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Joint Committee on Housing, Local Government and Heritage
Leinster House
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Tel: (01) 618 3325
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Ref: **HLGH-i-11**

Mr Eamonn Kelly
Principal
EU & International Planning Regulation
Department of Housing, Planning and Local Government
Custom House
Dublin 1

E-mail: transboundaryeia@housing.gov.ie

Issued by email

22 October 2020

Re: Transboundary Environmental Consultation pursuant to the Convention on Environmental Impact Assessment in a Transboundary Context (the "Espoo Convention") concerning the Proposed development of the Sizewell C Nuclear Power Station, Suffolk, United Kingdom

Dear Mr Kelly

I am writing to you on behalf of the Joint Oireachtas Committee on Housing, Local Government and Heritage in relation to the Transboundary Environmental Consultation, pursuant to the Convention on Environmental Impact Assessment in a Transboundary Context, concerning the proposed development of the Sizewell C Nuclear Power Station, Suffolk, United Kingdom.

The Committee, at its meeting of 20 October 2020, agreed to forward the following observations as part of the consultation process.

1. Brexit, Euratom & Nuclear Safety Regulations

The Committee would like to share its concerns around the British Government's decision to leave Euratom[1], the European Atomic Energy Community, as part of its withdrawal from the European Union. The Committee echoes

[1] www.onr.org.uk/safeguards/euratom.htm

the concerns outlined by the Office for Nuclear Regulation (ONR) regarding Britain's readiness to leave Euratom including:

- skills shortages to deliver a British State System of Accountancy for control of nuclear material to meet its international obligations;
- the on-time delivery of an effective replacement IT system to track nuclear material;
- the long-term funding of the new nuclear regulator.

The Committee also has concerns that once Britain has left Euratom, the British Government will no longer be subject to legal proceedings at the European Court of Justice in the event of failures to comply with nuclear safety regulations.

2. Impact of a Nuclear Incident

The Committee also expresses concerns surrounding the detrimental effects on Ireland that may result from an incident at the Sizewell C Power Plant.

- The Committee notes research[2] that an incident at Sizewell C could result in food controls and agricultural protections being introduced in Ireland.
- The Committee also notes research[3] which estimates the potential financial losses to Ireland in the event of a nuclear incident to be as high as €160 billion, and, even in the event of an incident where there is no contamination in Ireland, the reputational losses in relation to tourism and export markets could be as high as €4 billion.

Conclusion

Taking in to account the absence of access to the European Court of Justice post-Brexit, the ambiguity of the long-term funding of a new nuclear regulator, and the potential impacts to both the Irish public and the Irish economy in the event of an incident, the Joint Committee would like to register its objection to the proposed development of the Sizewell C nuclear power station.

Yours sincerely

[redacted]

Steven Matthews TD
Chairman

[2] https://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf
[3] https://www.esri.ie/system/files?file=media/file-uploads/2016-12/BKMNEXT313.pdf

From: attracta@ien.ie
Sent: 28 October 2020 17:08
To: planningdevman@carlowcoco.ie; Plan@cavancoco.ie; transboundaryeia@clarecoco.ie; planningpolicy@corkcity.ie; PlanningSizewell@corkcoco.ie; transboundary@dublincity.ie; planningsecretariat@dlrcoco.ie; planning@donegalcoco.ie; Fingal.DevelopmentPlan@fingal.ie; Planning; Planning Department; plandept@kildarecoco.ie; plan@kerrycoco.ie; planning@kilkennycoco.ie; planning@limerick.ie; planning@longfordcoco.ie; transboundary@louthcoco.ie; transboundarysub@laoiscoco.ie; planning@leitrimcoco.ie; planning@meathcoco.ie; planning@mayococo.ie; planning@monaghancoco.ie; planning@offalycoco.ie; planning@roscommoncoco.ie; planning@sligococo.ie; planning@tipperarycoco.ie; sizewell@waterfordcouncil.ie; submissions@wexfordcoco.ie; plandev@wicklowcoco.ie
Subject: Transboundary environmental public consultation – Sizewell C Nuclear Power Station
Attachments: EP and ELO submission on Sizewell C Transboundary Consultation.pdf; Annex I NFLA_New_Nuclear_Monitor_No63_Irish_Councils_Sizewell_EIA (1).pdf; Annex III pnnl-27120_harvesting_Dec2017-1.pdf; Annex 2 SZC Carbon reduction FINAL (1).pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Sir/Madame,

Please see attached submission in respect of the above . Please acknowledge receipt.

Yours sincerely

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Attracta Uí Bhroin

Environmental Law Officer

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NFLA New Nuclear Monitor Policy Briefing

Edition Number 63, October 2020

The proposed development of Sizewell C – Irish transboundary response to

i. Overview of Policy Briefing

This edition of the NFLA New Nuclear Monitor has been developed by the NFLA Secretariat in cooperation with the Irish Environmental Network to respond to a call from the Irish Government for views in Ireland on the proposed development of the Sizewell C nuclear reactor site in Suffolk, England.

Under the terms of the 1991 United Nations Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention), and the EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive), EU Member States are required to engage in transboundary public consultation in respect of projects likely to have significant effects on the environment of neighbouring States as part of the environmental impact assessment of a proposed development. As the UK is still in the transition period of leaving the EU, it is bound by the EU Directive, as well as the wider Espoo Convention.

All planning authorities in Ireland have recently received information in the form of a letter of notification dated 8 July 2020 from the United Kingdom's Planning Inspectorate (PINS) to the Irish Government Department of Housing, Planning and Local Government (DHPLG) relating to an application for development consent (planning application) for the proposed Sizewell C Nuclear Power Station, which is to be constructed in Suffolk, England, UK.

Submissions or observations on the proposed Sizewell development are open now, which should be made by e-mail to the relevant local County / City Council planning authority to be titled "**Transboundary environmental public consultation – Sizewell C Nuclear Power Station**" by no later than the **28th October**. The planning authorities will then send these responses to the Irish Government, who will pass them on to the UK Planning Inspectorate.

The NFLA provides below a model response to the proposed Sizewell C development to assist individual councillors, full Councils, regional assemblies, environmental groups and interested individuals to this consultation. In the past, NFLA have worked with other groups, such as the Irish Environmental Network (IEN), on holding local events with Councils on this issue, but the Covid-19 outbreak precludes such meetings taking place. This model response has been developed though in liaison with the IEN.

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Model response for Irish Councils to the Transboundary Consultation on the environmental impacts of the proposed Sizewell C nuclear reactor

1. Resolution passed by Irish Regional Assemblies in reference to the transboundary consultation on Sizewell C

As part of encouraging Irish Councils to consider developing a local response to this consultation, the NFLA has, on the request of a number of councillors, issued a model resolution to a number of Regional Assemblies. It has now, for example, been passed by the Northern and Western Regional Assembly. The resolution summarises our core concern with the transboundary environmental impacts of the proposed Sizewell C nuclear reactor, which is developed further in the coming sections of this model response. It is the core summary of the concerns Irish Councils should express through the consultation.

The resolution passed by the Regional Assembly is as follows:
"This Assembly calls upon the Government's Minister for Housing, Planning and Local Government and the Minister for Communications, Climate Action and Environment to object in the strongest possible terms to the proposed construction of two EPR-type nuclear reactors at Sizewell in Suffolk in the UK on the grounds that a severe accident, however remote the possibility, could have a devastating impact on the island of Ireland, and such a possibility has not been properly considered.

This Assembly also calls on the Government to seek a full Environmental Impact Assessment (EIA) to be conducted by the UK Government under national regulations informed by EU law. This includes a full invocation of Ireland's call to be fully consulted and for Irish public input to be included in the EIA and Appropriate Assessment. This Assembly calls in addition for an EIA to be undertaken as part of the UNECE Espoo Convention, ensuring that transboundary impacts cannot be excluded.

A severe accident scenario, such as the one suggested by the Radiological Protection Institute of Ireland, (1) would involve a loss of coolant with a release of fission products to the environment. This Assembly notes that impacts from the Chernobyl severe accident impacted on Ireland, and it notes an ESRI report that has indicated that, even in a severe accident scenario of no radioactive fallout hitting Ireland, the discounted economic losses were €4 billion, due to reputational impacts to tourism & agriculture. (2)

Nuclear engineer, the late John Large, expanded on this type of scenario pointing out that the fuel core would completely melt after about 16 hours. This could cause an explosion and a scenario very similar to the events at Fukushima. (3) Although EDF Energy´s Environmental Statement for a similar plant to Sizewell C being built at Hinkley Point C (HPC) says the likely impacts of an accident do not extend beyond the county of Somerset and the Severn Estuary, a report for the Austrian Environment Agency says severe accidents at HPC with considerable releases of radioactive caesium-137 cannot be ruled out, although their probability may be low. There is no convincing rationale why such accidents should not be addressed in the Environmental Statement (ES); quite to the contrary, it would appear rather evident that they should be included in the assessment since their effects can be widespread and long-lasting. (4)

This Assembly also calls on cooperation with the All Ireland Nuclear Free Local Authorities (NFLA) Sustainable Energy Forum, potentially in collaboration with the Irish Environment Network, to developing a detailed report on this matter with facilitation of a local workshop webinar on this matter, should the Assembly wish it."

(1) Proposed nuclear power plants in the UK – potential radiological implications for Ireland, RPII, May 2013
http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

(2) The Potential Impact of a Nuclear Impact – An Irish Case Study, ESRI, December 2012
https://www.esri.ie/system/files?file=media/file-uploads/2016-12/BKMNEXT313.pdf

(3) John Large Witness Statement in THE QUEEN (on the application of AN TAISCE) Claimant -and-SECRETARY OF STATE FOR ENERGY AND CLIMATE CHANGE Defendant -and- NNB GENERATION COMPANY LIMITED, 12th Nov 2013, http://www.largeassociates.com/cz3222/R3122-B-12-11-13.pdf

(4) Oda Becker, Hinkley Point C: Expert Statement to the EIA. Austrian Environment Agency, 2013 http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0413.pdf

2. Specific Irish concerns on the proposed Sizewell development

The NFLA has discussed this consultation response in detail with the Irish Environmental Network (IEN). Both NFLA and the IEN want to make Councils aware of the various practical considerations that come out of the UK Government's transboundary consultation on Sizewell C. It thanks Attracta Ui Bhroin for her helpful comments that we have included in this model response.

Ireland naturally respects the UK has the right to pursue its own energy mix, but Irish citizens and some public representatives are also conscious of the UK's legal obligations to consult on the transboundary impacts of the project and indeed its future operation and decommissioning.

In this regard it is of serious concern that there has been such a limited and inadequate consideration by the UK of the potential for transboundary impacts on Ireland. The overall messaging from the UK has been there is a very low likelihood of potential for transboundary impacts, and this was expressed clearly in the letter of 8th July 2020 from the UK Planning Inspectorate (PINS) to DHPLG and in the published transboundary screenings undertaken on behalf of the UK Secretary of State. This has been without clearly establishing how unacceptably narrow its consideration has been of the risks on us here in Ireland, and in particular the failure by the UK to adequately or at all, consider airborne transport of radiation from the UK to Ireland. These matters are set out in more detail below with reference to the application documentation.

The failure to consider airborne transportation in the Sizewell application documents and in the screening by the Secretary of State of the potential airborne passage of radioactive fallout impacting Ireland is entirely unacceptable. Radioactive fallout from Chernobyl impacted Ireland, and Chernobyl is of course much further east than Sizewell is from Ireland. It is worth remembering in the aftermath of Chernobyl in 1986, almost 10,000 upland sheep farms in Wales, Cumbria, Scotland and Northern Ireland had restrictions put on animal movement given the effects the effects of airborne radiation. The curbs, which were put in place on food safety grounds, meant that sheep had to be tested for radiation if taken to market. The last remaining post-Chernobyl restrictions on sheep movements were only lifted in 2012, some 26 years later. The consideration of potential greater levels of radiation which might result from Sizewell are also of concern as is highlighted elsewhere in this submission, and indeed the very significant impacts arising for Ireland in the event of a nuclear incident – even where no radioactive contamination impacts Ireland – and in the event it does.

It is regrettable that this message of 'no significant impacts' has been allowed to dominate the limited discourse there has been around this consultation in Ireland and to disperse any concerted focus on it here. The messaging from the UK authorities has been unchallenged or unqualified by the Irish authorities in publicising the consultation with the Irish public in both the newspaper notice advertising the consultation and in the text of the Department of Housing, Local Government and Heritage webpage for the consultation.

However by stark comparison the text of the Irish EPA in its screening assessment is buried in the Department's website, compounding the concerns over its handling of successive consultations in recent years on such matters. The EPA's screening assessment has the following contrary conclusion to that of the UK authorities – which highlights that risks, albeit unlikely, cannot be discounted:

"Therefore, while there is no measurable radiological impact expected from the expected routine environmental releases from Sizewell C, given the potential transboundary effects in Ireland of a severe (albeit unlikely) nuclear accident at the

Sizewell C site it is recommended that Ireland register as an interested party in the in the examination process".

Furthermore, although it is doing little to engage or alert people to the consultation, the fact the consultation has been extended to all Irish Local Authorities also confirms that the Irish Government cannot exclude such effects. Because when considering its obligations under the Planning and Development Act, and associated regulations, the Irish Government felt obliged to extend the consultation to all Irish Local Authorities and the public in these counties on the basis it could not exclude those counties being effected by Sizewell C.

While it is welcome that the EPA and Irish Authorities have not discounted the risk – the potential for the risk to arise is arguably under-stated, and is certainly inadequately assessed for 6 main reasons:

a) Duration:

Firstly, while the EPA at least addresses the risk of airborne transport of radiation, it was also arguably very optimistic in its report back in 2013 (see sections 5 and 7 below) in what it considered as the most severe scenario in its impact assessment. This was in respect how long the release of radiation would last for before containment is achieved. In short, as is set out elsewhere with reference to analysis by the late John Large – the EPA's worst case scenario and the duration of radioactive release falls far short of what is a credible worst case scenario set out by an independent nuclear expert.

In its more recent screening the EPA does not shy away from the chilling and openly acknowledged conservative assessment by the ESRI of the effect on our economy (noted in section 8 of this response), but the EPA still fails to consider our ability to sustain the necessary extent of sheltering needed to avoid impacts in the context of the potential duration of impacts.

