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Nuclear safety and security in Europe

Report[1]
Committee on Social Affairs, Health and Sustainable Development
Rapporteur: Ms Emine Nur GÜNAY, Turkey, European Conservatives Group

Summary

Nuclear safety and security concerns have been on the rise in Europe ever since the Chernobyl and Fukushima accidents (respectively, in 1986 and 2011), as well as recent terrorist attacks. Moreover, many of Europe's nuclear facilities are rapidly ageing, making the probability of serious incidents and accidents higher.

The report points to the secrecy surrounding the operation of nuclear facilities and the fact that there has been no meaningful public consultation prior to the construction of the bulk of the European nuclear "fleet". As many nuclear plants in Europe operate close to large cities and densely populated areas, European States must provide unquestionable and "reasonably achievable" protection to these strategic objects. Emergency-preparedness capacity and contingency plans should be enhanced, in particular in cross-border situations.

Accordingly, the draft resolution makes a series of recommendations in general and regarding the new nuclear plant in Ostrovets (Belarus), and expresses deep concern about the nuclear power plant under construction in Akkuyu (Turkey). It notably calls for more frequent periodic safety reviews for nuclear installations and enhanced safety perimeters, independence and capacity of national nuclear regulators, protection of reactors and spent fuel pools.

1. Reference to committee: Doc. 14033, Reference 4225 of 24 June 2016.

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A. Draft resolution[2]

1. Europe is highly dependent on nuclear energy: with 184 reactors in operation in 2018, 17 European countries are home to 41% of the world's nuclear "fleet". An additional 15 reactors are under construction, including the first ever floating nuclear power plant. This energy choice has been polarising public opinion for decades, given the secrecy surrounding the operation of nuclear facilities and the risk of dramatic consequences in case of accidents.

2. Nuclear safety concerns have been looming ever since the Chernobyl accident in 1986 and further escalated as a result of the Fukushima accident in 2011. Moreover, due to recent terrorist attacks in France and Belgium, greater attention in being paid to the security of nuclear infrastructure given that nearly all nuclear plants currently in operation were designed and built in an era when security concerns were of a different nature. Because the consequences of a nuclear accident – be it due to a malevolent act or a system failure – can be so widespread and very serious, the European public needs reassurance that the authorities in charge of nuclear safety and security are protecting the population effectively.

3. The Parliamentary Assembly welcomes the efforts of its member States and of the competent international organisations towards the continuous strengthening of reference standards for nuclear safety and security through technical, regulatory and legal frameworks. It believes that greater harmonisation of those standards to upgrade the overall nuclear safety and security levels across Europe is necessary and should involve all States, including those that are phasing out nuclear energy and those that are building new nuclear facilities.

4. The Assembly notes that many of Europe's nuclear facilities are rapidly ageing: in 2018, 82 out of 184 reactors had been in operation for 35 years or more, and roughly one in six reactors is more than 40 years old. Even when the facilities are properly maintained, the overall condition of these reactors is gradually deteriorating, increasing the probability of serious incidents and of accidents. The Assembly views independent oversight and periodic safety reviews as crucial to maintaining public trust in nuclear safety and believes that the frequency of safety reassessment should be increased for reactors which are more than 40 years old.

5. The Assembly is concerned about the fact that there has been no meaningful public consultation prior to the construction of the bulk of the European nuclear "fleet". It also points out that present generations have to bear the brunt in terms of operational safety and security risks, as well as the cost of decommissioning, nuclear waste processing and long-term waste disposal. The Assembly is convinced that the key challenge from a political angle is to provide adequate information to the public without undermining security and to achieve a democratic consensus over the strategic orientations and the level of nuclear safety and security we want. The European countries should work together to ensure greater transparency and improved communication around the nuclear energy challenge.

6. As many nuclear power plants in Europe operate in close proximity to large cities and densely populated areas, including those beyond national borders, the Assembly considers that European States should provide unquestionable and "reasonably achievable" protection to these strategic objects, where appropriate in close co-operation with the neighbouring countries concerned. It believes that emergency preparedness capacity and contingency plans should be enhanced across Europe, in particular in cross-border situations; they should be based not only on minimalistic technical considerations but also on socio-economic imperatives, realistic scenarios of meteorological conditions, local specificities and lessons drawn from recent major nuclear accidents (such as Chernobyl and Fukushima).

7. Regarding the construction of new nuclear power plants in Europe, the Assembly urges the States concerned to ensure that heightened safety and security requirements are fully taken into account regarding design, operational principles, regulatory measures, external protection arrangements and emergency preparedness plans. Regarding the nuclear power plant in Ostrovets (Belarus), under construction just 45 kilometres from the neighbouring State's (Lithuania) capital city Vilnius, the Assembly recalls its Resolution 2172 (2017) on the situation in Belarus which deplores the lack of respect for international nuclear safety standards and major incidents on the construction site. In light of the latest developments, notably the national

2. Draft resolution adopted unanimously by the committee on 18 September 2018.

stress test report (comprehensive risk and safety assessment) and the related peer review mission, the Assembly urges the nuclear regulatory authorities of Belarus not to issue an operational license for the Ostrovets plant before:

7.1. the recommendations of the European Nuclear Safety Regulators Group (ENSREG) peer-review report on the Belarus stress test (adopted by ENSREG on 2 July 2018) are fully implemented;

7.2. seismic resistance of the nuclear power plant, in particular as regards systemic safety functions and the spent fuel pool, is reinforced;

7.3. the Ostrovets reactors' protections against a fall of a heavy commercial airplane are enhanced (as has been done for the same reactor design in Finland);

7.4. incident notification measures in respect of neighbouring communities and countries are improved, and emergency management agreements with the neighbouring countries, in particular Lithuania, are concluded, such as on the basis of the Melk protocol regarding the nuclear power plant in TemelÍn, on the border between Austria and the Czech Republic;

7.5. the assessment of the Ostrovets site is fully completed in line with international requirements, including the Convention on Nuclear Safety, the Convention on Environmental Impact Assessment in a Transboundary Context ("Espoo Convention") of the United Nations Economic Commission for Europe (UNECE) and the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters ("Aarhus Convention"), and a full scope International Atomic Energy Agency (IAEA) site evaluation mission (Site and External Events Design Review Service, SEED) is has been carried out for the nuclear power plant site in a comprehensive manner.

8. Regarding the proposed plans by Turkey and the Russian Federation for the construction of the nuclear power plant of Akkuyu in the province of Mersin (Turkey), situated just 85 kilometres from the border with Cyprus and in very close proximity to the other neighbouring countries, the Assembly expresses its deep concern regarding the construction of this nuclear power plant in an earthquake-prone region of Turkey, also as per European Parliament Resolution (2016/2308(INI) of 6 July 2017. It therefore asks the Turkish Government to join the Espoo Convention and to take into account all concerns expressed also by its own citizens asking it to consult with neighbouring countries according to the International Convention on Nuclear Safety.

9. The Assembly recommends that the competent authorities of all Council of Europe member States with nuclear facilities on their territory:

9.1. enhance the frequency of periodic safety reviews for nuclear installations, in particular as regards reactors which are more than 40 years old;

9.2. strengthen the independence and capacity of national nuclear regulators;

9.3. reassess, and where necessary reinforce, the physical protection of reactors and spent nuclear fuel pools;

9.4. investigate the cases of drone overflights over nuclear infrastructures and take measures to prevent such overflights from reoccurring;

9.5. reinforce the safety perimeter and protections against unauthorised access to nuclear plants;

9.6. provide adequate information to the local population, including in cross-border areas, about the relevant nuclear safety and security guarantees, radiological emergency management plans and any new measures taken in that respect;

9.7. consider early decommissioning for the potentially most vulnerable nuclear plants where investment in safety and security upgrades versus risk analysis would exceed reasonable amounts;

9.8. improve and consider unifying the nuclear liability regime towards increased coherence of applicable international legal norms and enhanced financial security limits for cross-border compensation of damages in case of nuclear accident.

10. The Assembly also invites the European Commission to enhance the safety perimeter requirements beyond 5 kilometres around nuclear power plants where evacuation, sheltering or iodine prophylaxis may be required in case of nuclear accidents, so as to better take into account the experience from the Fukushima accident and public expectations in terms of radiological protection.

11. Finally, the Assembly calls on the International Atomic Energy Agency to show greater openness to developing contacts and providing essential information to the representatives of national parliaments and regional parliamentary assemblies on the various aspects of the nuclear energy sector that fall within its competence.

