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Harmonising Nuclear Safety Regulation in the EU: Which Priority?

Nuclear power presents the risk of severe accidents which can potentially lead to very high costs to society and the environment. In that respect, the Fukushima accident has reminded us that a nuclear catastrophe can even occur in a country with an advanced nuclear industry and has led to renewed scrutiny of nuclear safety regulation in Europe. The European Union, with its 143 nuclear power plants (NPPs), is one of the most nuclearised regions in the world, with about one-third of the world's nuclear capacity. In addition, European NPPs are spread over a large number of countries in a relatively small geographical area. As a consequence, transborder damage from severe nuclear accidents is potentially a major issue for the EU.

The 1957 Euratom Treaty and European Court of Justice (ECJ) case law[1] recognise the EU competency for liability rules and nuclear safety standards, respectively. Despite this legal basis for EU intervention in these two policy areas and the fact that the Euratom Treaty is often described as one of the "three pillars" of the EU, the current framework can be pictured as a patchwork of national laws with limited efforts to harmonise nuclear safety standards and no legislative action in the field of nuclear liability rules.

In this paper, we propose to summarise the current legal and institutional frameworks regulating nuclear safety standards and liability rules in the EU and explore their economic consequences.

The Economics of Nuclear Safety in a Nutshell

Nuclear safety is characterised both by ex ante (i.e. standards) and ex post (i.e. liability) regulation. Nuclear safety standards are based on the concept of "defence in depth", which encompasses the actions and systems in place to prevent the risks of a nuclear core failure and the release of nuclear materials in the atmosphere and water. While some risk classes – such as terrorist attacks – are difficult to be conceived of in a probabilistic framework and follow a deterministic approach, nuclear safety standards result from probabilistic risk assessments of nuclear core damage. They are set regardless of the expected cost of a nuclear accident. By contrast, liability rules apply ex post. They govern the allocation of financial responsibilities in the case of a nuclear accident and the compensation to victims. They can also require the operator to have liability insurance available up to a specific amount. In that case, liability insurance will vary depending on the expected damage that an NPP can cause.

From an economic point of view, the socially optimal level of care occurs when the marginal cost of care (i.e. the safety efforts and investments made by the operator) equals the marginal benefit (i.e. the marginal reduction in the expected cost of a nuclear accident). The economic literature[2] recognises that the combination of these two instruments can be necessary to achieve an efficient level of safety. On the one hand, when the cost of a nuclear accident differs among NPPs, the safety standard is inefficient because it does not take into account the heterogeneity in nuclear damage; unlimited liability is then superior to internalise the expected cost of a nuclear accident. On the other hand, unlimited liability is ineffective when the expected cost of damages exceeds the operator assets and standards are therefore necessary to enforce the efficient level of care. In practice, priority is given to ex ante regulation as the cost of a severe nuclear accident will both far exceed the assets of any nuclear operator and is difficult to estimate by insurers.[3]

The right balance between national and supranational nuclear standards must also be found. As seen in Chernobyl and Fukushima, most nuclear damage occurs at the local level and impacts the local population, i.e. the inhabitants in a 20-50 km radius. The local population also gets a share of the benefits through employment and taxes. It is therefore economically recommended that nuclear safety regulation take into account the way local inhabitants balance the expected costs and benefits of a nuclear power plant and its safety improvements. Within the EU, these preferences are very heterogeneous. The variation of local risk aversion across the EU is illustrated by opinion polls. According to Eurobarometer, on average 37% of the EU public are in fa-

1 European Court of Justice: Judgment of the Court of 10 December 2002 – Commission of the European Communities v Council of the European Union, Case C-29/99, European Court Reports, 2002.

2 S. Shavel: A model of the optimal use of liability and safety regulation, in: RAND Journal of Economics, Vol. 15, No. 2, 1992, pp. 271-280; M. Trebilock, R. Winter: The economics of nuclear accident law, in: International Review of Law and Economics, Vol. 17, 1997, pp. 215-243.

