

IOP Institute of Physics

Submission to the House of Lords EU Energy and Environment sub-committee inquiry into Brexit and energy security

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1. The Institute of Physics is a leading scientific membership society working to advance physics for the benefit of all. We have a worldwide membership from enthusiastic amateurs to those at the top of their fields in academia, business, education and government. Our purpose is to gather, inspire, guide, represent and celebrate all who share a passion for physics. And, in our role as a charity, we're here to ensure that physics delivers on its exceptional potential to benefit society. Alongside professional support for our members, we engage with policymakers and the public to increase awareness and understanding of the value that physics holds for all of us. Our subsidiary company, IOP Publishing, is world leader in scientific communications, publishing journals, ebooks, magazines and websites globally.
2. The IOP welcomes the opportunity to submit evidence to the House of Lords EU Energy and Environment sub-committee inquiry into Brexit and Energy security. Our written evidence concerns the implications of the UK's withdrawal from Euratom and implications of withdrawal from the EU for the UK's energy security.

Our concerns about leaving Euratom can be categorised into four areas: safeguarding issues, trade of nuclear materials, movement of nuclear services and expertise, and research in nuclear fission and fusion.

Safeguarding

3. Nuclear safeguards are a set of technical measures by which the International Atomic Energy Agency (IAEA) verifies that countries are complying with their international obligations to use nuclear material and technology only for peaceful purposes.¹ The UK is a nuclear-weapons state, which means that it is not required to adopt safeguards under the non-proliferation treaty. However, the UK has signed a voluntary offer safeguard agreement with the IAEA, which means its civil nuclear activities are subject to IAEA safeguards.²
4. Currently, the UK meets its safeguarding requirements through Euratom, as Euratom provides safeguarding inspections for more than 100 UK facilities (including non-power-producing nuclear facilities). This includes 15 power reactors which provide approximately 21% of the UK's electricity.³ In 2014 safeguarding inspections required some 220 inspections, involving 1,000 person-days of Euratom effort.⁴ The equipment required to do these checks is also the property of Euratom.
5. The Government intends to transfer safeguarding duties to the Office for Nuclear Regulation (ONR) through the Nuclear Safeguards Bill, announced in the 2017

Queen's speech.⁵ However, in order to comply with the safeguarding agreement with the IAEA, safeguarding inspections must be carried out by international inspectorates. This could be arranged through the IAEA but it would require time to negotiate these arrangements. It will also come at a cost, as training to be a safeguards inspector can take up to ten years from starting a degree in a relevant field, such as physics or engineering. The Nuclear Safeguards Bill will need to pass through parliament quickly to enable time for a new safeguarding regime to be implemented before the date at which the UK leaves the EU and Euratom. Only when the UK has made new arrangements to comply with the non-proliferation treaty can new Nuclear Cooperation Agreements (NCAs) begin to be negotiated. This will depend on the Nuclear Safeguards Bill passing through parliament, which will give the ONR responsibility to arrange the UK's safeguards.

Trade of nuclear materials

6. New NCAs will need to be in place for the trade of nuclear materials to and from the UK to continue after the date at which the UK leaves Euratom, as countries will not trade with the UK unless a new agreement is confirmed. This is in accordance with Article III of the non-proliferation treaty which requires signatories to ensure countries with which they trade comply with international safeguards.⁶ Currently, most of the UK's NCAs are agreed through Euratom. The UK also has its own bilateral arrangements (e.g. UK-Japan) but some of these refer to Euratom safeguarding and will need to be renegotiated when the new regime has been established. The UK will need to do either of the following prior to the leave date in order to continue the trade of nuclear materials and ensure energy security:
 - Enter into a bilateral agreement with Euratom and then organise separate agreements with countries outside of Euratom.
 - Arrange separate bilateral agreements with all countries (inside and outside of Euratom) with which the UK wants to trade.
7. Even with willingness from other countries, the complexity of renegotiating almost all of our NCAs will take time, especially alongside other matters to be settled during the Brexit negotiations. New NCAs must be agreed by the date at which the UK leaves Euratom, or at a minimum, a transitional agreement must be in place to ensure the UK's security of supply in the immediate term. If neither of these options is achieved, the UK will not be able to legally trade nuclear materials with other countries. This will have an immediate impact on UK energy security, as nuclear power currently provides 21% of the UK's electricity supply⁷ and the power plants use imported fuel and components. When the fuel runs out, power plants will need to shut down.
8. The UK is reliant on imports of radioisotopes such as molybdenum-99 and technetium-99m for medical purposes, which makes it vulnerable to any issues with shipping and importation as well as global shortages.⁸ The government has said the trade of medical radioisotopes will not be directly affected by leaving Euratom as they are not subject to safeguards.⁹ However, the UK is a part of the European Observatory on the Supply of Medical Radioisotopes, which has a mission to ensure security of supply of medical radioisotopes for all members of Euratom.¹⁰ If the UK

does not remain a member of the Observatory, it would need to find an alternative way to ensure a secure supply.