As will be seen later below when considering what is detailed on duration in the Sizewell application document – they do not even include any view on durations when considering a severe accident scenario. Instead they merely rely on UK nuclear regulation to discount the need for consideration and the ability to manage the risk down to an acceptable level of remote probability, in as much as such management is deemed to be reasonably practicable – all encompassed by the acronym "TifALARP".

b) Brexit impacts and the UK's withdrawal from Euratom

It is also notable and very disappointing then that, in relying on its previous report from 2013 in assessing the risk as being "unlikely", the EPA clearly has not considered the wider implications for risk consequent on Brexit. Further risk has arisen since the UK referendum in 2016 nearly some 3 years after the report was done. Brexit means the UK's departure not just from the EU environmental acquis and independent oversight by the EU Commission, the EU Court of Justice, in the conduct of environmental assessment, but it also departs from Euratom, the treaty for the community of nuclear states.

In departing from Euratom, the UK leaves the independent oversight of its nuclear operations, including inspection of nuclear facilities, oversight of the separation of military and civilian nuclear inventories and over of movements of nuclear inventories including in and out of the UK, bearing in mind those movements may arise as close at 12 miles off our shores, the limit of our territorial waters.

As a result of Brexit, the Euratom regime is to be replaced by the UK's Office of Nuclear Regulation. The funding for this function and the level of independence it can exercise on this and the adequacy of the new regime solution specified are not adequately considered.

The further pressures and risks which may arise consequent on the impact to the UK economy in the context of both Brexit are addressed elsewhere in this submission where the experience of the issues which arose previously at times of difficulty in the running of the UK's nuclear plants and Sellafield in particular.

c) Covid-19 pandemic and risks consequent on the economic situation

The further consequential risks which arise consequent on the impact to the UK economy because of the Covid-19 pandemic are also not reflected in the EPA's assessment and determination of likelihood. They are however also considered further in this submission, and most particularly in the context of the economics and practicalities for the running and maintenance of nuclear operations, and the issues which have arisen previously in the running of UK nuclear facilities at times of internal difficulties. The recent experience of the choices and approaches made by UK authorities in recent years in the context of Brexit and in the management of the pandemic and associated approach to issues impacting on public health also warrant some serious consideration in the context – given the implications such an approach has for the consideration and management of nuclear risk.

d) Delayed delivery of new plants and consequential pressure to continue existing old nuclear operations to maintain a place for nuclear in the UK's energy mix.

The EPA considers the risk and likelihood of an accident solely in the context of risks from the new plant. The EPA fails to consider the consequential risks arising from the new build programme in its assessment of nuclear impacts arising from the pressure to keep old plants running until the new builds are on stream. This creates an associated, albeit indirect risk from the new build given the increased risk potentially arising from the old plants running past their sell-by date so to speak.

The development of the UK's new nuclear build programme for these new generation nuclear power plants are all running significantly over schedule. The continued expectation that the UK will be develop new nuclear power solutions means it is staying vested in a significant nuclear element to meeting its energy needs. This is instead of bringing in alternative renewable energy sources and transitioning away from nuclear. This in turn means that pressure continues to maintain the nuclear component of its energy supply, and existing plants are being forced to run past their original period of operation, and indeed in circumstances where previous safety standards are now being revised in order to allow them continue their operations, as has been seen most recently in the context of Hunterston B in Scotland. Thus, associated with the new build there is the associated risk which arises from the associated consequential pressure to keep the old plants running to keep the nuclear slot in the UK's energy supply mix open.

e) Radioactive waste disposal risks

There has also been a complete failure in respect of the assessment of risk associated with the disposal of the nuclear waste arising. This must be a concern given the UK has not completely excluded consideration of Northern Ireland as a site for the geological disposal of waste, and indeed precipitate a consultation to assess communities receptiveness to such proposals. Though it should be noted that almost every Northern Irish Council passed a resolution opposing the hosting of such a facility. It has additionally not ruled out such sites being partially under the Irish Sea. Indeed the only Council that has so far expressed an interest in hosting such a repository, Copeland Borough Council (where Sellafield is situated), has expressly suggested a partial under-sea site may be a possible solution for it. In the context of an as yet undefined and unspecified solution and location for the waste, and the lack of clarity on the technologies for storage and the transport mechanisms to be employed and associated risks – it is not appropriate to discount transboundary risks for Ireland, where such solutions may arise on this island or in the seas surrounding us, and/or involve transport close to our shores.

Furthermore, Sizewell C will produce the equivalent of about 80% of the total radioactivity already created in the UK by existing nuclear sites. If all the proposed new nuclear reactors get built this will at least quadruple the amount of radioactive waste the country will have to deal with. (1) After three years of deliberation, the Committee on Radioactive Waste Management (CoRWM) decided that geological disposal is the best available approach for the long-term management of higher level waste, but lots of caveats and important recommendations were ignored by the Government. CoRWM specifically said it did not want its recommendations seized upon as providing a green light to build new nuclear reactors which raise different political and ethical issues when compared with wastes which already exist. In other words it might be morally defensible to look for the 'least-worst option' to bury dangerous waste already created, but we really shouldn't be creating any more. NFLA remain concerned about the real technical and scientific issues around 'deep geological disposal' for existing waste, but the potential levels of highly radioactive new build waste add a greater level of concern that alone should see a new nuclear programme halted.

f) Flood Risk

The implications of climate change and sea level risk are regrettably becoming even clearer. In 2012 'The Guardian' reported on an unpublished UK Government report assessing flood risk at the sites of the new nuclear programme builds. Sizewell C does not perform well.
It was assessed as a "high" flood risk in 2010, and is high in 2020s, 2050s and 2080s. (2)

There is in summary no place for complacency by Irish Local Authorities in turning to examine the potential risks to their counties, and to this state and its citizens. Further consideration is given the adequacy of the assessment on the potential scale of impacts elsewhere in this submission, given the potential significance of the radioactive fallout which could result in the event of a severe accident.

Vigilance must be exercised when calling for a full environmental impact assessment to be conducted under both:

i) The UNECE Convention on Environmental Impact Assessment in a transboundary Context, "the Espoo Convention" and also
ii) Under whatever UK regulations implement the EU Environmental Impact Assessment Directive or which apply post Brexit to replace them

Matters are clearly complicated by the fact the UK is departing the EU Environmental acquis, and the extent to which the EIA for Sizewell will fall to be fully assessed under regulations reflecting the EU EIA Directive. International law obligations should continue to apply but clearly even that has become a controversial matter in recent months. However under the Espoo Convention – the UK's position on Sizewell has complicated matters further. The UK has a position that no likely effects arise and it has merely notified Ireland and other countries as a courtesy. Therefore it does not automatically fall that a consultation and a full EIA assessment under the Espoo Convention will happen. It is thus essential that Ireland and all Local Authorities must be vigilant in an unequivocal position that:

a) Effects on Ireland cannot be ruled out
b) A full Environmental Impact Assessment needs to be conducted, including under the Espoo Convention.

Local Authorities are urged to make this clear to both the Irish and the UK Authorities.

3. Airborne transport of radioactive fallout in the event of a severe accident at Sizewell

As indicated above, it is clear from a close scrutiny not just of the summary screening assessments pointed to in the letter from the UK authorities, but in particular of a review of the underlying materials – that the UK's assessment of transboundary risk fails to fully consider airborne transport of radiation in the event of a severe nuclear incident. It also includes significant reliance on UK regulation to avoid accidents, and to argue for a very low probability.

The first screening conducted by the UK Planning Inspectorate (3) on behalf of the UK Secretary of State in October 2019 indicates as follows:
"Radiological exposure - The Scoping Report acknowledges the potential for exposure to radiation from discharges of aerial and liquid radioactive emissions and direct radiation from radioactive sources."

6.19.26 The following documents will also be used to inform the assessment: • project risk registers; • Outline Construction Environmental Management Plan (OCEMP); • Flood Risk Assessments; • Euratom Treaty Article 37 submission; • Cabinet Office National Risk

Register of Civil Emergencies; and • European Commission's Major Accident Reporting System (eMARS) (Ref 6.77).

The scoping document relied on the Euratom report and assessment process to consider this, but it does not appear to have been done.

The second screening assessment done refers to Chapter 27 of the application documents. In respect of receptors – which are effectively pathways to transmit radioactive effects chapter 27 says the following in respect of major accidents and hazards, (MA&D): (emphasis added):

"27.3.10 Each identified MA&D hazard and threat has been assigned an individual study area taking consideration of hazard or threat source, any identified impact pathways, potential receptors, and the reasonably foreseeable worst-case environmental consequence, if the event occurred. The study area for the identification of potential receptors differs depending on the specific hazard or threat and is determined on the basis of a worst-case impact area of a similar incident that has previously occurred, if information on this is available, or on the basis of professional judgement, if not available. The study areas are identified within the Environmental Risk Record included as Appendix 27A of this volume and range from the area within the site boundary to the catchment area modelled for flood risk (as set out in the relevant Flood Risk Assessments, Doc Ref. 5.2-5.9)."

From this it is clear that the study areas do not include consideration for airborne transport.

Turning to the referred to appendix 27A to examine the receptors considered even in the context of a major nuclear incident at Sizewell C – it is notable that for MA&D Id O14 – described as: "Civil nuclear incident or major accident at Sizewell C" the only receptors considered are:

"On site: Sizewell C workers
Off-site: General public
Agricultural land
Sensitive environmental receptors (ecological, heritage sites, groundwater, surface water, marine receptors)"

Furthermore, the associated columns for this scenario on "Maximum study area", "Worst case severity of Harm", "Duration", "Category of Consequence" are not completed – instead the following incomplete text is inserted:

"Separate regulatory processes are in place to assess and control the safety of UK EPR reactors for the operation of the Sizewell C nuclear power station, a detailed risk assessment is therefore not presented as part of the EIA. These hazards would be assessed in detail as part of the Nuclear Site Licensing requirements. For example, as part of Nuclear Site Licensing Regime, EDF will need to ensure the safe operation of the Sizewell C Project and protection of the workers, public and environment. This includes providing the Office for Nuclear Regulation with a robust Safety Case demonstrating that all hazards associated with the development or that may impact the development are well understood and adequate arrangements are in place to reduce these risks to an acceptable level. In addition, it requires appropriate emergency plans and arrangements to be established and agreed with the local authority, for the range of accidents and incidents that could occur. These processes will ensure that risks relating to Nuclear Safety are reduced to TifALARP. Furthermore the assessment of risks associated with the use and storage of…."

The remainder of the text is obscured and cannot be read.

There is additionally an over-reliance on the UK's regulatory regime to ensure accidents will not happen. Accidents by their very nature are accidental. Furthermore, there is an over-reliance on what are estimated as very low probabilities for major accidents to dismiss the need for adequate consideration and assessment of impacts and preparedness of other states which might be impacted. No one recollects the probabilities associated with

Fukushima Daichi or Chernobyl or Three Mile Island – all most remember about them is that they happened.

In the application documents, document ref 6.11: Volume 10 Project-wide, Cumulative and Transboundary Effects, Chapter 5 Transboundary Effects, Appendix 5A: Long Form Transboundary Screening Matrix, (Revision: 1.0 Applicable Regulation: Regulation 5(2)(a) PINS Reference Number: EN010012) the following is stated (4):

"The UK Government believes that new nuclear power stations would pose very small risks to safety, security, health and proliferation (of nuclear materials). Government also believes that the UK has an effective regulatory framework that ensures that these risks are minimised and sensibly managed by industry (Source: White Paper on Nuclear Power, January 2008 (Ref. 1.2)). Nuclear safety is regulated by the Office for Nuclear Regulation (ONR) through a Nuclear Site Licence which places conditions on the Licensee to assure the safety of all aspects of power station construction, operation and decommissioning. This Licence must be in place ahead of construction of safety critical parts of the plant. The risk of accidents and possible radiological impacts on the airspace, land, water and humans in other EU member states is also covered by the Euratom Treaty obligations. The proposed UK EPR design of reactor has been the subject of a regulatory justification process. The Secretary of State (SoS) decided that the generation of electricity using the UK EPR is justified under the Justification of Practices Involving Ionising Radiation Regulations 2004. The SoS considers that the likelihood of an accident or other incident occurring at an UK EPR giving rise to a release of radioactivity is very small. The Major Accidents and Disasters assessment assesses the risk associated with hazards and threat from on-site and offsite sources during the construction and operation of the Sizewell C Project. This assessment provides details of the mitigation measures that are in place to reduce the likelihood of a risk event occurring. Further details of this assessment are provided within Volume 2, Chapter 27 of the ES."

So in summary it is clear even in the context of the most severe accident considered – there has been a complete failure to consider the potential transport to Ireland of airborne radioactive fallout in the key chapter 27 assessments.

5. Sizewell C and severe nuclear accident scenarios

A severe accident scenario, such as the one suggested by the Radiological Protection Institute of Ireland (now part of the Environmental Protection Agency), (5) would involve a loss of coolant combined with a bypass of the containment. In this scenario core damage would be initially delayed by actions of the plant operators, but eventually take place after 12.75 hours. The release of fission products to the environment starts 12.8 hours after reactor shutdown, and lasts for 35.2 hours eventually stopping 48 hour after reactor shutdown.

Nuclear engineer, the late John Large, expanded on this type of scenario pointing out that the fuel core would completely melt after about 16 hours and the corium mass slumps to the bottom of the Reactor Pressure Bessel (RPV), thereafter burning through the RPV steel shell to fall and slump onto the primary containment floor. At this point in time, the hydrogen gas in the RPV circuit is released into the primary containment whereupon it reacts with the air in the containment, deflagrating and exploding with sufficient might to breach the containment surety and, with this, the first phase release of radioactivity to the atmosphere for dispersion and deposition further afield commences. He said this scenario is very similar to the events at Fukushima. (6)

According to EDF Energy´s Environmental Statement for Hinkley Point C (Appendix 7E "Assessment of Transboundary impacts"), the likely impacts of an accident do not extend beyond the county of Somerset and the Severn Estuary. In contrast a report for the Austrian Environment Agency says severe accidents at HPC with considerable releases of caesium-137 cannot be ruled out, although their probability may be low. There is no convincing rationale why such accidents should not be addressed in the Environmental Statement (ES) for the proposed Sizewell C reactor; quite to the contrary, it would appear rather evident that they should be included in the assessment since their effects can be widespread and long-lasting. (7)

The EPA / RPII Severe Accident Scenario suggests a radioactive release of I-131 and Cs-137 amounting to 610,000TBq which is quite a bit larger than Fukushima. Cs-137 has a half-life of 30 years, whereas I-131 only has a half- life of 8 days. So Cs-137 is much more important in the longer term. With its longer half-life Cs-137 is around for much longer. Having said that I-131 distribution after an accident is important when looking at the incidence of thyroid cancer. Austria had the second highest average I-131 deposition density, outside Belarus, Ukraine and Russia, after Chernobyl. (As ever, whether there was an increase in thyroid cancer in Austria after Chernobyl is controversial – see TORCH 2016).

