



Scientific Committee on Health, Environmental and Emerging
Risks

SCHEER

SCHEER review of the JRC report on *Technical
**assessment of nuclear energy with respect to the 'do no
significant harm' criteria of Regulation (EU) 2020/852
('Taxonomy Regulation')***



The SCHEER adopted this document by written procedure on 29 June 2021.

ABSTRACT

Following a request from the Commission, the Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) reviewed the Joint Research Centre (JRC) technical report on nuclear energy with respect to the Do no significant harm criteria (DNSH) of the Taxonomy regulation. The SCHEER was asked to review the JRC technical assessment report and provide an independent opinion (1) on the findings and recommendations of the report and (2) on the completeness and robustness of the assessment that underpins them. The SCHEER agreed to develop a Review on the formal and conceptual issues and findings discussed in the JRC Report, and to focus on the aspects of expertise recognised within the SCHEER, specifically a broad range of expertise, including: risk assessment to human health and the environment, pollution prevention, biodiversity/ecosystem protection, and ensuring the protection of water and marine resources. It was noted that the SCHEER did not include experts in long-term high-level radioactive waste treatment and storage technologies and risks and therefore any comments on those sections are limited.

The SCHEER is of the opinion that the findings and recommendations of the report with respect of the non-radiological impacts are in the main comprehensive. However, the SCHEER is of the opinion that there are several findings where the report is incomplete and requires to be enhanced with further evidence. For the DNSH criteria, in many cases the findings (comparing Nuclear Power Plant (NPP) to other energy generating technologies already in Taxonomy) are expressed as *do less harm* than at least one of the **comparator technologies, which in the SCHEER view is different to "do no significant harm"**. It is the opinion of the SCHEER that the comparative approach is not sufficient to ensure "no significant harm."

The JRC report concludes that NPP operation activities do not represent unavertable harm to human health or to the environment, provided that the associated industrial activities satisfy appropriate Technical Screening Criteria ((**Regulation (EU) 2020/8521 ('Taxonomy Regulation')**). The SCHEER broadly agrees with these statements, however, the SCHEER is of the view that dependence on an operational regulatory framework is not in itself sufficient to mitigate these impacts, e.g. in mining and milling where the burden of the impacts are felt outside Europe.

With regard to the Impact of radiation on the environment, the concept expressed is **that "the standards of environmental control needed to protect the general public are likely to be sufficient to ensure that other species are not put at risk"**. It is the opinion of the SCHEER that this statement is simplistic and does not allow estimation of the potential risks to the environment, without an assessment of the potential exposure of the different components of the ecosystems. In particular, with regard to protection of water and marine resources as well as biodiversity the notion that thermal pollution of seawater **is less of a problem because of "practically infinite mixing" is not shared by the SCHEER** since the potential problems in shallow coastal areas and vulnerable ecosystems (e.g. coral reefs) are overlooked.

Keywords: review, Nuclear energy, do no significant harm (DSNH), EU Taxonomy Regulation

Opinion to be cited as:

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SCHEER

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1. MANDATE FROM THE EU COMMISSION SERVICES

1.1. Background

Any information judged useful to better understand the scientific, technical and legislative context of the mandate, as appropriate.

Regulation (EU) 2020/8521 ('Taxonomy Regulation') establishes a framework for the development of an EU classification system ("EU Taxonomy") of environmentally sustainable economic activities for investment purposes. While the Regulation provides the general framework for an economic activity to qualify as environmentally sustainable, it empowers the European Commission to set the actual performance criteria (technical screening criteria) to determine under what conditions an economic activity qualifies as environmentally sustainable.

