



**Committee on Radioactive Waste Management**

**CONSULTATION  
RESPONSE:  
TOWARDS FUSION  
ENERGY**

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# CORWM RESPONSE TO CONSULTATION: TOWARDS FUSION ENERGY

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## 1 Overview

CoRWM welcomed publication of the Green Paper, Towards Fusion Energy, and has considered the implications for regulation and decommissioning of fusion power plants, and the management and disposal of associated radioactive wastes. Herein, CoRWM sets out its response to selected consultation questions in the Green Paper, of relevance to its remit. CoRWM has recently set out its first consideration of managing radioactive wastes from fusion energy, in a Preliminary Position Paper on Radioactive Wastes from Fusion Energy; <https://www.gov.uk/government/publications/radioactive-wastes-from-fusion-energy-preliminary-position-paper>. Consideration of this topic will continue and CoRWM will produce a further consolidated position paper in due course.

## 2 CoRWM Response to Consultation Questions

1. Are there other critical regulatory areas that the government should address when considering the regulatory framework for fusion energy in the UK? Please explain what these are and why they are important.

CoRWM considers that government has identified the critical regulatory areas of importance to fusion energy in the UK.

2. Do you agree with the Government's conclusions regarding the expected hazards of future fusion power plants? Please provide as much evidence as possible to support your view.

CoRWM is in agreement that the currently identified / known hazards of fusion energy are as not the same as those of nuclear fission. It would appear that Beyond Design Basis (catastrophic) Accidents are not considered feasible at the present level of knowledge. However, it is felt that it is best practice to keep an open mind and keep the technology and its regulation under review. Of significant importance here is the potential need for a liability management / insurance scheme to provide investor and commercial confidence that a "belt and braces" approach is in place to protect their interests as the technology develops and matures.

CoRWM notes the reasonable use of representative worst case and a hypothetical catastrophic accident scenario in evaluating the expected hazards of fusion power plants, given the significant uncertainty around the radiological inventory. Nevertheless, CoRWM is of the view that public confidence in regulating the hazards of fusion power plants will be strengthened by evaluation of more realistic accident scenarios.

Further comments specific to radioactive waste management are given below.

3. Do you agree with the proposal to maintain the existing regulatory approach? Please explain your response.

CoRWM considers that it is not necessary to make a decision to alter the approach at this relatively early point in the development of fusion energy technology. CoRWM is of the view that it is better to maintain current approaches that command public and key stakeholder confidence as and until the level of uncertainty about the risk profile of fusion technologies is better understood.

Notwithstanding, the full nuclear regulatory regime currently applied to nuclear fission technology may prove to be overly burdensome in the long term, given the likely level of potential hazard presented by fusion energy. However, it is too early and arguably unnecessary to make that determination at present.

CoRWM opines that public and investor confidence is an important consideration. The significant “big picture” potential societal benefits of fusion technology – in sustainable energy provision; in underpinning action to reduce greenhouse gas emissions and the rate of global warming, and hence climate change; and in the potential for the UK to take the lead in an international market in fusion technology; would appear to justify maintaining trusted regulatory approaches in the medium term. The current approach to nuclear regulation relies upon an established system of nuclear liability insurance and an independent regulatory regime that underpins public assurance and reassurance, and investor confidence. Regulator competence and independence from the technology provider / system operator is also fundamental to that process.

4. Do you agree that IRR 2017 and EPR 2016 provide for the consenting and permitting (respectively) of fusion power plants in a way that is proportionate and appropriate? Please explain your response.

CoRWM recognizes that IRR 2017 and EPR 2016 provide an option for regulation of fusion power plants but believes that the government should keep their options open for managing future hazards from fusion appropriately.

5. Do you think that fusion power plants should be considered to be nuclear installations under the terms of the Nuclear Installations Act 1965 and so be brought within the remit of the nuclear licensing framework led by ONR, either at this stage or in the foreseeable future? Please explain your response.

CoRWM emphasises its advice that the risks of nuclear fusion technology need to be seen to be managed carefully, openly and by public bodies that are accountable and carry public and investor confidence. Seeking to disassociate fusion energy from nuclear fission by defining fusion power plants not as nuclear installations but as some other category of installation could be interpreted as attempting to loosen controls prematurely and for the wrong reasons.