3 This is because of the complex nature of nuclear radiation's impacts on the environment and human health and because of the (fortunately) too limited historical number of severe accidents on which actuarial calculus can be based.

vour of nuclear energy, but support runs as high as 68% in Hungary and as low as 8% in Austria.[4]

However, significant damage can also affect distant zones owing to the dispersion of radioactive elements by aerial and water currents. Similarly, some of the benefits of nuclear power generation are enjoyed at a large distance from the power plant. To cope with these long-distance external effects[5], the preferences of people living outside the local zones of NPPs also have to be taken into account by nuclear safety regulation.

To simplify the discussion for the EU, the local vs. global dichotomy for the external effects could be assimilated to a national vs. European distinction. The majority of EU member states are small countries, and many NPPs are located close to national borders. For instance, trans-border damages are potentially an important issue for the EU as about 25% of the 143 NPPs are located within a 30 km radius of another member state (and 40% are within a 100 km radius).

To sum up, from an economic perspective there is no reason to impose a "one size fits all" level of nuclear safety. Because of local preferences, especially regarding risks, it is economically rational for identical power plants in two different areas to be regulated differently (e.g. shutting one down completely and extending the life of the other conditioned on safety improvements). To put it another way, it is not irrational that in Europe a less safe NPP could have its life extended whereas a safer one is shut down. Conversely, due to potential trans-border damage, it must be possible to shut down an NPP even if the local population would rather not close it. Neither the national nor the supranational level can unilaterally impose its safety decision upon the other. A mix between national and international standards is required, even within the EU.

What is the right mix between ex ante and ex post regulation and between state and EU-level regulation? Our aim is not to provide a definite normative answer to these difficult questions. We only seek to provide some factual and analytical elements to facilitate the discussion.

4 House of Lords European Committee: 37th Report, 2006, http://www.publications.parliament.uk/pa/ld200506/ldselect/ldeucom/211/21105.htm#a12. Moreover, a more recent Eurobarometer poll (March 2011) indicates that on average 41% of EU27 citizens agree with the proposition that "the benefits of nuclear as an energy source outweigh its risks". This figure is 59% in the Czech Republic and 11% in Cyprus. See: http://ec.europa.eu/energy/nuclear/safety/doc/2010_eurobarometer_safety.pdf.

5 Note that the image and the future of the nuclear power generation industry as a whole are affected by any single catastrophe. Safety standards set by collective organisations such as Institute of Nuclear Power Operations in the USA or the World Association of Nuclear Operators attempt to mitigate this negative long-distance external economic effect of severe nuclear accidents.

Nuclear Safety Standards in the EU

Traditionally, member states have been divided on the issue of common nuclear safety standards, which have been left in the hands of national safety authorities. At the same time, the 2002 ECJ case law 29/99 recognises that the Commission shares competences with member states in the field of nuclear safety, and with the perspective gained via the inclusion of nuclearised states from Eastern Europe in the EU enlargement, the European Commission has initiated a series of proposals to harmonise nuclear safety rules in Europe since the 2002 nuclear package. This complex and heavily debated process eventually led to the 2009/71/Euratom directive (hereafter the 2009 directive) "establishing a Community framework for the nuclear safety of nuclear installations".

Beyond the political opposition surrounding the negotiation of this directive, the European Nuclear Safety Regulators Group[6] (ENSREG) has analysed the pros and cons of establishing detailed and binding nuclear safety standards at the EU level. The ENSREG is an expert body set up to advise the Commission on nuclear safety issues and is composed of the heads of national safety authorities from the 27 EU member states. As ENSREG argues, European common nuclear safety standards would strengthen the independence of national regulators, provide the possibility for the EU to take the international lead on nuclear safety, improve dialogue with the industry at the EU level and make communication about safety more transparent. Conversely, because of differences in safety cultures and approaches, agreeing on common rules would be costly in terms of time and resources, would create problems of transposition and interpretation into national laws, would monopolise the resources of national regulators and could lead to decisions based on the least common denominator with respect to safety standards for existing reactors.

More generally, the political divisions between the proponents and opponents of nuclear power make it likely that the former may perceive EU intervention in the field of nuclear safety as a threat of legal proceedings in front of the ECJ by member states opposed to nuclear power.