Movement of nuclear services and expertise

9. The nuclear industry is international in nature. The UK imports expertise and relies on foreign investment. For example, the two new reactors being built at Hinkley Point C are European Pressurized reactors (EPRs), developed by the French company Areva. There are already at least 300 EPRs in operation, including 75 in France.¹¹ Most potential builders of nuclear power plants are not from the UK - the construction of Hinkley Point C is led by the French company EDF.
10. A number of nuclear technologies will be important to future energy markets and the UK does not have expertise in all of these technologies. For example, Horizon Nuclear Power UK, an owned subsidiary of Japanese company Hitachi, is proposing a new UK Advanced Boiling Water Reactor design for two reactors in North Wales and South Gloucestershire.¹² The UK does not have experience in this technology at the moment and requires expertise and investment from overseas.
11. Where the UK does have expertise, in areas including Small Modular Reactors and decommissioning, the technology and skills can be exported. Workers in the nuclear industry cross borders where their expertise is required. As with nuclear fuel, the UK's ability to trade in nuclear goods and services will rely on new suitable trade agreements being in place by the point at which the UK leaves Euratom. If they are not, there will be a risk that new build projects will be delayed.

Nuclear fission research

12. Leaving Euratom will have implications for nuclear fission research in the UK, including access to European programmes and facilities. Nuclear fission research involves a wide range of areas, including waste management, decommissioning, regulation, public acceptability, existing operations, new nuclear build, advanced reactor technology, the fuel cycle and geological waste disposal.¹³ Many of these areas require research infrastructures, which are commonly a result of international collaborations due to the large expense of building them. The UK does not have any of its own civil research reactors now that CONSORT at Imperial is being decommissioned.¹⁴ This makes UK access to European research reactors and the ability to access the results of the R&D that takes place there all the more important to nuclear fission research. Leaving Euratom and the EU could impede UK access to a number of programmes and facilities as set out below.
13. The European Strategy Forum of Research Infrastructures (ESFRI) was set up in 2002 and has a mandate from the EU Council to 'support a coherent and strategy led approach to policy making on research infrastructures in Europe' and to 'facilitate multi-lateral initiatives leading to better use and development of research infrastructures'. ESFRI brings together representatives from EU member states to the forum to coordinate the development of new world class facilities. If the UK wishes to

retain its strength in nuclear research, it should seek to remain a part of ESFRI after leaving the EU.

14. The UK is part of the Euratom Research and Training programme, which runs from 2014 to 2018 and complements the Horizon 2020 program, covering both fission and fusion research. The 2016-17 work programme places emphasis on the long term security of energy supply at an EU level, and has a number of specific objectives. These include: supporting the safety of nuclear systems, supporting development and sustainability of nuclear expertise and excellence in the EU, moving toward demonstration of feasibility of fusion as a power source, promoting innovation and industrial competitiveness, and ensuring availability and use of research infrastructures of pan-European relevance.¹⁵
15. The nuclear activities of the European Commission Joint Research Centre¹⁶ are funded by the EC framework programme for research and innovation, amounting to €1.9 bn¹⁷ for the period from 2014-2020, and the Euratom Research and Training Programme, amounting to €560 m for the period from 2014-2018. The JRC receives additional funding from European Free Trade Agreement countries and other associated countries. This amounted to an additional €17.1 m in 2015.¹⁸
16. JRC activities take place at four research reactors; Karlsruhe, Petten, Geel and ISPRA. ISPRA in Italy is the largest JRC campus and has 1850 staff. There are also other reactors which the UK benefits from access to, such as the Jules Horowitz water moderated materials test reactor (JHR), currently under construction in Cadarache, France. The JHR is a major international collaboration to meet materials test requirements as old reactors are ageing - The UK committed an initial £12.5 m to the project in 2013.
17. Continued commitment to this R&D programme is essential for the UK to play a part in nuclear safety in Europe and the future energy mix. Leaving Euratom will mean that access to the JRC, JHR and other reactors will need to be renegotiated. If there are delays in arranging this it could have a severe impact on nuclear energy research.

Nuclear fusion research

18. The Euratom Research and Training programme includes the “European Consortium for the Development of Fusion Energy”, or Eurofusion. Eurofusion manages and funds European fusion research activities on behalf of the European Commission. Fusion research activities are funded in line with the roadmap to the realisation of fusion energy, which “outlines the most efficient way to realise fusion electricity by 2050”.¹⁹ The roadmap states that fusion will contribute up to 30% of electricity production by the end of the century. There is a risk that leaving Euratom will seriously undermine the stake of the UK in this future grid electricity generation technology.

