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# **PERSPECTIVES OF THE DEVELOPMENT OF NUCLEAR ENERGY IN EUROPEAN REGION**

**Jukka Laaksonen**  
**Vice president, Rusatom Overseas**

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# Outline

- This presentation summarizes country specific perspectives of the development of nuclear energy in all EU countries that
  - have nuclear power plants (NPP) in operation today or
  - have recently considered starting NPP construction.
- In addition, the perspective of Switzerland is included.
- The focus is on the current policies of each country and in the foreseeable future of about ten years.
- The information is confirmed by recent direct communication between the author and the leading regulators in each country.

# Belgium

- Seven operating NPP units, net nuclear capacity 5943 MW, nuclear share in 2011 power production 51 %.
- National policy and public opinion are leaning towards nuclear phase out and are thus against building new NPPs. Law of 2003 requires closing down all NPPs after 40 years of operation:
  - 2015 for Doel 1/2 and Tihange 1,
  - 2022 for Doel 3 and Tihange 2,
  - 2025 for Doel 4 and Tihange 3.
- In July 2012 the government announced a decision to confirm the closure of Doel 1&2 in 2015 but to allow life extension of Tihange 1 by 10 years. Decision was made over concerns that the country may not be able to generate enough alternative energy. Operation of Tihange 1 beyond 2015 still requires a law change and implementation of certain safety upgrades.
- Final closure dates of the operating NPPs are still regarded as uncertain, and may be re-considered depending on the availability of other power sources.



# Bulgaria

- Two operating NPP units, net nuclear capacity 1906 MW, nuclear share in 2011 power production 33 %. Four NPP units prematurely shutdown as a condition to join EU, two in 2002 and two in 2006.
- Belene NPP project was re-started in 2002 and contract on constructing a new NPP with two 1000 MW VVER units on Belene site was made in November 2006 after tendering. In 2007-2009 active site preparation was conducted. Also the main reactor plant components have been manufactured. Regulator has thoroughly reviewed the detailed design with support of Bulgarian, German and French expert organizations as well as by a group of experts gathered by the IAEA. At the beginning of 2012 the regulator was ready to approve the design.
- However, the power company has not been able to provide financing for the project
- Government decided in March 2012 to cancel the Belene project and is considering a new unit at Kozloduy NPP.
- A feasibility of for Kozloduy 7 is underway and set to be completed by March 2013. Alternative options are considered for the plant type. Also bids for EIA of Kozloduy 7 were invited in September 2012.

# Bulgaria, Belene site in 2009





# Czech Republic

- Six operating NPP units, net nuclear capacity 3744 MW, nuclear share in 2011 power production 33 %.
- There is a plan to construct two additional NPP units to Temelin site, and three vendors (Areva, Westinghouse, and a consortium led by Skoda) submitted their bids at the beginning of July 2012. The proposed units are of about 1100 to 1600 MW size, depending on vendor. The choice of the vendor is expected in 2013.
- In the long term, some considerations have been made on potential construction of new units at Dukovany site.



Temelin site model

# Estonia

- Estonia has never had a NPP under construction or in operation.
- In the past few years some feasibility studies on constructing its own NPP
- Stopped planning of its own NPP
- Expects to get a share of the ownership and production of the NPP being planned in Lithuania.
- Also studying possibilities to have some share in the new NPPs in Finland.

# Finland

- Four operating NPP units, net nuclear capacity of 2741 MW, nuclear share in 2011 power production 28 %.
- An EPR of 1600 MW designed by Areva is under construction at Olkiluoto site. Areva plans to connect the new unit in power production in 2014, about five years behind the original schedule. However, the power company has publicly presented its doubts on the realism of this schedule.
- Two further NPP projects are prepared. In May 2010 the Government made a Decision in Principle (DiP) on both and the DiPs were ratified by Parliament in July 2010. DiP is the first step in licensing, and the power companies have now called for tenders from vendors with whom they have made feasibility studies. Selection of vendors is expected in 2013 and applications for construction permits in 2014. Prospective plants are of size 1400-1650 MW.
- Also a third power company, whose DiP application was not approved at this time (Government took a position that construction of three new plants at the same time is too much), is planning to make a new application in some years.