B. Explanatory memorandum by Ms Emine Nur Günay, rapporteur

1. Introduction: "Not in my backyard"?

1. Nuclear energy has a reality in Europe for decades. Although the first fundamental agreement – the Euratom Treaty – was signed as early as 1957 (in the same year as the treaty establishing the European Union), the massive deployment of nuclear power dates from the 1970s, after the 1973 oil crisis. Today, out of 184 nuclear reactors in operation across Europe, 29 units are more than 40 years old and are close to the end of their lifespan, with questions arising about their operational safety. Nuclear safety concerns have been looming ever since the Chernobyl accident in 1986 and have further escalated as a result of the Fukushima accident in 2011.

2. Although "only" 17 out of 47 Council of Europe member States are home to nuclear power plants, the population of neighbouring countries will also be directly concerned by nuclear spillovers in the event of an accident with radioactivity release. In light of the recent terrorist attacks in France and Belgium, increased attention is being paid to the security of all nuclear infrastructure. Because the consequences of a nuclear accident – be it due to a malevolent act or a system failure – can be widespread and deadly, the European public needs reassurance that the authorities in charge of nuclear safety and security are doing their utmost to protect the population.

3. On 10 October 2016, I was appointed rapporteur on "A potential threat to European countries imposed by the nuclear power plant in Belarus" (Doc. 14033). In addition, the motion for a resolution on "Nuclear security in light of emerging terror threats in Europe" (Doc. 14179) was referred to the Committee on Social Affairs, Health and Sustainable Development to be taken into account in the preparation of this report. Several years ago, a question on earthquakes and nuclear safety was raised in the Parliamentary Assembly but it did not lead to a report.[3] At my proposal, the committee decided that the scope of the present report should reflect the major concerns over nuclear safety and security in Europe and accordingly modified the title. Therefore, the objective of this report will be to focus on several aspects of the use of nuclear energy and technology in Europe, including the situation as regards the construction of new nuclear power plants in the current context, notably in Belarus.

4. With the present report, the Assembly should review the main reference standards at the European and global level in relation to nuclear safety and security requirements, while addressing the issues of good neighbourliness and openness as regards the process of siting new nuclear power plants. To that end, the committee has held a series of discussions with experts and representatives of European institutions, the nuclear energy industry and civil society.[4] Moreover, in my capacity as rapporteur, I have carried out an information-gathering visit to the Nuclear Energy Agency (NEA) and used website resources of the International Atomic Energy Agency (IAEA).

5. I wish to stress from the outset that this report is not intended to take sides "for" or "against" nuclear energy: it seeks to look at the current situation as it stands in terms of nuclear safety and security, and to make proposals, where relevant, for any improvements and confidence-building measures. I consider that it is our duty as elected representatives to ascertain with a high degree of confidence whether the European nuclear sector strives for excellence and maximum public security. My comments will naturally be limited to the civil uses of nuclear technology, mainly focusing on power plants.

2. Basic facts about nuclear energy in Europe

6. There are some 453 nuclear reactors in the world, operating mostly in countries with an advanced economy; nearly half of the world's nuclear "fleet" is in Europe, with some countries (such as France, the Slovak Republic, Ukraine, Belgium and Hungary) relying on nuclear power for most of their electricity supply. It has been estimated that the world consumption of energy has almost doubled during the past 30 years and current trends point towards an even faster rate of consumption in the future.[5] With the conclusion of the Paris

3. See Doc. 12928 (motion for a recommendation on earthquakes and nuclear safety) and Doc. 12925 (motion for a resolution on Metsamor nuclear power station – a permanent danger to the South Caucasus and Europe).
4. The committee notably held hearings with representatives of the European Commission (Directorate-General for Energy), FORATOM (association of the nuclear energy industry in Europe) and its ENISS (European Nuclear Installations Safety Standards Initiative) programme, Greenpeace (nuclear campaign branch) and with experts from Lithuania and Belarus concerning a nuclear power plant under construction in Ostrovets.
5. Essam E. El-Hinnawi, Review of the Environmental Impact of Nuclear Energy, www.iaea.org/sites/default/files/20205083242.pdf.

Agreement on climate change, the world acknowledged the necessity to reconsider its energy policies. In order to remain below the 2°C target to contain global warming, massive decarbonisation efforts are required[6] and many parties to the Paris Agreement are considering using sources of energy with lower greenhouse gas (GHG) emissions, such as renewables and nuclear power.

7. Each country is free to decide on its preferred energy mix.[7] Today, nuclear power plants generate about a third of all electricity in the European Union at a very competitive price and represent about 800 000 jobs.[8] There are 126 nuclear reactors in operation in 14 European Union countries[9] and another 58 are located in other parts of Europe (mainly in the Russian Federation and Ukraine); 15 units are under construction in seven European countries,[10] including three EU member States (Finland, France and the Slovak Republic have four units in construction phase), and capacity expansions to existing nuclear facilities are planned or proposed in Bulgaria, the Czech Republic, Finland, France, Hungary, Poland, Romania and the United Kingdom. Finally, Turkey has started building its first nuclear power plant in Akkuyu on the Mediterranean coast. Controversies surrounding the construction of the first nuclear power plant in Belarus (designed and built by the Russian State corporation Rosatom), near Ostrovets, close to the Lithuanian border, sparked the motion for a resolution which led to this report (see a separate chapter below on this matter).

8. Modern Europe still bears the scars of the 1986 Chernobyl disaster, which led to the contamination of land and water in Belarus, Ukraine and Russia, and had dramatic negative effects on the region's environment and public health. It was only at the end of 2016 – 30 years after the worst nuclear accident in Europe – that the damaged reactor was finally safely covered with an airtight steel structure above the emergency "sarcophagus", costing the international community over €1.5 billion. This final protective structure should keep the site safe against radioactive releases for about 100 years. However, people are still not allowed to return to the area around the Chernobyl site.[11] As one of the lessons from the Chernobyl accident, some RBMK-type reactors (LWGR category according to the IAEA's classification) were retrofitted with a partial containment structure and other safety features. In total, 11 reactors of this type remain in operation; they are all located in Russia (Kursk, Leningrad and Smolensk units).

9. As a general rule, the operational life of a nuclear power plant extends to between 40 and 60 years. Europe's nuclear "fleet" is rapidly aging: in 2018, 82 out of 184 reactors had been in operation for 35 years or more, and roughly one in six reactors in Europe is older than 40. Even when the facilities are properly maintained, the overall condition of these reactors is constantly deteriorating, making the probability of serious incidents and accidents higher. As a representative of FORATOM explained during the committee's hearing in January 2018, decisions on closure for the oldest reactors are normally taken by the operators, in some cases after the periodic safety review (which included an assessment of components' safety given that some of these could not be replaced at all) and an analysis of the lifetime performance of a plant. In certain situations, however, an injunction to close a reactor might be issued by a national regulator.

10. Following the Fukushima nuclear accident, European Union countries ran comprehensive risk and safety assessments ("stress tests") on the existing reactors, which delivered very high safety results overall and confirmed a strong political will to seek continuous improvements in safety and security frameworks. No reactor had to be closed in the wake of those assessments; however, some countries decided to phase out nuclear power altogether: Germany, for example, plans to do so by 2022 and one reactor (Gundremmingen B) was closed at the end of 2017. In Switzerland, in June 2011, parliament resolved not to replace any of its four nuclear reactors, and hence to phase out nuclear power gradually (this policy was confirmed in a 2017 referendum).[12]

11. The decommissioning of a nuclear power plant or of individual reactors is a long and financially discouraging process. Whilst a reactor can in principle be shut down immediately if deemed necessary, some three to four years might be needed to ensure a lasting closure and to start decommissioning works which in turn would take several decades or at least 15 years. Moreover, the environmental consequences of

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6. According to the UN Development Programme (UNDP), reduction of carbon emissions by 80% is needed in the global North.
7. Council Directive 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations, http://eur-lex.europa.eu/.
8. FORATOM data.
9. www.iaea.org/PRIS/WorldStatistics/OperationalReactorsByCountry.aspx.
10. The European nuclear society (www.euronuclear.org) and the IAEA PRIS database – see the appendix. In 2019, Russia plans to inaugurate the world's first floating nuclear power plant called Akademik Lomonosov.
11. "Chernobyl disaster site enclosed by shelter to prevent radiation leaks", article of 29 November 2016 in *The Guardian*.
12. www.world-nuclear.org/information-library/country-profiles/countries-o-s/switzerland.aspx.

disposing of used nuclear fuel and waste are far from being sufficiently understood.[13] One aspect systematically raised during committee discussions was that of public consultation on the construction of nuclear power plants and the information disclosed to the public on safety and security issues at the existing plants. It appears that there has been no meaningful public consultation prior to the construction of the bulk of the European nuclear “fleet” and present generations have to bear the brunt in terms of operational safety and security risks, as well as the cost of decommissioning, nuclear waste processing and long-term waste disposal.