Table 1 Comparison of Source Terms for Cs-137

Largest release from HPC suggested in UK Article 37 Submission	0.0447TBq (8)
EIA for the planning Dukovany NPP (Czech Republic)	30TBq (9)
EIA for the planned Hanhikivi NPP (Finland)	100TBq (10)
RPII ST4 severe accident scenario	10,000TBq (11)
Austrian analysis severe accident at Hinkley Point C	53,180TBq (12)
Severe accident in the HPC spent fuel pool	1,780,000TBq (13)
Fukushima disaster, 2011	12,000TBq (14)
Chernobyl disaster, 1986	80 – 85,000TBq (15)

6. Spent Fuel Storage

Unlike spent fuel generated by existing UK nuclear reactors, it is not the intention of future reactor operators to reprocess spent fuel from new nuclear reactors. As a result, spent fuel will almost certainly remain on-site for decades, rather than being transported off-site to Sellafield as it is at the moment at most sites, apart from Sizewell B. Although it is possible that spent fuel might start to be transported off site during the 60 year lifetime of new reactors, prospective operators generally take the view that it is prudent to plan to store all of the lifetime arisings of the planned reactors on-site probably in spent fuel storage ponds. At Hinkley Point C, EDF is planning to be able to extend the life of the storage ponds for up to 100 years after the reactors close. (16)

A recent study in the US detailed how a major fire in a spent fuel pond "could dwarf the horrific consequences of the Fukushima accident." The author Frank von Hippel, a nuclear security expert at Princeton University, who teamed with Princeton's Michael Schoeppner on the modelling exercise said "We're talking about trillion-dollar consequences." (17) This would clearly involve major transboundary radioactive releases much larger than those suggested in the RPII scenario, because the spent fuel store could contain up to 60 years' worth of spent fuel.

According to the Austrian Analysis PSA 2 results (in the Pres-Construction Safety Reports by EDF and Areva) show that a possible severe accident in the spent fuel pool could result in a release of 1,780,000 TBq of Cs-137. (18)

In other words, the greatest risk is one that could remain in place until at least 2130.

7. EPA / RPII Severe Accident Scenario (ST4)

According to the UK Government's Article 37 submission to the European Commission on Hinkley Point C, a severe accident would only release 0.0447TBq of radioactivecaesium-137. Given the proposed Sizewell C reactor would be a carbon copy of the Hinkley Point C reactor, the figure for it will be comparative.

The RPII (now the EPA) looked at the impact of a severe accident at a new nuclear station at Wylfa on Anglesey. This concluded that up to 10,000TBq could be released. The EPA should consider conducting a similar report for Sizewell C.

Doses to adult inhabitants of Dublin:

Total radiation dose to an adult in Dublin from inhalation, cloudshine and groundshine	Amount in sieverts
After the plume passage	18,084 µSv
Cumulative after a week	19,834 µSv
Cumulative after a year	43,794 µSv

Intervention levels have been established for emergencies by the International Atomic Energy Agency. These suggest that sheltering should be recommended if the dose is expected to reach over 10,000 µSv over a two day period.

In the scenario the radiation dose during plume passage is predicted to exceed the intervention level for sheltering, thus people would be advised to remain indoors during the passage of the plume (approximately 24 hours in a particular weather scenario). The intervention levels for iodine prophylaxis (iodine tablets) or evacuation is not exceeded. A radiation dose of just over 9000 µSv (9mSv) from inhalation of iodine-131 was predicted. While this is below the intervention level of 50,000 µSv (50mSv) for administration of iodine tablets (and was based on the assumption that people were outside during the passage of the plume), the RPII notes that staying indoors could reduce this radiation dose significantly. However the 50,000 µSv intervention level is very high. It would certainly be worth taking potassium iodate tablets if a 9,000 µSv was in prospect and these tablets will not do you any harm. (19)

The radiation doses from the table above do not include ingestion doses. The reason given by RPII for this is:
"These radiation doses were treated separately as in an emergency this pathway is extremely amenable to significant reduction. Indeed, the appropriate use of food controls and agricultural measures can substantially reduce the transfer of radioactivity to the food-chain."

If no action is taken the ingestion dose resulting from the accident scenario could be as high as 275,000 µSv, bringing the total dose to almost 320,000 µSv. RPII comments:

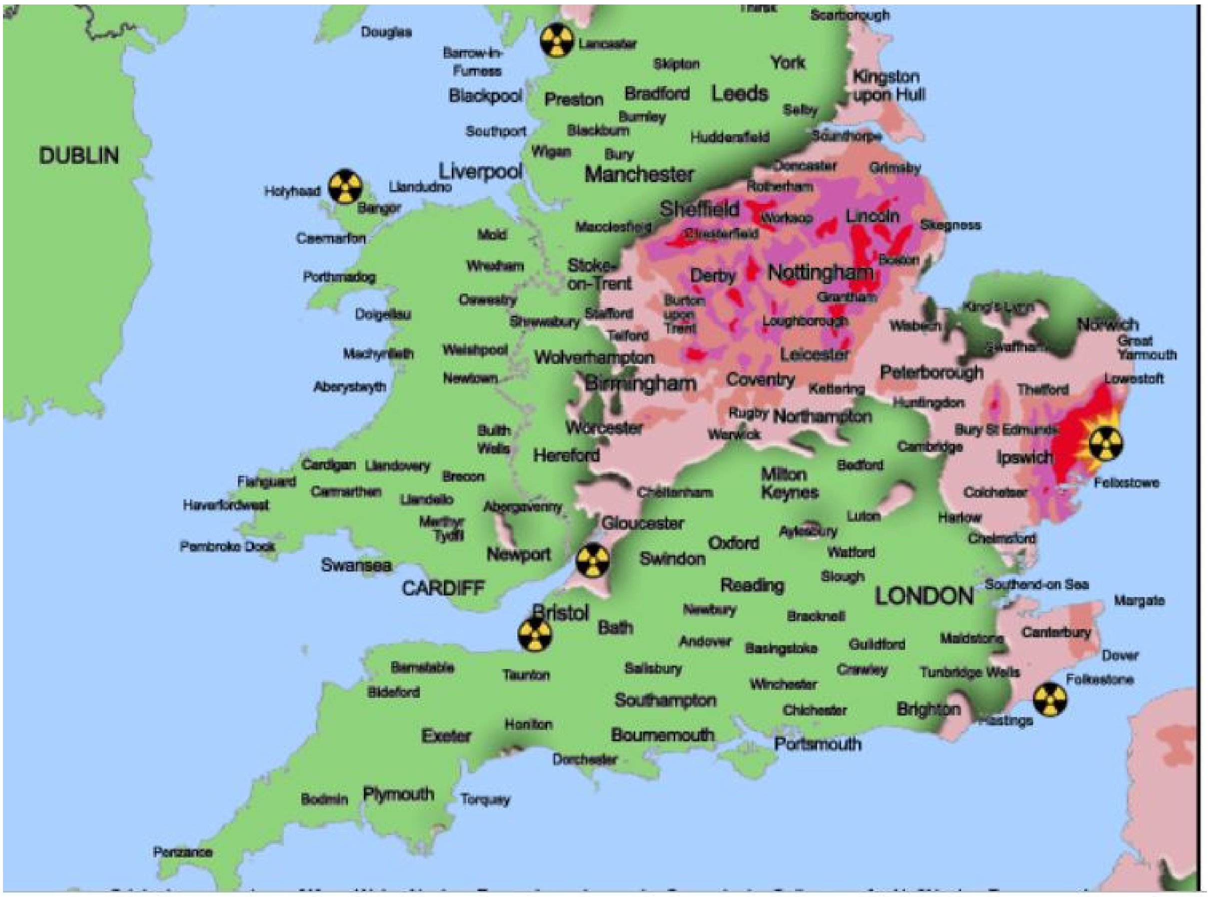
"If no protective actions were taken, a dose of this magnitude might be expected to result in an observable increase in cancers in the decades following the accident. For comparison, the annual average radiation dose from all sources of radiation received by members of the Irish public is estimated to be 3950 µSv."

RPII also notes that:
"In the absence of any protective actions having been taken to reduce or eliminate the contamination of food and animal feed, all of the food types would exceed the Maximum Permitted Levels for a period of at least two months (for meat and root vegetables even after one year, the radioactivity concentrations were predicted to be significantly higher that the permitted levels in the scenario studied)."

RPII notes in passing that while the protective actions could be highly effective in reducing radiation doses, their implementation may not always be straightforward. Obviously the disruption to the Irish agricultural industry could be considerable. In addition, experience of food contamination issues elsewhere suggests that, even in cases where the EU Maximum Permitted Levels are not exceeded, the economic consequences from loss of market due to the 'perception' that food is contaminated can be considerable.

Obviously for the people of central England, an accident at Sizewell C would have a much greater impact in comparison to the impact of an accident at Wylfa on Dublin. With Sizewell we do not have the benefit of 100 kilometres of sea between the accident and the nearest centre of population.

By superimposing the fallout map from Chernobyl onto a map of the area around Sizewell it is possible to get an idea of what the impact a severe accident might look like, depending on the wind direction. The red shading represents the area which would have required compulsory resettlement in Belarus and Russia and the pink are where additionally compulsory resettlement would be compulsory in the Ukraine.



8. Economic costs of a nuclear accident to Ireland

Finally NFLA notes an important report by the Economic and Social Research Institute – 'The Potential Economic Impact of a Nuclear Accident – an Irish cast study'. (20) NFLA had pushed for this report to be developed through its representative to the Environment Protection Agency Radiation Issues Committee, Dr Paul Dorfman from the UCL Energy Institute.

Core headline figures from this study include:

- In the worse-case scenario, a nuclear disaster from a nuclear reactor in northwest Europe could cost Ireland **€161 billion**.
- Agricultural production would grind to a halt, with the tourism industry and exports also incurring substantial financial damage.
- Even under the most benign scenario considered by ESRI, where no radioactive contamination occurs - total loss is estimated at **€4 billion**.
- The report analysis may actually underestimate the true extent of its cost to the Irish economy.
- Health risks from high levels of contamination could put a significant strain on the health service.
- Total cost of a low-level contamination scenario, which requires the imposition of food controls to reassure the public, would cause restrictions on food imports from Ireland, would be €18 billion.
- The impact on tourism would also be significant, with long-term reputational damage resulting in an economic cost of as much as €80 billion.
- Not only would exports be decimated but the need to import much of the country's food would lead to far higher domestic costs.
- There could also be significant emigration from the island.

Such costs should be of alarm to all Irish Councils and the Irish Government and needs to be fully taken into account when considering transboundary impacts to Ireland in the event of a nuclear accident from any UK or French nuclear reactor.

9. Conclusion

This response outlines some of the core concerns of the NFLA and the IEN around trans-boundary impacts to Ireland should there be an accident at the Sizewell C, or for that matter any UK new or existing nuclear reactor.

New nuclear reactors, like the one being put forward by EDF Energy for Sizewell C, have many serious local impacts to the population of the south east of England. They also though have alarming impacts in the event of a severe accident taking place. Whilst that may remain a low risk, in the event it happens, there are clear risks and damage to Ireland should a severe accident take place.

Those issues are multi-faceted – environmental, reputational and economic. They are serious enough for Irish respondents to fairly object to the development of the proposed Sizewell C reactor, or any new nuclear reactor developed across the Irish Sea.

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How much Carbon would Sizewell C save?

Professor Steve Thomas[1] & Alison Downes[2]

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1. Introduction

There were three main arguments for the programme of new nuclear reactors in the UK proposed in 2006.

- First, nuclear power was cheaper than other sources of low-carbon electricity and was therefore the most cost-effective way to meet our emissions targets
- Second, there was a need for base-load power stations that other low-carbon sources like renewables could not meet; and
- Third, even with a substantial renewables and energy efficiency programme, the UK could not reduce its carbon emissions sufficiently to meet its emissions targets.

The first two arguments have failed. In addition, the evidence that warming is increasing faster than expected has led to consensus that we are in a 'climate emergency' and need to decarbonise much more rapidly than previously expected putting a premium on measures that can be implemented quickly.

Assessing the contribution new nuclear power plants, such as SZC, could make to emissions reductions from power generation is therefore crucial to the case for new nuclear. In its Sustainability Statement,[3] EDF claims (emphasis added):

> *'The electrical output would provide a low carbon source for over 20% of the UK's homes and, **based on current grid intensity*** [average CO_2 emissions per kWh of electricity produced], *offset approximately 7 million tonnes of CO_2 per annum by displacing the existing mix of more carbon intensive electricity from the National Grid. The development of the Sizewell C Project would therefore play a significant role in the UK's transition to a low carbon economy.'*

This statement is worthless because SZC will not be complete before 2034, by which time, the grid intensity will be far lower than now.

If new nuclear plants are not cheap and base-load capacity is not needed, the claim that nuclear power is essential if the UK grid is to be de-carbonised is the only remaining substantive argument for nuclear power. If nuclear capacity cannot be expanded sufficiently in the time-frame required, even assuming it can make a useful contribution to emissions reductions, it will be too late.

2. The UK government's 2050 target

On 27th June 2019, the UK government made its target for 2050 emissions legally binding:[4] *'The target will require the UK to bring all greenhouse gas emissions to net zero by 2050, compared with the previous target of at least 80% reduction from 1990 levels.' 'Net zero means any emissions would be balanced by schemes to offset an equivalent amount of greenhouse gases from the atmosphere, such as planting trees or using technology like carbon capture and storage.'*

The electricity sector will be key in meeting the CO_2 element of the target. It remains a large consumer of fossil fuels but decarbonising the two other key sectors, space heating, now largely met by natural gas, and vehicle transport now met by petroleum, will require an affordable low-

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[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-001959-SZC_Bk6_ES_V2_Ch26_Climate%20Change.pdf
[4] https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

carbon electricity system. Electricity generation has the advantage of having affordable, well-proven low-carbon technologies already available. On these grounds, electricity is likely to be ahead of other sectors in decarbonising.

