

# Management of Megaproject During the Turbulent Period of Economic and Political Transformation in Slovakia\*

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Megaprojects have distinctive characters when compared with smaller construction projects. Cost overruns and time delays are quite common. Risk management of such projects is quite complex, and many risks are not evident at the beginning. We deal in detail with serious political risks that are quite strong especially in Central and Eastern Europe. At the end, the author outlines the economic impact of the project as well as possible lessons that were acquired during its realization. In the present paper, the author analyzes the process of completion of Units 3 and 4 of the nuclear power plant (NPP) in Mochovce—the largest megaproject ever realized in Slovakia. Large and complex projects, especially highways, bridges, and NPPs are unique in that their construction ventures into the jurisdictions of many other utilities and disciplines, and they tend to affect large industrial or commercial areas. As such, they influence and get influenced by many stakeholders. Project managers who are not attentively interacting the project environment are likely to face difficulties during planning and execution of their projects. Stakeholder management is a major activity in projects. This is further emphasized when projects are large and complex by nature.

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Projects that can be characterized as “megaprojects” are large-scale investment projects, which costs are worth more than 0.5 billion euros. The common denominator of megaprojects is an extreme difficulty of technical, technological, financial, and social sphere as well as their long-term nature. Megaprojects bind most of the government and private spending on infrastructure creation and successful implementation are reflected in the income area of public finances, and at the same time, significantly affect the society as a whole. During the past decade, megaprojects have had an enormous impact on the global economy and the advancement of transition and developing countries. Research of megaprojects tends to focus on their failures in terms of cost overruns, delays, and endemic stakeholder conflicts. However, there are also great benefits that are associated with project development and implementation processes that are rarely discussed (Greiman, 2013).

Other projects that cost less than 0.5 billion euros are sometimes also called megaprojects. In this case, it depends on the location of the project. For example, a project in the amount of 0.3 billion euros in

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medium-sized city can also be considered as “mega”. Management of megaprojects with the specific requirements for their construction and subsequent operation is very difficult. It means work for specialists, who are led by project manager. Mitchell, Agle, and Wood (1997) suggest that power, legitimacy, and urgency are key stakeholder characteristics. As such, a project manager is required to develop sufficient understanding of such characteristics, which are in fact changing variables within the various stakeholders in a project environment. The number and nature of stakeholders will vary with the life of the project (Moodley, 2002).

Risk factors are significant. This is such a cost overrun—excess in the amount of 50% is normal, but an excess of 100% is not uncommon.

One of the major determinants of large construction projects is determining the right area. It means for example, the reconciliation of the investment plan and land use plan of the site, taking into account the tectonic and seismic activity area, extreme meteorological conditions in the field, or if it is not a flood zone, a major requirement may also be the presence of water source and other factors that could significantly affect total value of future investments. In the following sections, the author will focus primarily on seismic risk factors, floods, and extreme weather conditions (Spirkova, Ivanicka, & Urbanovsky, 2012). The construction of nuclear power plants (NPPs) represents a lengthy process, which is very cost intensive. Non-stable economic and political environment, the technological progress, the governmental decisions, and the activity of stakeholders may be the source of serious uncertainties that can result in considerable delays and overruns of the project costs of construction of the NPPs that by their scope represent the megaprojects. The growing requirements for safety of the nuclear power station, the transformation of country to market economy, privatization, the stakeholder attitudes, and transformation of the financial markets had impacted the project development of the nuclear power blocks in the important way. While this situation is typical for majority of the countries which build the NPPs in the world, the situation in the Central and Eastern Europe has its specifics because of the realized economic transformation.

The project of completion of the third and fourth NPP in Mochovce, Slovakia is typical large-scale investment megaproject costing more than 0.5 billion euros. As other megaprojects in Europe, it is extremely complex and it has the long record of late delivery, frequent changes, and substantial cost overruns financed in the large part from the public funds.