The **Regulation** determines that in order to qualify as environmentally sustainable, an economic activity must: (1) make a substantial contribution to one of six environmental objectives¹; (2) do no significant harm (DNSH) to the other five objectives; (3) meet minimum social and governance safeguards; and (4) comply with certain technical screening criteria, **specifying the conditions of 'substantial contribution' and DNSH for economic activities that are selected and addressed by the taxonomy.**

While there are indirect references in the Regulation to the issue of nuclear energy (including to nuclear waste), co-legislators ultimately left the assessment of nuclear energy to the Commission, as part of its work on the delegated acts establishing the technical screening criteria. It is important to underline that the non-inclusion of a sector or activity in the Taxonomy does not in any way preclude on-going or future financial investment in the sector (e.g., in the case of nuclear energy, for improving safety of or decommissioning existing nuclear plants). It also does not categorise the **sector or activity as "brown"; it just means the financial sector cannot include investments in the sector/activity as counting towards the proportion of investments with the financial product that meet the taxonomy criteria and, thus, labelled "green".**

A Technical Expert Group on Sustainable Finance (TEG) was tasked with advising the Commission on the technical screening criteria for activities substantially contributing to the climate change mitigation and adaptation objectives. As part of this task, the TEG undertook an analysis of the impact of nuclear energy on the other four environmental objectives that are addressed by the taxonomy. However, the TEG considered that **"it was not possible for TEG, nor its members, to conclude that the nuclear energy value chain does not cause significant harm to other environmental objectives on the timescales in question"** and indicated further assessment of the **'do no significant harm' aspects of nuclear energy** would be necessary. With the taxonomy likely to act as guiding framework for significant proportions of the (short-term)

¹Climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to the circular economy including waste prevention and recycling, pollution prevention and control, protection and restoration of biodiversity and ecosystems

funding that will be disbursed under the updated MFF and Next Generation EU, the issue has acquired additional importance and urgency.

The Joint Research Centre (JRC) has been invited to carry out such analysis and to draft a technical assessment report. The aim is to analyse the DNSH aspects of nuclear energy, assessing its environmental risks with respect to the taxonomy environmental objectives with particular attention to water, circular economy, pollution prevention, and ecosystems/biodiversity objectives. This should support the Commission's decision if nuclear energy can meet the criteria under the Taxonomy Regulation, and if so, what DNSH technical screening criteria could be associated

Specifically, the JRC has been asked to:

A) Conduct a review of the state of the art to assess nuclear energy generation **under the "do no significant harm" (DNSH) criterion**. The assessment should consider the effects of the whole nuclear life cycle on the existing and potential environmental impacts across all objectives. As per the TEG recommendations, special attention should be given to impacts on the objectives relating to circular economy, pollution and biodiversity criteria; but ensuring the protection of water and marine resources is also very important and should be considered.

B) Conduct a specific assessment on the current status and perspectives of long-term management and disposal of nuclear waste. The final comments of the TEG rely among other things on the consideration that there is no robust evidence regarding the DNSH criteria concerning high-level radioactive waste.

The JRC technical assessment will gather and present evidence that helps evaluating the existing problems and the pros and cons of existing and proposed solutions, with a specific focus on the risks and nature of potential environmental impacts over the timescales commensurate with long-term nuclear waste management, treatment and storage.

The period of execution of the assessment by the JRC is six months (to be completed by end-December 2020). This timetable is indicative but a draft report should be prepared at the latest by 15 November 2020. The JRC technical report will be reviewed by radiation protection and waste experts appointed by the Scientific and Technical Committee under Article 31 of the Euratom Treaty, who will be invited to provide their opinion on JRC technical report.

However, it was deemed important to also seek an opinion on the JRC technical report from an independent environmental expert group or scientific committee. Having reviewed available expertise, we believe SCHEER is best suited to this task.

1.2. Terms of Reference

Within this process, SCHEER is asked to review the JRC technical assessment report and provide an independent opinion (1) on the findings and recommendations of the report and (2) on the completeness and robustness of the assessment that underpins them.

In doing so, SCHEER should consider, among other things, the following key questions:

- To comment on the level of uncertainty and the level of scientific consensus with **respect to the report's findings, in particular with a view to the precautionary principle** enshrined in Article 191 TFEU (and referred to in Art.19.1(f) of the Taxonomy Regulation).
- Are there existing gaps in scientific knowledge and data that could affect the determination of the risks addressed by the report?
- Are the described '**residual' risks** (i.e. the risk that remains after implementation of the identified mitigating measures) plausible when considering the timescales involved (e.g. uncertainty relating to the practical feasibility of future technologies) and the influence of the discount factor use²?