3. Arguments for and against new nuclear capacity in the UK

3.1. Cost

The UK Nuclear Industry Association claims that if construction cost risk could be reduced and financing models more advantageous to nuclear (implicitly by shifting risk from developers to consumers under the Regulated Asset Base model), the cost of existing projects, like Sizewell C (SZC) could reduce to £60/MWh. However, this would still be 50% more than the most recent offshore wind price bids, the largest potential power resource of the renewables.[5] The expectation is that the next round of offshore wind bids will produce even lower prices. By contrast, despite claims throughout the history of nuclear power that costs would soon start to fall, real costs have only ever risen and a real reduction in nuclear costs is therefore implausible.

3.2. Need for base-load power

Smart grids, dramatic improvements in electricity storage technologies and demand side measures have removed the need for base-load capacity. To be clear, while there is a level below which demand does not fall – the base-load – it is a non sequitur to assume that there needs to be a dedicated set of plants operating at full power round the clock – base load capacity - to meet it. It may make sense to run some plants on base-load, especially those that have very high fixed costs, but that is not the same as saying there is a need for base-load capacity. Five years ago, Steve Holliday, the then CEO of the UK's National Grid Company (NGC) said, 'The idea of large power stations for baseload is outdated.'[6] His argument was that in the past, electricity systems were built around base-load plant with mid-load and peaking plants added to meet the hour by hour fluctuations in electricity demand. Holliday claimed, '*the solar on the rooftop is going to be the baseload'*. Renewables will therefore be at the heart of the system with other capacity added to ensure security of supply. The function of grid supplied power will be to fill in the gaps when renewables are not available. Holliday warned that large nuclear plants do not fit well with such a system: '*If you have nuclear power in the mix, you will have to think about the size of these plants. Today they are enormous. You will need to find a way to get smaller, potentially modular nuclear power plants.*'

It was possible to reduce the output of Sizewell B (SZB), which is only two thirds the size of SZC, by 50% because it has two small turbines rather than one large one as is the case for all other large reactors worldwide and as will be the case for HPC and SZC.

3.3. Need for policies that can be rapidly introduced

The two most advanced nuclear projects, Hinkley Point C (HPC) and SZC were announced in 2009 and 2015 respectively but, on current projections, it will be almost two decades from these announcements before power is being produced (2027 in the case of HPC and 2034 in the case of SZC) and there is ample scope for further delay. As with costs, the nuclear industry has continually claimed that new projects would learn from past mistakes and lead-times for new projects would be much shorter. However, even in the unlikely event that the lead-time

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5 https://www.niauk.org/wp-content/uploads/2020/06/Fortyby50_TheNuclearRoadmap_200624.pdf p 8.

6 https://energypost.eu/interview-steve-holliday-ceo-national-grid-idea-large-power-stations-baseload-power-outdated/

could be halved, that would probably still be too long. In addition, while it seems possible to expand offshore wind with a large number of simultaneously constructed projects, it seems unlikely that more than a very small number of nuclear projects could be pursued at the same time. So on the criteria of meeting a 'climate emergency', nuclear power fails.

4. Carbon emissions associated with a nuclear power plant

While some assert nuclear power is zero carbon, this is false even though the routine operation of a nuclear power reactor does not directly produce CO_2 (there are some emissions from worker transport and back-up power facilities). Emissions of CO_2 occur in the fuel cycle – the various steps from mining of uranium to disposal of spent fuel - and are embodied in the inputs – the huge amount of material and labour, far larger than other forms of generation – to the construction of the plant. EDF also notes emissions from back-up diesel generators, a back-up CHP plant and from vehicle journeys during the operating life of the plant.

The main emissions from the construction phase are from the manufacture of the materials used, such as concrete and steel, with some emissions from worker and materials transport. Other forms of low carbon generation and energy efficiency require materials that will result in the production of CO_2 but the volumes of material are far lower than for a nuclear plant.

The fuel cycle[7] accounts for the vast majority of CO_2 emissions associated with operation of a nuclear plant. Many of these stages are not in the UK and will not be reflected in UK emissions, but given that climate change is a global problem, it would be wrong to discount these emissions simply because they do not occur on UK soil. Estimates of the carbon content of the fuel cycle vary massively depending on assumptions made on the quality and depth of the uranium ore deposits and on the composition of the national electricity system in which the highly electric intensive process of enrichment[8] takes place. Experience of reactor decommissioning is minimal and the final stage of the fuel cycle, disposal of spent fuel, has not been carried out yet anywhere in the world and is probably decades away from being demonstrated. It is therefore not possible to estimate the carbon content of decommissioning and disposal of spent fuel but it will not be zero.

In 2008, Sovacool[9] surveyed the various estimates of the CO_2 content of the nuclear fuel cycle finding a range of 1.4-288g of carbon dioxide equivalent per kWh (g CO_2e/kWh) with a mean value of 66g CO_2e/kWh. In 2012, Warner & Heath[10] carried out a similar survey and found a range of 4-220g CO_2e/kWh with a median of 13g CO_2e/kWh. If we assume SZC has a load factor of 85% and a capacity of 3340MW, the range of annual CO_2 emissions is 35,000-721,000 tonnes (t) of CO2 under Sovacool's range.[11] The range of subsequent estimates has not got

[7] Emissions occur in the mining of the ore, the processing of the ore to separate the uranium, the shipping of the ore to the location of enrichment, the shipping of the enriched uranium to the fuel fabrication plant, shipping of the fuel to the reactor, storage and cooling of the spent fuel for decades, packaging of the spent fuel ready for disposal, transport of the spent fuel to the disposal site and disposal and eventual sealing of the disposal site. The last two stages are not demonstrated and alternative options are possible.

[8] Only 0.7% of naturally occurring uranium is fissile, able to sustain a nuclear chain reaction, U235, with the majority the non-fissile U238. For the majority of reactor types the U235 content much be increased to 3.5-5% via process such as centrifuging to separate the lighter isotope from the heavier.

[9] B Sovacool, 2008, Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey *Energy Policy* 36(8):2940-2953

[10] E Warner & G Heath, Life Cycle Greenhouse Gas Emissions of Nuclear Electricity Generation *Journal of Industrial Ecology*, **16**, S73, (2012)

[11] The molecular weight of carbon is 12 and CO_2 44, therefore 1t of carbon is equivalent 3.7t CO_2.

smaller. The Intergovernmental Panel on Climate Change (IPCC) assumes 12g CO_{2e}/kWh[12] and UK's Committee on Climate Change (CCC) estimated the carbon content as 6g CO_2e/kWh, at the lower end of Sovacool's and Warner & Heath's range.

As the world's uranium reserves are depleted, it might be expected that poorer quality ore at deeper depths will have to be mined increasing the emissions from this stage, although historically, this does not always appear to have been the case because much of the world has yet to be explored for uranium. The enrichment process will tend to lead to less emissions as electricity systems are decarbonised.

5. Electricity system operation

EDF suggests that nuclear and renewables such as wind and solar are 'complements', implying that when renewables are not available additional nuclear output can substitute for it. In its Sustainability Statement for SZC, EDF claims:[13]

> *'Whilst a range of technologies will be vital to achieving this* [decarbonising the UK electricity generation sector], *nuclear power will have an important role to play in providing a stable baseload of power, to complement other technologies such as wind and solar power.'*

This is highly misleading as both nuclear and renewables have inherent inflexibilities that make them a poor match. Physically and economically, nuclear power plants should run at full power whenever they can. The level of solar and wind available output is determined by the weather conditions although, unlike nuclear plants, renewable output can readily be reduced.

- This means that when demand is high and availability of renewables and nuclear is low – nuclear reactors break down or are on outage all too often – a large volume of flexible plant will be required.
- Equally, when demand is low and availability of nuclear and renewables is high, output of renewables will have to be restricted because of the physical inflexibility of nuclear plants.

This first happened in the UK in 2019 and is happening now with SZB running at 50% with only one of its two generators operating, an option not open to HPC or SZC as they would only have one large turbine per reactor.

As the capacity of renewables grows, this will be an increasing constraint on the UK electricity system.

Both nuclear and renewables impose extra system costs; for renewables, it is the reinforcement to the grid needed to bring power from off-shore windfarms and from windier areas to demand centres. For nuclear, it is because of the need to be able to maintain supplies if a generator breaks down generally met by 'spinning reserve', in other words a generator that can be switched on within seconds.

The large size of the proposed new reactors means spinning reserve will have to be much larger than now. At present, the largest turbines on the system – this determines the size of the spinning reserve needed - are the 600MW turbines at each of the seven AGR stations and at

[12] https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf#page=7
[13] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-002235-SZC_Bk8_8.13_Sustainability_Statement.pdf p 1

the SZB PWR[14] as well as some fossil-fired stations like Drax. The EPR turbines will be more than 1600MW so the spinning reserve size will have to almost triple. Spinning reserve is generally met by fossil fuel generators that are hot and ready to operate or by gas turbines. Both options lead to the burning of fossil fuel.

Since 1990, the UK has tried to operate the British electricity power station system as a competitive market, although the proportion of wholesale power bought and sold at market-determined prices has always been relatively small, and generators with low running costs and high fixed costs do not fit easily into a system designed to produce competition on an hour-by-hour basis.

Nuclear plants are categorised as 'must run' because they are physically inflexible and should not be asked to vary their output on an hour to hour basis. For example, when the SZB plant was asked to reduce its output by 50 per cent, it was given at least a month's notice. So adding a must run, base-load plant to the system will mean that the utilisation of all plants that are not 'must run' will tend to be slightly reduced. Where these plants use fossil fuel - in practice natural gas as coal generation has essentially already been phased out - this reduction will reduce carbon emissions across the generation system.

The output of new nuclear reactors in the UK, including HPC, will inevitably be sold on 'take-or-pay' fixed price terms (so-called contract for difference), in other words, the plant owner will be paid the fixed purchase price for the power the plant could produce whether or not the output can be used. Off-shore wind and other large renewables will also be paid on take-or-pay terms, while smaller renewables, like solar panels and on-shore wind generate whenever available and are generally paid for under 'feed-in tariffs'. As the proportion of demand met by plants that are guaranteed a price and therefore not competing in the wholesale market increases, new arrangements to buy the power might have to be introduced. However, it is clear that the existing and committed renewable and new nuclear capacity was only possible because of the guarantee that all potential output would be sold at a guaranteed, fixed non-market price.

6. Carbon emissions saved

To calculate accurately the emissions reductions resulting from adding a nuclear plant to the generation mix would require complex simulations of the electricity system with and without the reactors. This would require accurate information on demand over the life of the plant as well as information on the timing and type of new capacity additions and capacity closures, at least until the electricity generation system is fully decarbonised, assumed to be by 2050 at the latest consistent with the UK government's legally binding commitment to bring all greenhouse gas emissions to net zero by then. It is unlikely that this data can be accurately forecast over the period required and a less precise but inevitably less accurate methodology may be required.

The higher demand is, all else being equal, the longer fossil fuel plants will have to continue to generate to meet demand and the larger the amount of carbon, SZC will save. UK governments of all complexions have consistently massively overestimated electricity demand growth in the 60 years since the Magnox reactor programme was started. At the time the nuclear programme was announced in 2006, it forecast an increase in demand of about 20 per cent by 2020. In fact

[14] Unlike other PWRs which have only one large turbine, Sizewell B has two medium-size turbines. At the time Sizewell B was built the UK turbine industry had no experience of supplying a large turbine so the more expensive but less risky option of using two medium-size turbines was chosen.

demand has fallen by about 20 per cent in that period and is continuing to fall. The UK government's commitment in July 2020 to spend £3bn on improving the energy efficiency of homes and public sector buildings[15] will reduce demand even more and will reduce the impact on electricity demand of measures to move space-heating from natural gas to electricity.

Similarly the quicker investment decisions are taken on low-carbon generation and on energy efficiency measures, the less fossil fuel plants will have to generate and the lower the carbon savings from SZC will be.

A July 2020 report from the UK NGC[16] claimed that in three out of four of its scenarios, 'net emissions from the power sector are negative by 2033'. Seven out of eight of the existing nuclear plants will be retired by then leaving only SZB (2% of power) and HPC, if it is completed by then (7%), so this outcome is not strongly dependent on a significant nuclear contribution in 2033.

If these scenarios are accurate, there will be no carbon emissions for SZC to save by the time it comes online and it will be a net contributor to the UK's emissions because, unlike other low-carbon electricity sources, nuclear reactors require fuel that results in CO_2 emissions. So while the emissions associated with renewables are essentially completed once the plant is online, a nuclear plant will effectively be emitting carbon throughout its life and beyond. So once the existing fossil fuel generation has been phased out, far from reducing emissions, SZC, HPC and any other reactors built will be adding to them albeit some of these emissions will be in other countries notably the country the uranium is mined and the country where it is enriched if this is not at the UK Capenhurst facility.

7. EDF's Claims for SZC

EDF claims SZC will be online in 2034, producing 3340MW net power, contributing about 7 per cent of the UK's electricity and operating for 60 years. EDF forecasts that construction will begin in 2022 and will take 12 years.

7.1.Materials

EDF's Climate Change Statement for SZC[17] breaks down the carbon content of construction as: 5.74 million tonnes (Mt) of carbon equivalent (CO_2e) with 84% from the materials used, 4% construction activities, 5% materials transport and 5% worker transport. The carbon content of the materials and labour will take six years to be paid off by the output of SZC, if we assume EDF's average carbon reduction forecast, before SZC provides a net reduction in carbon emissions.

In its Sustainability Statement (p 83)[18] for Hinkley Point C, EDF states: 'Whilst the CO_2 emissions arising from construction are significant when considered in isolation, it is important to identify that these are very low by comparison to the benefit of generating low carbon electricity from the plant during its 60 year operation. Indeed calculations would demonstrate

[15] https://www.ft.com/content/a72ec4e9-9942-4794-a519-b42e28b36289
[16] https://www.nationalgrideso.com/document/173821/download
[17] chttps://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-001959-SZC_Bk6_ES_V2_Ch26_Climate%20Change.pdf
[18] https://webarchive.nationalarchives.gov.uk/20191119152111/https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010001/EN010001-005331-8.14%20Sustainability%20Statement%201.pdf

that this embodied carbon during construction would be offset within as little as two months generation from HPC once operational.'