At the same time, the project has significant implications for society in Slovakia and Central Europe. The completion of NPP enables to achieve the higher level of the self-sufficiency of power generation in Slovakia. Successful project delivery will have major implication for new owner ENEL S.p.A. (*Ente Nazionale per l'energia Elettrica*, Italy) and government finances as well. This completion is one of three NPPs currently being built in EU (European Union):

- (1) The third unit and fourth unit will be put into operation in 2015 and 2016, individually;
- (2) Each unit output of 440 MWe;
- (3) Non-nuclear part contractor: ENEL Ingenerate & Innovazione;
- (4) Contractor of control and management system: Areva-Siemens;
- (5) Up to 2/3 of work was carried by Slovak (local) companies;
- (6) Communication strategy of the completion is based on transparency, and therefore more than 2/3 of Slovak population and more than 87% of the population in the 10km zone around the plant support the completion.

### **History of NPPs Construction as Important Megaprojects in Slovakia**

The construction of the NPP started more than 50 years ago in Slovakia when the project of the first research development pilot NPP named A1 was launched in 1958 and commissioned in Slovak village Jaslovske Bohunice in 1972. A1 unit has been in operation from October 1972 to February 1977, since then, it is in the process of decommissioning .

Later, another four nuclear power reactors of Voronezh type (V1 and V2) were built in the close distance to A1 unit. Construction of V1 was launched in April 1972. The first unit of V1 was put into trial operation in December 1978 and the second unit V1 in March 1980. On the basis of Government Resolution No. 801/1999 in accordance with the Treaty of Accession to the EU, the first unit V1 NPP was shut down on December 31, 2006, and the second unit was shut down on December 31, 2008. V1 Nuclear Power Unit is currently in the I. stage of decommissioning. Due to the expected deficit in the electric energy, it was decided to build two more units of improved Voronezh type reactor VVER 440 Model 213 (V2). The construction of the third reactor V2 started in 1976<sup>1</sup>.

The last one—a total of four units, is localized in Mochovce—in the South of Slovakia between towns Nitra and Levice.

The Slovak Republic has decided to build a new NPP in the area of Jaslovske Bohunice in future, for which new strategic construction partner will be Czech company CEZ. The value of investments should get from four to six billion euros. Historical ties of Czech and Slovak nuclear energy and industry of both countries are ones of the tightest among the whole Europe. Both building partners, JAVYS Company and energy group CEZ are connected with a rich common past. Nuclear energy in Slovakia and the Czech Republic has been built on a single nuclear program in the former Czechoslovakia. By that, Slovakia and Czech Republic had a common energy system since 1993. Both countries built together a water pressurized nuclear reactors (Jaslovske Bohunice, Dukovany, Temelin, and Mochovce) in their territories. Both countries still have a similar mix of energy resources, legislative and regulatory environment, as well as ongoing business and personal ties, which are attributes that can fully capitalize on the upcoming project of building a new NPP.

### **Completion of NPP Mochovce—Units 3 and 4**

Completion of the third and fourth unit of NPP Mochovce was planned in 2012 and 2013. This would be the largest private investment in the history of Slovak Republic. Output of each unit will be 440 MWe. *Slovenske Elektrarne, a.s.* (SE Inc.) began with the completion of Units 3 and 4 by formal opening of construction works on November 3, 2008. The German, Italian, French, and Russian companies take part in this process. Thus, the complex network of relations among stakeholders for completion of the NPP Mochovce was established as shown on the following scheme (see Figure 1).

#### **Cost Management Processes**

The construction of NPP Mochovce was funded by state resources until 1991. By the end of 1991, about 19 billion euros of Czechoslovak crowns were invested into the project. In the early 90s, lack of resources greatly influenced the construction of NPP Mochovce. The third and fourth units were reported to be only 40%

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<sup>1</sup> Materials of Slovak Nuclear Power Company.

and 30% complete when work was halted on at the beginning of 90s. The only way to continue the construction was searching for funds abroad. In September 1995, the government approved a model of financing of Units 1 and 2. It was agreed that the completion will be carried out within the range of the original design and the original contractors. Contracts with suppliers and credit institutions were signed in 1996 where the government agreed to take over loan guarantees for the completion of Units 1 and 2. Table 1 presents total costs related to the construction of the NPP Mochovce.

In October 2004, the Italian national utility ENEL acquired 66% of stakes in SE and, as part of its bid, proposed to invest nearly two billion euros in new nuclear generating capacity.