The review is expected to require a broad range of expertise, including on: risk assessment, pollution prevention, biodiversity/ecosystem protection, ensuring the protection of water and marine resources, circular economy, and long-term high-level radioactive waste treatment and storage technologies and risks.

1.3. **Deadline**

SCHEER is asked to provide its opinion 3 months after receiving the final JRC report.

2. **REVIEW**

The SCHEER was asked by the mandating DG (DG ENV) to:

"provide an independent opinion (1) on the findings and recommendations of the report and (2) on the completeness and robustness of the assessment that underpins them."

Following discussion with DG ENV, to fulfil point (1), it was agreed that the SCHEER would perform a "Review" focussing only on the JRC Report³ without performing any additional independent research or literature surveys. To complete a SCHEER opinion, and fulfilling points (1) and (2) would have required the SCHEER to carry out an independent evaluation using primary data sources including a call for external experts. To complete such a task would require 6 months, and DG ENV confirmed that the review needed to be completed by the end of June 2021 and it was therefore jointly agreed that a SCHEER opinion was not what was being sought.

The SCHEER agreed to develop a Review on the formal and conceptual issues and findings discussed in the JRC Report, and to focus on the aspects of expertise recognised within the SCHEER, specifically a broad range of expertise, including on: risk assessment including to human health, pollution prevention, biodiversity/ecosystem protection, ensuring the protection of water and marine resources. It was noted that the SCHEER,

² Sensitivity to the discount rate grows as benefits and costs stretch further into the future. Thus, the effect any discount rate(s) that may be applied and the implications (e.g. on net present value estimates of future costs and benefits) are important to consider when looking at long time horizons.

³

https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/210329-jrc-report-nuclear-energy-assessment_en.pdf

given the time constraints, could not invite external experts in long-term high-level radioactive waste treatment and storage technologies and therefore any comments on those sections of the JRC report are limited.

SCHEER considered, among other things, the following key questions:

To comment on the level of uncertainty and the level of scientific consensus with **respect to the report's findings, in particular with a view to the precautionary principle** enshrined in Article 191 TFEU (and referred to in Art.19.1(f) of the Taxonomy Regulation).

The SCHEER performed a critical review on the formal and conceptual issues and findings discussed in the JRC Report and focussed on the aspects of expertise recognised within the SCHEER, specifically a broad range of expertise, including risk assessment to human health and the environment, pollution prevention, biodiversity/ecosystem protection, and ensuring the protection of water and marine resources. Accordingly, the SCHEER is not able to specifically comment on the level of scientific consensus except as reported within the JRC report since it was not possible to carry out an independent literature review nor appoint any external experts to the SCHEER working group.

Within our review, the SCHEER identified several issues where further evidence is required. We also note that the JRC report has delivered findings and conclusions couched in terms of comparisons with other energy generating technology already included in the **Taxonomy, and that DNSH is often addressed as "no evidence that NPP does more harm..."** which is not equivalent to **"do no significant harm"**. **Regarding waste management and storage**, we note that the findings are based on models only (without external validation) that make a number of assumptions, and which provide predictions over long timescales. These therefore present a moderate/high-level of uncertainty.

Where the JRC report has identified significant environmental or human health impacts, a reference is made to mitigating actions and Technical Screening Criteria, e.g. around design parameters, site choice and the regulatory framework. However, the SCHEER is of the view that dependence on an operational regulatory framework is not in itself sufficient to mitigate such impacts.

Are there existing gaps in scientific knowledge and data that could affect the determination of the risks addressed by the report?

Given the short time available for the mandate, the SCHEER was unable to perform a literature review or consult external experts as it would normally do. As a result, the SCHEER is not able to reply directly to this question. During the review process itself and on the basis of the SCHEER expertise, areas where additional supporting evidence is required to address uncertainties or where the SCHEER felt the evaluation could be improved were identified, e.g. on waste recycling, high level waste storage, mining and milling impacts and protection, thermal impacts, and restoration of biodiversity and ecosystems.