# Finland, Olkiluoto 3 on September 2012



# France

- 58 operating NPP units, net nuclear capacity 63130 MW, nuclear share in 2011 power production 74 %.
- An EPR of 1600 MW designed by Areva, is under construction at Flamanville site. According to current information by Areva, commercial operation of Flamanville 3 plant is planned to start in 2016. This could imply first grid connection in 2015.
- The new President of France committed in his campaign to reduce the share of nuclear in the country's energy mix, and as a concrete measure pledged to order the closure of the two 900 MW unit Fessenheim plant – the oldest nuclear power plant in France – before the end of his first term in 2017. After taking his seat President has confirmed this concrete measure, provided that electricity supply and employment can be secured in the region.
- On the other hand, President is not against completing construction of EPR plant in Flamanville and starting another similar construction on Penly site. The schedule of Penly construction is still open.
- A national debate will be launched later this year to discuss France's 'energy transition'. The results of the debate will be used in formulating a new energy policy bill in mid-2013.

# France, Flamanville 3 on September 2011



# Germany

- Nine operating NPP units, net nuclear capacity 12003 MW, nuclear share in 2011 power production 23 %.
- Eight oldest NPP's were finally closed down after the accident in Fukushima.
- Germany has established a firm nuclear phase out policy.
  - The plants still remaining in operation will be closed down, one by one according to a planned schedule.
  - Three youngest plants, the so called Konvoi plants, will be closed down in 2022.



Krümmel NPP,

# Hungary

- Four operating NPP units, net nuclear capacity 1880 MW, nuclear share in 2011 power production 42 %.
- In 2009 Hungarian Parliament decided to start new nuclear built in Paks. Since then nuclear safety regulations have been revised for the new construction. Environmental legislation also needs update before start.
- The current Government, in power since May 2010, did not initially prioritize nuclear in its agenda.
- In June 2012 the Prime Minister decided to act on the new build plans
  - A new subsidiary established by the Hungarian Power Company for preparation of the project. A Ministerial Committee at the end of August for the same purpose.
  - The goal is to call for bids early in 2013.
  - Hungary is committed to pressurized water reactors, and bids are expected from all five PWR / VVER vendors that operate on the global markets.

# Italy

- Italy has had four NPPs in operation, first of them started in 1963.
- Production of power at all NPPs ended in 1987, in the aftermath of Chernobyl accident. Government decision on final closure of all operating plants in 1990. Also construction of three new NPPs, two of them almost ready for start-up, was terminated.
- In 2008, Government policy towards nuclear changed and a new nuclear program was planned. Legislation setting up arrangements to generate 25% of the country's electricity from nuclear power by 2030.
- However, in June 2011 referendum the 2009 legislation was rejected.
- In the foreseeable future, there are no plans to re-start the nuclear programme in Italy.



# Lithuania

- Lithuania has no operating NPP units. Two NPP units were prematurely shutdown as a condition to join EU, first unit in 2004 and second unit in 2009.
- Political drive to start new nuclear program in Lithuania since the Prime Ministers of all three Baltic States made in February 2006: a joint invitation to state-owned energy companies to invest in a new nuclear power plant in Lithuania.
- Law on building a new nuclear power plant in June 2007
- Hitachi offered in July 2011 a deal and in June 2012 Lithuania's parliament backed the deal that includes also other Baltic States.
- A non-binding referendum will be held on the project 14 October 2012.
- Final investment decisions and construction start are not expected before 2015.



Ignalina NPP

# Netherlands

- One operating NPP unit, net nuclear capacity 485 MW, nuclear share in 2011 power production 3 %.
- Government formed in 2010 stated in its programme that if an application to construct a new NPP would be received, complying with requirements, a license would be given within the Government term (2010-2015). One of the potential applicants had sent in June 2009 an official notification to start environment impact assessment. The regulator started in 2010 to increase its staff number and to prepare regulations for the new reactors. This work has progressed well.
- In spring the Government lost its support and new elections were held in September 2012. The nuclear policy of the new Government is still unknown. New build plans in the Netherlands have changed during this year.
- New build of NPP's seems to be postponed at least for several years.