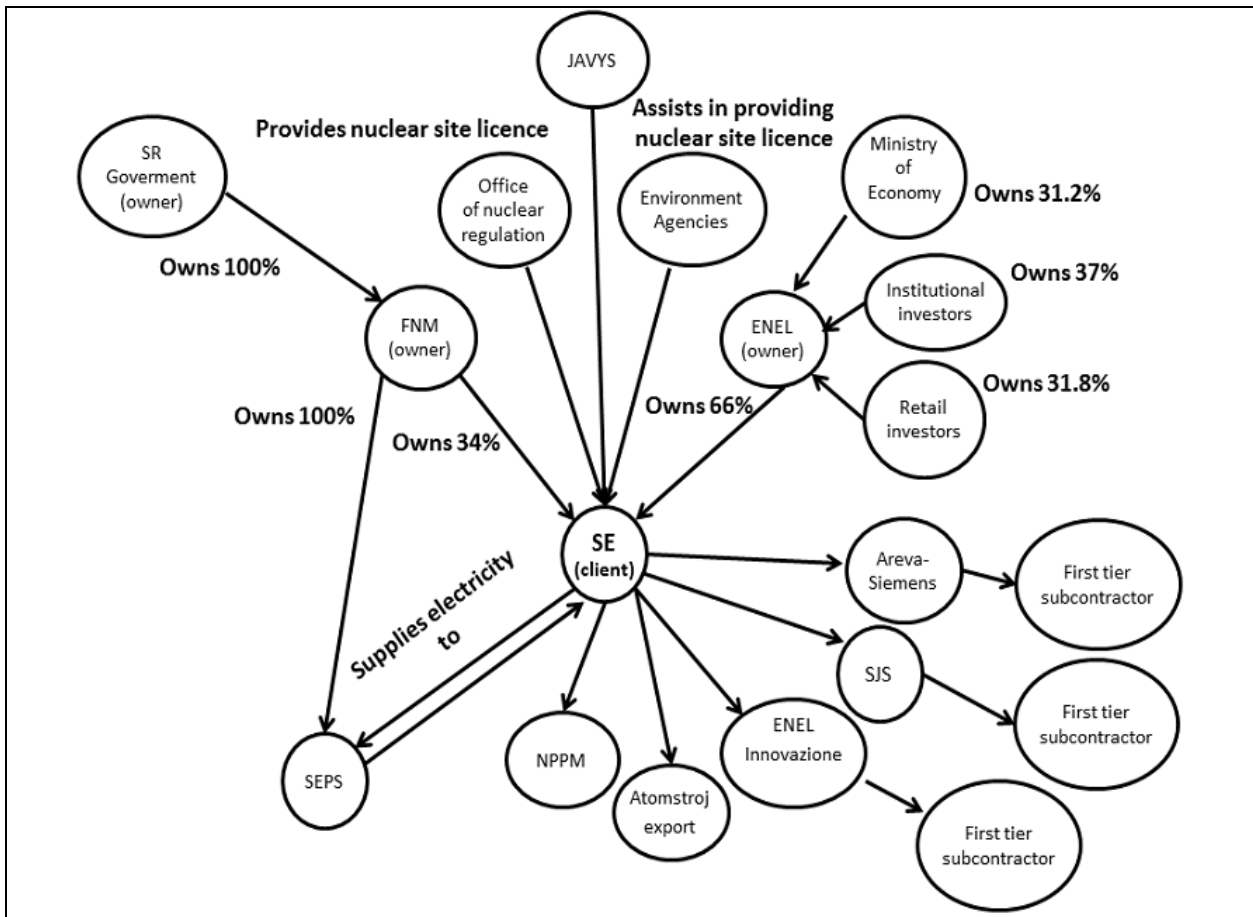


Figure 1. Stakeholders for NPP Mochovce completion—Units 3 and 4. Source: Spirkova et al. (2012).

Table 1

Total Costs in Construction of the NPP Mochovce

Units	1 & 2	3 & 4
Start of construction	1986	1987
Grid connection	1998/1999	2015/2016 (estimated data)
Total costs of construction (million €)	1.930	3.8 (final approved amount for the completion of Mochovce may still increase)

Note. Source: the author’s processing.