Are the described 'residual' risks (i.e., the risk that remains after implementation of the identified mitigating measures) plausible when considering the timescales involved (e.g. uncertainty relating to the practical feasibility of future technologies) and the influence of the discount factor use⁴?

With regard to the impacts of the NPP lifecycle on the environment and human health, there is limited discussion in the JRC report about the human element and past experience has shown that many nuclear incidents have been due to human failures, or underestimating environmental hazards such as earthquakes, rock slides or tsunamis, or not considering the possible risk amplification, e.g. due to multi-site NPP units.

In many cases within the report, where significant environmental or human health impacts are identified, the mitigating measures are described in terms of the existence of a regulatory framework. It is the SCHEER view that relying on the existence of a regulatory framework is insufficient to mitigate the significant harms without addressing management and monitoring of the implementation of such regulations.

The SCHEER is not able to address this specific question regarding waste management or storage.

The SCHEER is not able to provide any comments concerning the discount factor use.

3. DATA AND METHODOLOGIES

For this review, the SCHEER reviewed the JRC report "Technical assessment of nuclear energy with respect to the 'do no significant harm' criteria of Regulation (EU) 2020/852 ('Taxonomy Regulation')." No additional literature searches were carried out in view of the mandate and the timescale.

The weight of evidence approach (SCHEER, 2018) has been followed only in so far as 1) clarification of the scientific statement to be assessed from the mandate and problem formulation, 3) assessment of the JRC report based on the evaluation of the relevance and reliability of the data presented therein, with any limitations and gaps identified and finally 4) validity of the conclusions.

4. ASSESSMENT

4.1. General comments

The SCHEER was asked by the mandating DG (DG ENV) to:

"provide an independent opinion (1) on the findings and recommendations of the report and (2) on the completeness and robustness of the assessment that underpins them."

⁴ Sensitivity to the discount rate grows as benefits and costs stretch further into the future. Thus, the effect any discount rate(s) that may be applied and the implications (e.g. on net present value estimates of future costs and benefits) are important to consider when looking at long time horizons.

The SCHEER agreed to develop a Review on the formal and conceptual issues and findings discussed in the JRC Report, and to focus on the aspects of expertise recognised within the SCHEER, specifically a broad range of expertise, including on: risk assessment including to human health, pollution prevention, biodiversity/ecosystem protection, ensuring the protection of water and marine resources.

Given the SCHEER expertise, our focus has been Chapters 3 and 4 Part A, and general comments on chapters 1, 4 and 5.

4.2. **Specific comments**

Part A: Review of the state-of-the-art to assess nuclear energy generation under **the "do no significant harm" (DNSH) criterion**

The SCHEER is of the opinion that the findings and recommendations of the report with respect of the radiological and non-radiological impacts of NPP activities (Part A) are generally comprehensive, however, there are several findings where the SCHEER is of the opinion that the review is incomplete and needs to be enhanced with additional evidence or more in depth consideration. For the DNSH criteria, in many cases the findings (comparing nuclear power plant (NPP) to other energy generating technologies already in Taxonomy) are expressed as 'do less harm than at least one of the comparator technologies', **which in the SCHEER view is different (not equivalent) to "do no significant harm"**. For GHG mitigation, there are other energy generating technologies, which outperform NPP, without the additional challenges of waste management. It is the opinion of the SCHEER that, in many cases, the comparison is quite superficial, without the necessary detail, e.g. the origin of impacts determined by the various phases of the life cycle for different energy generating technologies.

It is the SCHEER view that a lifecycle approach to the DNSH assessment is essential. The SCHEER also considers that the environmental and human health impact indicators selected are in the main appropriate. The SCHEER is in general agreement with the finding of the JRC report that the NPP non-radioactive impacts (over the lifecycle) on the four environmental objectives are comparable to other power generating technologies in the Taxonomy, but has identified in the subsequent text, areas where, in the SCHEER view, additional considerations are required.

