# Legal barriers to the deployment of SMR and ANT reactors in the European Union. Is the Euratom Treaty sufficient?

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**Abstract**

A rash of news about planned SMR and ANT projects is being observed around the world. More stakeholders are announcing plans, often very ambitious, to build nuclear power plants of this type. At the same time, so far not only has no commercial SMR and ANT reactor been built, but no construction work has even begun, and no technology supplier has passed a full certification process in any jurisdiction. This creates a major challenge and development roadblock. Reasons for this include:

- a rigid legal framework for the certification and construction of all nuclear technologies,

- lack of a common or uniform system of certification or any formal mutual recognition of issued certifications.

These legal problems are additionally exacerbated by major shortage of actual technical experience in the construction of such units, as well as currently observed shortage of experts able to support suppliers and contractors in the process of implementing the project into reality.

What is particularly important, despite the increasingly progressive harmonization of intra-Community regulations, as well as despite the obligation of the Community stated in the EURATOM Treaty to "*create the conditions necessary for the speedy establishment and growth of the nuclear industries*" there are little tangible steps towards harmonization of EU regulations on the implementation of ANT nuclear facilities.

The purpose of this research is to specify what are the main reasons for this and what measures can be taken to mitigate risks associated with the remaining obstacles for development of standardised nuclear plants. Within this document the following shall be briefly analysed: certification process for nuclear technology in Poland, main bottlenecks and roadblocks, EURATOM/EU initiatives undertaken so far to mitigate it, how similar problems were resolved (or not) in aviation and railway sector, possible solutions.

The key finding is that some parts in the licensing process shall be standardised at EEU level and the European Commission within EURATOM may play a key role in that.

Keywords:

#ANT, #SMR, #EURATOM, #EURATOMTreaty, #EuropeanCommission, #nuclear, #nuclearPL

## Introduction

As the climate crisis looms, nuclear technologies are increasingly seen as one of important, if not necessary, instruments of decarbonisation in the world. This includes areas such as Western Europe or the United States, where for many years interest in new deployments of nuclear power was very limited. Limited new deployments over last decades, however, have seen a lot of challenges. Multiple announced projects – some of them even licenced – were abandoned for variety of reasons. Those few, which actually progressed into construction phase, encountered multiple difficulties across all stages of their lifetime, from licencing, to construction, to commissioning, greatly exceeding both anticipated budgets and planned schedules.

It is unlikely that all the problems encountered can be resolved easily by simple decisions or design features, however reduced scale and improved standardisation of new nuclear technologies – especially those labelled as Small Modular Reactors (SMRs) or Advanced Nuclear Technologies (ANTs) – might help in overcoming considerable portion. Some challenges, especially regarding public acceptance, may also be reduced by introduction of some 'advanced' technologies providing better efficiency, reduced waste generation and other process-related benefits. Nevertheless, even though features of new technical solutions seem promising as such, any real benefits will only be experienced, if those solutions can be deployed rapidly and in considerable amounts. That will require construction of multiple new plants in quick succession or even in parallel. In order to reduce burden on single investors and countries, and accelerate maturation of new solutions, such projects should appear in many countries. But any attempt to deploy new nuclear reactor designs in multiple countries will inevitably face the problem of separate jurisdictions. Even though the general principles of nuclear safety do not differ between countries as such, actual legal interpretation of those principles and related procedures may differ considerably. The processes are also quite disjointed, requiring any vendor willing to deploy their new design in several countries to repeat the same kind of work in several "versions". While this is certainly not the only barrier in development of new nuclear projects, it is certainly one which can pose a great challenge already at an early stage of a technology's lifetime, possibly even preventing successful deployment of new designs.