In 2007, the feasibility study has been completed. The result was positive but the timescale to complete NPP Mochovce 3 and 4 slipped. By 2007, the expected completion date was 2012 when the contracts for completion were expected to be signed in mid-2008. Obtaining of finances became a problem. In 2007, a consortium of nine banks agreed to provide ENEL/SE with 800 million euros “revolving credit” facility over seven years. However, in 2008, under pressure from Greenpeace, three banks—ING Bank N.V., Banca Intesa, and Erste Bank, refused to allow the credit facility to be used for the completion of Mochovce and then projected of cost 1.7 billion euros. ENEL/SE was forced to make a statement that it would finance completion of the plants from internally generated cash. The process was further delayed in September 2008 by a Slovak Government decision to require ENEL/SE to complete a new Environmental Impact Assessment (EIA). As the consequence of the delays, some of the contractors have augmented their prices. The European Commission also became concerned in May 2008 that the designs were not adequately safe. The commission has expressed the concerns that the facility is not meeting the objectives of the Euratom Treaty, “provided that the utility bring(s) the design in line with the existing best practices” including the protection against external attack. Based on such opinion, the new safety measures were implemented. Not long ago, Nuclear and Decommissioning Company of Slovakia (JAVYS) proposed to build another NPP unit at Bohunice site, expected to come on line in 2020. As a result of that, a surplus of base-load power might be available and this could force down the price ENEL/SE would receive for the output of NPP Mochovce 3 and 4. Such situation would mean the reduced profits or even losses for ENEL/SE. In 80s, the planned cost of construction of Units 3 and 4 represented 1.3 billion euros. In 1992, construction works on the completion of Units 3 and 4 were stopped. One reason was the lack of funds. The construction work of Units 3 and 4 were recommenced in 2007, which raised the costs to 3.4 billion euros. At that time, it was expected that the completion of Mochovce NPP—Units 3 and 4 will cost three billion euros, where the equity financing would represent 2.2 billion euros and 500 million euros will come from foreign sources. Since the financial performance of the SE was at that time positive, the equity financing seemed to be a good option. When ENEL took over SE, the forecast completion date for the reactors was 2011-2012. ENEL was expected to finalize a feasibility study in April 2007 and then to take a final decision whether it would invest in the units.

### **Impact of Fukushima Accident on the Completion of Mochovce Power Plant**

The challenges which nuclear safety and its governance face were highlighted in the accident at the Fukushima reactors in Japan which happened because of the earthquake and the tsunami in March 2011. Fukushima accident on March 2011 was a series of equipment failures, nuclear meltdowns, and release of radioactive materials at the Fukushima NPP. The results from the accident have shown that nuclear reactors must be protected even against accidents, which have been assessed as highly improbable. The most important reasons of the Fukushima accident were the faulty design, insufficient backup systems, human factor failure, inadequate contingency plans, and poor communications. The EU reacted on Fukushima accident by ordering the comprehensive and transparent risk and safety assessment (“stress tests”) and proposed any improvements by the end of 2011 that may be necessary. Although based on the stress tests, national regulators concluded that there are no technical reasons requiring the shutdown of any NPP in Europe, nevertheless, practically all NPPs are expected to undergo safety improvements, as hundreds of technical upgrade measures have been identified. These measures include additional mobile equipment to prevent or

mitigate severe accidents, the installation of hardened fixed equipment, and the improvement of severe accident management, together with appropriate staff training measures. The costs of additional safety improvements were estimated to be in the range of 30 million euros to 200 million euros per reactor unit in 2011. Based on the necessity of realizing stress tests, implementing additional safety measures, ENEL has substantially delayed the completion of the third and fourth blocks of NPP, while demanding additional 800 million euros for the completion.

The ENEL's SE requested for additional funding of NPP Mochovce from Slovak budget what raised the resentment from the Slovak Government. The government declined the request for the second time on May 28, 2013, and ENEL threatened to stop the construction works. The missing agreement on raising the budget may endanger the completion of the entire project, in which Czech companies are taking part. The costs of completion of the Units 3 and 4 have increased to 3.8 billion euros from the originally estimated three billion euros. This would endanger jobs in the construction and cause a fall of tax revenues to the state budget, SE said. The investment in the completion of the third and fourth units of Mochovce represents a significant contribution to the growth of the Slovak economy. The government would however like to force SE to complete the project, under the threat of sanctions. The construction has already been delayed. Originally, the two units supposed to be completed in the course of last year and this year. According to ENEL, the delay has been caused partly by additional measures aimed at enhancing the plant's safety, which ensued from stress tests. Owing to the delay of the launch of the two new reactors, the state loses dividends from SE's profits. The third and fourth units could collect more than 300 million euros per year, according to the planned volume of production at current prices. Part of this amount be through dividends could have been received also by the state budget.