Sustainable use and protection of water and marine resources

The JRC report finds that for nuclear energy, its impact on water consumption and potential thermal pollution of water bodies does not meet the DNSH, but that there are mitigating factors, which would allow the impacts to be appropriately addressed, including site selection, facility design and plant operation phases. The SCHEER is in agreement with this finding but goes further since in the phases of mining and milling, although less water is used, potential contamination may be higher. It is opinion of the SCHEER that this contamination source should be better quantified. Regarding ecotoxicity, the dominant contribution of mining and milling to freshwater and marine ecotoxicity should be further investigated. With regard to thermal pollution, it is the opinion of the SCHEER that the JRC report could further highlight the use of warm water for several purposes (e.g. heating of greenhouses, aquaculture, etc.). This would be relevant in the framing of the circular

economy. The SCHEER is in broad agreement regarding thermal pollution, but concludes that the impact has the potential to be greater than described in the JRC report. Taking mixing as an example, the JRC consideration may be appropriate for deep marine areas, but will not be the case in shallow coasts, where warm water emissions may alter the temperature in relatively large areas. Moreover, vulnerable benthic communities (e.g. coral reefs) may be seriously affected by thermal pollution. Therefore, the bathymetric and ecological conditions in the discharge site must be carefully checked to not interfere with areas of specific ecological relevance (e.g. reproductive sites, migratory routes, etc.).

Transition to the circular economy

In the JRC report it is stated there is no evidence that nuclear energy does more harm to the transition to a circular economy, including waste prevention and recycling, than other energy technologies included in the Taxonomy.

With regard to radioactive waste specifically, clearly nuclear energy produces larger quantities of waste than other energy generation technologies. The SCHEER is of the opinion that there is a paucity of evidence relating to the circular economy, the report itself comments on the limited data available to compare the abiotic depletion potential (the chosen indicator) (only 3 sources cited). With regard to waste recycling, there is limited evidence provided and a more realistic assessment of the actual recyclability in current decommissioning procedures would be useful. The present limitations of recyclability of spent nuclear fuels (SNF) under open and partly closed cycles and the need for its optimization could be addressed, as part of the transition to the circular economy. While in the future, fast reactors may be commissioned which will enable fully closed cycles with reduction of uranium mining and impacts of transport and storage of SNF, this technology is neither widespread nor fully developed.

The problem of chemical and radioactive wastes is also discussed in regard of the circular economy. High-level radioactive waste is proposed to be stored and is not then considered within a circular economy. It is therefore the opinion of the SCHEER that the overall conclusion of **"no evidence of does more harm"** is not sufficiently supported by the information provided within the report.

Pollution prevention and control

The JRC report focusses on a number of additional indicators (including ozone depletion, VOC, PM, NO_x and SO₂ and a human toxicity potential (HTP)) and concludes that NPP compares favourably to other energy generating technologies. With regard to HTP, it is the opinion of the SCHEER that the evidence base for this section is small (a small number of papers/studies are frequently cited) and the report notes that the methodology being used differs amongst the studies and indicates that there is some variability amongst the studies thus making comparisons difficult (if not infeasible), without giving details. The JRC report states for non-radioactive impacts **"If the whole nuclear lifecycle is considered, then uranium mining has large contribution (≈ 32%) to the total GHG emission and dominates the following impacts: SO_x emission (≈ 88%), NO_x emission (≈ 78%), water pollution (≈ 91%) and land use (≈ 68%). Mining is almost exclusively (≈ 99%) responsible for the potential eco-toxicity and human toxicity impacts and also dominates the acidification (≈ 82%), ozone creation (≈ 86%) and eutrophication (≈ 53%) potentials". It follows that**

almost 100% of the total eco-toxicity and human toxicity impacts over the whole nuclear lifecycle is connected to mining and milling and this phase also dominates the acidification, ozone creation and eutrophication potentials. While mining and milling is regulated, 90% of what the EU need globally comes from 7 countries (none in Europe). The SCHEER notes that the majority of these impacts therefore occur in non-European countries while the remainder of the impacts on human health and the environment occur within Europe. . For radioactive impact, **“uranium mining is responsible for about 55% of the total gaseous radioactive emissions during the total nuclear lifecycle (reprocessing provides the rest)”**. Therefore, the burden of the total eco-toxicity and human toxicity impacts due to mining and milling needs to be reconsidered. The reliance on a regulatory and management framework to mitigate the challenges is in principle appropriate but given that the mining and milling impacts, including impacts of clean-up and remediation of sites will be felt outside Europe, this needs further consideration.

