# THE CHANNELING OF LIABILITY AND SMALL MODULAR REACTORS: IS IT AT ALL ADEQUATE?

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**Abstract**

**The principle of channeling liability serves as a cornerstone of the regime for nuclear damage liability.** Conventions offer limited exceptions for operators to escape liability. However, despite leveraging established technologies, SMRs present a unique scenario with the first-of-a-kind (FOAK) commercial deployment. The question arises as to whether the aforementioned circumstances warrant an augmented scope of liability for the supplier.

**Hypothetically assuming an affirmative response,** crucial questions arise regarding the implementation of such enhanced liability: Should the channeling principle be abandoned in favour of joint and several liability? Alternatively, could existing recourse mechanisms be expanded, allowing operators to seek compensation beyond contractual agreements, for instance, by proving supplier negligence as a causal factor in an accident? The current regulatory landscape in the scope of the right to recourse may create negotiation impasses, potentially favouring the supplier’s position and hindering the development of SMRs and their role in decarbonization. The outcome may also differ: if the technology supplier is held liable, even on a recourse basis. This could significantly increase investment costs and render SMRs an uncompetitive market solution.

**The issue is inextricably linked to liability limits.** Current liability limits vary across Conventions and national legislation. Additionally, Conventions offer different possibilities for reducing liability limits based on installation characteristics. While SMRs can currently be classified as low-risk installations, it is essential to consider harmonizing regulations across Conventions to acknowledge this distinction and potentially adjust permissible liability limits in conjunction with compatible channeling solutions.

**It is important to try to find an answer to this debate.** This requires legal and economic analyses of the potential costs for stakeholders. Any changes must be introduced with respect to the legitimate interest of potential victims. The impact on the process of technology development and clean energy transition must also be a determining factor.

## Introduction

The principle of channeling liability is a structural principle of liability for nuclear damage. Under the existing Conventions[[1]](#footnote-2), a few exceptions allow the operator to be released from liability in favour of the entity actually liable under the general rules of tort liability. After many years of its application, the rule of channeling is also questioned in contemporary literature as an archaism that is no longer justified in view of the significant development of nuclear technology and the associated changes in the nuclear industry [1]. If SMRs are to be deployed for commercial use, it is necessary to verify whether the legal framework developed over decades for the nuclear sector is compatible with the innovation that SMRs represent, and what actions need to be taken to allow projects to develop and to eliminate the state of legal uncertainty. In the case of SMRs, which will be used commercially for the first time in this form, for several reasons, it can also be asked whether it is not the technology suppliers (in general, entities involved in the implementation process) who should have a greater scope of liability for possible nuclear damage. The question raised may be provocative, but the analysis presented in this paper leads to much less provocative conclusions.

A few words about the characteristics of SMRs and why the channeling principle may not be adequate. Within the category defined as SMRs, there are significant differences between projects. A very large number of projects are currently being developed - the Nuclear Energy Agency, in its report entitled “The NEA Small Modular Reactors Dashboard: Second Edition” analyzes 56 projects and identifies a total of 98 projects [2]. Certainly, not all projects can reach the commercial use stage. However, this is still an unprecedented situation in the nuclear industry. On the one hand, the number of projects shows how difficult it is to update legal frameworks uniformly for reactors that differ significantly from each other in this group. On the other hand, it is also not possible for operators to be well-informed clients and have sufficient knowledge about each project. All the knowledge about solutions that cannot be seen in practice at this stage remains with the technology suppliers. Some SMRs are very close to the well-known reactors known so far, as well as those that pose completely new challenges in terms of civil liability principles for nuclear damage, such as SMRs that assume fuel loading by the supplier at the factory and transport of entire modules to the site. This raises many detailed questions about the application of existing Conventions, the scope of the operator definition, the definition of nuclear installation, and the geographical scope. It is also possible to distinguish some common features of all projects:

1. innovative and first-of-a-kind nature; there are no commercial SMRs in countries covered by the regime of any Convention. In addition, SMRs are to be built in countries that have no experience in the use of nuclear energy on a broader scale in traditional power plants, e.g., Poland, which means that they do not have highly specialized and experienced personnel and technology transfer will also have to include extensive know-how in the field of operation;
2. modular manufacturing and factory production, in some cases fuel already loaded in factor, which really means a huge impact of suppliers on the implementation with limited influence of the operator;
3. installed capacity up to 300 Mwe per module makes them an attractive option for energy-intensive industries. Still, it also introduces new investment model challenges;
4. various applications, not only for electricity generation but also for heat or hydrogen production;
5. a high level of advancement of the applied technological solutions, which the future operator will have to learn about and provide appropriate, well-educated personnel.