The stress tests in post-Fukushima period and the implementation of the results have caused another delays and cost overruns in the project. The following changes were added to design of NPP:

- (1) Severe accident consequence mitigation;
- (2) Seismic reinforcement;
- (3) Enhancement of plant protection to area events (flooding, fire, etc.);
- (4) Plant instrumentation, control, and human machine interface;
- (5) Protection from high energy pipe breaks;
- (6) Minimization of radioactive wastes.

The management and verification of the design works are being performed by SE through a dedicated engineering team which consists of specialists from NPP Mochovce 3-4, NPP Mochovce 1-2, NPP Bohunice, and from Enel SpA. For the technical activities, SE is assisted by an international engineering consultant. In order to ensure that the revision of basic design is performed by implementing the best applicable safety practices, SE has also set up a Safety Board, composed by six leading national and international experts in nuclear safety, which is aimed at providing guidelines as well advice on all subjects concerning safety.

The most important events that had the impact on the megaproject completion are shown on the following figure (see Figure 2).

1980	<b>Start of construction</b>	Site permit
1987		Building permit – start of construction
1992	<b>Halt of construction works</b>	Halt of construction works
1993		Start of preservation and protective works
2000		Approval of the NPP Mochovce 3&4 Strategic preservation maintenance and protection plan by the Nuclear Regulatory Authority (NRA)
2002		Takeover of the supplies in the property of Slovenske elektrarne
2007		Realization of feasibility study
February 2, 2007	<b>Continuation and planned completion of the project</b>	Slovenske elektrarne stakeholders announced the intention to complete the construction of units 3&4
July 15, 2008		European Commission issues positive statement on NPP Mochovce - units 3&4
August 14, 2008		NRA approved NPP Mochovce 3&4 design modifications and prolonged the building permit by Dec 31, 2013
November 3, 2008		Inauguration of the re-start of construction works
2009		EIA process for NPP Mochovce 3&4 operation (public participation)
June 11, 2009		Signing of contracts with the main suppliers
April 30, 2010		Ministry of Environment issues its Final Statement on the EIA Report
September 5, 2010		Installation of unit 3 reactor pressure vessel
2011		Realization of stress tests of NPP Mochovce units (that were not planned) as the result of accident NPP Fukushima
2012		Decision on delay of commissioning NPP Mochovce units 3&4
2015-2016		Commissioning of NPP Mochovce - units 3&4 (the original date 2014 -2015)

Figure 2. Construction schedule of the third and fourth units of NPP Mochovce. Source: the author's elaboration based on materials from SE.

### Political Environment

In 1992, all work on the third and fourth units was stopped for lack of money, and experts began to preserve equipment. At that time, the third and fourth units were reported to be only 40% and 30% complete. Work started on the first and second units, however, continued with interruptions. In 1995, the Slovak Government approved the financial model of financing of the first two units of NPP Mochovce.

The first reactor became fully operational in 1998. Two years later, the second unit was put into operation. The gross output of each unit in 2008 was increased from the original 440 to 470 MWe. As a condition of accession into the EU (2004), Slovakia was forced to deactivate two reactors at the V-1 plant in Jaslovske Bohunice. The first reactor was shut down at the end of 2006, the second on the last day of 2008. A provision in the accession treaty allowed for reactivation in case of emergency.