No calculations are given but under any plausible grid intensity, offsetting the construction emissions in two months is totally impossible.

EDF does not give the source or the details of the calculations of carbon content of construction so we have no basis for assessing the accuracy of their figures. It is worth noting that construction delays will inevitably increase the number of person hours of labour and the volume of materials, increasing the carbon content of construction. The poor record of the EPR design being built to time suggests a delay is very likely. The two EPRs under construction in Europe are now more than a decade late and even the two completed ones in China were four years late, an unprecedented delay for reactor construction in China.

7.2.Fuel cycle

EDF claims the emissions due to the fuel cycle of the plant will be 4.5g CO_2e/kWh, far less than the IPCC's central estimate of 12g, giving annual emissions of 1040t CO_2e. (EDF also confusingly uses 9-10g in some documents,[19] but their graphs are all based on just under 5g.) If the IPCC's estimate was used, the emissions would be 3160t, using Warner & Heath's median value would yield 3420t and Sovacool's mean 17370t. Over its lifetime, it would between emit 62,400t CO_2 on EDF's assumptions and 1.04Mt using the mean from Sovacool. EDF's calculations cannot be scrutinised as they have not been published; in the Development Consent Order application for HPC, EDF claimed a Life Cycle Assessment Study had concluded HPC's emissions would be 4.8g CO2e/kWh, but this study was never published despite being referenced as "available" in the DCO application.[20] EDF claimed it is commercially sensitive, and a Freedom of Information request by Stop Sizewell C confirmed that it had never been submitted to the Planning Inspectorate during the project's examination.

7.3.Other emissions during plant operation

EDF estimates that back-up generators, CHP plant and vehicle journeys produce 470,000t of CO_2 over the assumed 60 year life, or about 8,000t per year.

7.4.Emissions reductions

The forecast of the emissions that SZC will save depends on two main assumptions that determine grid intensity: the rate of growth of renewable capacity; and the evolution of demand. The more rapidly capacity of renewables grows, the quicker use of fossil fuel plant can be reduced. The lower demand is (and demand has fallen by 20% since 2005) the less the need to generate using fossil fuel plants.

Grid intensity

As new renewables come online replacing fossil fuels, the carbon emissions from UK electricity generation are falling and by the early 2030s, the mean emissions per kWh of electricity will have fallen from about 130g of carbon per kWh in 2020 to about 40g based on the UK government's 2018 figures from the Department of Business Energy & Industrial

[19] Eg, see pages 1 and 38 https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-002235-SZC_Bk8_8.13_Sustainability_Statement.pdf
[20] https://webarchive.nationalarchives.gov.uk/20191119152111/https:/infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010001/EN010001-005331-8.14%20Sustainability%20Statement%201.pdf Page 62

Strategy (BEIS).[21] EDF assumes a straight line reduction in carbon intensity to 2050 when the intensity will have fallen to 20g. However, the BEIS forecasts are out of date and, even when published, lacked credibility. EDF's extrapolation of grid intensity to 2050 takes no account of the UK government's legally binding commitment to make 'to bring all greenhouse gas emissions to net zero by 2050.'[22]

Given that electricity is widely seen as one of the easiest sectors to decarbonise and will probably be one of the first to do so, SZC will effectively cease to contribute to emissions reductions well before 2050 and will make a net addition.

On the basis of the outdated carbon intensity forecast, EDF claims SZC will reduce the UK's carbon emissions by 1Mt carbon in 2034 (excluding the contribution of construction to emissions).[23] EDF admits that it will take about 6 years (i.e. until 2040 if SZC is finished on schedule) to offset emissions from construction, stating *"it is conservatively estimated that GHG emissions from the construction of Sizewell C will be offset* ***within the first six years of operation*** *assuming the equivalent energy were otherwise to be generated by the anticipated mix of grid electricity generation sources."*

EDF claims SZC will have displaced a net 6.26Mt of CO_2 or an average of about 0.4Mt per year from 2034 onwards.

Electricity demand

For its electricity demand projections, EDF relies on the UK government's forecasts in its 2011 'Overarching National Policy Statement for Energy'.[24] This stated: 'Looking further ahead, the 2050 pathways show that the need to electrify large parts of the industrial and domestic heat and transport sectors could double demand for electricity over the next forty years.' This implies demand growth of nearly 2% per year. It is hard to understand why such an outdated forecast has been used. In the period 2011-19, far from rising by 18% as the government expected, electricity demand fell by 8% and in the first quarter of 2020, before lockdown slashed electricity demand even further, fell again by 1.4% allowing coal generation to be phased out almost completely. Historic experience suggests that following a deep economic recession as is now inevitable as a result of the Covid-19 pandemic, electricity demand will recover much more slowly than the economy as new energy efficient businesses replace old, less efficient businesses that failed in the recession. Even allowing for the electrification of transport and space heating, the 2011 demand forecast for the period appears far too high.

8. Sizewell C Project Uncertainties

EDF's financial position is very poor and a French government rescue plan, Opération Hercule, has been underway since early 2019. What the shape of the rescued company will be and what activities will have to be sacrificed to ensure the surviving elements are financially viable is

[21] BEIS (2019) Updated Energy and Emissions Projections 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794590/updated-energy-and-emissions-projections2018.pdf

[22] https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

[23] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-001959-SZC_Bk6_ES_V2_Ch26_Climate%20Change.pdf

[24] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf

not clear. China General Nuclear's participation in the SZC project has also raised concerns about national security.

EDF has stated that it is unable to finance SZC and so the plant will only go ahead if the UK government approves EDF's suggested method of finance, the Regulated Asset Base (RAB) model. Under this, ownership of the plant would be expected to be held by institutional investors such as pension funds who would provide the investment funds. A consultation on this method was launched in July 2019 and since January 2020, there have been continual rumours that publication of the result of the consultation was imminent but by August 2020, nothing had appeared. Even if the government approves the RAB model, it is far from clear that investors will be willing to invest in a nuclear project, especially if any of the project risk falls on them rather than on consumers.

There is also scope for delay, and even under EDF's figures, the later the plant is commissioned, the lower the savings over its lifetime will be. EDF's assumed commissioning date of 2034 is dependent on construction start in 2022 and given the large number of steps needed before construction can start and the delays likely to be caused by Covid-19 constraints, this looks unrealistic. For example, in 2009, when HPC was at about the same point as SZC is now, EDF was claiming HPC would start generating in 2017. EDF's most recent estimate forecast the earliest completion date as 2025 but with a significant risk it will be delayed till 2027 well before the pandemic struck. The impact of Covid-19 on construction activity makes the 2025 date implausible and puts in doubt even the 2027 forecast. There is clearly ample scope, with most construction at HPC still to take place, for even further delays at HPC as has happened with the EPRs at Olkiluoto and Flamanville, both now more than a decade late. The repeated claim that EDF will learn from past mistakes and, for SZC, things will go smoothly is threadbare.

Precisely when, and whether SZC's construction emissions can be paid off will depend on electricity demand growth and the construction rate of renewables but, at best, any saving will be very small.

9. What will the net emissions from Sizewell C be?

For all the major assumptions needed – demand, grid intensity, CO_2 content of the fuel cycle - EDF has chosen figures that provide a very favourable outcome for climate change emissions. If we substitute more realistic figures for demand, grid intensity and fuel cycle, SZC emerges as a net contributor to CO_2 emissions. We construct two alternative scenarios, one using somewhat higher assumption and one using assumptions that, on experience with HPC, are more realistic.

For construction emissions, we assume construction will overrun raising emissions by 25% and 50%. For the fuel cycle, instead of EDF's assumption of 4.5g CO_2/kWh, for the medium scenario, we use the IPCC assumption of 12g and for the high scenario, we use Warner & Heath's median of 13g. For the medium scenario, we assume that the net effect of lower demand growth, lower grid intensity and delays in completion of SZC is to halve the savings. For the high scenario, we assume the grid is decarbonised by 2033 so there will be no savings regardless of demand growth and completion date.

Table Net emissions savings from the whole life cycle of Sizewell C

Million tonnes

	EDF assumptions	Medium scenario	High scenario
Emissions			
Construction	5.7	7.2	8.6
Fuel cycle	0.1	0.2	0.2
Other operational	0.5	0.5	0.5
Savings			
Operation	12	6	0
Net savings	5.7	-1.9	-9.3

Source: EDF figures and authors' calculations

10. Conclusions

Given the collapse of arguments for new nuclear capacity on cost and the need for specific base-load generation, the only remaining substantive argument is that it is needed to reduce emissions from CO_2 from the electricity generation sector. Even if it would save emissions, the consensus of a 'climate emergency' needing quick action means that we need much quicker to implement measures than Sizewell C, which would not be generating until 2034 and would not make a net contribution, on EDF's admission taking account of emissions embodied in construction, until 2040.

EDF's forecasts for its UK nuclear programme in terms of timing and cost have invariably been hugely optimistic. This over-optimism extends to its forecasts of carbon reduction, which are based on a grossly inflated estimate of electricity demand growth and an unrealistically high CO_2 grid intensity by the earliest time Sizewell C can come on-line. More realistic assumptions on these factors suggest that, because of the expectation that the UK grid will be carbon-neutral by the mid-2030s, Sizewell C will make a net increase to UK emissions primarily because of the emissions content of the construction materials. Sizewell C has yet to start construction and with uncertainty about the method of finance and the risks it would place on consumers so the only sensible option is to abandon it now and focus on projects that can deliver quickly and cheaply.

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Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal

December 2017

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Abstract

As U.S. nuclear power plants look to subsequent license renewal (SLR) to operate for a 20-year period beyond 60 years, the U.S. Nuclear Regulatory Commission and the industry will be addressing technical issues around the capability of long-lived passive components to meet their functionality objectives. A key challenge will be to better understand likely materials degradation mechanisms in these components and their impacts on component functionality and safety margins. Research addressing many of the remaining technical gaps in these areas for SLR may greatly benefit from materials sampled from plants (decommissioned or operating). Because of the cost and inefficiency of piecemeal sampling, there is a need for a strategic and systematic approach to sampling materials from structures, systems, and components (SSC) in both operating and decommissioned plants. This document describes a potential approach for sampling (harvesting) materials that focuses on prioritizing materials for sampling using a number of criteria. These criteria are based on an evaluation of technical gaps identified in the literature, research needs to address these technical gaps, and lessons learned from previous harvesting campaigns. The document also describes a process for planning future harvesting campaigns; such a plan would include an understanding of the harvesting priorities, available materials, and the planned use of the materials to address the technical gaps.

Summary

The decommissioning of some nuclear power plants (NPPs) in the United States after extended operation provides an opportunity to address a number of materials degradation questions that add to confidence in the aging management systems used by the nuclear industry. Addressing these questions is expected to provide reasonable assurance that systems, structures, and components (SSCs) are able to meet their safety functions. Many of the remaining questions regarding degradation of materials will likely require a combination of laboratory studies as well as other research conducted on materials sampled from plants (decommissioned or operating).

Evaluation of material properties of SSCs from operating or decommissioned NPPs can provide a basis for comparison with results of laboratory studies and calculations to increase confidence that long-lived passive components will be capable of meeting their functional requirements during operation beyond 60 years. A strategic and systematic approach to sampling materials from SSCs in both operating and decommissioned plants will help reduce costs and improve efficiency of materials harvesting. In turn, the ability to efficiently harvest materials is expected to lead to opportunities for benchmarking laboratory-scale studies on materials aging, identifying constraints on materials/components replacement in operating plants, and determining condition assessment methods that may be applied to these components in the field.

This document describes a potential approach for prioritizing sampling (harvesting) materials using a number of criteria that incorporate knowledge about the specific technical gaps closed through the sampling process. At the highest level, the major criteria are:

- Unique field aspects, if any, that drive the importance of harvesting the material
- Ease of laboratory replication of material and environment combination
- Applicability of harvested material for addressing critical gaps (dose rate issues, etc.)
- Availability of reliable in-service inspection techniques for the material
- Availability of materials for harvesting.

A number of information sources on materials degradation in NPPs were reviewed to assess key technical gaps that may be relevant for SLR. Information from these sources were cross-referenced (where possible) and collated to assess harvesting priority. In this document, several examples of this process are described, along with experiences from harvesting materials at several operating and closed plants. Using these lessons learned from previous harvesting campaigns, a harvesting process is defined that includes many of the criteria that should be taken into account during any harvesting campaign.

The use of information tools can assist with this harvesting process, and one concept for such a tool is described in this document. This tool is expected to provide a mechanism for easily sorting and searching through information from multiple sources, integrate subject matter expert input into the technical gaps assessment and prioritization process, and generate the appropriate prioritized harvesting plan. In theory, such a tool could be extended to include a mechanism for collating the findings from any research conducted using the harvested material and enable a seamless way for accessing the necessary information for any subsequent decisions.

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Acronyms and Abbreviations

ALARA	as low as reasonably achievable
AMP	aging management program
ASME	American Society of Mechanical Engineers
BWR	boiling water reactor
CASS	cast austenitic stainless steel
CM	condition monitoring
Code	ASME Boiler and Pressure Vessel Code
DBE	design basis event
DMW	dissimilar metal weld
dpa	displacements per atom
EAB	elongation-at-break
EMDA	enhanced materials degradation assessment
EPR	ethylene propylene rubber
EPRI	Electric Power Research Institute
GALL	Generic Aging Lessons Learned
IASCC	irradiation-assisted stress corrosion cracking
ISI	in-service inspection
LWR	light water reactor
NDE	nondestructive evaluation
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
OE	operating experience
OMB	outside the missile barrier
PMDA	proactive materials degradation assessment
PWR	pressurized water reactor
RPV	reactor pressure vessel
RRIM	Reactor Reliability and Integrity Management
SCC	stress corrosion crack
SLR	subsequent license renewal
SME	subject matter expert
SSC	structures, systems and components
XLPE	crosslinked polyethylene
XLPO	crosslinked polyolefin

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1.0 Introduction

The nuclear power fleet in the United States currently consists of approximately 98 operating reactors, of which 87, as of October 2017, have received licenses to operate beyond the original license period of 40 years (NRC N.D., Appendix A). The license renewal for these plants extends their operating life to 60 years and the U.S. nuclear power industry is now looking at a further extension of this operating license period.