**Current status**

In the second and beginning of the third decade of the 21st century, the world witnessed a significant retreat from nuclear power with fewer and fewer projects being planned and implemented. However, the market abhors a vacuum and new ideas emerged for the presentation and use of nuclear power in the world. Small nuclear reactors (SMRs) and fourth-generation reactors, the so-called advanced nuclear technologies (ANTs), were advertised as a remedy for existing problems and people's fears about nuclear power. ANT and SMR are presented as those that allow for the highest safety standards while being able to be deployed much faster and cheaper than large Generation III and III+ reactors. In the media releases that appear, one can observe announcements of even several times shorter implementation times for such technologies , and, in terms of construction costs, lower prices to a fraction of the cost of building large nuclear units.

Despite these announcements, to date no nuclear power plant based on SMR or ANT has been built in Europe[1]. The announced projects are at various stages of the licensing phase and some have been abandoned at a relatively early stage. Any construction work, and only preliminary, is being carried out by Ontario Power Generation in Darlington, Canada, where a nuclear power plant based on GE Hitachi's SMR, the BWRX-300, is planned. Despite the hype, the rapid deployment of SMRs and ANTs is not as noticeable as could be expected from the numerous announcements. It is therefore important to ask the question why this is happening.

An analysis of this issue, based on the Polish market, indicates that there are several categories of problems that prevent rapid implementation of SMR/ANT projects. Among these, one can point to:

- rigid legal framework for certification and construction of all nuclear technologies. In fact, the law does not, as a rule, differentiate requirements based on the size of the reactor or the technology on which it is based;

- high requirements and time-consuming certification procedures that are not differentiated according to the size of the project or the technology used;

[1] One might argue that certain prototypes from 1970s, 80s and 90s, such as THTR-300 of West Germany or Superphénix of France were, in fact, representatives of ANTs, however these were build in the days of totally different legal framework and are not considered here.

- lack of a generic design assessment procedures, as introduced by several countries (notably USA and UK), which could facilitate fleet deployments, supposed to be a highlight of ANT and/or SMR technologies;

- the lack of a common or uniform certification system or formal recognition of issued certificates between different countries, resulting in the need to license the adopted solutions separately in each market where they are to be applied;

- different approach to verification of compliance of both design and actual works between national regulators[2];

- different construction requirements in different countries, which makes it difficult to design standardised buildings, which – on the other hand – in many advanced designs form an integral functional part of safety systems;

- difficulties in demonstrating the credibility of projects due to complex and lengthy licensing procedures, which in turn translates into difficulty for the investor to make a final investment decision.

To be able to analyse the problem, it is necessary to look at the licensing process of nuclear power plants in Poland.

**Licensing process in Poland**

The process of obtaining required permits, approvals and licences for constructing a nuclear power station is quite extensive and complex, and often causes confusion among entities considering their first nuclear project. Such process cover all type of nuclear reactors to be commercially used, not dividing them in the manner of size, power, technology etc. A diagram shown in Figure 1 presents, in a simplified way, the processes which the stakeholders need to complete in order to obtain the final Building Permit – last formal document before actual power station construction can be started.

[2] A problem that has already manifested itself in case of traditional nuclear technologies at Olkiluoto-3 project, where French supplier, despite its vast experienced, proved unprepared to work according to principles set out by STUK, the Finnish regulator.