12. Nuclear energy is generally considered to be one of the most environmentally friendly means to generate power as regards emissions, producing zero pollutants or greenhouse gases.Proponents of nuclear energy underline that it plays a vital role in providing clean energy for sustainable economic development around the world. However, in April 2001, a United Nations Sustainable Development Conference refused to label nuclear energy as a sustainable technology.[14] Generally speaking, Europe needs a fast energy transition based on renewable energy: legislators are already taking steps in the right direction by restricting nuclear power and introducing more renewables into the energy mix. For instance, Germany has pledged to convert the electricity supply system towards the use of 100% renewable energies by 2050.[15] Assembly Resolution 1977 (2014) on energy diversification as a fundamental contribution to sustainable development recommended that Council of Europe member States “give priority to better exploiting the most abundant, clean, cost-efficient and locally present energy sources, in particular renewables such as biomass”, while recognising that “nuclear energy will remain part of Europe’s energy landscape for reasons of security of supply, competitiveness, low carbon emissions and a global growth potential, but requires stricter safety risk policies and long-term solutions for nuclear waste management.”

3. Nuclear security concerns on the rise

13. Most countries use the IAEA definition of nuclear security as a reference: “The prevention and detection of and response to theft, sabotage, unauthorised access, illegal transfer or other malicious acts involving nuclear or other radioactive substances or their associated facilities.” In short, nuclear security deals with external risks and threats of physical and cyber nature. Given the potentially catastrophic consequences of nuclear terrorism, this area largely belongs to the sphere of national security and is protected under defence secrecy rules. At European Union level, there is no specific common legislation on nuclear security; however all EU member States and Parties to the Euratom Treaty are Contracting Parties to the IAEA’s benchmark Convention on the Physical Protection of Nuclear Material (adopted in 1979 and in force since 1987) and can request a Site and External Events Design Review Service (SEED) mission by the IAEA.

14. Nuclear terrorism has become a very serious risk in the 21st century. Terrorists could target nuclear power plants in an attempt to cause a major release of radioactive substances into the environment and surrounding communities. Possible scenarios are only limited by the imagination: a plant could be hit with a bomb, or attacked by a plane as a guided missile to crash into a nuclear facility, or sabotaged by an insider or by intruders, possibly even by remote electronic means.[16] As many power plants in Europe operate in close proximity to large cities, the disastrous effects of such an event would claim the lives and affect the health of thousands of people, while also contaminating European soil, water and food for decades. Without adequate protection, any nuclear installation can become a nuclear time-bomb. In light of recent terrorist attacks in Europe, it has become paramount for governments to reconsider certain aspects of domestic nuclear security.

15. In this regard, I should mention incidents which took place in 2014 at the Fessenheim nuclear plant (the oldest one in France), located 75 km from Strasbourg,[17] and in 2017 at the Cattenom nuclear plant (close to the border between France and Luxembourg).[18] In both cases, Greenpeace activists easily managed to enter the power plant sites, exposing flaws in the power plants’ security. As the Greenpeace representative

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13. Sweden, Finland and France carry out a lot of research in this area seeking to identify solutions that would cause no harm to environment due to nuclear waste. Finland has authorised building a facility for the final geological disposal of nuclear waste.

14. Greenpeace, www.greenpeace.org/.

15. According to the World Nuclear Association, Sweden has a tax discriminating against nuclear power – now about €0.75/kWh, which makes up about one third of the operating cost of nuclear power. Wind and biomass are subsidised by about three times that. The tax is to be phased out by 2019.

16. Council on Foreign Relations, Targets for Terrorism: Nuclear Facilities, January 2006, www.cfr.org/.

17. J. McKeating, Greenpeace activists occupy France’s Fessenheim nuclear power plant, March 2014, www.greenpeace.org/.

18. Article on “Greenpeace fireworks at Cattenom” (“Feu d’artifice de Greenpeace à Cattenom”) published on 13 October 2017 in *L’Alsace*.

explained to the committee on 6 December 2017, “most in-service nuclear facilities were designed at a time when threats were of a different nature”. If activists could get close to a spent fuel storage pool, ill-intentioned persons could do the same and wreak havoc.

16. The Greenpeace report on nuclear security in France and Belgium (published on 10 October 2017 and based on the work of seven independent experts) argues that spent fuel storage pools are not well protected. In case of damage to these pools, they would not be cooled and would overheat, with large-scale chain reactions setting in. There are 63 such storage pools in France alone – the most nuclearised country in Europe and probably the world. Whilst reactors are generally well protected by thick concrete walls, there seem to be major doubts about the protection of storage pools. Their enhanced “bunkerisation” may be necessary.

17. Moreover, in 2014, drones flew over all the French nuclear power plants. It is still not known who was at the origin of these acts, and such drone overflights still occur. They cast doubt about possible breaches to cybersecurity of nuclear plant installations (which are otherwise “off-line” to protect computer-managed systemic functions against any hacking attempts). Furthermore, drones can drop dangerous portable devices on nuclear facilities, or take pictures for later malevolent acts.

18. In the post-September 11th context, further questions arise about the physical protection of nuclear facilities and radioactive materials which is related to each country's security and defence policies, and lies mostly within their competence. In 2004, the European Nuclear Security Regulators Association (ENSRA) was launched for a confidential exchange of information and experience on nuclear security. In 2011-2012, and in parallel to the process of stress tests, an Ad Hoc Group on Nuclear Security was also created. Every European country has its own security regime based on the “design basis threats” assessment and the “defence-in-depth” principles (prevention, detection, response and mitigation/recovery procedures). National security organisation usually devolves certain responsibilities to nuclear facility operators, safety authorities and specialised ministries/services. The operators’ responsibilities cover a site protection policy, a model for physical site protection and measures to organise transport of nuclear materials to/from the nuclear installations.[19]

19. In this area, parliamentarians must exercise their oversight function as members of parliamentary committees dealing with national security issues so as to ensure that adequate efforts are deployed by the State to provide unquestionable and “reasonably achievable” protection to vital strategic objects. These include domestic nuclear installations or those of neighbouring countries that are in close proximity to national borders. Moreover, heightened attention is necessary to prevent any unauthorised access to nuclear facilities and nuclear material (on-site or in transport, e.g. of nuclear fuel or waste), for example to build a “dirty bomb”.

20. Last but not least, as we saw in Fukushima, natural risks represent a very real security hazard for nuclear installations. Indeed, any environmental or economic benefits of nuclear power could be largely outweighed by the risks related to the occurrence of an accident (or attack) leading to the release of a considerable amount of radioactive substances into the surrounding areas. Modern nuclear power plants claim to be designed to withstand hurricanes, tornadoes, earthquakes,[20] and small plane crashes; but the 2011 Fukushima accident showed that the plant could not withstand the double whammy of an earthquake and a tsunami.[21] The safety of older plants built in areas susceptible to natural disasters such as earthquakes needs

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19. See the declassified minutes (AS/Soc (2018) PV 01add2) of the hearing held by the Committee on Social Affairs, Health and Sustainable Development on 25 January 2018.

20. The Metsamor nuclear power plant – located in Armenia (operational since 1980) – was built without emergency shelter structures; it had to be closed in 1989 after the Spitak earthquake, and one reactor was restarted in 1995 after multiple safety improvements (including high-resistance storage batteries, reinforced reactor building and cooling towers) had been implemented. In 2015, the IAEA granted an extension which allows the plant to operate until 2027. The European Union regards the plant as unsafe and considers its “swift closure and decommissioning” as “a key objective for the EU and the European Neighbourhood Policy Action Plan, as this power plant cannot be upgraded to meet internationally recognised nuclear safety standards” (according to the Statement of Ms Federica Mogherini, Vice-President of the European Commission, on 6 October 2017).

21. It is reported that immediately after the earthquake, the active reactors automatically shut down their sustained fission reactions. However, the tsunami disabled the emergency generators that would have provided power to control and operate the pumps necessary to cool the reactors. The insufficient cooling led to three nuclear core meltdowns, hydrogen-air explosions, and the release of radioactive material. Loss of cooling also caused a pool for storing spent fuel to overheat due to the decay heat from the fuel rods. There were 11 nuclear reactors on the shore that housed Fukushima. The accident affected four units of the Fukushima Daiichi plant. Reaching the conclusion above based only on the Fukushima Daiichi accident may not be realistic. But it is true that nuclear power plants that have not been modernised and do not have the latest safety measures bear a considerable risk. The Fukushima Daiichi is a second generation nuclear plant built

to be reconsidered, and more studies are required in order to accurately assess the security level of all nuclear power plants in case of severe attacks, for instance a hijacked plane collision or the use of portable missiles.