While the 2009 directive must still be transposed into national laws[7], legal scholars argue that this one is substantially

6 ENSREG: Discussion document on consequences of EU instruments in the field of nuclear safety, final report, 31 March 2009, http://circa.europa.eu/Public/irc/tren/nuclear_safety_and_waste/library?l=/general_archive/public/p2009-08_instrumentspdf_2/_EN_1.0_&a=d.

7 Member states have until June 2011 to transpose directive 2009/71/Euratom into national laws.

watered down compared to the initial proposals.[8] The initial proposals created legally binding nuclear safety standards with monitoring mechanisms through the creation of an EU regulatory committee chaired by the Commission. The current directive is essentially devoted to the requirement that member states have national frameworks for nuclear safety with independent safety authorities and that they report to the Commission through a peer-review process as well as transparency platforms. In that respect, the 2009 directive is partly based on the International Atomic Energy Agency's (IAEA) "Fundamental Safety Principals" and makes these voluntary standards binding for EU member states. Moreover, the importance given to the independence of nuclear safety authorities can be considered a significant provision of the directive[9], as nuclear safety authorities face inherent risks of government pressure to ease or trigger nuclear safety standards. On the other hand, no clear definition of EU nuclear safety standards was made; this task falls to ENSREG in accordance with the mandate given to it by the Commission.[10]

In parallel to ENSREG and the EU framework, the Western European Nuclear Regulators' Association (WENRA) acts as a discussion forum to develop a common approach to nuclear safety in Europe. WENRA is a network of 17 European nuclear regulators and was created in 1999 to assess nuclear safety standards in accession countries to the EU. The WENRA members are essentially the same as those of ENSREG. However, membership is not bound to the EU borders and only includes countries with nuclear reactors. While WENRA does not have a formal mandate within the EU, it has contributed to the improvement of nuclear safety in Europe in two different areas:

- Firstly, WENRA expertise was used to provide an independent assessment of the national frameworks for nuclear safety in Eastern European accession countries. Based on its recommendations, the closure of eight NPPs in three countries was made a necessary condition for them to join the EU.[11]

- Secondly, following the Fukushima accident, WENRA expertise has also been requested by the Council to develop a common stress test of the safety margins and emergency preparedness of European NPPs in light of the events that led to the Fukushima accident.

These two WENRA contributions to a common approach for nuclear safety highlight the fact that national regulators can cooperate on a voluntary basis to promote nuclear safety standards in Europe beyond the provisions of the 2009 directive. In that respect, this framework reflects a balance between the national and supranational dimensions of nuclear safety as mentioned in the first section. Moreover, it can be argued that WENRA may be more efficient than ENSREG in making decisions to further enhance nuclear safety; at the time of writing this paper, the recent failure of ENSREG to agree on the WENRA proposal for EU stress tests shows that the political divisions between proponents and opponents of nuclear energy within the EU can hinder the efforts to agree on nuclear safety standards in Europe[12] and that achieving more harmonisation of nuclear safety standards through the EU institutions – beyond the provisions of the 2009 directive – would be a difficult task.

Liability Rules in the EU

Unlike ex ante nuclear safety regulation, the European institutions have not intervened in the field of nuclear liability rules[13], which are regulated by international conventions and national laws. First and foremost, it should be noted that the Euratom Treaty clearly states that nuclear risks should be covered by insurance contracts by member states and that both the Council and the Commission should issue directives in this field[14] and take action if a member state fails to cover these risks.[15] Despite this clear provision in the Euratom Treaty, the EU has never issued a directive or a regulation in this field; even a directive it issued for liabilities from environmental damage excluded nuclear damage from its scope.[16]

8 A. Stanič: EU Law on Nuclear Safety, in: Journal of Energy and Natural Resources Law, Vol. 28, No.1, 2010, pp. 145-158; M. Sousa Ferro: Directive 2009/71/Euratom: the losing battle against discrimination and protection of sovereignty, in: International Journal of Nuclear Law, Vol. 2, No. 4, 2009, pp. 295-312.