The Russia-Ukraine gas dispute in January 2009 disrupted natural gas supplies and electricity generation. On January 10, 2009, the Slovak Government decided to urgently restart the reactor. Eventually, the reactor was not started. This is one of the most important projects of present and future. Project of the third and fourth units of Mochovce NPP is the largest private investment in the Slovak Republic since its creation. Slovak power plants invested in the completion of construction approximately three billion euros over five years. Already about 80% of contracts were signed with the Slovak and Czech companies. In addition to the pulse for economic development at present, the completion of these units will contribute

significantly to the energy security of Slovakia in the future. Already, the production of one unit covers about 12% of electricity consumption in Slovakia. Nuclear energy is an important part of the energy package of Slovak Republic. The share of nuclear energy on total energy consumption is around 35%. NPPs have significant proportion of producing the electricity. In 2007, 55% of electricity was generated at NPPs in Slovakia. After 1998 and 2000, when the first two units of the Mochovce were completed (EMO 1 & 2), Slovakia has become self-sufficient in electricity production by 2006 and part of the strategic commodities was exported. Change occurred after the shutdown of unit V1 NPP in Jaslovske Bohunice (EBO V1) in 2006 and in 2008—Slovakia has again become an importer of electricity. Such a situation motivated the Slovak Republic to complete and launch Units 3 and 4 in Mochovce (EMO 3 & 4), which should enable Slovakia to become self-sufficient in electricity production again. All Slovak Governments since 1989, considered the nuclear energy as the most important part of the energy package and none of them expected to fully replace nuclear energy with other sources. Document Energy Security Strategy of Slovak Republic (ESS SR) is the current framework document, which was approved by the government on October 15, 2007, with the perspective to 2030. One of the key information at the beginning of ESS SR refers to the fact that the EU is unable to guarantee the energy security of its members. Therefore, in the competence of the EU member states remains setting energy policy, and particularly, the determination of the energy mix. The energy mix of EU 27 is composed of 14.4% from nuclear energy. The government pays particular attention to the nuclear energy. “Nuclear Illustrative Program” is also part of the Energy Policy for Europe—which together with the European Council and their action plan on energy policy became the basis for energy policy in the short and medium term.

All post-communist countries of Central Europe are virtually no political opposition to nuclear energy. If these countries are some political parties with antinuclear orientation, their marginal formations are scoring low in elections; in addition, if they gain parliamentary seats, according to analysts, it is because of other themes. The dominant political parties in these countries are pro-nuclear. The general attitude toward nuclear energy in the studied countries was explored by Eurobarometer in 2009. Eurobarometer asked whether the share of NPPs in the production of electricity should change. Great support for increasing the share or maintaining it at the present level was witnessed in all post-communist countries even after disaster in Fukushima.

The Czech Republic, Slovenia, Hungary, and Poland are dominantly pro-nuclear, whereas neither in Austria nor in Germany we would find today—a relevant political actor offering an alternative to the moratorium on NPP construction.

### **Relations With Austria**

For Austria, the nuclear power euphoria was typical for 60s. They had started construction of NPP Zwentendorf, which was expected to be completed in 1976. But during 1975, the protest movement was developed and half of the population was against the operation of NPPs. The referendum in 1977 forbade commissioning Zwentendorf plant. The disaster at Three Miles Island in 1979 and Chernobyl catastrophe further strengthened anti-NPP opposition in Austria. Moreover, the NPP agenda enabled to join political forces that were against the former Prime Minister Bruno Kreisky.

Current support of nuclear power in Austria by the public is the lowest in the whole EU. Antinuclear stance is also typical for Austrian Parliament and government, while parliament is in their views more radical and more approaching to public attitude (Pavlikova, 2011).

In the section on foreign policy, Austria expressed concern over the “nuclear renaissance”. Austria will protest against the presentation of nuclear energy as a safe and sustainable form of energy and will strongly advocate for the proliferation—and the form of a multilateral system of controlling access to nuclear fuel. Austrian politicians and media promote a strict anti-nuclear policy, not only on its territory, but also in relation to other countries, especially neighbors, and will try to promote anti-nuclear concept at EU level. Before 1989, Austria had no real possibility to influence nuclear policy of states that were behind the Iron Curtain, however, the situation has changed later and Austria began to oppose the development and operations of NPPs in Slovakia and the Czech Republic very strongly, since these facilities are located not far from the Austrian borders, and in the case of serious disaster, it would be impossible to protect the Austrian citizens.

Austria stood out as very active at international level against the completion of Mochovce. The Austrian anti-nuclear power activists from Greenpeace and Global 2000 occupied the Slovak Embassy in Vienna in May 1998 and demanded all the technical documentation for NPP Mochovce (Böck & Drabova, 2005). The pressure from the activists was also focused on banks which were providing the credit for completion of the third and fourth units of EMO Mochovce, and in some cases, they succeeded in a way that the banks refused to provide the credits for completion. The 2011 crash of Fukushima plant in Japan has caused renewed growth of anti-nuclear tendencies.