The protection and restoration of biodiversity and ecosystems

The JRC report finds there is no evidence that nuclear energy ‘does more harm to the protection and restoration of biodiversity and ecosystems than other energy technologies included in the Taxonomy’. The findings are based on three indicators, namely terrestrial ecotoxicity potential, the potentially disappeared fraction of species per 1m² of earth and the biodiversity impact of land use. However, it is the opinion of the SCHEER that the problem is only briefly discussed, without details that would be very useful for a better understanding of the findings. For example, there is a lack of explanation on the origin of the impacts, there is variability among different cited sources and the differentiation of the impacts dependent on the various phases of the life cycle (structure and location of the plants, extraction of materials, etc.) is not detailed.

NPP operation and power generation

The JRC reports states that, provided that nuclear power plants are built, operated and decommissioned within the limits set by existing regulations, and that the associated industrial activities satisfy appropriate Technical Screening Criteria, they do not pose a significant harm to any of the TEG objectives and that it can be concluded that NPP operation activities do not represent unavertable harm to human health or to the environment.

The SCHEER broadly agrees with these statements but is of the view that, while the regulatory regimes exists and in principle should be sufficient, there is a valid concern regarding the implementation of the regulations, and appropriate monitoring of the effectiveness of such regimes.

Impact of storage and disposal of radioactive waste, spent nuclear fuel and technological waste

The SCHEER agrees that, regarding the construction of repositories, the magnitude of the impacts (which are mainly due to the operations and reposition) are dominated by the impacts of the activities related to excavating the tunnels and to building the multiple engineered barriers. The SCHEER did not undertake a full review of the long-term waste disposal and management dealt with in part B of the JRC report.

Potential radiological impacts of ionizing radiation on the environment and human health

The JRC report identifies the dominant lifecycle phases of nuclear energy significantly contributing to potential radiological impacts on the environment and human health as: uranium mining and milling (ore processing); NPP operation (production of electricity by means of nuclear fission reactors); and reprocessing of spent nuclear fuel. The SCHEER generally agrees that provided releases of radioactive substances to the environment are maintained well within statutory limits using technology, there is a low impact on global human health.

Notwithstanding, the SCHEER considers it relevant to complement the LCA based on the dominant NPP phases with a more deterministic effect analysis per unit of electricity generated, targeting workers on-site and general public living in the vicinity of the reactor(s) unit(s) by quantifying dose-response and cancer/non-cancer effects (number of cases, cancer incidence and other indicators i.e. per geographic region). In addition, it would be important to dis-aggregate the normal operations, in order to identify the major contributors to possible human health effects, observed at low doses of radioactive emissions (radon, uranium isotopes, etc) and non-radioactive emissions (nitric acid; hydrofluoride; fluorine gas, etc).

The SCHEER also stresses the importance of conducting risk analysis of NPP operation and reprocessing of spent nuclear fuels in terms of human health and environmental impacts, by evaluating multi-unit as well as single-unit site risks (Kim *et al.*, 2017).

Impact of radiation on the environment

The section in the JRC report does not provide any useful or detailed information for assessing the impacts. In the last part of the section, the concept expressed is that, since mammals are **the most sensitive organisms to radiation exposure**, "*the standards of environmental control needed to protect the general public are likely to be sufficient to ensure that other species are not put at risk*". **It is opinion of the SCHEER that this statement is simplistic and does not allow estimation of the potential risk for the environment, without an assessment of the potential exposures and sensitivities of the different components of the ecosystems.**

Impact of severe accidents

An approach based on the use of a site-specific Probabilistic Safety Assessment (PSA) is used to quantify the risks associated with severe accidents based on two risk indicators (fatality rate and risk aversion). It is concluded in the report that overall, the fatality rates due to normal operations are much higher than the corresponding rates due to severe accidents.