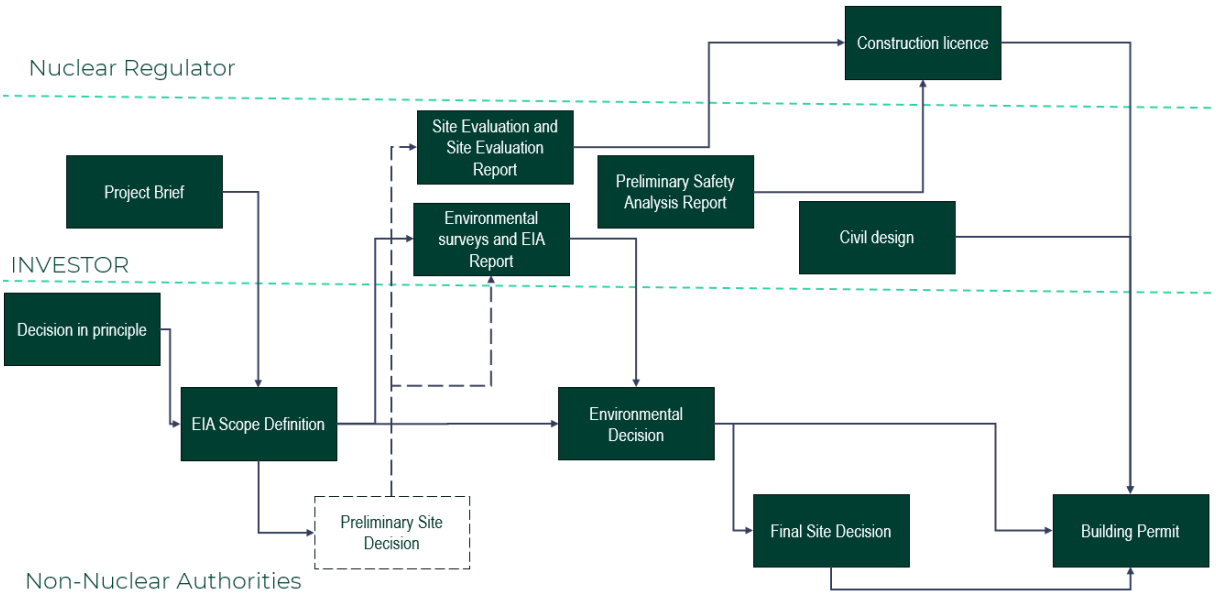


*Figure 1. Simplified diagram showing steps and processes leading to obtaining a Building Permit, enabling start of actual power station construction (by Nuclear PL).*

The formal permitting and licencing process is started by obtaining a Decision-in-Principle. Then the investor develops a Project Brief and submits it to GDEP, whereupon GDEP issues a decision which identifies an obligation to assess the environmental impact of the project which may have a significant environmental impact, and on the scope of such assessment. At the same time, GDEP launches the transboundary procedure. Once the scope is set, the investor carries out its environmental survey (possibly together with the site evaluation for the "nuclear licencing needs", as combining the two may lead to lower cost of contracting such surveys; the site evaluation may also be started somewhat later). If performing surveys requires access to a property not owned by the investor, and the owner denies access, the investor may apply for an optional Preliminary Site Decision authorising such access regardless of the opinion of the site owner. Once the environmental survey is completed, and EIA Report compiled, the report is submitted to the GDEP, which reviews it and issues the Environmental Decision. Thereafter, the investor may apply for the Final Site Decision, which enables land use by the investor. In parallel the investor may conduct engineering activities and development of a PSAR. Once PSAR and Site Evaluation Report are completed and reviewed by the PAA, a Construction License may be obtained from the regulator, followed by the Building Permit issued by a non-nuclear authority. This last document authorises the investor to start construction (certain limited preparatory activities may be conducted earlier, as discussed further in this Report).

The whole process, from the day of submitting a file for Decision-in-Principle until the day of issuance of Building Permit can be expected to take at least seven years. Only a proceeding for issuance of the Construction Licence takes at least two years, but it must be preceded by preparatory of the Preliminary Safety Analysis Report, which shall be based on environmental and site evaluation (additional 2-3 years). Such time shall be extended by the time of delays which, having in mind number of entities and people engaged in the whole process, number of very complex matter subject matter of this proceedings, plenty of interactions of all stakeholders, etc.

Moreover, abovementioned period does not cover time necessary for business decisions, analyses, surveys, negotiations of contracts with vendors, contractors, financial institutions and other business related issues, which are inevitable steps on the path to deploy the nuclear power plant.