The SMRs can be divided into two groups according to certain common features within these groups: Type 1: land-based SMRs based on known technologies in which fuel is loaded only on site and Type 2: fuel is loaded already at the factory, and the reactor loaded in this way is transported to the country of destination, and after use is transported back to the country of the producer; within the second type, we can distinguish land-based and marine-based [3].

In this paper, the author will focus on land-based SMRs of type 1 and type 2 for two reasons: firstly, because the definitions of “nuclear installation” in the existing Conventions [4] [5] apply to them, and secondly, because these SMRs will have the broadest range of applications on the way to decarbonizing the economy [6].

## **The Origins of the Channeling Principle**

The channeling principle has been implemented in all applicable international Conventions concerning civil liability for nuclear damage (the Vienna Convention of 1963, and 1997 Protocol, the Paris Convention of 1960, and the Amended Paris Convention of 2004, the Convention on Supplementary Compensation for Nuclear Damage of 1997). This principle has remained unchanged over the years. In the late 1950s and early 1960s, when the civil nuclear power industry was developing and a regime of liability for nuclear damage was being established, the main reasons for the introduction of channeling were: on the one hand, to facilitate the pursuit of claims by victims, who otherwise might have difficulty in identifying the liable entity, which could potentially be several. On the other hand, to support the development of nuclear power, as suppliers were reluctant to export nuclear technology outside the supplier’s country, recognizing the risk of their unlimited liability to both victims and the operator [7]. A similar phenomenon occurred again in the 1990s when Western European suppliers began to supply their reactors to Eastern European countries and sought to have the channeling principle implemented in those countries through accession to the 1963 Vienna Convention [8]. It can be said that today, as far as SMRs are concerned, we are in a similar situation as many years ago. On the one hand, creating legal frameworks would support their development; on the other hand, we are richer by several decades of experience in the peaceful use of nuclear energy.

It is worth noting that the Conventions were created at a time when reactors were already in commercial use. In the case of SMRs, their practical application in reality is not yet known, and complete knowledge of SMRs is possessed only by suppliers. It cannot be overlooked that in the case of Type 2 SMRs, it is the suppliers who will manufacture the components in their factory, load them with fuel, and transport the loaded modules to the site - whether the investor or the future operator will have much less influence on the production and construction process. In the whole puzzle of circumstances, one cannot forget that the regulator watches over the entire process and must issue appropriate decisions - it will not do so if the SMR does not meet certain standards. Still, again, the regulator does not yet have practical knowledge and makes an assessment for the first time, relying on documentation and information directly from suppliers. This position of suppliers shows that from a legal point of view, due to their exclusive knowledge of the technology and very wide scope of participation in the process of producing components for SMRs, broader liability for potential nuclear damage may seem justified.

## **Advantages and Disadvantages of the Channeling Principle for SMRS**

The channeling of liability in the case of SMRs has its advantages and disadvantages. An obvious advantage for technology suppliers is their protection from liability in the event of a nuclear accident [9]. This means that they do not have to take this liability into account in their risk analysis and can thus reduce the costs of their operations and offers, which can promote the development of projects in their initial phase of activity in exchange for capital investment in technology development. On the other hand, potential investors can also benefit from channeling by transferring risk to a special purpose company dedicated to the operator’s function so as not to burden the entire business with risk. An obvious advantage for victims is the lack of uncertainty as to who claimed should be against [10]. As far as transport is concerned, especially of modules with loaded fuel, channeling (provided that as many states as possible through which the transport will be carried out, would be parties to the Conventions) allows an unbroken chain of liability to be maintained. However, the regime is not uniform, and this issue poses a challenge [11].