At the end of March 2012, Austria decided to undertake the action against Czech and Slovak Republic in front of the European Court of Justice (ECJ). It was part of new action plan adopted by the Austrian Government in the document “International Rethinking of Nuclear Power to Renewable Energy and Energy Efficiency”, which was approved on March 3, 2011 (Rehfus, 2011). The program aims to promote the closure of NPPs across the EU, through extensive campaigns and cooperation with other anti-nuclear oriented countries. For many years, the European authorities closely monitored the safety of the nuclear reactors in Czech and Slovak Republics, as well as in other new European countries, which was quite fruitful approach leading to many changes that had led to implementation of many safety measures. However, EU has never shared the extreme opinions of Austrian politician to the development of the nuclear power stations. So, when Vienna provincial government sued Slovakia for the completion of the third and fourth EMO units in 2011, it did not succeed. The Slovak-Austrian controversies regarding the operation of NPP in Mochovce are likely to continue in the future, even though the safety standards were significantly augmented. Otherwise, there are no real problems between both countries, which otherwise have friendly relations; many Austrian companies operate in Slovakia, and the intensity of mutual advantageous economic relations is growing.

### **Economic Environment**

In times of economic recession, this investment is a huge stimulus to the national economy. More than 1.6 billion euros of the total investment is being spent in Slovakia. The construction directly involves about 3,000 people for three years and already created additional 300 permanent jobs for operation in new blocks. It also indirectly involves several thousand of people who provide infrastructure for the project, most of them from Nitra Region.

NPPs belong to low carbon technologies (and in fact, greenhouse gas emissions are running at close to zero), so the construction of two new nuclear units will significantly contribute to the fulfillment of the

commitment of Slovakia to reduce CO<sub>2</sub> emissions by 2020. Each reactor VVER 440 will save about 3.7 million tons of CO<sub>2</sub> each year. Otherwise, this greenhouse gas will flow to air from coal-fired power plants.

Based on the document ESS SR, the final consumption of electricity represents about 20.7% share of total energy consumption and until 2030 is expected to rise to 22.8%. This increase is consistent with the expected growth of the economy, while reducing the energy consumption. In connection with this fact, it is quite a significant factor in the expected increase in energy prices. Production costs of nuclear energy in comparison with coal and gas resources are less sensitive to price changes. This is mainly because of the sufficient number of world's uranium deposits and it is possible to diversify the vendors.

From an economic point of view, it is important to know that equivalent amount of heat contained in coal is seven to eight times more expensive than nuclear fuel. Price of brown coal is 11 times more expensive and price of natural gas is 20 times more expensive than the nuclear energy. The operation of NPP is therefore at least in economic terms more favorable than production of electricity from brown coal or fossil fuels, although the initial investment is much higher. The strategy also keeps in mind the possibility that the price of uranium will grow dynamically in the future and the privileged position will be given to countries that have this material.

In this case, the government of Slovak Republic does not exclude the possibility of restart of mining uranium in Jahodna localities, Novoveska Huta, Kluknava, and Kalnica-Selec. This policy is also linked the necessity of amending the relevant laws and strategic documents, allowing for maximum protection of the environment. Another rather significant fact is that the uranium is not imported from politically unstable countries, and it is possible to buy and maintain stocks for a longer period than in case of oil or gas. All these factors speak in favor of using more nuclear energy and to plan and build additional NPPs from economic and political point of view.

A major factor for the regional development is completion of the first and second blocks of nuclear plant Mochovce, which meant influx of young people—nuclear experts—in this region, which was initially strongly agricultural. Construction of Mochovce brought directly or indirectly induced investments (e.g., new hospital in Levice, construction of new flats, as well as all related services and infrastructure). Construction of the third and fourth blocks also means new job opportunities for people from the region, as well as from more distant parts of Slovakia or abroad.