What is of critical importance to any potential fleet deployments of ANT or SMR plants, the entire process is site-specific. While it may be expected that licencing of follow-up plants based on the identical reactor design will proceed smoother, taking into account lessons learned from previous deployments, in formal terms each next licencing process is entirely separate and all the documents have to be evaluated again by the regulator.

All these circumstances create significant roadblock to quickly deploy a SMR or ANT based nuclear power plant. If the preparatory phase, which must be finished before the construction of the facility, takes at least seven years, there are no available remedy steps which may mitigate all delays at the later stage.

**Does legal barriers may be eliminated by the change of Polish law?**

One of the ideas, presented in a public domain, how to eliminate such legal barriers in development of SMR and ANT projects is a change of Polish law. According to the several proposes, Polish atomic law and act on developing and carrying out investment projects concerning nuclear power facilities and associated investment projects, should be amended to significantly reduce the requirements for technologies classified as SMR or ANT. Arguments which are often raised for such amendment are:

- SMR and ANT facilities are much smaller than large nuclear power plants, so it seems reasonable not to pose such rigid requirements as for bigger units;

- Proposed solutions, especially ANT, are new generation of nuclear technology, which are much safer than older units, so not all requirements shall be binding for these facilities.

At the same time, no specific proposal of amendment of Atomic law and act on developing and carrying out investment projects concerning nuclear power facilities and associated investment projects were observed in the public domain in manner of safety related issues or licensing process. What we can observe are generic statements on the highest safety standards of the proposed solutions and much shorter time of construction due to the size differences.

The main question that may arise is whether such ideas can be implemented in Polish law. The answer is not simple, and depends on a number of factors.

Firstly, the safety issues of nuclear facilities are a priority and any changes to them must not undermine confidence in the proposed solutions. If proposals to amend the law were to involve interference in this sphere, it is necessary to analyse them in detail to ensure that the highest safety standards are maintained and that changes do not create a public perception of deteriorating safety requirements. Moreover, given the complexity of the issue and the peculiar complexity of nuclear safety solutions, the proposed changes may address specific issues rather than changing entire procedures. In turn, it can be assumed with a high degree of probability that such changes will not translate into a significant reduction in the duration of official procedures, and may even be marginal.

Secondly, the changes may cover issues not strictly related to nuclear safety, but concerning construction aspects. Some work can be seen in this area related, for example, to the introduction of new institutions, such as a permit for early construction works, previously unknown to the Polish legal system[3]. Initiatives of this type can, in principle, be applied in our legal order and indeed optimise the time of the entire project. However, they do not in any way affect the acceleration of licensing processes. These have to be preceded by physical work on the construction site, and their conduct before the conclusion of the licensing procedures is de facto undertaken at the investor's risk.

Thirdly, a theoretical solution could be to consider the creation of completely new procedures and requirements (which has also appeared in media messages), in which more issues could be carried out in parallel, giving real improvements in time. However, such a concept seems to be

[3] The Polish legal framework does include a “Preliminary works permit”, but it only enables very limited site preparation – removal of trees, grading, construction yard deployment. No civil works related to actual structures of the final plant may be performed before the final Building Permit though.

a phantasmagoria - it would require a significant amount of time to create them, would result in the nullification of existing efforts for other projects, and, moreover, their implementation and the time required for all stakeholders to adjust would be so significant that the potential benefits (if any) would not compensate for the difficulties involved.

**Does legal barriers may be eliminated at the international level?**

When change of Polish law does not seem to be the proper solution how to speed up licencing process, some solutions at supranational level to facilitate the licensing process seem desirable. There are examples from other economic sectors that show that international facilitation measures for the certification of technological solutions can bring significant benefits. There are also examples to the contrary: the lack of such facilitation can result in significant business impediments for service providers and benefits for users.