4. Nuclear safety – a permanent challenge

21. Together with nuclear security, nuclear safety is paramount for public safety. In some aspects, they are closely intertwined and require constant improvements, alas too often triggered as a result of major accidents (notably, Three Mile Island, Chernobyl, Fukushima). As for nuclear security, the IAEA's definition serves as the reference for nuclear safety: "The achievement of proper operating conditions, prevention of accidents and mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation risks." Nuclear safety (and its regulation) is viewed as a dynamic learning process that concerns the design, construction, operation and decommissioning of nuclear installations, as well as the entire nuclear fuel cycle.[22]

22. The IAEA has developed a consistent set of safety standards, from fundamentals (such as the 1996 Convention on Nuclear Safety and the 2001 Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management) to recommendations and guidelines. At European level, WENRA (Western European Nuclear Regulators Association), the European Commission[23] and the ENSREG (European Nuclear Safety Regulators' Group), as well as EUR (nuclear licensees' body) and WNA/CORDEL (World Nuclear Association's Cooperation in Reactor Design Evaluation and Licensing Working Group) also play major roles in terms of standards, regulations and implementation. Importantly, the EU directives[24] are binding for member States, whereas the IAEA's standards serve more as general benchmarks; however the IAEA covers the European countries more fully than the European Union's umbrella. The Integrated Regulatory Review Service (IRRS) and ENSREG peer-missions provide highly valuable guidance for continuous nuclear safety improvements in individual countries.

23. Special efforts are deployed in the area of harmonisation of nuclear safety rules across Europe, in particular in EU countries. The most recent initiatives for harmonisation emanate from the European Commission (such as on prevention of accidents and avoiding radioactive releases), WENRA (on safety objectives for new reactors and reference levels for existing reactors) and the industry (on specifications for new reactors through EUR, a licensees' body). In line with the European Union's periodic safety review requirements, compliance checks and upgrades of installations are carried out at least every 10 years. After the Fukushima accident, additional stress tests were carried out for all reactors in EU countries and in several non-EU countries.[25] Although no reactor was stopped as a result, some safety upgrades had to be launched rapidly: modifications were implemented to increase robustness against external hazards, and revisions of safety standards were undertaken.[26] Some longer-term improvements are on track or planned for the coming years (deliverable by 2020 at the latest) as they require rather complex "back-fitting" for the specific designs of existing plants.

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in the 1970s, which is hardly a modern nuclear plant by today's standards. Moreover, some reports show that the Japanese authorities identified technical trouble well before the accident but did not act on it due to administrative problems. It would be problematic to state that the sole reason for the accident was the design of the nuclear plant.

22. The nuclear fuel cycle covers the extraction and enrichment of the uranium ore; the production, transportation and use of nuclear fuel, and finally, the reprocessing of spent fuel and the storage of nuclear waste.

23. The European Commission's work in relation to nuclear energy focuses on radiological safety. To that end, the Commission has established a general and binding legal framework composed of several directives, whilst the EU Council has put forward a general energy policy framework with climate objectives in mind. The Nuclear Safety Directive of 2009, as amended in 2014 after the post-Fukushima stress tests, established common safety rules for nuclear installations. The Directive for the Management of Radioactive Waste and Spent Fuel sets rules for safely disposing of used radioactive materials. Moreover, the 2014 Directive on Radiological Protection of Citizens and Workers (Basic Safety Standards Directive) also covers requirements on emergency preparedness.

24. The Nuclear Safety Directive of 2009, as amended in 2014, the Directive for the Management of Radioactive Waste and Spent Fuel and the 2014 Directive on Radiological Protection of Citizens and Workers (Basic Safety Standards Directive).

25. Switzerland and Ukraine participated fully in the EU-driven stress tests and peer reviews, whereas neighbouring countries such as Armenia, Belarus and Turkey used the same methodology but applied different timetables.

26. See Communication from the European Commission to the Council and the European Parliament "on the comprehensive risk and safety assessments ('stress tests') of nuclear power plants in the European Union and related activities" (COM(2012)571final / SWD(2012)287final) and ENSREG Summary Report of the post-Fukushima accident workshop on National Actions Plans, 2013.

24. The defence-in-depth concept is a fundamental approach to nuclear safety, combining both prevention of incidents or accidents at nuclear plants and mitigation of their consequences through multiple safety barriers. Its application in the design and operation of nuclear facilities aims to provide solid protection against equipment failures, human-induced events and any interferences originating from outside. According to the international nuclear events scale (INES), safety failures at nuclear installations are rated at seven levels, with the upper levels (4 to 7) being termed accidents and the lower levels (1 to 3) being called incidents. The latter normally cause no off-site impact but may lead to on-site contamination and exposure of workers, whereas accidents cause more or less important radioactivity release outside the plant, damages to the reactor and fatal exposure of workers (such as in Chernobyl and Fukushima – level 7 accidents).

25. After the Fukushima accident, the EU countries and their partners were urged to better tackle external hazards such as earthquakes and flooding based on the assessment of the most severe event around the site of a nuclear power plant over the last 10 000 years. This recommendation applies in particular to decision-making with regard to the construction of new plants (notably, plant design "must be able to withstand an earthquake producing at least a peak ground acceleration of 0.1g"[27]). For existing plants, the new safety requirement stresses the need for means to fight accidents to be adequately stored off-site (such as portable electricity generators, pumps, hoses, ventilation equipment, diesel fuel and vehicles, fire trucks) and the reactors and spent fuel pools to be more adequately protected against multiple risks and simultaneous failures. The NEA (Nuclear Energy Agency) also emphasises the need to enhance robustness of reactor-containment systems and to reinforce the safety culture (including human and organisational aspects).

26. Moreover, periodic safety reviews (PSRs) at nuclear plants are carried out regularly in light of the inevitable aging of installations. These reviews are meant to assess the safety of components (given that some could not be replaced at all) in relation to the analysis of the lifetime performance of a plant and in order to identify possible improvements towards meeting the recent safety objectives. The reviews are performed under the supervision of national nuclear regulators whose independence and effectiveness is paramount for a sound result. In addition, the Probabilistic Safety Assessment for specific types of hazards enables a rational safety investment planning.

27. Finally, we should also bear in mind the fact that there are a number of nuclear research reactors in Europe; some of them are undergoing the decommissioning stage and are subject to the same safety rules as nuclear power reactors. However, overall nuclear waste management and storage remain problematic in Europe, in particular long term. Some countries are making progress in this area, such as Finland which is constructing a deep geological repository for spent nuclear fuel, the first one in the world. Both the EU directive (2011/70/EURATOM) and the IAEA's Joint Convention concord in spirit and oblige member States to assume full responsibility for nuclear waste management and disposal without harm to humans or the environment; the latter instrument also stipulates that the burden of nuclear waste management should not be unduly imposed on future generations. Since 1993, the dumping of nuclear waste in seas and oceans has been banned by international treaties; until then, some 14 countries had disposed of their solid and liquid radioactive waste in containers.[28] TEPCO, the operator of the Fukushima plant, is still searching for solutions concerning close to 777 000 tons of tritium-polluted water from the reactor cooling facilities and has been considering releasing part of it into the Pacific Ocean.

5. What if: crisis management readiness for nuclear emergencies

28. As highlighted above, important lessons have been drawn by the international community from past nuclear accidents. The IAEA's conventions on Early Notification of a Nuclear Accident and on Assistance in the case of a Nuclear Accident or Radiological Emergency were both adopted in 1986 in the aftermath of the Chernobyl accident. They require, respectively, countries to promptly "notify of any nuclear accident that may affect other countries" and to engage in an international framework for co-operation (including between States, with the IAEA acting as the focal point) towards facilitating assistance and support in nuclear or radiological emergencies. In this context, the IAEA helps member States develop their emergency-preparedness capacity (standards, training and workshops) and test it through field exercises of various complexities.

27. COM(2012)571final / SWD(2012)287final.

28. Those countries (ten of them European) have altogether dumped about 85 100 TBq (Bq – becquerel) of nuclear waste, excluding sunken nuclear submarines. This compares with 12 060 TBq total release due to the Chernobyl accident, and 11 346 TBq total aerial release due to the Fukushima accident (plus an estimated 15-27 TBq leak of reactor cooling water). Near the European coastline, nuclear dumping has occurred in the North Atlantic and the Arctic Ocean.