Due to the closure of two old nuclear units at Bohunice (V1) between 2006 and 2008 (due to the political decision taken during the pre-accession negotiations with the EU Treaty), Slovakia stopped to export the electricity and has become the importer of electricity. The total production capacity of NPP in Slovakia decreased by 880 MWe. Such conditions will continue to run until an adequate additional capacity is put into operation. Considering the current state and potential viability of new investments, Mochovce 3 and 4 will be probably the only equivalent for replacing closed plants. Based on the current construction schedule of Mochovce 3 and 4, Slovakia will be dependent on importing electricity until at least 2015. Electricity which will come from Mochovce 3 and 4 would be sufficient for Slovakia to be a minor exporter in the period from 2015 to 2019. It is expected that in the medium term some additional new project will be implemented which will have capacity of about 400 MWe and with this output, the export capacity of Slovakia will increase.

### **Sustainability**

The new production capacity in Mochovce will become the next great stabilizing element in

Slovak energy system and it guarantees stable and secure supply of electricity. Placing the third and fourth blocks of Mochovce into operation in 2013 will replace fossil fuel burning in the central region of Slovakia. It is expected that this would reduce the volatility of electricity prices for households and industry in the Slovak market.

SE invests more than 3.8 billion euros in the construction of Mochovce NPP Units 3 and 4.

Further investments were concluded with the modernization and power up-rate of existing units in Jaslovske Bohunice NPP (EUR 0.5 billion) and Mochovce NPP power up-rate. The strategic plan involves also full hydro power plant automation and modernization of the existing hydro units, introduction of biomass in the fleet of thermal power plants (Vojany and Novaky), and development of renewable—mainly photovoltaic and small hydro power plants.

### Conclusions

It is expected that the completion of NPP Mochovce would have the significant local and global economic impact on:

- (1) Stabilizing economy and economic growth;
- (2) New working opportunities and indirect impact on community development;
- (3) Increase of tax revenues for municipalities;
- (4) Reduction of negative environmental impact and efficiency increase;
- (5) Company SE EMO 3 and 4 as independent power producer (IPP) can be successfully designed and financed as sole project;
- (6) The preliminary calculates internal rate of return (IRR) of the project which was around 18.61% for the whole life cycle of the project/40 years.

The new production capacity in NPP Mochovce will become the next great stabilizing element in Slovak energy system and it guarantees stable and secure supply of electricity.

The expected benefits are high enough. The paper also shows the difficulties of completion of the nuclear power megaproject in the Central Europe during the period of technological changes, political shifts, economic transition, and economic cycles. Such events as the shifts from public to private financing, the establishment of the sovereign state of Slovakia, development of the Slovak Government, EU accession and frequently changing power relations could hardly be without any consequences on the cost and project completion schedule.

Several lessons could be learnt from following:

Such megaprojects need very strong and intelligent political support during the turbulent times. This is not easy to achieve in the situation when the political and public servants elites frequently change.

The NPP Mochovce megaproject represents certain form of private-public partnership in which the risk should be distributed among the partners by using legal, economic, managerial, and other instruments. These instruments are often not very well known in public sector in Central European transition countries and megaprojects of this size and purpose have to face with some of the risks such as the impact of Fukushima accident or referendum on construction of NPPs in Italy on the completion of Mochovce. Power plants in Slovakia are not easy to be predicted and they can hardly be eliminated without substantial cost and time overruns. Moreover, it is quite difficult to deal with the environmentalist groups, such as Greenpeace or the groups representing anti-nuclear power stance in the adjacent countries. In fact, these groups have been able to

undermine the credit agreement with the consortia of foreign banks that would help to accelerate the completion. Also, the understanding of the motivation (real and hidden) of the engaged stakeholders is the necessity for the progress of the project.

Even though the realized feasibility study (in 2007) for the completion of the NPP Mochovce revealed the substantial positive economic effect for Slovakia including the self-sufficiency of Slovakia in the energy production, yet the real outcomes will be lower than predicted because of the realization of many unpredicted events.

Project management of megaproject in the future would probably require to realize the scenario analysis which might help to some extent forecast the possible positive as well as negative features in the future that can help to prepare the alternative strategies for the finishing of the project. In practice, it is difficult to achieve, since there is the tendency to show the positive events, which support the acceptance of the project, while negative scenarios may undermine the starting of the project, throwing it into serious doubt concerning its feasibility. Such exercise might be useful for the preparation of better contracts, it can be helpful in negotiations with stakeholder, and finally, it may enable the more efficient sharing of the risks.

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