**How was it resolved in aviation and railway sectors?**

One sector, where similar problems have been resolved, is the civilian aviation. This is one of the industries, where standardised technical products – the airliners – are sold internationally, built in hundreds of examples to identical specifications (at least from safety-related engineering perspective). This has been mostly achieved thanks to internationalisation of the safety approval processes – introduction of single type certificates, additionally mutually recognised between a pan-European certificate and US certificate. This enabled creation of massive fleets of certain types of aircraft, and built basis for an industry, where hundreds of airframes are contracted by customers from all over the world before the first prototype is flown – or in fact before its construction is even approved. Except for greatly facilitating the engineering process and reducing product development costs associated to potential re-engineering for specific national codes and standards, separate certification, and later after-sales support of multiple versions, this situation also leads to improved operational safety, easier implementation of lessons learned, and – not insignificantly – much better flexibility to operators, who benefit from global maintenance organisations, but also pools of type-trained aircrew who can work in different countries without lengthy and expensive conversion training.

On the other hand, another mode of transportation – the railways – clearly demonstrates difficulties of providing standardised products and services in the market, where such internationalised approach is not adopted. Despite all the efforts to promote rail transport as

environmentally friendly (especially when compared to air travel), currently still every EU Member State has its own rail vehicle design approval criteria and lengthy certification processes. Besides, there are still national-specific and mostly incompatible safety systems, and also various and incompatible electrification systems. Because of this, most locomotives or multiple units currently used, can still only be operated in a single country. There is an increasing number of multi-system locomotives or electric/diesel multiple units in operation, but in most cases they are only adapted for two or three systems, with very few cases of four-system compatible trains. There is no single locomotive which could be legally operated in all mainland EU Member States. Therefore, even though railway vehicle suppliers are following the general trend to standardise their products internationally, it is still necessary to design country-specific (or operator-specific) versions of vehicles belonging to the same general design family, and then have them certified in all countries in which they are to be used separately.

In case of railway, this is partially compensated by large sizes of orders coming from single countries or single customers, where despite the need to design multiple versions, each version may be sold in dozens or hundreds of examples. Nuclear industry however cannot hope to cope with the issue in such a way, as no single investor is going to buy dozens of reactors of a new type, due to the very nature of the product and its cost.

**What may be done?**

As we can see, a path practiced in aviation sector may bring nuclear energy sector a good example how to resolve problems connected with separate systems of technology certification. Therefore, practically the solution that could allow a significant acceleration of investments seems to be the introduction of advanced standardisation of technology devices and certification procedures, and, in addition, striving to introduce an international certification system for nuclear technologies to the greatest possible extent.

Of course, this kind of ‘mutual recognition’ must raise a number of questions of a substantive and formal nature, such as those related to: scope of competences of regulators in particular countries; adaptation of standardised solutions in all countries, regardless of their specific conditions; influence of political conditions on decisions of international bodies, as well as a number of other issues. On the other hand, the introduction of mechanisms whereby all or a significant part of the technological solutions are subject to a single, internationally agreed

procedure, without the need to duplicate it for each individual project in front of national regulators, will have a significant impact on the timing of individual investments, as well as the costs involved. This, in turn, will result in a decrease in the differences for nuclear power projects compared to conventional power projects – currently, it is the duration of the licensing procedures that is the main difference between these types of energy in terms of implementation time. At the same time, national risks can be mitigated by, for example, staging the various certification phases and allowing regulators to make a sovereign assessment of specific scopes.

The benefits of a form of 'mutual recognition' of certification should encourage their implementation and use.

**Who can do that?**

The entity which may have proper abilities and power in Europe seems to be the European Commission within European Atomic Energy Community (EURATOM). According to the EURATOM Treaty, a EURATOM was established to contribute to the raising of the standard of living in the Member States and to the development of relations with the other countries by creating the conditions necessary for the speedy establishment and growth of nuclear industries. In order to perform its task, EURATOM shall, in particular: (a) promote research and ensure the dissemination of technical information; (b) establish uniform safety standards to protect the health of workers and of the general public and ensure that they are applied; (c) facilitate investment and ensure, particularly by encouraging ventures on the part of under takings, the establishment of the basic installations necessary for the development of nuclear energy in the Community; (g) ensure wide commercial outlets and access to the best technical facilities by the creation of a common market in specialised materials and equipment, by the free movement of capital for investment in the field of nuclear energy and by freedom of employment for specialists within the Community; (h) establish with other countries and international organisations such relations as will foster progress in the peaceful uses of nuclear energy.