29. Crisis-management preparedness also demands an adequate (effective and regular) exchange of information. To this end, the IAEA's Incident and Emergency Centre runs the Emergency Preparedness and Response Information Management System (EPRIMS), which is an interactive web-based tool for information sharing, and the International Radiation Monitoring Information System (IRMIS), another tool for the reporting of the radiological data during emergencies.

30. Closer to home, the European post-Fukushima stress tests have signalled the need to improve the Severe Accident Management Guidelines so as to cover a broader range of situations, and to implement them fully and rapidly. During the discussions held in our committee, members noted that many nuclear power plants are situated close to border areas or in close proximity to densely populated areas. This has obvious implications for the appropriate use of the INES scale in communicating with the public in emergency situations, in particular in a cross-border context. In addition, specific bilateral agreements may be necessary to ensure the smooth exchange of information on nuclear safety matters between neighbouring countries with a view to building trust through official channels and matching the expectations of the general public.

31. Concerning the handling of emergencies at nuclear power plants and their consequences, a State's liability is only theoretically unlimited; in practical terms, especially as far as compensation is concerned, various international legal regimes *de facto* set limits.[29] In terms of WENRA's stated safety objectives for handling emergencies and in line with the European Commission's Nuclear Safety Directive (as amended in 2014), accidents without core melt should have no or minor radiological impact and accidents with core melt with large radioactivity releases must be practically eliminated; the suggested safety perimeter is 3 to 5 km only where evacuation, sheltering or iodine prophylaxis may be required.[30] However restrictions on locally-produced food could be imposed for a year following a major accident. By comparison, the IAEA's suggested sheltering zone is in the range of 5 to 30 km around the nuclear installation. It is not clear though how the meteorological conditions in case of an accident can affect the *de facto* needs of evacuation or sheltering.

6. The case of the Ostrovets nuclear power plant in Belarus

32. In light of past nuclear accidents and modern safety requirements, special attention should be paid to the matter of international co-operation and good neighbourliness in the process of choosing the location of new nuclear plants. The most recent conflict regarding location has occurred between Belarus and Lithuania regarding the construction of the Ostrovets power plant in Belarus, 20 km from the Lithuanian border and 45 km from Vilnius, the Lithuanian capital. The main concerns raised by Lithuania relate to the justification of the selection of the construction site (in particular, in light of possible seismic activity in the region).

33. Assembly Resolution 2172 (2017) on the situation in Belarus deplores "the lack of respect for international standards for nuclear safety and serious safety violations and major incidents during the construction" of the nuclear power plant in Ostrovets. It points to a potentially "devastating impact on the health and safety of most of Europe and its people", whilst enumerating breaches of the international legal instruments[31] and mentioning concerns raised by competent international organisations (such as the IAEA, WENRA and ENSREG). Subsequently, in October 2017, Belarus published a national stress test report on its nuclear power plant built in Ostrovets pursuant to the agreement with the European Commission and the ENSREG on 24 May 2011.[32] This was followed by the ENSREG peer-review mission to Belarus mid-March 2018, and the peers' report was adopted on 2 July and published on 4 July 2018 together with a set of recommendations on safety upgrades required regarding: 1) earthquakes, flooding and extreme weather conditions; 2) loss of electrical power and of ultimate heat sink; and 3) severe accident management.[33]

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29. Most Western European countries have signed up to the 1960 Paris Convention (updated in 1964 and 1982, and amended with a Protocol in 2004) and the 1963 Brussels Supplementary Convention (amended by a 2004 Protocol) established by the OECD, whereas many eastern European countries follow the 1963 Vienna Convention (revised in 1997) established by the IAEA. In 1992, the Joint Protocol created linkages for both groups of countries. The Fukushima accident prompted the launch of an additional global instrument – the Convention on Supplementary Compensation for Nuclear Damage – in 2015. However, many gaps and uncertainties persist with the current patchwork of nuclear liability regimes (see the study on "The global nuclear liability regime post Fukushima Daiichi" by Raphael J. Heffron, Stephen F. Ashley and William J. Nuttall of July 2016: www.sciencedirect.com/science/article/pii/S0149197016300415).

30. WENRA report on safety of new nuclear power plant designs (p. 28), study by the Reactor Harmonization Working Group, March 2013.

31. The Convention on Nuclear Safety, the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention), the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki Water Convention).

32. www.ensreg.eu/document/belarus-stress-test-final-report.

34. As rapporteur I received various written contributions on this case from the Belarusian and Lithuanian authorities. Moreover, experts[34] from Belarus and Lithuania provided enlightening comments during the committee's exchange of views on 20 March 2018. I should recall that the plant in Ostrovets, the first one Belarus is building, has been designed by the Russian State corporation Rosatom and is implemented by a Rosatom subsidiary. The plant will contain two reactors with an operating lifetime of up to 60 years. Given that construction works are 90% finished, the first reactor may be launched before the end of 2019 and the second one in 2020. This power plant is hence a concrete fact. However, as one of our experts pointed out, it should only be put into operation once the major concerns over its safety have been fully addressed.

35. Here is an overview of issues concerning the nuclear and environmental safety of the Belarusian plant project:

– **Site selection**: According to the written explanation I have received from the Belarusian authorities, 74 areas were initially screened and 15 sites were selected for further assessment, which led to the shortlisting of two sites, then two further alternatives (including the Ostrovets site) and a final decision in favour of Ostrovets. The main arguments for eliminating other alternative sites were the unfavourable geological stability factors, but Krasnaya Polyana and Kukshinovo sites remained as reserve sites. The Belarusian authorities claim that the environmental impact assessment has been carried out in line with the requirements of the Espoo Convention with regard to the transboundary environmental impact (consultations were held with six neighbouring countries – Austria, Latvia, Lithuania, Poland, Russia and Ukraine), whereas the Lithuanian authorities consider that the consultations were insufficient. Similarly, they claim that the obligations under the Aarhus Convention relating to public consultations have been inadequate.

– **Seismological factors**: The Lithuanian authorities have signalled that the area around Ostrovets experienced major earthquakes in 1887, 1893, 1896, 1908 and 1987. There are images of deep geological cracks on the surface. The Belarusian experts have proposed in the national stress test report that further seismic hazard assessments are necessary.

– **IAEA's field missions**: At the request of the Belarusian authorities, an Integrated Nuclear Infrastructure Review Mission (INIR) was carried out in June 2012 by the IAEA for phases 1 and 2. This has led to the preparation of the Strategic Action Plan and Co-operation Plan for Capacity Building to Enhance Gosatomnadzor[35] of the Ministry for Emergency Situations. Further to proposals from the Lithuanian authorities and at the request of Belarusian authorities, the IAEA's SEED mission took place in January 2017 focussing on hazards evaluation deriving from site-specific consideration; yet modules 1 to 4 relating to the integrated site-safety assessment have apparently not been completed (IAEA review missions are arranged at the request of the host country). Belarus has joined the World Association of Nuclear Operators (WANO) which is expected to carry out peer controls on the Ostrovets plant in line with its own terms of reference.

– **Aircraft crash resistance**: Although air corridors above and near the plant have been banned for commercial overflights, the danger of a terrorist attack cannot be excluded whereas the reactor shelter is able to withstand a crash of only a small airplane (up to 5 tons). In Finland, the same reactor design has been enhanced (by Rosatom) with additional concrete protection. The Lithuanian authorities demand that evaluations be carried out on the resistance of the Ostrovets reactor protections against a fall of a heavy commercial airplane of 200 tons or more.

– **Impact on transboundary water resources**: Water from the transboundary Neris River (or Vilija River as it is called in Belarus) is foreseen to be used as a cooling source for the nuclear power plant in Ostrovets. This river flows through the Lithuanian capital Vilnius before joining the Nemunas River; both river basins cover about 72% of the Lithuanian territory. In case of a major incident or an accident at the Ostrovets plant, radiological and thermal pollution of the Neris River would significantly impact potable water resources in several Lithuanian cities (notably Vilnius, Kaunas and Jonava) as well as in smaller settlements, whilst also contaminating the surrounding ecosystems.