# Poland

- Poland has no nuclear power plants in operation or under construction today.
- Construction of a VVER type plant was underway in 1982-1989, but in 1990 the Government decided to scrap the project.
- Early in 2005, the Government decided that for energy diversification and to reduce carbon and sulfur emissions the country should move immediately to introduce nuclear power. The Government resolution called for construction of at least two plants.
- In line with the Government's objectives, the utility PGE announced in January 2009 plans to build two nuclear power plants. In February 2012, PGE's supervisory board approved this plan.
- Four state-owned companies signed in September 2012 a letter of intent for participation in the preparation, construction and operation of Poland's first nuclear power plant. An agreement could be signed by the end of the year.

# Romania

- Two operating NPP units, net nuclear capacity 1310 MW, nuclear share in 2011 power production 19 %.
- Government plans to have two additional NPP units on the Cernavoda site and a large part of the civil structures for these were constructed already years ago in expectation of building a NPP with five units.
- Regulatory body has conducted tentative safety review of the planned units 3 and 4 and considers them licensable. Proposed units are improved from the old ones on the same site, taking into account latest IAEA safety standards and the Fukushima Daiichi lessons.
- In spite of the Government will and the readiness of the operating organization, the new projects lack financing. Interest of potential investors and financing organizations had been requested by September 2012 but according to unconfirmed information no positive answers were received.

# Slovakia

- Four operating NPP units, net nuclear capacity 1816 MW, nuclear share in 2011 power production 52 %. Two NPP units were prematurely shutdown as a condition to join EU, first in 2006 and second in 2008.
- Two NPP units of VVER-440 type are under construction on Mochovce site. Their start up is planned in 2013 and in 2014.
- The Slovakian power production was last year in balance with the consumption. Commissioning of the new Mochovce units will change the situation such that Slovakia starts to export power. In addition, planned power uprates of the operating Mochovce NPP units will increase the total nuclear capacity.
- Since 2008 there have been plans for extending Bohunice NPP with a new unit.
- Expansion of nuclear power has strong political support but in the current economic situation it has been difficult to find financing and there is no determined project to prepare new construction. Instead, a feasibility study has been conducted for several years by a group of experts and still continues.
- It is generally expected in Slovakia that no new plant would be ready for operation before 2025.

# Slovakia, Mochovce NPP





# Slovenia

- One operating NPP unit, net nuclear capacity of 696 MW, nuclear share in 2011 power production 38 %.
- Slovenia has been considering expansion of nuclear power use but currently there are no projects going on towards that direction.
- There is no policy to exclude nuclear power as an energy source.



Krsko NPP

# Spain

- Eight operating NPP units, net nuclear capacity 7448 MW, nuclear share in 2011 power production 20 %.
- In Spain the nuclear debate is focused around Garona NPP that is of the same type and age as the Fukushima Daiichi 1. Regulatory body accepted its lifetime extension by 10 years until 2019 but Government gave permit only to mid-2013. New Government promised to reverse the decision and changed legislation allowing the licensee to apply for operation until 2019. However, the licensee uses Garona as leverage trying to avoid new nuclear tax, and has announced that making required safety back-fits and paying new tax would prevent profitable operation. Thus the licensee did not apply for lifetime extension by deadline. Government is upset because its readiness for extended lifetime was quite unpopular. It is unclear whether Garona will continue to operate beyond 2013.
- All other NPPs are expected to continue operation until the age of 60 years. No serious discussion is held on their premature closure although license renewal is needed after 40 year of operation. New licenses can be granted for 10 years and again for another 10 years.
- In the current economic situation no new NPP construction is being considered. Power demand has been decreasing and Spain has much more generation capacity than it needs for its own use. In expecting more power need, Spain constructed in 1990's power and heat-cogeneration plants and since start of this century has constructed ample wind and solar power with generous subsidies.