As it was agreed in the EURATOM Treaty, one of the main tasks of the European Commission is to facilitate investments in nuclear energy, promote this type of energy and establish uniform safety standards, however in a very narrow scope. However, the European Commission's powers and capabilities in these areas are modest and mostly limited to managing information and taking a position on planned projects. The power to set standards is minimal. In practice,

the Commission has almost illusory powers and tools that could make a real difference in improving projects.

As a consequence, one of the few initiatives, which is clearly visible, is the SMR Industrial Alliance, announced by the European Commission at the beginning of 2024. The general objective of the European Industrial Alliance on SMRs is to facilitate and accelerate the development, demonstration, and deployment of the first SMRs projects in Europe in the early 2030s, by assisting emerging SMRs projects to reach the demonstration and deployment phase. Specific objectives creates an area for collaboration of several SMRs' stakeholders in improvement of their projects. Such an initiative, creating a platform for the exchange of knowledge and experience for those interested in the development of the SMR industry, is necessary and certainly influences the development of their cooperation and can affect the development of many ideas and concepts in this area.

At the same time, the European Commission, within the framework of EURATOM, is not pursuing initiatives to effectively speed up projects, simplify procedures, etc. Despite the existence of a strong need for this, as can be seen from the existing status of SMR projects (none of which in Europe has yet gone beyond an early stage of the applicable licensing process), and at the same time bearing in mind the need to develop stable energy sources in the context of a major problem in the fuel market for conventional energy sources, such initiatives are not being taken. An obstacle is, of course, the provisions of the EURATOM treaty, among others, which are not in line with current realities and needs. However, efforts to change them are unseen. This situation should unfortunately be viewed with some disappointment.

**Results**

Summarising the considerations raised in this paper, a number of interesting conclusions can be reached.

The global situation where, on the one hand, the fossil fuels supplying conventional power plants (coal, gas), which are essential for the stability of the power systems' foundations, are expensive and the possibility of providing them is uncertain, and, on the other hand, it is necessary to provide energy from low-carbon sources, should naturally promote nuclear energy.

At the same time, nuclear power projects face the problem of long lead times. One of the key issues affecting this is the period needed to certify the technological solutions adopted. Due to the stringent safety regulations for nuclear technology, the lack of experience in designing and

building small nuclear and ANT reactors, as well as the need to conduct certification procedures separately for each project, the preparation and implementation time for such a project is longer than for other power plants, including conventional ones.

In these circumstances, it seems reasonable to strive for a situation in which nuclear technology designs are highly standardised, and certification procedures, at least in the major part, are moved to the common highly specialised authorities within the European Union. A natural basis for this would appear to be the development of EURATOM's competences and the creation within it of an organisational structure capable of carrying out such activities.

In order to do so, it is first necessary to adequately amend the EURATOM Treaty. Substantive and in-depth consultations and discussions within the European Union, including consultations with regulatory authorities, as well as nuclear experts from individual Member States, including vendors and consultants and consultancy firms, are necessary for this.

Such changes, introducing regulations for the mutual recognition of nuclear technologies, would provide the basis for clear, uniform certification processes at EU level, without the need to duplicate the same activities in front of individual regulators. At the same time, these regulations should ensure that individual regulators can influence the solutions to be adopted in terms of site-specific and ambient conditions of the planned process. Such a solution, which on the one hand offers the possibility of speeding up and streamlining the work of nuclear projects, and on the other hand ensures that local regulators have adequate scope of authority, seems to be a desirable solution to be opted for.

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