The U.S. Nuclear Regulatory Commission (NRC) regulations in 10 CFR 54.31(d) allow nuclear power plants (NPPs) to renew their licenses for successive 20-year periods. The biggest challenges for the NRC and the industry will be addressing the major technical issues for this second ("subsequent") license renewal (SLR) beyond 60 years. As summarized in SECY-14-0016 (SECY-14-0016 2014; Vietti-Cook 2014), the most significant technical issue challenging power reactor operation beyond 60 years is assuring long-lived passive components are capable of meeting their safety functions. In particular, the accumulation of degradation in four classes of systems, structures, and components (SSCs) is of concern (INL 2016):

- Reactor pressure vessel (RPV)
- Reactor internals and primary system components
- Concrete and containment degradation
- Electrical cables.

Understanding the causes and control of degradation mechanisms forms the basis for developing aging management programs (AMPs) to ensure the continued functionality of and maintenance of safety margins for NPP SSCs. The AMPs, along with the appropriate technical basis, are used to demonstrate reasonable assurance of safe operation of the SSCs during the SLR period.

Addressing many of the remaining technical gaps for SLR may require a combination of laboratory studies and other research conducted on materials sampled from plants (decommissioned or operating). Evaluation of materials properties of SSCs from decommissioned NPPs will provide a basis for comparison with results of laboratory studies and calculations to determine if long-lived passive components will be capable of meeting their safety functions during operation beyond 60 years. Because of the cost and inefficiency of piecemeal sampling (i.e., harvesting materials on an ad-hoc basis), there is a need for a strategic and systematic approach to sampling materials from SSCs in both operating and decommissioned plants.

This document describes a potential approach for sampling (harvesting) that focuses on prioritizing materials using a number of criteria. These criteria also help define the specific problems that will be addressed and the knowledge gained/technical gaps closed through the sampling process. Using a number of lessons learned from previous harvesting campaigns, a harvesting process is defined that includes many of the criteria that should be taken into account during any harvesting campaign.

2.0 Nuclear Plant Materials Harvesting

A key challenge to addressing the gaps in materials aging and degradation through 80 years of operation is the ability to perform tests that mimic the aging process in operating plants. Often, such tests are performed (and materials performance data obtained) through accelerated aging experiments, where the material under test is subjected to higher stresses (mechanical, thermal, and/or radiation) than those seen in operation. Such tests enable the experiments to be completed in a reasonable timeframe but need to be benchmarked with performance data from materials that have seen more representative service aging.

Where available, benchmarking can be performed using surveillance specimens. In most cases, however, benchmarking of laboratory tests will require harvesting materials from reactors.

Over the past several years, a number NPPs (both within the United States and elsewhere) have either permanently ceased operation or have indicated that they will shut down in the next few years. These shutdown plants provide an opportunity to extract materials that have real-world aging and provide an avenue for benchmarking laboratory-scale studies on materials aging. The resulting insights into material aging mechanisms and precise margins to failure will be essential to provide reasonable assurance that the materials/components will continue to perform their safety function throughout the plant licensing period. The extracted materials could also help in determining specific methods for condition assessment or non-destructive evaluation (NDE) that may be applied to these components in the field to assess component aging.

Note that while shutdown nuclear plants provide an unparalleled opportunity for ex-plant harvesting, similar harvesting opportunities may exist in operating plants. Scheduled repairs or replacements may provide opportunity to extract materials to address specific knowledge gaps associated with materials performance during SLR. In other instances, specific but unusual operational experience may dictate the need to harvest materials to better understand the observed phenomena.

Harvesting is not the sole answer to addressing knowledge gaps. In some cases where harvesting is most needed, such as the RPV, internals, and concrete in the shield walls, the components exist in areas with high radiation doses. Because of the need to minimize personnel radiation doses to levels as low as reasonably achievable (ALARA), worker access to these areas is stringently controlled. The benefits of harvesting may not be enough to overcome the costs of procurement, evaluation, and subsequent disposal of the materials.

Given the advantages and disadvantages associated with harvesting, there is a need for processes to identify, assess, and prioritize harvesting opportunities. The next section discusses criteria for harvesting and provides examples of applying these criteria.

3.0 Materials and Harvesting Prioritization

This section describes the sources of information used in the assessment and proposes several criteria for use in the prioritization of harvesting decisions. Several examples are included that show the application of these criteria to provide a qualitative assessment of harvesting priority.

3.1 Literature Sources

There are two general classes of degradation mechanisms that are of interest (Cattant 2014). The first class is mechanisms that lead to failure (such as corrosion, fatigue, or wear) while the second class concerns materials aging (such as irradiation embrittlement and thermal aging). In general, the second class of degradation mechanisms results in a change in material properties (reduction in toughness, increase in hardness, etc.) that can facilitate failure through one of the failure mechanisms. In this document, this distinction is not strictly followed and the terms “degradation mechanism” and “aging” are used somewhat generically to refer to either of the two classes.

A wide variety of literature exists with information on materials degradation that may be relevant to life extension of NPPs. Early materials aging insights for light water reactor components were summarized in a number of documents (Blahnik et al. 1992; Shah and MacDonald 1993; Livingston et al. 1995; Morgan and Livingston 1995; NRC 1998). More recently, the literature in this area includes the NRC Generic Aging Lessons Learned (GALL) reports (NRC 2010a, 2017b, a); *Expert Panel Report on Proactive Materials Degradation Assessment (PMDA)* (Andresen et al. 2007); *Proactive Management of Materials Degradation - A Review of Principles and Programs* (Bond et al. 2008); and *Expanded Materials Degradation Assessment (EMDA),* NUREG-7153:

- Volume 1 (Busby 2014)
- Volume 2 (Andresen et al. 2014)
- Volume 3 (Nanstad et al. 2014)
- Volume 4 (Graves et al. 2014)
- Volume 5 (Bernstein et al. 2014)

The GALL report is the NRC staff's generic evaluation of the acceptable aging management for the period of extended operation based on the technical basis developed in the EMDA and PMDA. Based primarily on the operating experience from the fleet of operating plants in addition to EMDA and PMDA, GALL assesses the acceptable aging management approach for passive SSCs, based on material type and operating environment. The Electric Power Research Institute (EPRI) has also documented materials aging issues in the form of Materials Degradation Matrix and Issue Management Tables (EPRI 2013a, b, c). The matrix is used to document potential degradation mechanisms for primary system components, while the tables provide the basis for determining the consequence of component failures along with possible mitigation options. Further, a number of technical gaps have been identified in the understanding of degradation growth in specific materials; these are the current focus of active research by a number of organizations (IAEA 2012; McCloy et al. 2013; INL 2016).

Two factors play an important role in the ability to detect and mitigate materials degradation. First is an understanding of the materials degradation processes that contribute to the progression of degradation and, if not detected and mitigated, an eventual loss of structural integrity. The second factor is the availability of NDE methods and associated condition monitoring (CM) techniques that are capable of detecting the degradation in a timely fashion (before it grows to the point where loss of structural integrity occurs).

It is important to note that these two factors are connected and advances in one may help address any perceived deficiencies in the other. For instance, lack of a comprehensive understanding of the mechanism (how it develops and grows) may be mitigated somewhat if adequate methods for detecting the degradation are available. Likewise, lack of adequate methods for detection may be mitigated if improved understanding of the mechanisms exists.

Note that the sources of information for these two factors are not always connected. A number of studies have examined the ability to detect degradation in a timely manner. These studies have generally focused on assessing the reliability of NDE methods and the factors impacting reliability. Current techniques such as ultrasonic testing and eddy current testing that are applied for NPP in-service inspection (ISI) tend to focus on detecting signatures from mechanisms (such as cracking) that lead to failure. These studies are usually based on a comprehensive round-robin assessment of the technique, instrumentation, or personnel (Crawford et al. 2015; Meyer and Heasler 2017; Meyer et al. 2017; Ramuhalli et al. 2017). These types of studies have led to changes in the American Society of Mechanical Engineers (ASME) Boiler and

Pressure Vessel Code (hereafter the Code) around the implementation of techniques to assure reliable detection of cracking in the field (Doctor et al. 2013).

It is important to note that current NDE techniques have not seen real-time or in situ application for the detection and characterization of general materials aging. However, there is a rich set of literature that is examining the applicability of these same techniques as well as new techniques for this purpose, although the work has stayed largely in the basic research phase (Bond et al. 2009, 2011; Meyer et al. 2012; IAEA 2013; Ramuhalli et al. 2014; Fifield and Ramuhalli 2015).

3.2 Literature Assessment

The literature identified above, especially for materials degradation mechanisms, cover a broad range of materials, mechanisms, and environments, for both pressurized water reactor (PWR) and boiling water reactor (BWR) plants.

From the perspective of SLR, a number of studies, such as the EMDA and PMDA, have identified technical gaps associated with understanding the contributing factors for materials degradation development and growth. These studies, typically conducted as expert elicitations, have resulted in phenomena identification and ranking tables listing the susceptibility of materials to specific degradation mechanisms and the level of knowledge available. The tables also include general information on the environment that these materials operate in, as the specific degradation mechanisms are intimately tied to the environmental conditions in which the material operates.

It is important to note that the information in the literature sources identified in Section 3.1, while similar in form, differs in specificity. Studies such as the EMDA and PMDA have focused on specific materials (alloys, specific compositions, etc.) while other studies may refer to generic materials while recognizing that differences in material composition and grade may exist. As an example, different grades of stainless steel are used in the current nuclear power fleet and while there may be similarities in how they behave under different environmental conditions, differences that are related to specific compositional variations may drive their behavior over the long term under specific operating conditions.

A specific example of this is the structural steels used in RPVs, where compositional variations may be a driving force in the loss of fracture toughness (Sokolov and Nanstad 2016). Concern now focuses on the possibility of late-blooming phases (Malerba 2013) that may cause changes in fracture toughness over longer operating periods. However, the development of such phases appears to be a function of the specific composition and the operational environment.

Materials degradation analyses, as well as inspection methods, have tended to focus on metals and pressure boundary components, such as the phenomenon identification and ranking table analysis conducted under the PMDA effort (Andresen et al. 2007). As plants consider SLR out to 80 years of operation, concerns about non-metallic passive components are increasing. These long-lived components, broadly divided into concrete and electrical cables, are generally difficult (if not impossible) to replace and would require a significant investment if across-the-board replacement is considered. As a result, recent assessments such as the EMDA have included a significant emphasis on identifying knowledge gaps related to these long-lived non-metallic components (Bernstein et al. 2014; Graves et al. 2014). At the same time, there is increased attention being focused on developing CM and NDE methods for concrete and electrical cables, with the objective of defining methods and acceptance criteria that would provide reasonable assurance that degradation would be detected before it reaches a state where it begins to affect the safe operation of the plant.

Collectively, these studies point to several potential knowledge gaps regarding specific materials and degradation mechanisms. These knowledge gaps are related to an understanding of the conditions leading to degradation initiation and growth, and to methods for detecting and mitigating such degradation in a timely fashion. Note that this is not a blanket statement about all materials and all mechanisms; in many instances, sufficient knowledge exists about the mechanism and methods for detection such that appropriate AMPs may be used successfully to manage these mechanisms of aging and degradation out to 80 years of operation.

The implication of the foregoing discussion is that certain mechanisms and materials, within the context of SLR, may be considered as a high priority when it comes to addressing technical gaps in degradation initiation, growth, and detection; however, a systematic approach is needed to objectively identify these materials and mechanisms. This systematic approach could also identify one or more criteria that can be used in the prioritization process. From the perspective of materials harvesting, priorities may also need to account for the connection between materials degradation and CM/NDE, and include an assessment of available NDE or other CM techniques. Assuming such a prioritization can be made, the materials identified would then become the target of activities related to ex-plant harvesting.

There have been similar studies in the past, where the objective has been to develop a systematic methodology for prioritizing harvesting opportunities (Johnson Jr. et al. 2001). This study builds on these previous efforts, focuses on harvesting needs for increasing confidence in aging management for SLR, and incorporates lessons learned from harvesting efforts in the years since these previous studies.

The next several subsections describe potential criteria and provide several examples of the analysis that can be conducted using these criteria for identifying high-priority components/materials for ex-plant harvesting.

3.3 Criteria for Prioritizing Harvesting

3.3.1 Criteria

Criteria for prioritizing harvesting of components/materials need to be relevant to the organization's specific needs. For example, one of the questions that will need to be addressed is whether for a given material within a specific environment, the failure mechanisms are understood sufficiently. If so, the harvesting priority for the material exposed to this environment is likely lower. Likewise, if there are sufficient options for monitoring, mitigation, and repair, and these have been validated in representative materials/conditions, harvesting priority may be low. Uncertainty in any of these factors may drive up the priority for harvesting in an effort to reduce the uncertainty. For CM/NDE, the needs are generally about the mechanism and geometry but not how the degradation was created (accelerated vs. real time). A need also exists in simulating "realistic" degradation, and this is where limited harvesting may be useful for benchmarking purposes.

Given this background, criteria for prioritizing harvesting may be broken into five major categories, with several other lower level criteria for fine-tuning the information. At the highest level, the major criteria are:

- Unique field aspects, if any, that drive the importance of harvesting the material. This focuses on materials that are not easily available presently, such as legacy material formulations and fabrication methods that may be outdated. Also within this category would be operating experience (OE) associated with a specific class of materials in a relevant environment. If OE is available, especially for materials considered to be low in susceptibility to a specific degradation mechanism, for instance stress corrosion cracking (SCC), it may be worth harvesting the material if possible.