– **Reliability of the reactor cooling system**: The Neris River, which is to be used for cooling purposes in Ostrovets, is situated at about 10 km distance from the plant and is some 55-65 meters below the plant level. It is of utmost importance to ensure that the water pumps have external and autonomous power

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33. www.ensreg.eu/EU-Stress-Tests/Country-Specific-Reports/EU-Neighbouring-Countries/Belarus for peer review report and its executive summary.
34. Mr Anatoly Bondar, Chief Engineer of the Belarusian Nuclear Power Plant, and Mr Laurynas Juodis, Senior Scientific Researcher at the Center for Physics Sciences and Technology (Lithuania).
35. The Belarusian State nuclear safety regulator.

supply to avoid any disruptions in the cooling process of the reactor in case of extraordinary events (such as in Fukushima where major problems arose in this area and led to reactor core melt, a very dangerous situation).

– **Incidents at the construction site and the general safety culture**: At least four notable incidents took place during construction works in Ostrovets in 2016. Each time, the neighbouring countries learned about them several weeks later and even the Belarusian authorities were informed with some delay after reports about accidents leaked into the independent local media. The most serious incident caused the fall of a 330 ton reactor vessel from a height of 4 meters; the damaged vessel was finally replaced by the Russian contractor at the insistence of the Belarusian authorities. However, the incident notification record so far is very poor and does not contribute to the building of trust with the population in neighbouring communities and countries. Like at the time of the Chernobyl accident, the competent authorities' first reaction was denial, followed by reluctance to admit the facts and finally, efforts to downplay the importance of the incident or accident. Such an approach to communication is not reassuring in terms of emergency preparedness and crisis management even though, as we have learned from the expert, technical capabilities are being put in place.

– **National nuclear regulator**: As a new entrant into the world of nuclear energy, Belarus will gain experience in organising the work of its nuclear regulatory authorities over time.

– **Proximity to densely populated areas**: The Belarusian nuclear power plant is built 140 km from Minsk, the capital of Belarus, but only 45 km from the Lithuanian capital which together with surrounding areas is home to one third of Lithuania's population. With unfavourable meteorological conditions in the event of an accident at the plant, the evacuation of the population of the capital Vilnius may become unavoidable. Although there are no formal IAEA recommendations specifying a safety distance between nuclear plants and human settlements, lessons drawn from past accidents should prompt the competent authorities to establish more clear guidelines in this respect, in particular for projects in close proximity to other countries that do not necessarily share the same enthusiasm for nuclear energy.[36]

37. From the above considerations we can conclude that improvement in transparency and communication with the public would contribute to better perception of the safety credentials of the Ostrovets project. The most daring critics of the project even see the political ramifications behind the decision to site the project at the nearest possible distance from the neighbouring country's capital. That being said, the reality is such that the two countries most concerned with the project are bound to co-operate towards working out mutually acceptable communication and coordination channels, in particular with regard to emergency preparedness, which could be done based on the Melk Protocol (concluded in 2000 between Austria and the Czech Republic on the Temelín nuclear power plant). There is still time to invest in enhanced containment structures to better protect the reactors and spent fuel pools against external hazards such as a heavy airplane crash and to strengthen the capacity of the national nuclear safety regulator.

7. Conclusions

37. Nuclear installations in Europe have a long history of satisfactory performance [if we exclude the Chernobyl accident], contributing to energy security, economic competitiveness and lower greenhouse gas emissions in countries that have embraced nuclear energy. By definition though, decisions in favour of nuclear energy commit multiple successive generations and the utmost attention needs to be paid to safety and security so as not to run the risk of facing dramatic consequences. The nuclear safety and security objectives have been generally adequately integrated by the competent European and national authorities into technical, regulatory and legal frameworks, but the secrecy surrounding the operation of such strategic objects stirs mistrust among the public at large.

38. As we can see from this report, nuclear safety and security is a dynamic process that requires continuous adaptation of existing, often highly complex frameworks based on experience, research and developments in society. Zero risk does not exist in any domain, yet in the nuclear sector we aim to avoid the worst case scenarios through "reasonably achievable" safety objectives and we have to pay the price accordingly. So the key challenge from a political angle is to provide adequate information to the public without undermining its

36. In Lithuania, the public rejected plans to build a new nuclear power reactor: in a referendum held in October 2012, 63% of voters said "no" to nuclear energy.

security and to achieve a democratic consensus over the strategic orientations and the level of nuclear safety and security we want. We should therefore aim for greater transparency and improved communication around the nuclear energy challenge.

39. For this reason, we should particularly welcome the publication, on 28 June 2018, of the parliamentary enquiry report on the safety and security of nuclear installations in France, following alarming signals from various sources.[37] This comprehensive, frank and captivating report highlights the complexities, as well as the uncertainties, surrounding the management of the existing nuclear reactors and past legacy against the backdrop of new threats and risks. We should pay particular attention to the questions relating to the transport of radioactive substances (notably nuclear fuel and waste), sub-contracting practices that affect control of the 'human factor' and the sky-high costs of securing the nuclear facilities. Given the vast experience France has in this area, I highly recommend this report as a major reference text for parliamentarians and nuclear regulators in other European States, in particular those with nuclear plants on their territory.

40. Although decisions on nuclear safety and security belong to the national sphere, the role of specialised international organisations and supra-national institutions can hardly be underestimated. We have to support their work in developing standards, providing guidance and enabling the sharing of good practices. Harmonisation of standards and practice is desirable for many aspects of nuclear safety where the aim is to strive for excellence and enhanced protection, in particular in light of new risks such as ill-intentioned attacks against nuclear facilities. However, case-specific solutions may be more appropriate in response to external hazards as evaluated against a particular design of a given installation. We have learned about the potential vulnerabilities linked to spent fuel pools and drone overflights and should follow up these signals at national level as appropriate.

41. Drawing lessons from the nuclear accidents of the past, it appears that the human and organisational factors are crucial determinants in most aspects of nuclear safety. Highly valuable initiatives in this area have been taken by several NEA member countries and should be further developed so as to involve all the European countries concerned, with special attention to decision-making responsibilities and co-ordination in emergency situations. In all territories with nuclear installations, local authorities should be involved in emergency management planning. Finally, in response to people's expectations and new hazards, I believe that we have sufficient reasons to ask the relevant international organisations to provide more adequate guidance on the siting of new nuclear power facilities at an appropriate distance from densely populated areas.

37. See document No. 1122 – report by Ms Barbara Pompili on behalf of the parliamentary enquiry committee on safety and security of nuclear installations – on the French National Assembly's website, www.assemblee-nationale.fr/15/rap-enq/r1122-tI.asp#P1778_481514.

Appendix 1 – Nuclear power plants in operation in Europe

Country	Reactor name	Reactor type	Net capacity (MW)	Date connected	Age in 2018	Proximity to nearest border (km)	Border country
Armenia	Armenia-2	WWER	375	1980	38	16	Turkey
Belgium	Doel-1	PWR	433	1974	44	4	Netherlands
Belgium	Doel-2	PWR	433	1975	43	4	Netherlands
Belgium	Doel-3	PWR	1,006	1982	36	4	Netherlands
Belgium	Doel-4	PWR	1,033	1985	33	4	Netherlands
Belgium	Tihange-1	PWR	962	1975	43	38	Netherlands
Belgium	Tihange-2	PWR	1,008	1982	36	38	Netherlands
Belgium	Tihange-3	PWR	1,038	1985	33	38	Netherlands
Bulgaria	Kozloduy-5	WWER	963	1987	31	5	Romania
Bulgaria	Kozloduy-6	WWER	963	1991	27	5	Romania
Czech Republic	Dukovany-1	WWER	468	1985	33	32	Austria
Czech Republic	Dukovany-2	WWER	471	1986	32	32	Austria
Czech Republic	Dukovany-3	WWER	468	1986	32	32	Austria
Czech Republic	Dukovany-4	WWER	471	1987	31	32	Austria
Czech Republic	Temelin-1	WWER	1,026	2000	18	50	Austria
Czech Republic	Temelin-2	WWER	1,026	2002	16	50	Austria
Finland	Loviisa-1	WWER	496	1977	41	75	Russia
Finland	Loviisa-2	WWER	496	1980	38	75	Russia
Finland	Olkiluoto-1	BWR	880	1978	40	220	Sweden
Finland	Olkiluoto-2	BWR	880	1980	38	220	Sweden
France	Belleville-1	PWR	1,310	1987	31	260	Switzerland
France	Belleville-2	PWR	1,310	1988	30	260	Switzerland
France	Blayais-1	PWR	910	1981	37	223	Spain
France	Blayais-2	PWR	910	1982	36	223	Spain
France	Blayais-3	PWR	910	1983	35	223	Spain
France	Blayais-4	PWR	910	1983	35	223	Spain
France	Bugey-2	PWR	910	1978	40	64	Switzerland
France	Bugey-3	PWR	910	1978	40	64	Switzerland
France	Bugey-4	PWR	880	1979	39	64	Switzerland
France	Bugey-5	PWR	880	1979	39	64	Switzerland
France	Cattenom-1	PWR	1,300	1986	32	10	Luxembourg
France	Cattenom-2	PWR	1,300	1987	31	10	Luxembourg
France	Cattenom-3	PWR	1,300	1990	28	10	Luxembourg
France	Cattenom-4	PWR	1,300	1991	27	10	Luxembourg
France	Chinon-B-1	PWR	905	1982	36	393	United Kingdom
France	Chinon-B-2	PWR	905	1983	35	393	United Kingdom
France	Chinon-B-3	PWR	905	1986	32	393	United Kingdom
France	Chinon-B-4	PWR	905	1987	31	393	United Kingdom
France	Chooz-B-1	PWR	1,500	1996	22	4	Belgium
France	Chooz-B-2	PWR	1,500	1997	21	4	Belgium
France	Civaux-1	PWR	1,495	1997	21	400	Spain
France	Civaux-2	PWR	1,495	1999	19	400	Spain
France	Cruas-1	PWR	915	1983	35	160	Italy