# Sweden

- Ten operating NPP units, net nuclear capacity 9399 MW, nuclear share in 2011 power production 38 %.
- In 1980, Government decided to phase out nuclear power by 2010. However, in June 2010 Parliament voted to repeal this policy. First turn of the energy policy, made in 1997, already allowed 10 reactors to operate longer than envisaged in 1980, but also resulted in the premature closure of a two-unit plant, first unit in 1999 and second in 2005. Power uprates of other NPPs have almost compensated for the loss of capacity from the closed NPP.
- The current nuclear legislation in Sweden permits replacement of the operating NPP units with new units when the old ones are finally closed down but does not allow increase of the total number of operating NPP units. In line with this legislation, the largest utility in Sweden (Vattenfall) submitted in August 2012 an application to Swedish regulator concerning the replacement of up to two of its existing NPP units with new ones, although a decision on when to proceed with the new units is still several years away.

# Switzerland

- Five operating NPP units, net nuclear capacity 3252 MW, nuclear share in 2011 power production 38 %.
- Switzerland was until early 2011 proceeding towards construction of new NPPs. However, this process was stopped aftermath the Fukushima Daiichi accident by a decision of the Government and Parliament. The decision was that no new NPPs shall be built, but the 5 existing NPPs may operate “as long as they are safe”. There is no legal lifetime limit for NPPs in Switzerland. The 50 years often referred to is an assumption and has served as a basis for calculating the financial contributions of the NPPs to the decommissioning and the waste funds. Many politicians refer to the 50 years as if it would be a lifetime limit, but it is not.
- The nuclear phase-out is currently being incorporated to the Nuclear Energy Act, and this legislation change is expected to be completed by Parliament in 2013. A national referendum may be initiated within 100 days after the parliamentary decision (i.e. not before 2013).
- All NPPs have been required to implement certain safety upgrades. In particular, Mühleberg that is of similar design as Fukushima Daiichi unit 1 has to make significant changes. The licensee of Mühleberg has informed that they will implement all required improvements.
- An idea of “safer plants of new generation” was generated by Parliament when it decided not to allow new built in Switzerland. Thus the Parliament does not want to prohibit NPPs in general, but leaves a door open to “new technologies”, hoping that someday there will be an inherently safe plant, which does not produce significant quantities of radioactive waste.

# United Kingdom

- 18 operating NPP units, net nuclear generating capacity 10038 MW, nuclear share in 2011 power production 16 %.
- Strong political and public support to start new build before the current plants have to be closed down due to their ageing. A new licensing approach has been developed, utilizing a Generic Design Approval process that is expected to facilitate and speed up licensing of a series of similar plants. Two NPP types have received an interim approval, which means that the remaining open issues are expected to be resolvable. The remaining issues are being worked on at one design (EPR by Areva) with a target to have them resolved in early 2013. This is one condition for starting the construction of a new plant. The assessment of remaining issues of the other plant type (AP-1000 by Westinghouse) has been terminated at request by vendor until a customer interested in investing to a new plant has been found and is committed to share the remaining costs of DGA.
- Licensing of the first EPR in the UK is in good progress and the goal of all involved parties is to start construction in 2013. If successful, several new applications for constructing plants based on Generic Design Approval are expected to follow.
- A second tranche for submitting applications to the GDA process is expected to be opened by the UK Government next year, and Rosatom has expressed its interest to submit a VVER design to the process.

# Summary

- From the 19 countries discussed above, 12 have currently active plans to start constructing a new NPP within some years, pending availability of financing. In addition, Estonia is looking forward to get a share of a foreign NPP.
- Two countries, Netherlands and Spain are expected to continue operation of their existing NPPs until 2030's but have currently no plans on new build.
- Switzerland is also expected to continue NPP operation until 2030's, but is preparing a legislation to would not allow construction of new plants.
- Belgium may close all of its NPP's by around 2025 and may not start new build.
- Germany is firmly committed to phase out nuclear power and close the three latest operating plants in 2022.
- Italy closed all of its NPPs in the aftermath of Chernobyl accident and has no plans to start new build.