- Ease of laboratory replication of material and environment combination. This criterion focuses on conditions that are not easily reproducible in a laboratory environment. Of the environments of interest, radiation environments are likely to be the most challenging to duplicate. This is more so for low-dose, long-term irradiation and is a concern if dose rate effects exist that may influence the mechanism initiation and growth.
- Applicability of harvested material for addressing critical gaps. The focus of this criterion is on the ease with which the harvested material may be used in laboratory studies to address gaps in knowledge. Ideally, research plans for use of harvested materials would be in place prior to the actual harvesting. A related question would be whether, in addition to laboratory studies using characterization tools, the material can be used in degradation initiation and growth studies. In this context, re-aging of harvested materials under accelerated conditions may provide additional insights. In cable aging, such studies have been proposed (wear-out aging).
- Availability of reliable CM/NDE techniques for the material and degradation mechanism. Such techniques may compensate for any uncertainties in knowledge about the formation and growth of degradation, and enable sufficient defense in depth. Note that, even with reliable CM/NDE methods being available, harvesting may be warranted in some instances if the degradation mechanism is likely to be a generic fleet-wide issue. In these cases, the harvested material may provide insights for repair/mitigation decision-making and improving the economics of plant operation. Further, it is possible that the harvested material may be useful for developing or improving CM/NDE techniques.
- Availability of material for harvesting. Knowledge of materials used in different operating and shutdown plants as well an understanding of which materials may be available for harvesting over different time horizons (short, medium, long) is necessary.

Note that the focus of this document is on identifying harvesting needs; other parallel activities are underway (and are expected to continue into the future) to identify material availability.

These high-level criteria focus on the ability of harvested materials to address gaps in materials performance knowledge for SLR. In tabulating the answers to these criteria, a variety of information will need to be gathered, possibly using one or more of the sources identified earlier. These include expert elicitation studies (EMDA, Materials Degradation Matrix, etc.) on the susceptibility of various materials in relevant environments to a number of degradation mechanisms. In addition to the susceptibility information from these expert panels, knowledge and confidence may be gained in the specific combination of material, degradation mechanism, and environment. In parallel, information in the GALL documents associate similar combinations with relevant AMPs, while other available documents provide insights into specific knowledge gaps.

Specific information from these studies that would be needed include:

1. Whether the material, degradation mechanism, and environment combination rated “high susceptibility” in expert elicitation reviews such as EMDA.
2. Whether the material, degradation mechanism, and environment combination rated “low knowledge” in the expert elicitation reviews such as EMDA.
3. AMPs that may be applicable to address the combination of the material, degradation mechanism, and environment.
4. Presence of OE associated with the material, degradation mechanism, and environment combination.

5. The level of understanding of the mechanism (ranges of environmental factors, initiation times and growth rates, other factors such as compositional variations, etc.). In effect, this is related to identifying the critical gaps in knowledge and also the ease with which the material, degradation mechanism, and environment combination may be simulated in the laboratory.
6. Options for mitigation, if any. Effective mitigation techniques (including a relatively easy and inexpensive path to replacement of the component) point to a relatively high level of understanding of the degradation mechanism. As a result, the added benefits from harvesting may be limited in these instances.
7. Amount of material use (plant-wide and fleet-wide). In addition to addressing the criterion on material availability, this information also plays into an assessment of the harvesting benefit. Widespread use of a specific material under similar environmental conditions could point to a large (potentially fleet-wide) benefit from harvesting.

It is important to determine whether the expected benefits from the harvested materials will clearly reduce any uncertainty associated with the materials' performance through 80 years of operation of the plant. If so, this potentially provides benefits from the regulatory perspective, while reducing any uncertainty around safety margins in these components.

3.4 Examples

In the interest of developing the process for prioritizing harvesting further, several examples are considered in this subsection. These examples are not intended to be comprehensive, but were selected to cover the potential range of priorities as well as highlight specific aspects of harvested materials that may be considered in the harvesting decision process. In each case, the criteria described above are assessed, with the additional information listed. The result is an assessment of the priority for harvesting should the material become available due to plant retirements or planned repairs.

The first example is of a non-metallic material (electrical cable insulation), illustrating the complexity of the problem and the unknowns in aging mechanisms and performance. This is followed by an example of cast austenitic stainless steel (CASS), which highlights several unknowns in aging mechanisms and the potential limitations of accelerated laboratory aging-based tests. This provides an example of a potential medium- to high-priority harvesting need. The next example (SCC in dissimilar metal welds [DMWs]) is evaluated for two specific scenarios and is considered a low priority for harvesting. The final example of vessel internals highlights unique aspects of field-aged materials (radiation damage) that makes harvesting a valuable but perhaps expensive proposition.

3.4.1 Electrical Cables

The issues associated with aging of electrical cables are generally complicated by the diversity in materials and formulations that were used in vintage cables. Given the qualification methods used when they were put into service, utilities were able to perform time-limited aging analyses to show with a reasonable assurance that electrical cables would be able to perform their necessary function under a design-basis event through a first round of license extension. However, as utilities approach a decision on SLR, there is a general consensus that available data on long-term performance of cables is sparse and in some instances contradictory.

Generally, utilities have adopted a CM approach to aging cable management. Given the uncertainties and knowledge gaps, they do not necessarily expect the cable to last for 80 years. Rather through their CM program, they are assured that they can detect damage before it becomes critical. The damaged cables or cable sections may then be repaired or replaced.

Harvesting cables has benefits and drawbacks. On one hand, it is possible to accelerate aging in a laboratory environment; this is likely to be informative for tracking and correlating inspection techniques over a full degradation lifecycle. On the other hand, such a study is not possible with a snapshot in time of a cable from a plant where the actual temperature and dose level is not known.

However, there is concern that the aging seen in accelerated tests may not always correlate well with field aging. In particular, dose rates and total dose effects, synergistic effects of thermal and radiation aging, and diffusion-limited oxidation are all concerns for the applicability of accelerated aging. Further, there are many instances where the formulations of cable insulation material (polymers) in plants (vintage material) are different from what is available today. In these cases, harvested vintage cables can be used for studies to provide the necessary data and plug the knowledge gaps.

From a CM perspective, the most interesting harvested cable samples will have failed some in-plant test (such as walkdown, indenter, withstand test, and time and frequency domain reflectometry [TDR and FDR]). These cables can then be subjected to alternative tests (like capacitance and higher-frequency FDR) and autopsy with laboratory tests like diffusion-limited oxidation and elongation at break (EAB).

Both operating and decommissioned plants may be sources of material, particularly if there is some indication of dose and/or elevated temperature exposure. A key advantage of material from these plants is the ability to compare laboratory and NDE tests of artificially aged cable to the naturally aged cable for verification of equivalency.

Harvested cables, when subjected to laboratory aging studies (wear-out aging) may be used with destructive and NDE tests (EAB, line resonance analysis, gel-swell, micro-indenter, atomic force microscopy, indenter, etc.) for increasing confidence in the ability to detect aging of concern and provide assurance that the insulation/jacketing material has not reached its end of life (defined as 50% EAB). While some of this has been done (Bernstein et al. 2014), there are still knowledge gaps that could benefit from this work.

The Cable EMDA includes the following classifications of material:

1. Cables at 35°C–50°C (95°F–122°F) and zero dose
2. Cables at 35°C–50°C (95°F–122°F) and up to 0.01 Gy/hr. (1 rad/hr.)
3. Cables at 45°C–55°C (113°F–131°F) and up to 0.1 Gy/hr. (10 rad/hr.)
4. Cables at 45°C–55°C (113°F–131°F) and up to 1 Gy/hr. (100 rad/hr.)
5. Cables at 60°C–90°C (140°F–194°F) and zero dose
6. Medium voltage cables in long-term wet conditions

For the above categories, material considerations were:

1. Crosslinked polyethylene (XLPE) (wet cables)
2. Crosslinked polyolefin (XLPO) (not for wet conditions)
3. Modern tree retardant XLPE
4. Flame-retardant ethylene propylene rubber (EPR)
5. EPR/neoprene

6. EPR/chlorosulphonated polyethylene (CSPE)
7. Black EPR
8. Pink EPR
9. Brown EPR
10. Butyl rubber
11. Neoprene
12. CSPE
13. Chlorinated polyethylene
14. Silicone rubber (not suitable for wet conditions)

For low-temperature, low-dose cases, susceptibility to embrittlement due to radiation and thermal aging was 0 to 2 (low susceptibility), and this is a well understood issue with knowledge consistently ranking at 3 (on a scale of 0–3). As the environmental exposure exceeds 45°C and up to 0.1 Gy/hr., susceptibility increases particularly with Neoprene, silicone rubber, and CSPE and the knowledge falls to 2–3. Thus, harvesting materials (especially Neoprene, silicone rubber, and CSPE) exposed to temperatures in excess of around 45°C and low-doses is likely to be of value. Table 1 provides a summarization for one type of cable in a specific environment, as a single example of non-metallic materials. Given the critical gaps and widespread nature of their use, these are considered a high priority.

Table 1. Assessment of Electrical Cable Insulation Harvesting Priority. Insulation and jacket materials considered are EPR and CSPE, at temperatures between 45°C–55°C and dose between 0.1–0.01 Gy/hr. (1–10 rad/hr.)

Criteria	Qualitative Assessment	Comments
Unique field aspects, if any	Vintage formulations, depending on manufacturer, real-world conditions.	10–12 manufacturers of vintage cable in U.S. fleet. Within a single plant, cable types and manufacturers can vary.
Ease of laboratory replication	Low-medium (long-term aging studies necessary)	
Applicability of harvested material for addressing critical gaps	High – Wear-out aging a possibility. Evaluation of CM for field degradation.	Requires knowledge on plant conditions
Condition monitoring/ISI for detection and sizing	Low to medium. Unclear how well proposed techniques would perform for low dose rate, low temperature aging of insulation.	Access limited; long-range methods are not fully understood
Availability of material for harvesting	TBD	Needs input from utilities
EMDA susceptibility score	Generally High (2–3)	
EMDA knowledge score	Medium (mostly 2)	Some data exist on long-term aging. Inverse temperature and synergistic effects are a concern. Inverse temperature effects apply and CSPE is formulation-specific.
GALL-SLR	Documented as a potential issue	AMP updates ongoing
OE	Yes	Documented in industry publications
Level of understanding of mechanism (environmental factors, initiation and growth of degradation, related factors)	Medium	See knowledge gaps below
Options for mitigation	Low	
Ease of replacement	Medium	Possible but can get expensive depending on specific locations
Amount of Use (in a plant and fleet-wide)	High	Low-voltage and medium-voltage cables extensively used in plants
Critical gaps in knowledge	Contribution to database for dominant effects, synergistic effects, dose rate effects for understanding accelerated aging vs. field aging, develop and qualify CM techniques	
HARVESTING PRIORITY		HIGH

3.4.2 Cast Austenitic Stainless Steel

CASS is used extensively in pressure boundary components in light water reactor (LWRs) coolant systems (Chopra and Rao 2016). Applications include piping, valves, vessel internals, pumps, support structures, brackets, and flow restrictors.

OE for material degradation has not been broadly encountered under 40 years of life. Under extended service life, the main concern is loss of fracture toughness due to aging (thermal and neutron embrittlement). Stress corrosion cracking and fatigue are not considered generic concerns for CASS. Under prolonged thermal aging, elements segregate and undesirable Cr-rich regions form within the ferritic phase, leading to degradation of mechanical properties. It is not known how radiation damage will interact with thermal aging.

At present, accelerated aging of CASS in the laboratory and computer simulations of microstructural changes are the main tools used to understand the aging of CASS in service. It would be useful to harvest reactor materials to validate the current accelerated aging program, computer models, and existing regulatory positions. Microscopy and mechanical testing of harvested materials will improve our understanding of aging behavior. In addition, accelerated aging of harvested materials will provide information on new degradation mechanisms that could crop up under extended life. While radiation damage has not been a concern in CASS, it would be prudent to harvest both unirradiated material (piping, pumps, etc.) and irradiated material (reactor internals) so that radiation effects on degradation under life extension can be reliably evaluated.

Below describes how the information on CASS may be mapped into the different criteria identified above.

1. The combination of material (CASS), degradation mechanism, and environment is rated high in the EMDA mainly for fracture of PWR piping in reactor water (no irradiation) and BWR vessel internals in primary water (radiation up to 1.5 dpa).
2. Both the knowledge and confidence scores are fairly high (~2, on a scale of 0–3) for CASS for all degradation mechanisms, because there have been limited instances of degradation in the OE and those were generally attributed to poor material quality or incorrect material processing.
3. The material, mechanism, and environment for thermal aging and loss of fracture toughness can be simulated in the laboratory. However, the relation between accelerated testing time and real-world service time is not clearly validated. Synergistic effects are difficult to reproduce in the laboratory. It would be valuable to look at the heat-affected zone in welded CASS material.
4. Knowledge gaps: There is data in the literature that suggests significant loss of fracture toughness for neutron exposures between 0.5 and 5 dpa due to the interaction of neutron and thermal embrittlement effects (Chopra 2015). This interaction needs to be understood for life extension.
5. Harvested materials can be used to address critical knowledge gaps in two areas: (1) calibration and validation of current accelerated testing procedures; and (2) assessment of the combined effects of thermal aging, coolant effects, and neutron irradiation. Degradation initiation and growth studies can be conducted with harvested materials. New/improved ISI procedures may be developed to detect degradation.
6. Reduction in fracture toughness as a result of thermal embrittlement can result in significantly increased crack propagation rates. While the delta ferrite content in CASS is one of the factors that controls crack (specifically SCC) initiation susceptibility, with higher delta ferrite generally resulting in lower SCC susceptibility but higher thermal embrittlement susceptibility, it is possible that other factors (such as fabrication irregularities or cold work) play a role in increasing the susceptibility to

SCC (Byun and Busby 2012). There is also active research to address potential gaps related to SCC initiation and thermal embrittlement during SLR.

The main microstructural mechanisms of thermal aging at less than 500°C are associated with the precipitation of additional phases in the ferrite: (a) formation of a Cr-rich α′-regions through spinodal decomposition, (b) precipitation of a γ-phase (Ni, Si-rich) and $M_{23}C_6$ carbide, and (c) additional precipitation and/or growth of existing carbides and nitrides at the ferrite/austenite phase boundaries (Ruiz et al. 2013). The formation of Cr-rich α′-regions by spinodal decomposition of δ-ferrite phase is the primary mechanism for the thermal embrittlement (Byun et al. 2016). The significant material signatures in the context of condition assessment for thermal aging appears to be the amount of Cr-rich α′-regions produced by spinodal decomposition of δ-ferrite and material hardness induced by thermal aging.

7. ISI methods are being evaluated to assess their ability to detect cracking in CASS. Currently, no technologies are deployed in the field for monitoring the thermally aged condition of CASS, nor does there appear to be an obvious immediate need for such technologies.