The main disadvantage of channeling liability in the case of SMRs is the lack of liability on the part of the entity that is actually responsible if the nuclear accident results from causes on the side of the supplier (and other entities engaged by it: engineers, architects, contractors). The literature indicates that all three major nuclear accidents were caused by causes on the part of both the supplier (design errors) and the operator in terms of operation (errors) [12]. If suppliers were liable for nuclear damage according to general rules, this would probably lead to greater diligence at the design and construction stage. The lack of liability for design and construction errors may be the reason why we have so many SMR projects in the development phase, and on the other hand, imposing liability and the need to bear greater risk could lead to a natural selection effect and further development of the safest projects [13] by the most financially sound entities. As far as victims are concerned, channeling means that they have limited opportunities to claim their rights, and the assets of suppliers are not available to them [14].

## Alternative solutions for SMRS

Given that the channeling principle does not have only advantages and can be questioned in relation to SMRs for various reasons mentioned above, it is necessary to consider what alternative solutions exist. In other words, what legal mechanisms can be used to ensure that suppliers bear liability, and what are the potential consequences of such solutions?

### Joint and several liability

One of the available solutions is joint and several liability, a well-known concept in civil law, in this case, of the supplier and the operator. Joint and several liability means that the injured party may demand compensation for damage from one of the persons responsible for the damage, from several of them, or from all of them, whereby the fulfillment of the obligation to pay compensation by even one of the joint and several debtors releases the others [15]. As a rule, joint and several debtors, after satisfying the claims, have the right to mutual settlements in accordance with the scope of liability on the basis of the right of recourse. The injured party, therefore, does not have to worry about the scope of liability of a particular debtor and can obtain full satisfaction of their claims from them. It should be noted that joint and several liability is known to the Conventions. Using the example of the 1997 Vienna Convention, in Article II.3.a), in a situation where more than one operator is responsible for nuclear damage, and their liabilities cannot be reasonably separated, such operators are jointly and severally liable. Therefore, this is not a complete novelty for this liability regime.

Directly imposing liability on suppliers as joint and several debtors alongside operators for nuclear damage in SMRs would necessitate the establishment of key principles governing such liability, including its prerequisites. It would likely be necessary to introduce a new definition of the supplier into the applicable Conventions and establish the circumstances under which they would be liable, whether on the same restrictive principles as the operator or whether the supplier’s fault would have to exist. Further questions arise as to whether such joint and several liability of the supplier would be time-limited (e.g., to the first few years of SMR operation) or indefinite throughout the life cycle of the installation, and whether limiting liability in terms of amount would still be justified [16]. It would need to be determined on what principles the operator and supplier have the right of recourse against each other. Finally, it would be a revolutionary solution compared to the channeling principle that has been in operation for nearly 70 years, and it should be considered whether there are sufficient grounds to introduce it only for SMRs while maintaining the existing principles for other large-scale installations.

The potential introduction of joint and several liability of the operator and supplier would give rise to many challenges and practical implications. An obvious advantage would be to increase the potential coverage of damage, as if two entities were jointly and severally liable, both would be obliged to have appropriate financial security, and their ability to cover damage would be greater. On the other hand, an obvious disadvantage may be the inhibition of the development of SMR projects and even the discontinuation of some of them due to the significant additional burden for suppliers. Additionally, this could significantly impact the claims process: the more potential liable entities, the more complications in pursuing claims and the higher their costs – the claims are not concentrated.

Introducing joint and several liability for both operators and suppliers of SMRs for nuclear damage would bring about a multitude of challenges and practical implications. While there are potential benefits to be considered, there are also significant drawbacks that need to be carefully evaluated. One of the primary advantages of joint and several liability is the enhanced financial protection it offers to victims of nuclear accidents. With two entities jointly and severally liable, the potential for adequate compensation for damages increases as both parties would be required to maintain appropriate financial security measures. This could provide greater assurance to affected individuals and communities in the event of a nuclear incident. On the other hand, joint and several liability could pose a significant challenge to the development and deployment of SMRs. The additional financial burden placed on suppliers, particularly in the early stages of SMR development, could discourage investment and hinder the growth of this promising technology. This could potentially lead to a slowdown in SMR projects or even the discontinuation of some initiatives. The implementation of joint and several liability could also introduce greater complexity into the claims process for nuclear accidents. With multiple potentially liable parties involved, determining responsibility and allocating compensation could become a more intricate and time-consuming task. This could lead to increased legal costs and delays in resolving claims. Striking a balance between these considerations is essential for making informed decisions that promote the safe and sustainable development of SMR technology.