9 For instance, the French nuclear safety authority (ASN) only became fully independent from the government in 2007.

10 Decision 2007/530/Euratom on "establishing the European High Level Group on Nuclear Safety and Waste Management".

11 Namely, NPPs in Lithuania, Bulgaria and Slovakia: Bohunice 1 and 2, Kozloduy 1 to 4 and Ignalina 1 and 2.

12 Euractiv: EU countries divided over nuclear stress tests, 13 May 2011. While the WENRA stress test proposal only included risks from environmental disasters, Commissioner Oettinger and member states such as Austria want to include terrorist attacks, plane crashes and human error risks. See: http://www.euractiv.com/en/energy/eu-countries-divided-nuclear-stress-tests-news-504812.

13 With the exception of two recommendations by the Commission during the 1960s (65/42/Euratom and 66/22/Euratom) and communication COM(2006) 844 final.

14 Euratom Treaty, Article 98: "Member States shall take all measures necessary to facilitate the conclusion of insurance contracts covering nuclear risks. The Council, acting by a qualified majority on a proposal from the Commission, which shall […] issue directives for the application of this Article."

15 Euratom Treaty, Article 203: "If action by the Community should prove necessary to attain one of the objectives of the Community […], the Council shall, acting unanimously on a proposal from the Commission and after consulting the European Parliament, take the appropriate measures.

16 Directive 2004/35/EC on environmental liability with regard to the prevention and remedying of environmental damage.

Table 1
Overview of the International Regimes for Nuclear Liabilities

International Regimes		Member States	
Paris regime (NEA)	Paris (1960) and Brussels (1963)[a]	Belgium, Denmark, Finland, France, the Netherlands, Germany, Sweden, Italy, the UK, Spain, Slovenia	
		Ratified Joint Protocol (1988)	Denmark, Finland, the Netherlands, Germany, Sweden, Italy, the UK, Spain, Slovenia
		Signed Joint Protocol (1988)	Belgium, France, the UK
	Paris (1960)[a] only	Portugal, Greece	
	Paris (2004)[b]	none	
Vienna regime (IAEA)	Vienna (1963)[a]	Bulgaria, Czech Republic, Estonia, Lithuania, Hungary, Poland, Slovakia, Latvia, Romania	
		Joint Protocol (1988)	All
	Vienna (1997)[b]	*Signed* Vienna (1997)	Czech Republic, Lithuania, Hungary, Poland
		Ratified Vienna (1997)	Latvia, Romania
Convention on Supplementary Compensation for Nuclear Damages (1997)		*Signed*	Lithuania, Czech Republic
		Ratified	Romania
Nothing		Austria, Luxembourg, Ireland, Cyprus, Malta	

[a] First generation; [b] Second generation.

Source: J. Handrlica: Euratom powers in the field of nuclear liability revisited, in: International Journal of Nuclear Law, Vol. 3, No. 1, 2010, pp. 1-18.

Table 2
Nuclear Liability Amounts Available Through the International Regimes
(€ million)

Convention	Who pays?	First generation	Second generation
Paris Convention	Nuclear operator	5.9	700
Brussels Supplementary Convention	Installation State	202.13	500
	Collective State Fund	148.62	300
Total Paris regime		356.7	1,500
Vienna Convention	Nuclear operator	4.2*	178.35
	Collective State Fund		178.35
Total Vienna Convention		4.2*	356.7
Convention of Supplementary Compensation	Operator/Installation State		356.7
	Collective State Fund		356.7
Total CSC			713.4

* (USD 1963 value).

Source: T.V. Borre: Shifts in Governance in Compensation for Nuclear Damage, 20 Years after Chernobyl, in: M. Faure, A. Verheij (eds.): Shifts in Compensation for Environmental Damage, Springer, Vienna 2007, pp. 261-311.

International nuclear law can be characterised by its division between two regimes – the Vienna and the Paris Conventions – which were themselves completed via distinct supplementary conventions but which are also linked through a joint convention which allows mutual recognition of the two regimes. The Paris regime takes place within the OECD Nuclear Energy Agency (NEA) while the Vienna regime takes place within the IAEA. Both regimes have specific rules with respect to liability amounts, definitions of nuclear damage – such as environmental damage – and periods for claims. The latest conventions of the Paris and Vienna regimes can be best described as three-tier systems of strict but limited liabilities: the first tier falls on the operator, the second tier on the installation state and the third tier comes from collective state funds. On top of these two international regimes, the 1997 Convention on Supplementary Compensation for nuclear damage (CSC) allows extra compensation of up to €713 million and more legal certainty. However, Romania is the only EU member state to have ratified this convention. Tables 1 and 2 present the general liability rules and the minimum liability amounts associated with them respectively.

