

Institution of Engineering and Technology's response to the Department for Energy Security and Net Zero consultation on 'Fusion energy facilities: new National Policy Statement and proposals on siting'

About the Institute of Engineering and Technology (IET)

The IET is an independent source of impartial evidence-based engineering and technology advice and welcomes the opportunity to respond to this important Department for Energy Security and Net Zero (DESNZ) consultation on fusion energy. The IET has produced a series of reports on low-carbon energy systems and has previously responded to a range of consultations on the topic of energy. We hope our responses are of value and would welcome the opportunity to elaborate on our feedback in person if required.

Executive summary

Fusion energy can play a key role in the UK's ambition to reach its Net Zero targets and build a secure and resilient energy system. Fusion energy facilities must be built in an efficient and safety conscious way to ensure both public support and value for money. This consultation is a helpful step towards ensuring that can happen. We have only provided answers to the questions on document 1 as this is the area our expertise is best placed to provide constructive analysis and advice. We are currently working on a project that explores the issues raised in document 2. However, this is not currently ready to publish. We will follow up with DESNZ once we can provide that information.

Our key comments relating to the questions in document 1 are as follows:

- We support many of the proposals that the government are consulting on. However, there are still a number of blind spots particularly in areas on development and site assessment. Before bringing forward legislation the Government must ensure that this is watertight and the concerns that we outline in this response have been considered.
- Building energy infrastructure in the UK remains a huge challenge. Firstly, government must get the definition of a fusion energy facility right in order to avoid the exploitation of loopholes during development. Ambiguity can open the door for legislation with good intentions to become inefficient and undermine output potential.
- Government must ensure that changes work within the boundaries of the Energy Act 2023. We have found areas in the recommendations that may contradict this Act.
- When developing fusion energy facilities government must take a full systems approach to the wider energy system. Whilst the first fusion energy facilities should be assessed on whether or not they reliably generate energy, when fusion develops into a more established energy source it should be assessed according to its role in the overall energy system, considering economics, security of supply and overall environmental impact. We would like to see a fully built out plan that highlights the important role that fusion energy will play in a future green energy system.

1. Do you agree that the planning process for fusion energy facilities should be aligned and maintained with other complex energy generation facilities?

We broadly agree with this statement. However, nuclear site licensing arrangements (as per a fission facility) shouldn't apply to a fusion site. If this was the case it would contradict clause 156 of the Energy Act 2023. There are critical differences between the fission and fusion which result in very different levels of hazard. The level of risk is greater for a fission site due to the potential for significant power excursions due to uncontrolled super-critical events, the challenge in managing decay heat, and the production of long-lived high-level radioactive waste. None of these hazards apply at fusion facilities, as such there is a clear rationale for applying a different licensing arrangement similar to those applied for other complex energy generation facilities. However, government should be aware that there are some risks associated with fusion facilities that are substantively different from those produced by other complex energy generating technologies (excluding fission). In particular the production of low and medium level radioactive waste and the need to manage high levels of gamma and neutron radiation. The adequacy of the planning process for managing these risks is outside the scope of this review but needs to be carefully considered. DESNZ should work across government departments to assess the adequacy of the planning process to effectively meet the needs of fusion sites.

2. Do you agree with the Government's proposal to include all fusion technologies in the NPS process?

We agree with this proposal. Different technologies for achieving fusion energy production should not be differentiated in the planning process, with the exception of fusion-fission hybrid reactors which we agree should be considered as nuclear facilities, regulated by the ONR and follow the planning and licensing process for nuclear facilities.

3. Do you agree with the Government's proposal to take an open-sited approach in the fusion NPS process?

The proposed open-sited approach will provide the maximum opportunity for communities to bid for a site in their area. However, we would like to draw the Government's attention to concerns that one of the proposed future uses of fusion heat, to run de-salination plants, would require sites to be close to the sea. This could create a natural monopoly for coastal sites and undermine any sense of an open sited approach.

4. Do you agree with the Government's proposal to include all fusion energy facilities in England, independent of capacity, in the fusion NSIP process?

We agree with this proposal. There are specific risks that come with fusion energy which remain significant even with smaller facilities. As a result, there is a concern that if the NSIP process only applied to fusion sites over a given capacity then it would be possible for a local planning authority to agree the construction of a small scale local fusion facility without proper consideration of the risks (ie the production of low and medium level waste,

management of high energy plasma, neutron shielding etc). Conversely, setting a threshold could also lead to unrealistic capacity claims to gain access to the preferential planning process for NSIPs.

5. Do you agree with the Government's proposal to include both thermal and electrical facilities in the fusion NSIP process?

Yes, both electrical and thermal facilities should be included. One of the potential benefits of fusion energy is the high-grade, GHG-emission-free heat which can be provided. The planning process should not give preferential treatment to either electrical or thermal output over the other.

6. Do you think the definition of a fusion energy facility, as provided in the Energy Act 2023, is suitable for distinguishing between a fusion energy facility and/or fusion research facility for the purpose of this NPS?