6. What are your views on the Government’s proposals in relation to the

### regulatory justification of fusion?

CoRWM considers that the regulatory justification process is essential. We know there are huge potential benefits associated with fusion energy, but the full costs and long-term risks are less well understood. In other words, the societal risk / benefit trade-off needs to be fully investigated through a risk / benefit informed process. Concrete questions remain regarding the future implementation of the technology. With regard to waste products, a full assessment of the management options, including possible consignment to a Geological Disposal Facility, should be part of that justification process.

7. Do you agree that a legislative approach is appropriate for clarifying that a nuclear site license would not be needed for fusion power plants? Please explain your response.

CoRWM believes a legislative approach is important for reasons of clarity and to avoid parliamentary, media and public misunderstanding. Sufficient and transparent regulation is important for public confidence and that can be provided without recourse to requiring a nuclear site licence. However, we would caution against making premature decisions, because current licensing arrangements are well understood. This a matter for future establishment of facts and arguments regarding the societal advantages and disadvantages of nuclear site licensing.

CoRWM notes that other major industrial countries are considering the most appropriate form of regulation for fusion power plant and this offers the potential to inform UK decisions. There may also be lessons from decisions in other countries on liability.

8. Do you agree with the proposal to establish a Fusion NPS based on the planning assumptions outlined above? Please explain your response.

CoRWM agrees with the proposal to establish a fusion energy NPS. We believe it is essential to give careful thought as to what this says about radioactive wastes, and how that fits into an overarching policy.

9. What other issues should a Fusion NPS address?

CoRWM advises that the fusion energy NPS should consider the whole “nuclear island”, since the breeder and fuel production plants are an integral part of the fusion power plant.

10. Do you believe that a third party liability regime is required for fusion?  
Please explain your response.

CoRWM has emphasised the importance of investor confidence. It is possible that a lower intensity liability regime – to reassure foreign vendors – may be appropriate but this requires careful prior investigation and appraisal.

11. What are your views on the principles and issues regarding third party liability set out in this paper?

CoRWM agrees with the consideration of decommissioning and radioactive waste management within the proposed nuclear fusion NPS. This may be an issue for third party liability.

12. What issues in addition to those described in this paper should any fusion third party liability regime address?

CoRWM suggests that it would also be appropriate to consider issues of commercial viability.

16. Do you agree that the proposed definition of fusion energy facilities that should be in scope for enhanced regulatory engagement and new guidance is appropriate? Please explain your response.

CoRWM considers that an enhanced regime for early engagement between developers and regulators for proposed fusion facilities is highly desirable. It will help to clarify uncertainties as to design, operation and types of hazard. Importantly, it will help to ensure that decommissioning and radioactive waste management are addressed at an early stage of design and minimize the likelihood of costly mistakes. It should also help to give confidence to the public and to investors in the technology. Plainly, the type of facilities subject to such a regime will need to be defined clearly so as to ensure transparency. While the proposed 50 MW /  $7 \times 10^{16}$  Bq Tritium definition seems logical, in terms of what is currently known about the technology, it will be important to keep this under review as any hazards associated with different designs become clearer and as more is known about the types of wastes which these facilities may produce. CoRWM advises that it is important to keep an open mind as to whether scale and tritium inventory are the only factors which may justify early and enhanced engagement, or whether there may be others – for example the radioactivity of components which are to be replaced or decommissioned. For that reason, it would be best if



the definition is in policy, rather than in legislation, to allow for relatively easier modification.

CoRWM notes that there may be lessons on enhanced regulatory engagement from other major industrial countries as fusion power plants are developed over the coming decade.

**22. What are your views on how the technical expertise of UKAEA could best be used to support the development of a regulatory framework for fusion energy in the UK and around the world?**

CoRWM considers that the expertise of UKAEA places the organization in prime position to help create and lead a strong UK PLC presence in a future international fusion market. However, CoRWM believes it is important for a UK regulator to have an independent source of technical support. CoRWM notes that the potential for UKAEA to contribute internationally might be limited by the tendency of governments to invest in and rely on their own national institutions.

**23. What are your views on how radioactive waste from fusion should be safely and sustainably managed?**

CoRWM has recently set out its initial position of managing radioactive wastes from fusion energy, in a Preliminary Position Paper on Radioactive wastes from fusion energy:

<https://www.gov.uk/government/publications/radioactive-wastes-from-fusion-energy-preliminary-position-paper>

CoRWM is of the view that radioactive wastes from nuclear fusion should be controlled in the same way as all radioactive wastes: they should be safely managed and in a manner that is sustainable in the long term – no matter what the source. The UK policy framework for managing radioactive substances and radioactive wastes should be applied to management of radioactive wastes from nuclear fusion. CoRWM notes that toxic waste streams, in particular significant quantities of beryllium, will also require management in addition to radioactive wastes.