### Right of Recourse

In addition to the existing mechanisms for extending supplier liability, the Vienna Convention, Paris Convention, and CSC Annex offer the option of stipulating a right of recourse in favour of the operator in a written agreement (Art. X.a) RVC, Art. 6.f).i) PC, Art.10.a) of the Annex to CSC). This means that the operator remains solely liable but can claim reimbursement from a third party for funds paid out in compensation in cases specified in the agreement. Given the unique characteristics of SMRs, it is worth considering whether these regulations should be amended to expand the scope of permissible recourse beyond the possibility of including such a right only in a contract. This could potentially involve establishing a mechanism to demonstrate that an accident resulted from supplier-related causes, such as a design error. While introducing such circumstances justifying recourse claims by the operator against the supplier is, of course, permissible in a written agreement [17], the question arises as to whether such a solution should be incorporated directly into the Conventions. Currently, operators can strive to include such contractual provisions in their agreements with suppliers. However, this can lead to a negotiating deadlock between the supplier and the operator and put the supplier in a stronger position [18][19]. Paradoxically, this could slow down the development of SMRs and decarbonization efforts, as fewer potential investors would be willing to take on such a risk. This could be a deal breaker for some investors, ultimately determining whether or not they invest.

Therefore, it is crucial to consider whether there are sufficient grounds to modify the Conventions in this regard and introduce a strict recourse claim against the SMR supplier at the level of mandatory provisions. This recourse claim would be applicable in cases where it can be demonstrated that the responsibility for the accident lies in the defectiveness of the supplied design or equipment caused by the supplier’s negligence or willful misconduct, similar to the principle of liability for a defective product.

Notably, a similar regulation exists in Indian national law and covers all suppliers without exception. According to Section 17(b) of the Civil Liability for Nuclear Damage Act 2010 [20], the operator has a right of recourse if “the nuclear incident has resulted as a consequence of an act of supplier or his employee, which includes supply of equipment or material with patent or latent defects or sub-standard services.” Additionally, the amount that can be claimed in recourse (the operator’s liability limit or the contract amount, whichever is lower) has been specified, and it has also been limited in time (the period of the issued license or the product liability period, whichever is longer).

Another example of legislation where the entity that is actually responsible bears the economic consequences of the event is the American 1957 Price Anderson Act, which implements the principle of economic channeling. However, this is mitigated by umbrella insurance, which the operator is obliged to have and which also covers suppliers.

If the right of recourse were to be extended under the Conventions in relation to SMRs, similar structural elements of this institution would need to be introduced and specified. It would need to be determined what circumstances would allow such recourse, whether at the level of the Conventions or whether Contracting Parties should be left free to establish them in their national law, the upper limit of the supplier’s liability, and the limitation of the right of recourse in time (again, whether this should be the first few years of operation of the installation or the entire period of its operation). As in the case of joint and several liability, the question would arise as to whether in this situation limiting liability would still be justified. In addition to the previously discussed aspects, it is worth examining whether the right of recourse against SMR suppliers could be contractually excluded. All these issues concern the balance of power between operators and suppliers, the potential for unequal bargaining positions, and the implications for risk allocation and liability management.

A positive consequence of this type of solution would likely be greater investor interest, as they would be aware of the limited exposure to one of the most expensive risks in nuclear power (albeit with a low probability). The element of fairness reappears: why should the entity that is actually responsible, in the event of an accident caused by circumstances solely on its part (design errors) and, moreover, in an innovative FOAK-type facility, about which the supplier has the greatest knowledge, not bear the burden of repairing the damage caused? In any case, the introduction of the recourse rule will increase costs for suppliers and, therefore, also cause a possible slowdown in the development of SMRs. However, it will also trigger a natural selection of numerous projects. It seems that the economy does not need to develop such a large number of projects to achieve the decarbonization goal. The multiplicity of technological solutions also makes regulatory oversight more difficult. If the right of recourse could be exercised up to the amount of the statutory limit of the operator’s liability, suppliers would of course seek to secure potential liability up to the same amount, which would in effect mean duplicating insurance costs without any clear benefit to the injured parties if the limit of available funds to satisfy claims remained at the same level [21]. This is a decidedly less revolutionary solution than the principle of joint and several liability, allowing the channeling principle to be maintained while at the same time spreading the risk between entities potentially actually responsible for the damage.