We encourage the Government to revisit this definition. In its current form the definition is not clear enough in areas such as fusion research facility consideration. Future fusion facilities will be used to perform some research, and all will generate heat from fusion reactions, so according to the current definition in the Energy Act 2023 a fusion facility built purely for research would still meet the definition because it will produce "heat". We worry that this is an unintended consequence of the NPS EN-8. We are concerned that the definition is currently too ambiguous which could lead to exploitation against the will of the government and spirit of the legislation. For example, the definition makes it permissible for a fusion energy facility to be built first as a fusion research facility and only later turned into a fusion energy facility. If that facility never became primarily used for the production of electricity or heat, there are questions over what the consequences would be under the planning laws. The definitions of NSIPs under the Planning Act 2008 do not include any kind of scientific infrastructure as far as we can see. The current definition could make it potentially easier to receive development consent for a fusion energy facility than a fusion research facility. It would be better to include all fusion facilities, whether primarily for research or for energy production, under the fusion NPS.

7. Do you agree with the Government's proposal to not set a deployment deadline for fusion energy facilities?

We support and agree with this proposal. However, we would like to refer back to the answer to question 6. If a facility starts as a research facility with the intent to become an energy generation facility, then timescales may be beneficial as an incentive to achieve the stated intent.

8. Should developers consider any other factors in assessing reasonable alternatives for fusion energy facilities?

There are a number of areas that developers should consider.

- The following areas should be taken into account:
 - The management and transportation of medium level waste,

- Physical and cyber security arrangements in the local area,
- Security of supply; - The extent to which the energy provided is dependent on external factors such as the wind, sun or imported goods, services and technologies.
- Flood risk; - In the context of climate change impact, which for example is expected to increase in London with increased rainfall and rising sea levels.
- Coastal erosion, which is greater than expected along the East Coast due to increased winter storms, hot weather and cracking of the sand-based coast. This is a particular issue if coastal siting is required for water access for cooling.
- The scale of the impact from these factors may have bearing on the assessment of the most suitable technology solution to meet the needs.

9. Do you believe that the proposed criteria cover all aspects necessary for assessing the suitability of sites for fusion energy facilities?

10. Are there any additional criteria that should be considered in the assessment process?

There are a number of aspects that have been overlooked in the proposal document and in EN-1. It is important that the government must assess all potential threats to fusion energy facilities and explore in detail how they can mitigate these concerns within legislation and the licencing and planning processes. It is of vital importance that on top of the existing issues raised in the documents the following concerns are also acknowledged when assessing the suitability of sites for fusion energy facilities:

- Emergency access – both for worst case scenario accidents (particularly events such as fire, uncontrolled chemical release or turbine disintegration) and for security incidents (i.e. control of the site being taken by a terrorist group).
- Vulnerability to low likelihood / high impact events (i.e. a tsunami) – credible sources of such events, the scale thereof, and thus the potential for designed mitigations and emergency preparations should form part of the assessment process.
- Radiation directed skyward should be considered in siting fusion facilities, as usually less shielding is provided above a fusion device than at ground level. This differs from what is usually seen with fission power plants and therefore may be an unforeseen matter to consider.
- The potential effect of radio-frequency heating and current-drive systems to radio-tele-comms, civil and military radar, radio telescopes, and other facilities and infrastructure using radiofrequencies should be considered in the siting assessment. This applies primarily to magnetic-confinement fusion devices, however, should also be considered for others fusion technologies depending on how they achieve fusion conditions.
- The likelihood of extreme heat and the impact this may have on fusion projects. Extreme heat may amplify risks such as land subsidence, general water demand, and population changes.
- In addition, there are a number of criteria which are mentioned at a high level within EN-1 but which do not appear to capture specific areas of risk which would apply to a fusion energy facility:

- Safety - EN-1 section 4.13 covers accidents at a generic level, however, a fusion energy facility would need the consideration of a number of specific risks which are not well covered at present and would benefit by being drawn out in more detail here. For example, fire and uncontrolled chemical release could both pose particular challenges due to unusual substances which would be expected to be found on a fusion site. Similarly, turbine disintegration events could generate high speed missiles which would represent a hazard both on site and to nearby public and industry, as they would at any electricity generating site with a turbogenerator.
- Security concerns – EN-1 addresses these, however, given the high profile status that the first generation fusion facilities would hold, it should be expected that terrorist, cybercriminal, or hacktivist groups would consider such facilities to be particularly attractive targets. Equally the status of these facilities in demonstrating the UK's position on the world stage would also mean that a successful attack (even if there were no wider consequences) could lead to a great deal of harm to national prestige and reputation. As such particular attention should be provided to ensuring the robustness of security arrangements. As such both physical and cyber security aspects should be considered, in line with critical national infrastructure.
- Effect on marine life – EN-1 Section 4.5 addresses the marine environment, however, this does not adequately address the potential impact on marine life due to increases of local water temperature where water is returned to the sea after being used for condenser cooling, as should be considered for any energy generating facility that uses seawater for cooling.
- Criteria should not only be considered in a restrictive sense, but also in an opportunistic sense, similar to how biodiversity gain is considered. Regarding cooling:
 - Developers should be encouraged to integrate their cooling systems with district heating systems, rather than consider low-grade heat as a waste product.
 - Greater use of newly created water bodies adjacent to proposed plants which would not only provide the required cooling to the energy facility, it could also provide a dedicated water supply as the demand for water increases, as well as part of a plan for enhanced biodiversity gain that would be lost during the construction process on green field sites.

11. Do you think there should there be a separate set of criteria for different fusion technologies?

There shouldn't be a separate set of criteria for different fusion technologies for reasons outlined in previous answers. However, it is acknowledged that radio-frequency interference may not be a significant consideration for some fusion technologies.

12. Do you agree with the proposed model for implementation of the Fusion NPS?

We agree with this proposed model.