursed through the streets, and fervent debates broke out in local government meetings. The situation gradually eased as the number of employees at the nuclear plant coming from Paks and the surrounding vicinity grew, as the first generation staff gradually retired.

For the larger area, Tolna County, the nuclear power station was extremely important. Tolna was relatively backward compared to neighboring counties, and the huge industrial plant provided more weight to Tolna in national politics. The new highways, railway lines, bus stations, and big houses contributed to the development of nearby Szekszárd as well, the county seat.

Media and nuclear energy
Due to the lack of civil society in state socialist countries, neither pro- nor anti-nuclear civil movements existed in Hungary in the early Brezhnev era. Forbidden Samizdat movements started in the early 1970s. The national media spoke of the agreement in an unequivocal supportive tone. Actually, it normally handled the nuclear plant construction as a triumph of Socialism, and a sign of Soviet-Hungarian friendship.

The developers of the project were not very interested in informing society about the progress of their work, and gave little attention to public relations. Nevertheless, national radio and television broadcasted reports on the Paks project every two to three month, and two TV reporters, János Bán and Marietta Szabó, became well-known for their reports. The local newspaper in Tolna County reported almost every step of the construction work. Some of the articles were later republished in a thick retrospecive book.

Chernobyl was reported somewhat belatedly in a comforting tone. Hungary's leadership at the time wished to calm the worries of the public and defend the Soviet Union. By 1986, however, the disaster at Chernobyl did not influence the ongoing project in Paks, where three reactors were already operating.

An analysis of the media's portrayal of nuclear power in Hungary would require a great deal more research. In the period of state socialism the public learned to read between the lines. It was a period when the number of newspapers, radio and TV channels was very limited. After 1990, however, the media became extremely complicated, branching and sub-branching and growing very complex. With Internet the situation has become even more complicated, and confusing for the researcher.

Section 3: Showcase

Research has revealed the most surprising historical case to be the fourth decision mentioned above, to postpone indefinitely planning and construction of the NPP. This event—what turned out to be a long pause in construction—was in itself revealing for the way in which a nuclear opposition within the state bureaucracy manifested itself (see the Section 4: Events), and very influential in terms of the final shape of the NPP and its components.

It should be understood that one of the major subjects of the long bargaining process between the Soviets and Hungarians that began in the 1960s was the power of the would-be plant. In the process of the mid-1960s negotiation, Hungarians expressed their interest for a plant of 800 MW. This was the type that was offered in the framework of CMEA and the Soviets provided the outlines of the design of this in 1965. By 1968 the power of the planned plant had grown to 860 MW, and some other parameters also improved.

The letter of cancellation or postponement that was the culmination of event four brought a great rethinking to the 1968 plan. The Hungarians expressed their intention to buy a more advanced nuclear plant later. They referred to the plant of 1000 MW that was under construction in Leningrad called RBMK (Reaktor Bolsoj Mosnosztyi Kanalnij). This upset the Soviets because by that time they had sold a 440 MW VVER plant in Finland which was proving very good in operation. In any case, the Hungarians were inclined to think in terms of 1000 MW reactors and by 1969 they corresponded with the Soviet partners on constructing two RBMK blocks in the future. With this, the Hungarians significantly increased their demand for nuclear energy to 4000 MW and in their long term plan (1991-2000) they spoke about a 14-16,000 MW need for nuclear energy.

When Hungarians renewed their nuclear energy project in 1972, they assumed between 1760-4000 MW nuclear energy in their energy mix by 1980. But in negotiations they soon understood that the Soviets would not undertake to provide a plant of 4000 MW. The realistic demand could only be 1760 MW, four VVER 440 reactor blocks. The final decision and documents signed then contained this, and this was what was ultimately constructed by the early 1980s.

The other major element of change was the new Soviet safety policy. Already in 1973, before the prime mister signed the final agreement, ERBE was assigned to make a contract with a Soviet foreign trade company to plan for the nuclear reactor assuming that it would be very similar to the one described in the agreement of the third decision. However, in a CMEA meeting, the Hungarian participants were informed about a new safety policy conforming to Western requirements.

The starting point for the new safety policy was preparation for a worst-case scenario. The Soviets assumed the break of the largest diameter tube in the cooling system and, simultaneously, a break in the supply of electricity. For this they had to construct a containment building, a 1.5 meter thick building made of concrete around the primary circuit. This massive hermetic box was intended to prevent release of radioactivity from the reactor. At the same time, a backup electric supply was installed.

These elements as well as others had serious consequences for the whole project. The task was twice as big as they calculated on the basis of the earlier contract and the product of construction became a prototype—an identical plant had never before been built.