### Liability Limit

The channeling is inextricably linked to quantitative liability limits as a rule that closes and balances the principle of channeling. The current liability limits set out in the Conventions vary. At the level of national legislation, there are even greater discrepancies due to the establishment in the Conventions of only a minimum liability amount. Both the Vienna Convention on Civil Liability for Nuclear Damage (art. V.2) and the Paris Convention on Third Party Liability in the Field of Nuclear Energy ((art.7.b).i)) allow the state to reduce the liability limit for a specific installation to significantly smaller amounts (RVC - 5 million SDR, PC – EUR 70 million) on condition that the state takes on the burden of ensuring the availability of the remaining amount up to the minimum liability limit set by the Conventions.

The justification for reducing the liability limit in both Conventions is the nature of the installation and the potential consequences that may result from an event. In the RVC, the second alternative factor is the nature of the substances used. The PC, on the other hand, also distinguishes between the possibilities of reducing the liability limit in transport to EUR 80 million due to the nature of the substances and the potential consequences of an incident. The Expos**é** de Motifs to the PC directly points to small research reactors as an example of such an installation, justifying this on the grounds of the need to avoid overburdening the operator with security costs in a situation where this is not justified [22].

SMR project suppliers assure that they can be considered low-risk installations both due to their lower installed power and the application of the most advanced technological safety solutions. In the current legal situation, any decision to reduce the liability limit under the Conventions is up to the state in the specific case being assessed, also on the basis of national regulations. This means that in one country, a given project may be recognized as such an installation, while in another, it may not. Such a solution, in turn, creates the risk that only some of the projects will receive essentially huge support from the state of location. In contrast, others will be omitted, which will, in turn, reduce the competitiveness and hinder the development of these projects. On the other hand, reducing the liability limit relieves potential operators and may increase the availability of SMRs to a larger number of potential investors, e.g., energy-intensive companies seeking to secure their own low-emission energy sources. If the liability limit were to be lowered for SMR projects, the state would have a greater burden, and yet it is the states that are obliged to decarbonize the economy - this would be a fair solution in terms of risk allocation.

What should be emphasized, when considering the possibility of using the option of reducing the liability limit, is that this cannot be done completely abstractly for the entire category of SMRs or all installations in the same technology, as projects differ from each other, at least in terms of installed power, but also total installed power of all modules. The possibility of adding further modules and, consequently, increasing the installed power of a given generating unit in the same location is indeed one of the inherent features of these types of reactors. It is also necessary to take into account the location of the installation and the methodology for determining the EPZ, such as that proposed by the NRC for the NuScale reactor, especially in the case of locating SMRs closer to human settlements, where a potential accident could cause more damage [23] [24].

 Another advantage of a lower operator liability limit could be the involvement of a larger number of entities in the provision of security services, particularly from the banking and financial sector, e.g., through the provision of guarantees. The conditions for applying a reduced liability limit for SMRs should be harmonized, at least through soft law guidelines for states on how to implement them.

### Proposed *Ad Hoc* Solutions

The above-mentioned solutions assume far-reaching changes in the structural principles of civil liability for nuclear damage, which are, in addition, not ideal and may have far-reaching implications for the development of SMRs, including potentially slowing it down. There is increasingly less time for the transformation of the economy to zero emissions. In addition, as experience shows, nuclear law is rather reactive than proactive, which is justified by following the development of technology rather than anticipating it without fully understanding it. However, there are already ways for SMR technology suppliers to share the risk of liability for nuclear damage, and consequently, the solidarity contribution to the development of these projects would be borne by all stakeholders on the basis of applicable regulations.