As Table 1 shows, member states differ in terms of the international nuclear law regimes they belong to and in terms of the conventions they have signed or ratified. Generally speaking, we observe that the old member states are part of the NEA regime while new member states from Eastern Europe are, with the exception of Slovenia, part of the IAEA regime. The 1988 joint protocol between the two regimes allows for mutual recognition, but some member states – Belgium, France and the UK – have not ratified this protocol. As Table 2 shows, both generations of the Paris regime foresee higher minimum liability amounts than the Vienna regime. However, only few states are part of the second generation of international liability regimes. For instance, no member states have ratified the 2004 Paris Convention – which amends the 1960 Paris Convention and the 1963 Brussels Supplementary Convention – and increases the total compensation available from €356 million to €1500 million.

The differences in terms of liability rules arising from the two international regimes are also reinforced by specific national legislation which can be set above the minimum liability amounts of the international regimes. Figure 1 provides an

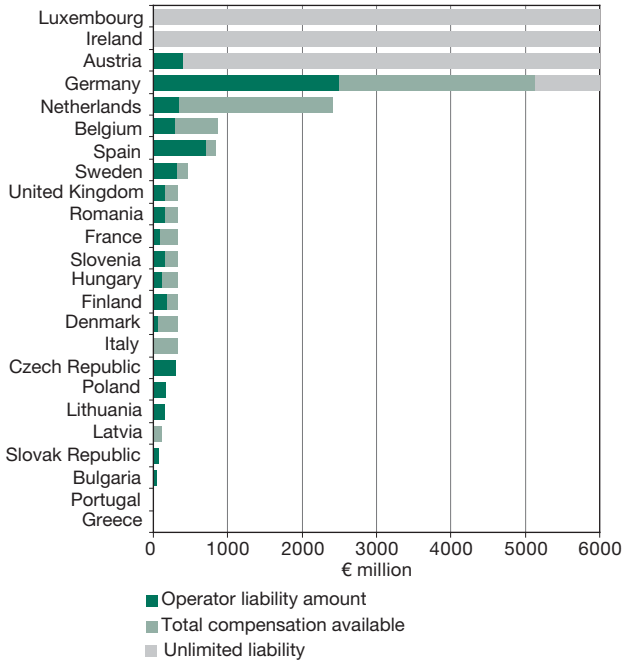
overview of the operator maximum liability amounts as well as the total compensation available from the installation state or international arrangements in EU member states.[17]

As Figure 1 shows, nuclear operator financial securities for nuclear liabilities and the total compensation available vary extensively among member states. Operator liabilities range from €5.4 million in Italy to €2500 million in Germany, and total compensation available ranges from €16.3 million in Greece and Portugal to €5130 million in Germany. Only Germany, Austria, Ireland and Luxembourg have introduced the rule of unlimited liability in their national legislations. Moreover, operator liabilities amount on average to 59% of the total compensation available, with the remainder being shared between the installation state (17%) and international arrangements (24%).

In that respect, EU citizens would not be entitled to the same level of compensation depending on the installation state where the nuclear accident takes place. Moreover, this discrimination is further strengthened by differences in terms of the legal definition given to nuclear damage and claim periods as well as in priority rules for victim compensation.[18] Such discrepancies create clear equality problems which are reinforced by the importance of the trans-border consequences of nuclear accidents.

Are these limits to nuclear liabilities high enough to internalise the risks of nuclear damage? Severe damage in the case of a core meltdown can amount to several dozens of billions of euros in liabilities. At the time of the writing of this paper, investment bank estimates of the damages resulting from the Fukushima accident range from $25 billion to $130 billion.[19] Similarly, while no complete study exists about the costs of the Chernobyl nuclear accident, estimates for the Belarusian economy alone amount to €235 billion.[20] These figures far exceed the national liability systems. The highest level of compensation available in Europe (i.e. in Germany) amounts to €5.1 billion. EU nuclear liability amounts are also low compared to the estimated cost of nuclear accidents based on probabilistic risk assessments. For instance, estimates by

Figure 1
Liability Amounts Available in EU Member States



the EU-financed ExternE project[21] of the expected external cost of a severe nuclear accident range from €431 million to €83 billion. Other estimates[22] give a range of €10-€100 billion.