This episode—the opposition to nuclear power in the Hungarian Socialist administration in the late 1960s, the pause in construction, the dramatic revision of plans, and, ultimately, the building of a prototype powerplants with four units still in operation—stands out as the outstanding event in the history of Hungarian nuclear power. The limits of what the archives can divulge and the sensitivities and discretion of historical actors still living prevent the present authors from stating more about individual identities of those who comprised the nuclear opposition, as well as other fascinating details of this event. Therefore, more stands to be learned about the nature of

the adoption and opposition to nuclear power in Hungary and in the Socialist-era Eastern European context. What can be said here is that for Hungary the whole episode ends with an ironic twist: when the halt to build a nuclear power station in Hungary was lifted, and planning and construction was resumed, a renewed plan was put forth more than doubling the amount of electric power provided by the station, influencing Hungarian energy policy for more than a generation.

Section 3: Events

The five major nuclear decisions leading to the construction of Hungary's nuclear plant, which comprise the events detailed in this country report, resulted from similar processes. The Political Committee of the Hungarian Communist Party, the most important decision-making body in Socialist Hungary, was decisive. Consisting of 10-15 members, including the prime minister, the Political Committee reported its decisions on the most important questions of the day to the government, who executed the decisions. The government carried out concrete studies and delegated the tasks of execution to ministries and other governmental agencies.

In its decisions the Political Committee relied on its bureaucratic apparatus. This involved sections (e.g. cultural, economic, etc. sections) and committees. The sections and committees relied partly on their own staffs and partly on the opinions of politically reliable experts. The sections and committees prepared proposals for the Political Committee to consider. In the case of nuclear power as in other matters of the day, these bodies provided information and opinions feeding the decision-making process.

These decisions, made in different historical periods and concerning three different types of reactors, varied in terms of the reasons, arguments and ultimate justifications for each case.

Event 1
The first decisions were made in 1955, and do not appear to have been difficult to arrive at. They stemmed from the Soviet Union's offer to build research reactors and accelerators in its Eastern European satellites and China (in response to the American Atoms for Peace initiative). The exact date of the Hungarian decision is telling. As noted, the suggestion to construct a nuclear reactor came from the Soviet Union—the Superpower who led the geopolitical alliance Hungary was a part of.

However, Hungary was not among the first cluster of countries invited to do so. The USSR Council of Ministers declared in January 18, 1955 its intention to aid its allies in the development of nuclear technoscience for peaceful purposes. It sent just such a proposal to the Chinese People's Republic, the Polish People's Republic, the Czechoslovak Republic, the Romanian People's Republic and the German Democratic Republic. Delegates consisting of physicists and engineers from these countries attended a meeting held in early April to discuss the details, and only then agreed to

extend the proposal to Hungary and Bulgaria. The treaty between Hungary and the USSR was signed on June 13, 1955. Like all such treaties, it was bilateral.

What is remarkable is that the Council of Ministers in Hungary ordered that an experimental reactor be built in a decision made on March 10, 1955—three months *before* the bilateral agreement. In fact, even before this, the Political Committee of the Hungarian Communist party (officially at the time: the Political Committee of the Party of Hungarian Workers) declared it necessary to construct a research reactor, and specified institutions responsible for the project. Therefore, we see a visible interest in nuclear power in Hungary that predates the Soviet-led decision to permit Hungary to build a nuclear reactor.

Event 2

The second decision, to construct a training reactor at the Technical University of Budapest, was made by the Hungarian government in 1962, late in the Khrushchev era. The goal was to train nuclear engineers for the promising future field of nuclear technology.

The process leading to this decision began in 1955, with the establishment of the Országos Atomenergia Bizottság, the OAB (the National Commission of Atomic Energy). Until 1970, the OAB was the highest level of government authority on nuclear issues, headed by a deputy prime minister. The commission entrusted experts working with the research reactor to elaborate plans for a training reactor. The Hungarian Academy of Sciences and the Committee of Education of the Party decided in favor of the plans. The head of the Section of Energetics of the Ministry of Heavy Industry signed the contract with Mihály Kökény, the secretary of the OAB, in 1962. The construction was financed by the OAB. Soviet experts acting as referees gave positive opinions on the plans for the reactor design. The design process lasted until 1966.

Event 3

The third decision, to build power-producing nuclear reactors, was much more complex and took much longer time than the first two. The process leading to the decision started in 1964. It was initiated and made by the Hungarian authorities, including the Party leaders and the government. All this happened in the Brezhnev era. The factors most influencing the decisional process were as follows:

i.) There was an ideological, philosophical component, tracing back to the Stalinist period or even earlier, that cannot be ignored. According to this ideology, science was the main driver of communist development. The mode of production is inextricably linked to production power—and production power increases via technological innovation. Hence, for arrival at a communist mode of production, technology must be modernized. Nuclear technology seemed to be a decisive component of modern technology; hence it should have widely been used.