Country	Reactor name	Reactor type	Net capacity (MW)	Date connected	Age in 2018	Proximity to nearest border (km)	Border country
France	Cruas-2	PWR	915	1984	34	160	Italy
France	Cruas-3	PWR	915	1984	34	160	Italy
France	Cruas-4	PWR	915	1984	34	160	Italy
France	Dampierre-1	PWR	890	1980	38	290	Belgium
France	Dampierre-2	PWR	890	1980	38	290	Belgium
France	Dampierre-3	PWR	890	1981	37	290	Belgium
France	Dampierre-4	PWR	890	1981	37	290	Belgium
France	Fessenheim-1	PWR	880	1977	41	1,5	Germany
France	Fessenheim-2	PWR	880	1977	41	1,5	Germany
France	Flamanville-1	PWR	1,330	1985	33	120	United Kingdom
France	Flamanville-2	PWR	1,330	1986	32	120	United Kingdom
France	Golfech-1	PWR	1,310	1990	28	144	Spain
France	Golfech-2	PWR	1,310	1993	25	144	Spain
France	Gravelines-1	PWR	910	1980	38	50	United Kingdom
France	Gravelines-2	PWR	910	1980	38	50	United Kingdom
France	Gravelines-3	PWR	910	1980	38	50	United Kingdom
France	Gravelines-4	PWR	910	1981	37	50	United Kingdom
France	Gravelines-5	PWR	910	1984	34	50	United Kingdom
France	Gravelines-6	PWR	910	1985	33	50	United Kingdom
France	Nogent-1	PWR	1,310	1987	31	175	Belgium
France	Nogent-2	PWR	1,310	1988	30	175	Belgium
France	Paluel-1	PWR	1,330	1984	34	100	United Kingdom
France	Paluel-2	PWR	1,330	1984	34	100	United Kingdom
France	Paluel-3	PWR	1,330	1985	33	100	United Kingdom
France	Paluel-4	PWR	1,330	1986	32	100	United Kingdom
France	Penly-1	PWR	1,330	1990	28	110	United Kingdom
France	Penly-2	PWR	1,330	1992	26	110	United Kingdom
France	St. Alban-1	PWR	1,335	1985	33	120	Switzerland
France	St. Alban-2	PWR	1,335	1986	32	120	Switzerland
France	St. Laurent-B-1	PWR	915	1981	37	315	Belgium
France	St. Laurent-B-2	PWR	915	1981	37	315	Belgium
France	Tricastin-1	PWR	915	1980	38	170	Italy
France	Tricastin-2	PWR	915	1980	38	170	Italy
France	Tricastin-3	PWR	915	1981	37	170	Italy
France	Tricastin-4	PWR	915	1981	37	170	Italy
Germany	Brokdorf (KBR)	PWR	1,410	1986	32	107	Denmark
Germany	Emsland (KKE)	PWR	1,335	1988	30	20	Netherlands
Germany	Grohnde (KWG)	PWR	1,360	1984	34	160	Netherlands
Germany	Gundremmingen-C	BWR	1,288	1984	34	106	Austria
Germany	Isar-2 (KKI 2)	PWR	1,410	1988	30	60	Austria
Germany	Neckarwestheim-2	PWR	1,310	1989	29	70	France
Germany	Philippsburg-2	PWR	1,402	1984	34	35	France
Hungary	Paks-1	WWER	470	1982	36	70	Serbia
Hungary	Paks-2	WWER	473	1984	34	70	Serbia
Hungary	Paks-3	WWER	473	1986	32	70	Serbia
Hungary	Paks-4	WWER	473	1987	31	70	Serbia
Netherlands	Borssele	PWR	482	1973	45	17	Belgium
Romania	Cernavoda-1	PHWR	650	1996	22	36	Bulgaria

Country	Reactor name	Reactor type	Net capacity (MW)	Date connected	Age in 2018	Proximity to nearest border (km)	Border country
Romania	Cernavoda-2	PHWR	650	2007	11	36	Bulgaria
Russia	Balakovo-1	WWER	950	1985	33	155	Kazakhstan
Russia	Balakovo-2	WWER	950	1987	31	155	Kazakhstan
Russia	Balakovo-3	WWER	950	1988	30	155	Kazakhstan
Russia	Balakovo-4	WWER	950	1993	25	155	Kazakhstan
Russia	Beloyarsky-3	FBR	560	1980	38	317	Kazakhstan
Russia	Beloyarsky-4	FBR	789	2015	3	317	Kazakhstan
Russia	Bilibino 1	LWGR	11	1974	44	-	-
Russia	Bilibino 2	LWGR	11	1974	44	-	-
Russia	Bilibino 3	LWGR	11	1975	43	-	-
Russia	Bilibino 4	LWGR	11	1976	42	-	-
Russia	Kalinin-1	WWER	950	1984	34	360	Belarus
Russia	Kalinin-2	WWER	950	1986	32	360	Belarus
Russia	Kalinin-3	WWER	950	2004	14	360	Belarus
Russia	Kalinin-4	WWER	950	2011	7	360	Belarus
Russia	Kola-1	WWER	411	1973	45	110	Finland
Russia	Kola-2	WWER	411	1974	44	110	Finland
Russia	Kola-3	WWER	411	1981	37	110	Finland
Russia	Kola-4	WWER	411	1984	34	110	Finland
Russia	Kursk-1	LWGR	925	1976	42	58	Ukraine
Russia	Kursk-2	LWGR	925	1979	39	58	Ukraine
Russia	Kursk-3	LWGR	925	1983	35	58	Ukraine
Russia	Kursk-4	LWGR	925	1985	33	58	Ukraine
Russia	Leningrad-1	LWGR	925	1973	45	66	Estonia
Russia	Leningrad-2	LWGR	925	1975	43	66	Estonia
Russia	Leningrad-3	LWGR	925	1979	39	66	Estonia
Russia	Leningrad-4	LWGR	925	1981	37	66	Estonia
Russia	Leningrad 2-1	WWER	1,085	2018	1	66	Estonia
Russia	Novovoronezh 2-1	WWER	1,114	2016	2	150	Ukraine
Russia	Novovoronezh-4	WWER	385	1972	46	150	Ukraine
Russia	Novovoronezh-5	WWER	950	1980	38	150	Ukraine
Russia	Rostov 1	WWER	950	2001	17	196	Ukraine
Russia	Rostov 2	WWER	950	2010	8	196	Ukraine
Russia	Rostov 3	WWER	1,011	2014	4	196	Ukraine
Russia	Rostov 4	WWER	1,011	2018	1	196	Ukraine
Russia	Smolensk-1	LWGR	925	1982	36	70	Belarus
Russia	Smolensk-2	LWGR	925	1985	33	70	Belarus
Russia	Smolensk-3	LWGR	925	1990	28	70	Belarus
Slovak Republic	Bohunice-3	WWER	471	1984	34	37	Czech Republic
Slovak Republic	Bohunice-4	WWER	471	1985	33	37	Czech Republic
Slovak Republic	Mochovce-1	WWER	436	1998	20	37	Hungary
Slovak Republic	Mochovce-2	WWER	436	1999	19	37	Hungary
Slovenia	Krsko	PWR	688	1981	37	14	Croatia
Spain	Almaraz-1	PWR	1,011	1981	37	100	Portugal
Spain	Almaraz-2	PWR	1,006	1983	35	100	Portugal