Hence, by several orders of magnitude, nuclear liability limits in the EU are below the cost of a severe nuclear accident. Economically speaking, this risk is far from fully internalised. Taxpayers will be the main contributors of funds to compensate victims rather than the shareholders of power companies or electricity consumers. The risk is implicitly carried by the state.

In short, nuclear liability rules are set at low levels compared to the expected cost of severe nuclear damage. This leads to important equality problems, as a victim's compensation will depend upon where the nuclear accident happens. Simultaneously, low liability levels might also breach EU economic principles, as they can be viewed as indirect subsidies. One proposal made by economists to solve these two problems

17 OECD: Nuclear operator liability amounts & financial security limits as of December 2009, http://www.oecd-nea.org/law/2009%20table%20liability-coverage-limits.pdf.

18 OECD: Priority rules on compensation for nuclear damage in national legislation as of December 2009. For instance, in Spain personal injury will receive priority over property damage, http://www.oecd-nea.org/law/TABLE%20-%20Priority%20rules%2015%2012%2009.pdf.

19 POWERnews: No Limits for TEPCO's Liability in Fukushima Crisis, Japan Says, 4 May 2011, http://www.powermag.com/print/POWERnews/No-Limits-for-TEPCOs-Liability-in-Fukushima-Crisis-Japan-Says_3686.html.

20 IAEA: Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts, 2005, http://www.iaea.org/Publications/Booklets/Chernobyl/chernobyl.pdf.

21 C. Schieber, T. Schneider: Valorisation monétaire des impacts sanitaires et environnementaux d'un accident nucléaire : synthèse des études ExternE, intérêts et limites de développements complémentaires, in: Rapport No. 275, CEPN, Paris, 2002, http://www.cepn.asso.fr/IMG/pdf/R275.pdf.

22 M.G. Faure, K. Fiore: An economic analysis of the nuclear liability subsidy, in: Pace Environmental Law Review, Vol. 26, No. 2, 2009, pp. 419-427.

is to create an EU pool of nuclear liability[23], which would increase the coverage of nuclear damage and, through the mutualisation of risks, reduce the cost of liability insurance. This system has already been implemented at the state level in Germany and in the United States, where it allows higher levels of compensation. Similarly, it has also been proposed to create an EU nuclear accident pool which reverses the channelling of responsibilities by making member states strictly liable[24] via a risk-sharing mechanism based on expected damage and offers the possibility for the state to delegate some responsibility to the operator. In any case, solutions to remedy the problems raised by the current liability system in the EU are required and economists and legal scholars have to be imaginative.

23 M.G. Faure, K. Fiore: The coverage of the nuclear risk in Europe: Which alternative?, in: The Geneva Papers in Risk and Insurance, Vol. 33, 2008, pp. 288-322.

24 G. Skogh: A European nuclear accident pool, in: The Geneva Papers in Risk and Insurance, Vol. 33, 2008, pp. 274-287.

Conclusion

Through several initiatives, EU institutions have devoted important political efforts to the harmonisation of nuclear safety standards in Europe. Thanks to these efforts, the Commission issued the 2009 directive and established ENSREG. These actions were made in parallel to the creation of the WENRA network which, through a voluntary association of nuclear regulators, has made several proposals to harmonise nuclear safety standards. Following the Fukushima accident, the political difficulty in trying to find agreement on EU stress tests show that political divisions among member states and with the Commission will make further EU binding harmonisation of safety standards difficult. Conversely, liability rules have received little attention despite the clear provisions set by the Euratom Treaty and the failure of member states to set liability rules at a level commensurable to the expected costs of nuclear damage. In that respect, it is urgent for the Commission to reallocate part of its resources and efforts from the harmonisation of nuclear safety standards to the harmonisation of liability rules.