ii.) Another component consisted of the USSR's relative advance in atomic technology, and its and others countries' displays of this technology at international forums. The Soviet Union had an advanced nuclear technology which impressed observers at the International Conferences on the Peaceful Uses of Atomic Energy held in Geneva the first time in August 1955. This series of conferences was one result of American President Eisenhower's Atoms for Peace speech, delivered to the United Nations in December, 1953. The conferences can be considered both a forum for international rivalry and an early step of détente. Hungarians attending these conferences were inspired to suggest to the Party that Hungary make preparations for the atomic age.

iii.) Yet another component consisted of institutional support for nuclear power development among the countries that made up the Socialist bloc of states. The Permanent Commission on Utilization of Atomic Energy for Peaceful Purposes was set up in CMEA in 1960. By 1964 Hungarian authorities began to believe that the CMEA member states might cooperate multilaterally in using nuclear power stations for enhancing energy supply, especially in light of the promisingly good performance and apparent relative affordability of the newest Soviet reactors.

iv.) A final component was domestic, though not unique to Hungary. Rapid industrial growth required more energy in the CMEA countries, Hungary included. Energy provision tripled between 1950 and 1960, and the 3rd (1966-1970) and 4th (1971-1975) Five Year Plans also prescribed fast increase of energy supply in a country previously rather energy poor. The question became, of course, which type of energy could secure the increase: coal, hydroelectric, oil and gas, nuclear energy, and/or some sort of electricity import. Most of the existing power stations were coal-fired. However, the scarcity and the low quality of Hungarian coal led the country to import large amounts of coal. Hungary's flat topography precluded hydroelectric energy. Oil appeared quite promising, given that the Soviet Union could provide it at a favorable price. Next to it, atomic energy appeared rather fantastic—however, it, too, might furnish the megawatts Hungary would need.

The Soviet proposal to provide a nuclear power plant arrived in 1965 in the framework of the CMEA cooperation mentioned above. As usual, following the suggestion of the Political Committee of the Party, the government made their decision, in favor of constructing a nuclear plant. The representatives of the Hungarian and the Soviet government signed an agreement to construct a nuclear power plant on December 28, 1966.

Event 4

The fourth decision, to halt the planning and construction of the nuclear power plant, was made again by the highest body of the party and the governmental authorities. They decided in January 1970 to postpone the construction of the nuclear power station for several years. This very fact shows that after the mid-1960s the Hungarian regime had departed from the previous Stalinist rigidity and became more flexible, accepting elements of market-driven decision-making and considering various stakeholder

interests. From this period of the Brezhnev era, negotiation and bargaining became particularly important activities in economics and politics, both domestically and internationally. We see that in a note provided at that time to Soviet authorities, reference is made to a reappraisal of the coming energy needs of the country in the period of the next five year plan, casting the need for the nuclear plant in enough doubt that planning for it was halted. Considering that no definite time for restarting the project (the note alludes only vaguely to sometime in the 1980s), the step represented by the note can be considered a de facto cancellation of the original agreement—and it was, in fact, accepted by the Soviets.

Event 5
The final and last decision in this brief historical review—the decision to resume planning and construction of the nuclear plant—was made definitively in 1975. The reconsideration of the 1970 decision to halt construction began in the spring of 1972. Hungarian energy experts' consultation with their Soviet analogues concerning the fifth Five-Year Plan led to a return to the view that nuclear energy would become indispensable. Speculation that oil prices would rise was soon met with the hard reality of just that. Hungarian Prime Minister Jenő Fock signed the final document in April 1975. All the decisive elements of the construction were agreed to and described by this time.

To summarize: in the Hungarian case, arguments both for and against nuclear power were framed in economic terms. .

Today, the planning and construction of the next generation of reactors to be built at Paks unfolds in a different political framework. Only years from now, as historical sources become available on contemporary events, will it be possible to compare today to the period that has so greatly influenced Hungarian energy policy—the time of the decision-making and construction of the Paks NPP.

Section 3: A note on sources

The historical study of nuclear energy in Hungary is barely started. Virtually nothing of a scholarly nature on the topic exists in English. Even in Hungarian, published sources at this point are limited in large part to the recollection of historical actors and historical summaries encouraged by state and parastatal institutions. Archival sources include folders in the National Archives of Hungary, especially in the boxes of the collection of the State Atomic Energy Committee (Országos Atomergia Bizottság, OAB). Outside the National Archives, one finds sources in the Archives of the Hungarian Academy of Science, and the Archives of the IAEA. The present authors also found sources in the Archives of the Foreign Ministry of the Republic of France, and no doubt similar sources can be found in the archives of other European countries.

As for memoirs that provide insight into the development of Hungary's research and training reactors as well as the Paks nuclear power station, one should consult:

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Szabó, Imre. “Az Upponyi- és a Bükk hegységi sugárzóanyag-kutatások története” [The history of radioactive substance research in the Uppony and Bükk hills]. *Érckutatások Magyarországon a 20 században*. (Sándor Szakáll and Gusztáv Morvai, eds). Miskolc—Rudabanya. 2002: 217-234.

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