CoRWM emphasises the importance of ongoing research and development to minimise radioactive waste arisings from fusion energy, by reducing activation through judicious materials design and selection. As part of the application of the broader waste hierarchy, minimizing such waste arisings is of fundamental importance in realizing a safe and sustainable regime for managing radioactive wastes. CoRWM notes that reuse or recycle of radioactive materials from

decommissioning of fusion reactors in subsequent systems, within regulatory control, has been proposed, with the intention of waste minimisation. Remote handling and fabrication techniques will be needed if the dose rate or inventory of the materials demand. It is recognised that there is considerable experience and capability in remote handling developed through operation and maintenance of the JET platform, however, it will be necessary to further innovate and optimise such technology for deployment in waste recycle and reuse applications, which may require considerable innovation and prove uneconomic.

Moreover, the materials and design considerations of future nuclear fusion systems have yet to be conceived, and it would be reasonable to assume they will evolve in an effort to improve performance. CoRWM considers that in the absence of enabling technologies and even a conceptual market, reuse and recycle of materials must be considered hypothetical. CoRWM therefore advises that it would be prudent and transparent to plan a baseline scenario of disposal of such materials as waste, if free release cannot be reasonably assumed. Reuse and recycle within regulatory control should only be considered as a viable alternative waste minimisation strategy when any necessary enabling technology is sufficiently mature and there is confidence of uptake as a feedstock for future fusion reactors.

**24. Do you believe that Government policy should reflect an expectation that radioactive waste from fusion can be disposed in near-surface disposal facilities? Please explain your response.**

CoRWM considers this question to be premature. CoRWM emphasises that radioactive wastes should be managed in a disposal setting at a depth and with containment appropriate to their radiological risk. CoRWM notes that there is currently considerable uncertainty in the radioactive waste inventory arising from fusion power plants and that this will be different for different technologies.

CoRWM considers that some radioactive wastes may potentially be suitable for disposal in a near surface facility. However, some key activation products of concern in radioactive wastes from fusion power, such as  $^{14}\text{C}$  and  $^{94}\text{Nb}$ , are long lived, and should be limited in near surface disposal facilities, given the reliance on engineered barriers to assure containment. CoRWM believes there is insufficient evidence and knowledge, at this time, to assure management of the radioactive waste inventory from fusion energy in only near surface disposal facilities. CoRWM therefore considers that geological disposal may be required for some of the longer lived waste inventory, to provide appropriate isolation and containment at depth. CoRWM advises

that consideration will need to be given to the issue of near surface disposal of discrete items, in terms of waste acceptance criteria in the context of human intrusion scenarios. This is because design of fusion reactors for modular assembly and for decommissioning could yield large activated single items which could be attractive for future recovery, if disposed in a near surface facility.

**25. What are your views on how a fusion facility should be decommissioned?**

CoRWM advises that decommissioning of fusion power facilities should be fully designed and costed in from the outset – including the potential disposal routes. Early discussion with regulators and other key stakeholders should form part of that design process.

CoRWM emphasises that the development of an integrated radioactive waste management strategy has enabled the development of more robust and cost effective decommissioning plans for nuclear fission reactors, through lifecycle management that accounts for the radiological, chemical and physical properties of the waste. This approach has also enabled development of the commercial environment to implement waste treatment technologies required to enable implementation of the waste hierarchy. CoRWM recommends that the development of a such a holistic planning strategy for management of waste from future expansion of nuclear fusion power would be advisable, such that the required waste treatment and disposal facilities can be planned and costed according to the projected volumes of waste arising, and the feasibility of reuse and recycle of activated materials assessed. This could function as a projected radioactive waste inventory, periodically updated as uncertainties in fleet size, disposition and materials are constrained.

**26. How should these topics be covered in any guidance developed for the fusion regulatory framework?**

CoRWM considers that the regulatory guidance should be clear, succinct, and communicated appropriately to engage public understanding and confidence.

**29. Do you agree with this proposed approach for keeping the fusion regulatory framework under review? Please explain your response.**

CoRWM agrees that, as a matter of good regulatory practice and engagement, particularly in the context of a maturing technology, that the

regulatory framework should be subject to periodic review, consultation, and update.