The SCHEER is of the view that fatalities is an indicator to assess the impact of severe events but not the only measure for risk assessment. The SCHEER also takes the view that concurrent accidents at multiple units on a site can occur in reality therefore, there is considerable interest to direct the PSA methodology to include multi-unit site risk assessment with improvement of the site safety level and enhancement of public safety. In addition, the risks of nuclear accidents will remain irrespective of regulatory safeguards.

In conclusion, the SCHEER is of the opinion that the findings and recommendations of Part A of the report with respect of the impacts are in the main comprehensive. However, the SCHEER is also of the opinion that there are several findings, where the review is incomplete and requires to be improved with further evidence. For the DNSH criteria, in many cases the findings (comparing NPP to other energy generating technologies already in Taxonomy) are expressed as do less harm than at least one of the comparator technologies, which in the SCHEER view is **different to "do no significant harm"**. It is **the opinion of the SCHEER that the comparative approach is not sufficient to ensure "no significant harm."**

The JRC report concludes that NPP operation activities do not represent unavertable harm to human health or to the environment, provided that the associated industrial activities satisfy appropriate Technical Screening Criteria. The SCHEER broadly agrees with these statements but is of the view that while the regulatory regimes do exist and in principle should be sufficient, there is a valid concern regarding the implementation and monitoring of such regulations and whether, e.g. for mining and milling, and that risks due to nuclear accidents remain regardless of mitigating measures.

Part B: Specific assessment on the current status and perspectives of long-term management and disposal of radioactive waste

Given the SCHEER expertise (which does not include expertise on management and disposal of radioactive waste), the SCHEER has provided only general comments on Chapters 1, 5 and 6 of Part B.

The SCHEER is of the opinion that any long-term management and disposal of radioactive waste must be supported by monitoring. The SCHEER is not in agreement with the phrase **"maintaining the safety.... constitutes an undue burden"** within the statement **"Permanent spent fuel and high-level waste storage under active human control is not an acceptable solution for long-term management, as maintaining the safety of the storage facility would constitute an undue burden imposed to future generations"**. **The expressed view seems in contradiction to a later statement that "This compliance (with the regulatory limits set for the radioactivity dose contribution to the non-professionally exposed population) must be ensured and demonstrated for all the steps subjected to active monitoring by the operators and also for the very long-term duration associated with the final disposal of long lived and high-level waste and spent fuel (post-closure phase)"**.

Within the JRC report (part B) the definition of accessible biosphere seems to exclude deep biosphere: deep sea environments and deep subsurface. The SCHEER is of the opinion given the timescales of storage that this definition needs to be reconsidered. The SCHEER is also of the view that Chapter 5 is too focussed on humans, with other organisms not explicitly protected.

With regard to Chapter 6, the SCHEER notes that many of the potential suitable geological repositories exist outside the EU (see our comments regarding mining and milling) and that the design and performance of engineered barriers remains an active research area. The SCHEER agrees that **"The current focus of basic research is to extend the body of knowledge to cover special cases, e.g. to reduce uncertainties associated with the very long timeframe of final disposal, e.g. the accurate determination of the inventory of**

radionuclides relevant to the **waste repository evaluations and/or the properties of "hard to characterize" radionuclides."**

The SCHEER notes that "there is no empirical evidence generated by a radioactive waste disposal facility that has gone through all the three stages (pre-operational, operational, and post-closure) for the entire timeframe foreseen; none of the existing facilities has completed its entire lifecycle". The SCHEER also notes that risk assessment to environment and human health of long-term disposal of radioactive waste is based solely on modelling, and over very long timescales thus increasing the uncertainties around any modelled impacts. The SCHEER is of the view that high-level waste storage remains an open research question, with considerable uncertainties.

5. REFERENCES

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