19. The UK is a world leader in nuclear fusion research²⁰ and its continued involvement in EU projects is vital for this to continue, due to the international nature of the large project. The UK has taken a lead role as the host of both MAST-U and the Joint European Torus (JET). JET currently receives around €56 m/£48 m annually from Euratom as part of the contract running until the end of 2018. The UK has committed to funding its share of JET until 2020²¹ but the EU still needs to agree to contribute its share of the funding for the project to continue beyond 2018. The next stage of the fusion roadmap is ITER: Euratom provides 45% of the funding for ITER which is currently being built in Cadarache, France.
20. For the UK to continue to have involvement in ITER and remain a leader in nuclear fusion, a new multilateral cooperation agreement must be negotiated. The other members of the consortium are China, India, Japan, Korea, Russia and the US which are all outside of Euratom, so it is feasible to arrange to participate. Euratom also has a range of bilateral and multilateral arrangements on nuclear R&D co-operation with other countries including Argentina, Canada, China, Japan and the USA.
21. The training component of the Euratom Research and Training programme has resulted in strengthened training capability in nuclear and plasma physics/technology at UK institutions. The Fusion Centre for Doctoral Training²² at the universities of Durham, Liverpool, Manchester, Oxford and York is essential for the training of the next generation of leaders in the field and universities are a crucial component of the UK fusion effort. While their funding comes from the EPSRC, their success relies upon access to world-class fusion facilities, including JET, MAST-U and the Eurofusion education fund.

**For further information, please contact
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¹ IAEA. Safeguards and Verification. <https://www.iaea.org/topics/safeguards-and-verification>

² Office for Nuclear Regulation. IAEA Safeguards in the UK. <http://www.onr.org.uk/safeguards/iaeaauk.htm>

³ World Nuclear Association. Nuclear Power in the United Kingdom. <http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/united-kingdom.aspx>

⁴ Office for Nuclear Regulation. Euratom Safeguards in the UK. <http://www.onr.org.uk/safeguards/euratom.htm>

⁵ Queen's Speech 2017: Background Briefing notes. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/620838/Queens_speech_2017_background_notes.pdf

⁶ IAEA. Treaty on the non-proliferation of nuclear weapons. <https://www.iaea.org/sites/default/files/publications/documents/infcircs/1970/infcirc140.pdf>

⁷ Energy UK. Electricity Generation. <http://www.energy-uk.org.uk/energy-industry/electricity-generation.html>

⁸ POST. Supply of Medical Radioisotopes. <http://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0558>

⁹ House of Commons Official Report Parliamentary Debates Volume 626 No. 7 Tuesday 27 June 2017, Euratom Treaty [900024]. <https://hansard.parliament.uk/Commons/2017-06-27/debates/3442FB6E-142E-4E5D-9A67-B3B190B2517C/EuratomTreaty>

¹⁰ European Observatory on the supply of medical radioisotopes. Mission Statement. http://ec.europa.eu/euratom/docs/radioisotopes_observatory_mission.pdf

¹¹ *Physics World*, April 2016. <http://live.iop-pp01.agh.sleek.net/2016/03/18/a-nuclear-revival/>

¹² Horizon Nuclear Power. <https://www.horizonnuclearpower.com/>

¹³ EPSRC, Nuclear fission strategic focus. <https://www.epsrc.ac.uk/research/ourportfolio/researchareas/nuclearfission/>

¹⁴ ONR, 2015. <http://www.onr.org.uk/pars/2016/imperial-college-15-010.pdf>

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- ¹⁵ European Commission. Euratom Work Programme 2016-17
http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/euratom/h2020-wp1617-euratom_en.pdf
- ¹⁶ European Commission. JRC in brief, <https://ec.europa.eu/jrc/en/about/jrc-in-brief>
- ¹⁷ Regulation (EU) No 1291/2013 of the European Parliament and of the Council. Establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020).
https://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/fp/h2020-eu-establact_en.pdf
- ¹⁸ European Commission. Nuclear Activities of the Joint Research Centre, October 2016.
<https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-euratom-facts-figures-2016.pdf>
- ¹⁹ European Fusion Development Agreement, 2012. A roadmap to the realisation of fusion energy.
<https://www.euro-fusion.org/wpcms/wp-content/>
- ²⁰ EPSRC Independent review in fission and fusion.
<https://www.epsrc.ac.uk/newsevents/pubs/indrevfissionfusion/>
- ²¹ Gov.UK Press release. Government commits to continue funding its share of Europe's flagship UK-based nuclear fusion research facility, <https://www.gov.uk/government/news/government-commits-to-continue-funding-its-share-of-europes-flagship-uk-based-nuclear-fusion-research-facility>
- ²² Fusion CDT. <http://www.fusion-cdt.ac.uk/>