#### Capital involvement of suppliers in SMR projects

One possible solution, which is not yet widely used [25], but may be interesting in the case of SMRs, is the capital commitment of the supplier to the project. In return for a capital contribution to the construction of an SMR, the supplier could receive better contractual terms, but crucially - shares in the entity operating the nuclear power plant, and both benefit from this and indirectly participate in the liability risk associated with operation. Such capital involvement of suppliers can be part of the development strategy as leaders and participants in future SMR reactor deployments [26]. In view of the fact that these projects will require large financial outlays, and due to the lack of experience, it is likely that schedules and budgets will be exceeded, this is a solution only for suppliers with a strong financial position. Entities that would be able to make a capital commitment to such an investment are likely to be experienced suppliers operating on the market for many years in the field of large-scale nuclear power, which are currently expanding their offer to include SMRs.

####  Promoting the Use of Contractual Recourse

Another solution that can be implemented immediately is to promote the use of a contractual right of recourse in favour of operators in contracts to the extent permitted by the applicable Conventions. The widespread use of this contractual mechanism, which is particularly justified in the case of SMRs, can positively impact their widespread use, in particular by improving the situation of investors other than large energy companies and making such an investment within their reach. This is particularly relevant to any energy-intensive companies that are actively seeking solutions for their decarbonization by investing in low-emission energy sources. The solution that is within their reach today is primarily renewable energy installations, also combined with energy storage. If SMRs are to be any alternative to this, then they must be a competitive solution for such companies in terms of capital investment costs. Here, a huge role is to be played by specialized organizations such as the IAEA or the NEA, which have the tools and resources to create soft law regulations or propose analyzes and specific solutions, such as model recourse clauses for use in contracts.

## FINAL CONCLUSIONS

As indicated at the outset, the conclusions drawn from the analysis are not as controversial as the question posed at the beginning. Introducing any revolutionary changes at this stage of SMRs development is not advisable and could have more negative consequences than benefits. Any action taken in this area requires not only legal analysis but also economic analysis of the potential costs for technology suppliers, investors and financing institutions, as the civil liability regime for nuclear damage plays a key role as a specific risk in this sector. Changes must also be made with respect to the legitimate interests of potential victims. The determinant of these analyses must also be the impact of potential legal changes on the process of technological development and the decarbonization goal. However, this does not mean that the channeling principle should not be subjected to critical analysis and discussion. After all, we are all aware that it is a unique construct and not comparable to any other solution used in other branches of the economy.

The large number of SMR projects under development makes it difficult, if not impossible, at this stage to create new categories and exceptions for them in terms of the principle of targeted liability. On the other hand, a complete departure from the channeling, which cannot be unequivocally assessed as positive in terms of its consequences, may currently be impossible and pointless due to economic, political and international conditions. Given the history of the nuclear damage liability regime, reaching a diplomatic compromise in this area seems unrealistic at this point. Nevertheless, there are strong arguments for evenly distributing the risk on the basis of the circumstances relating to SMRs mentioned at the outset, using the available legal solutions. There are justified grounds for imposing a certain scope of risk associated with SMR development on each of the stakeholders: the operator - because it wants to implement a new, hitherto non-commercial solution, the supplier - because it is its author and the only entity in the entire puzzle with full knowledge of the project, and finally the state and the international community - because they strive for the decarbonization of the economy, which is associated with the need to bear the costs of this decarbonization. This paper is not about whether one is on the side of operators or suppliers but whether one is on the side of the Net Zero by 2050 goal. All stakeholders should take efforts to develop and commercialize those SMR projects that can contribute to the decarbonization of the economy: including power generation, industry, and heating.

Finally, a general postulate should be made that none of the goals discussed in this paper will be achieved if we do not strive for a global, uniform nuclear damage liability regime, for example, on the basis of the CSC Convention. The channeling rule is very imperfect; it is a unique construct in relation to any other branch of the economy, but no one has yet come up with anything better. The nuclear damage liability system can work as designed, and the *ad hoc* solutions proposed in this paper can only be implemented if as many states as possible, including those planning to develop SMRs, are parties to international Conventions and enter into treaty relations with technology suppliers. Otherwise, the legal situation will be uncertain for each of the stakeholders involved and difficult to assess in terms of its consequences.

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