Country	Reactor name	Reactor type	Net capacity (MW)	Date connected	Age in 2018	Proximity to nearest border (km)	Border country
Spain	Asco-1	PWR	995	1983	35	155	France
Spain	Asco-2	PWR	997	1985	33	155	France
Spain	Cofrentes	BWR	1,064	1984	34	355	Algeria
Spain	Trillo-1	PWR	1,003	1988	30	287	France
Spain	Vandellos-2	PWR	1,045	1987	31	170	France
Sweden	Forsmark-1	BWR	984	1980	38	170	Finland
Sweden	Forsmark-2	BWR	1,120	1981	37	170	Finland
Sweden	Forsmark-3	BWR	1,170	1985	33	170	Finland
Sweden	Oskarshamn-3	BWR	1,400	1985	33	273	Latvia
Sweden	Ringhals-1	BWR	881	1974	44	94	Denmark
Sweden	Ringhals-2	PWR	807	1974	44	94	Denmark
Sweden	Ringhals-3	PWR	1,063	1980	38	94	Denmark
Sweden	Ringhals-4	PWR	1,115	1982	36	94	Denmark
Switzerland	Beznau-1	PWR	365	1969	49	6	Germany
Switzerland	Beznau-2	PWR	365	1971	47	6	Germany
Switzerland	Goesgen	PWR	1,010	1979	39	20	Germany
Switzerland	Leibstadt	BWR	1,220	1984	34	0,5	Germany
Switzerland	Muehleberg	BWR	373	1971	47	38	France
Ukraine	Khmelnitski-1	WWER	950	1987	31	160	Russia
Ukraine	Khmelnitski-2	WWER	950	2004	14	160	Russia
Ukraine	Rovno-1	WWER	381	1980	38	65	Russia
Ukraine	Rovno-2	WWER	376	1981	37	65	Russia
Ukraine	Rovno-3	WWER	950	1986	32	65	Russia
Ukraine	Rovno-4	WWER	950	2004	14	65	Russia
Ukraine	South Ukraine-1	WWER	950	1982	36	132	Republic of Moldova
Ukraine	South Ukraine-2	WWER	950	1985	36	132	Republic of Moldova
Ukraine	South Ukraine-3	WWER	950	1989	29	132	Republic of Moldova
Ukraine	Zaporozhe-1	WWER	950	1984	34	277	Russia
Ukraine	Zaporozhe-2	WWER	950	1985	33	277	Russia
Ukraine	Zaporozhe-3	WWER	950	1986	32	277	Russia
Ukraine	Zaporozhe-4	WWER	950	1987	31	277	Russia
Ukraine	Zaporozhe-5	WWER	950	1989	29	277	Russia
Ukraine	Zaporozhe-6	WWER	950	1995	23	277	Russia
United Kingdom	Dungeness-B1	AGR	520	1985	33	43	France
United Kingdom	Dungeness-B2	AGR	520	1983	35	43	France
United Kingdom	Hartlepool-A1	AGR	595	1983	35	330	Ireland
United Kingdom	Hartlepool-A2	AGR	585	1984	34	330	Ireland
United Kingdom	Heysham-1A	AGR	580	1983	35	210	Ireland
United Kingdom	Heysham-1B	AGR	610	1984	34	210	Ireland
United Kingdom	Heysham-2A	AGR	575	1988	30	210	Ireland

Country	Reactor name	Reactor type	Net capacity (MW)	Date connected	Age in 2018	Proximity to nearest border (km)	Border country
United Kingdom	Heysham-2B	AGR	610	1988	30	210	Ireland
United Kingdom	Hinkley Point-B1	AGR	475	1976	42	185	France
United Kingdom	Hinkley Point-B2	AGR	470	1976	42	185	France
United Kingdom	Hunterston-B1	AGR	475	1976	42	140	Ireland
United Kingdom	Hunterston-B2	AGR	485	1977	41	140	Ireland
United Kingdom	Sizewell-B	PWR	1,198	1995	23	140	Belgium
United Kingdom	Torness 1	AGR	590	1988	30	295	Ireland
United Kingdom	Torness 2	AGR	595	1989	29	295	Ireland
Source: International Atomic Energy Agency PRIS Database, updated 4/2018.							
AGR – Advanced Gas-Cooled, Graphite-Moderated Reactor;							
BWR – Boiling Light-Water-Cooled and Moderated Reactor;							
FBR – Fast Breeder Reactor;							
LWGR – Light-Water-Cooled, Graphite-Moderated Reactor;							
PHWR – Pressurized Heavy-Water-Moderated and Cooled Reactor;							
PWR – Pressurized Light-Water-Moderated and Cooled Reactor;							
WWER – Water Cooled Water Moderated Power Reactor;							

Appendix 2 – Nuclear power plants under construction

Country	Reactor Name	Reactor Type	Total MW
Belarus (2)	Belarusian 1	PWR	1,109
	Belarusian 2	PWR	1,109
Finland (1)	Olkiluoto 3	PWR	1,6
France (1)	Flamanville 3	PWR	1,63
Russia (6)	Akademik Lomonosov 1*	PWR	32
	Akademik Lomonosov 2*	PWR	32
	Baltiisk 1	PWR	1,109
	Kursk 2-1	PWR	1,115
	Leningrad 2-2	PWR	1,085
	Novovoronezh 2-2	PWR	1,114
Slovak Republic (2)	Mochovce 3	PWR	440
	Mochovce 4	PWR	440
Turkey (1)	Akkuyu-1	PWR	1,114
Ukraine (2)	Khmelnitski 3	PWR	950
	Khmelnitski 4	PWR	950

Total: 15 reactors

Sources: IAEA PRIS database; project sponsors; updated 4/2018

PWR – Pressurized Light-Water-Moderated and Cooled Reactor

* The world’s first floating nuclear power plant

Appendix 3 – Dissenting opinion by Ms Stella Kyriakides (Cyprus, EPP/CD),[38] member of the committee

The explanatory memorandum on "Nuclear safety and security in Europe" by Ms Günay (Turkey, EC) encompasses a very important issue of paramount concern for all citizens of Europe and beyond. Tragic nuclear accidents such as the one in Chernobyl, 32 years ago, which released thirty to forty times more radioactivity than the atomic bomb on Hiroshima, with incalculable consequences for the health of thousands of people and the environment, made us all realise that nuclear safety cannot and should not be compromised for any reason whatsoever.

In this regard it is, to say the least, unfortunate not to have any substantial reference regarding the construction, in co-operation with the Russian Federation, of the Akkuyu nuclear plant in the Mersin province, in Turkey, apart from a simple mention in paragraph 7 of the explanatory memorandum. This plant which has evoked a lot of reaction within Turkey and by neighbouring countries, such as Cyprus, approximately 85 km away, in very close proximity with the said earthquake-prone Turkish region. In this regard, the House of Representatives of the Republic of Cyprus unanimously adopted a resolution on 18 May 2018, asking, among other things, for a halt on such a construction.

In the same context, we cannot ignore either the European Parliament Resolution (2016/2308(INI)) of 6 July 2017 on the European Commission's report on Turkey, calling on the Turkish government: "to halt its plans for the construction of the Akkuyu nuclear power plant; points out that the envisaged site is located in a region prone to severe earthquakes, hence posing a major threat not only to Turkey, but also to the Mediterranean region; requests, accordingly, that the Turkish Government join the Espoo Convention, which commits its parties to notifying and consulting each other on major projects under consideration that are likely to have a significant adverse environmental impact across boundaries; asks, to this end, the Turkish Government to involve, or at least consult, the governments of its neighbouring countries, such as Greece and Cyprus, in relation to any further developments in the Akkuyu venture".

Unfortunately, none of the above were adhered to. Last April, President Erdoğan together with President Putin laid the founding stone of Turkey's first nuclear plant of Akkuyu. No prior consultation was made by Turkey with neighbouring countries, as also stipulated by the International Convention on Nuclear Safety.

In view of the above, it is imperative for the Turkish Government to halt and reconsider its said plans, taking into account all cautions, as also expressed by its own citizens and to consult with neighbouring countries according to the International Convention on Nuclear Safety. Turkey should also proceed without further delay in joining the UNECE Convention on Environmental Impact Assessment in a Transboundary Context ("Espoo Convention"). The health and well-being of our citizens and the protection of the environment should never be jeopardised for political or any other expediencies.

38. Rule 50.4 of the Assembly's Rules of Procedure: "The report of a committee shall also contain an explanatory memorandum by the rapporteur. The committee shall take note of it. Any dissenting opinions expressed in the committee shall be included therein at the request of their authors, preferably in the body of the explanatory memorandum, but otherwise in an appendix or footnote."