   In the event of a pressing need for such technology, the feasibility of monitoring the thermally aged condition of steels is suggested by the sensitivity of certain magnetic and ultrasonic NDE measurements to the precipitation and growth of second phases. It is reported that magnetic hysteresis loop analysis and magnetic Barkhausen noise emission can be used to estimate the amount of a non-ferromagnetic second phase material in a ferromagnetic material (Raj et al. 2003). Dobmann (2006) has investigated magnetic loop measurements for characterizing thermal embrittlement of WB36 low alloy steel. An estimate of the amount of copper phase precipitation is obtained from magnetic coercivity and results are presented that indicate a correlation between the coercivity measurements and Vickers hardness measurements. Similar studies are underway to assess precipitation of Cr-rich phases using magnetic measurements.

Harvested components are usually not necessary for condition assessment technology development as appropriate material conditions can be achieved and investigated by accelerated aging of laboratory specimens. Harvested materials may be useful to understand the interaction of radiation and thermal aging, to calibrate accelerated aging in the laboratory against long-term service in a reactor environment, and to estimate/predict the life time of CASS components for life extension. While the NRC is not currently funding research in this area, harvested CASS materials may help provide additional data to further inform the NRC’s regulatory decision-making.

The information above is summarized in Table 2.

Table 2. Summary of Harvesting Criteria for CASS, for All Mechanisms, in Reactor Water in Primary Loop Components

Criteria	Qualitative Assessment	Comments
Unique field aspects, if any	Vintage material, synergistic effects (especially radiation)	
Ease of laboratory replication	Low-medium	Gap relating accelerated aging studies to real-world service time
Applicability of harvested material for addressing critical gaps	Calibrate and validate accelerated aging procedures; assessment of the combined effects of thermal aging, coolant effects, and neutron irradiation; degradation initiation and growth studies; new/improved ISI procedures.	Potential need to validate methods for simulating SCC
Condition monitoring/ISI for detection and sizing	Limited (medium difficulty). Coarse-grained materials challenge ultrasonic testing. Challenge for meeting detection and sizing accuracy in thick-walled specimens.	Condition assessment methods for SLR may be unconventional. Access issues dictate probability of detection and sizing performance. Harvested materials useful to study issue and develop workarounds. Cases in the Code. Appendix to Section XI.
Availability of material	TBD	Needs input from utilities
EMDA susceptibility score	Generally high	BWR piping in reactor water (no irradiation), BWRs up to ~1.2 dpa, some PWR internals in primary water (up to 0.5 dpa)
EMDA knowledge, confidence score	Medium	All mechanisms
GALL-SLR	Variety of structures and similar components identified	No specifics on material composition
OE	Limited	Mostly due to poor material quality or incorrect processing
Level of understanding of mechanism (environmental factors, initiation and growth of degradation, related factors)	Medium	See knowledge gaps
Options for mitigation	Low	
Ease of replacement	Low	
Amount of use (in a plant and fleet-wide)	High (use of highest susceptibility CASS – CF8M – is lower)	Diversity in material composition and microstructure across plants. CF8M used in about 1/3 of PWRs that use CASS for Class 1 piping.
Critical gaps in knowledge	Synergistic effects of radiation and thermal embrittlement on fracture toughness, relation between accelerated tests and real-world service time, in-service material composition and microstructure	Multiple studies available using accelerated tests
HARVESTING PRIORITY	MEDIUM-HIGH	

3.4.3 Dissimilar Metal Welds

DMW joints are extensively used in NPP primary systems, and encompass a host of materials and locations. DMW are generally used to join ferritic and austenitic piping components, and employ either austenitic or nickel-alloy materials as the weld material. The ferritic end is buttered with several layers of a material close in properties to the main (austenitic) weld material, with a post-weld heat treatment usually applied to reduce residual stresses (Taylor et al. 2006).

A challenge with DMW is the presence of different materials within the weld, resulting in different material properties. These differences can result in reduced material toughness near some of the interfaces. Localized high temperatures and residual stresses may increase susceptibility to SCC in certain environments. Operating experience has also shown the possibility of cracking in such welds.

Below briefly describes how information on DMW may be mapped into the different criteria identified above. The focus is on Alloy 82/182 welds in these examples, given their wide use.

1. For the combination of DMW and primary reactor water at temperatures between 100°–150°F, the susceptibility to SCC is low (1–2 on a scale of 0–3). With higher pressures and temperatures, the susceptibility increases.
2. Both knowledge and confidence scores are fairly high because OE and laboratory studies have shown numerous evidence of SCC in materials at high temperatures and pressures. In contrast, there is limited OE for cracking at lower temperatures and pressures.
3. There is general consensus on the combination of factors that leads to crack initiation in these materials. These conditions can be simulated in the laboratory in accelerated aging tests. Limited data on crack growth rates in DMW materials have been generated in accelerated aging tests but it is not clear how well the data matches field experience.
4. Crack initiation in these materials is a function of several factors including the residual stresses and welding temperature variations. There is limited data on crack initiation in DMWs in general and may require additional studies.
5. Harvested materials may be used to address technical gaps related to crack initiation susceptibility and crack growth rates. However, it is likely that only a limited set of harvested materials may be needed (if any), given the ease with which the environmental conditions in operating plants may be replicated in a laboratory.
6. Several studies have demonstrated the viability of using one or more NDE techniques for detecting, characterizing, and monitoring SCC growth in these materials. While the reliability of these methods is still a topic of active interest, preliminary data appear to indicate the possibility of detecting and sizing to ASME Code requirements.

Tables 3 and 4 show a similar analysis summary for SCC in 82/182 welds in different environments. In this case, given the level of knowledge available about the susceptibility of the material to cracking when exposed to the environment and the options for detecting such cracking, these materials are considered to be at a lower priority level.

Table 3. Example Assessment for SCC in DMW: 82/182 Welds, for SCC, in PWR Primary Environments (Borated Demineralized Water (normally stagnant), 100°F–150°F, 640 psia). Components: ECCS Accumulator Piping to Cold Leg.

Criteria	Qualitative Assessment	Comments
Unique field aspects, if any	Vintage material	
Ease of laboratory replication	Medium/high	
Applicability of harvested material for addressing critical gaps	Calibrate and validate accelerated aging procedures; degradation initiation and growth studies	
Condition monitoring/ISI for detection and sizing	Available techniques may be sufficient for reasonable assurance of detection	Detection and sizing capability TBD but generally capable of meeting acceptance criteria set in the Code
Availability of material	TBD	Needs input from utilities
EMDA susceptibility score	Low-medium	Temperatures considered too low for SCC to be concern. However, cracking is a generic concern for these materials.
EMDA knowledge, confidence score	Generally high	
GALL-SLR	Nothing obvious listed for environment for this example.	AMPs are for components similar to the one listed above
OE	No.	Nothing was identified in Licensee Event Report searches to date
Level of understanding of mechanism (environmental factors, initiation and growth of degradation, related factors)	Medium-high	
Options for mitigation	Low	Given low susceptibility, this may not be an issue
Ease of replacement	Low	Given low susceptibility, this may not be an issue
Amount of use (in a plant and fleet-wide)	High	
Critical gaps in knowledge	Crack initiation time	Crack initiation probability considered low for the environment listed
HARVESTING PRIORITY	LOW	
ECCS = emergency core coolant injection system		

Table 4. Example of SCC in DMW: SCC in 82/182 Welds in PWR Primary Environment (reactor water, 653°F, 2250 psia) for Components: RCS Pressurizer DMWs, RPV DMWs, RCS SG, ECCS Accumulator Piping to Cold Leg, ECCS CVCS Piping to RCS Cold Leg

Criteria	Qualitative Assessment	Comments
Unique field aspects, if any	Vintage material	
Ease of laboratory replication	Medium/high	See gap on relating accelerated aging studies to real-world service time
Applicability of harvested material for addressing critical gaps	Calibrate and validate accelerated aging procedures, degradation initiation and growth studies, new/improved ISI procedures	Multiple studies available on SCC initiation and growth in nickel alloys and DMWs, mitigation proposals (overlay) also being studied.
Condition monitoring/ISI for detection and sizing	Available techniques appear sufficient for reasonable assurance of detection in pressure boundary components (ultrasonic testing, eddy current testing) and internals (visual testing). Generally easy to apply ISI (assuming access).	Potential need to validate methods for simulating SCC. Access issues dictate probability of detection and sizing performance. Detection and sizing generally capable of meeting acceptance criteria set in the Code.
Availability of material	TBD	Needs input from utilities
EMDA susceptibility score	Generally high	
EMDA knowledge score	Generally high	
GALL-SLR	Variety of structures and similar components identified, but no specifics on materials available	AMP XI. M7, M1, M2, M19: SG, Water Chem., ISI
OE	Yes	
Level of understanding of mechanism (environmental factors, initiation and growth of degradation, related factors)	Medium-high	See knowledge gaps
Options for mitigation	Low	
Ease of replacement	Low	
Amount of use (in a plant and fleet-wide)	High	
Critical gaps in knowledge	Crack growth rates, crack initiation time	Multiple studies available on SCC initiation and growth in nickel alloys and DMWs, mitigation proposals (overlay) also being studied.
HARVESTING PRIORITY	LOW	Multiple ongoing studies, significant advances in degradation understanding, availability of NDE drive priority assessment.

ECCS = emergency core coolant injection system
RCS = reactor coolant system

3.4.4 Vessel Internals

Vessel internals comprise a wide range of structures and components, with one defining characteristic: they are all exposed to the highest fluences within a NPP. Vessel internals are generally made of austenitic stainless steels (typically 304 or 316L) and the materials may be subjected to several processing steps, including cold work and welding, to form the component. Given the potentially high fluences experienced by these materials, several degradation mechanisms may occur over time, including irradiation-assisted SCC (IASCC), as well as other irradiation-assisted processes.

In the case of austenitic stainless steel exposed to irradiation and the primary systems water environments in LWRs, the following generic assessments may be made:

1. Susceptibility and confidence scores for SCC and other degradation mechanisms are generally high.
2. Knowledge scores are generally low-medium but this is a function of the specific degradation mechanism and specific environmental information.
3. OE has shown a number of cracks initiating and growing in baffle former bolts.
4. Critical gaps in knowledge include the specifics of irradiation-assisted degradation mechanisms—factors contributing to initiation and growth. A number of microstructural changes are possible in the presence of radiation, including void swelling, segregation, and precipitation. Gaps exist in understanding the factors that contribute to these mechanisms and their impact on the material functional performance.
5. ISI methods exist that can detect the presence of cracking and dimensional changes in components. The reliability of these methods is a function of several factors, including the critical flaw size (i.e., flaw length and through-thickness depth beyond which the structural integrity of the component may be affected with continued operation), physical access for inspection, and a number of factors associated with the inspection deployment technology.
6. Internal components embody certain unique aspects that are hard to duplicate in the laboratory. Unlike DMW, and to some extent CASS, the environmental conditions (especially higher fluences) are hard to generate in the laboratory. Even with access to specialized facilities, there is concern that degradation mechanisms may be flux rate- and spectrum-dependent, indicating that accelerated aging conditions typically encountered in test facilities may not be representative of the field-aged component. In this respect, internal components resemble electrical cables in that there is some evidence that field aging results in different microstructural conditions than accelerated conditions; at the same time, like cables (but unlike most metallic components including DMW and CASS), at least some internal components may be amenable to replacement.

Collectively, these criteria drive the need for harvesting internal components if available and result in a prioritization of medium to high.

Table 5. Example of Vessel Internals for Degradation in Austenitic Stainless Steels for Vessel Internals

Criteria	Qualitative Assessment	Comments
Unique field aspects, if any	High-fluence irradiation; vintage material	
Ease of laboratory replication	Low	Accelerated aging tests vs field aging service time
Applicability of harvested material for addressing critical gaps	Mechanisms of irradiation-assisted degradation—microstructure and mechanical properties	Re-irradiation may assist with understanding materials performance at SLR fluences.
Condition assessment/ISI	Available techniques (ultrasonic, visual) may be sufficient for reasonable assurance of detection. Sizing – maybe. Ease of ISI can be low depending on access.	Access issues may dictate probability of detection and sizing performance. Challenging environment for continuous monitoring.
Availability of material	Some materials being harvested; closed plants may provide additional opportunity	
EMDA susceptibility score	Generally high	Based on OE primarily
EMDA knowledge score	Generally low	
GALL-SLR	Variety of structures and similar components identified, but no specifics on materials available	
OE	Yes	Baffle bolt cracking, cracking in other internal components
Level of understanding of mechanism (environmental factors, initiation and growth of degradation, related factors)	Low-medium	See knowledge gaps
Options for mitigation	Low	
Ease of replacement	Depends on component	Some components (for instance, baffle bolts) can be replaced relatively easily.
Amount of use (in a plant and fleet-wide)	High	
Critical gaps in knowledge	Degradation mechanisms (IASCC, swelling, segregation, etc.), flux rate and irradiation spectrum effects, microstructural property changes, and links to mechanical properties.	
HARVESTING PRIORITY	HIGH	Unique field aspects and degradation mechanisms drive this prioritization.

4.0 Harvesting Plans

4.1 Ex-plant Harvesting Experience

4.1.1 Harvesting Projects

Harvesting activities have been carried out at a number of plants in years past. These have included decommissioned plants as well as cancelled or terminated plants. Of the cancelled or terminated plants, the harvesting effort appears to have been opportunistic and focused on accessing components that were fabricated, but not commissioned. Examples of these plants include Shoreham, River Bend Unit 2, and the Washington Public Power Supply System Units 1 and 3. In these cases, the focus was primarily on harvesting metallic components with a view to obtaining as-built materials for studies on crack growth, fracture toughness, and fabrication flaw density.

In recent years, harvesting efforts have generally focused on accessing materials from plants that have been decommissioned. The bulk of the effort appears to have been on three plants—Zion (both units) and Crystal River Unit 3 (all in the U.S.), and Zorita (in Spain). Zion is a decommissioned two-unit Westinghouse-designed four-loop PWR facility. The units were commissioned in 1973, permanently shut down in 1998, and placed into SAFSTOR in 2010 (Rosseel et al. 2016a). Crystal River Unit 3 is a PWR that ceased operation in 2013. Zorita is a 160-MWe PWR designed by the Westinghouse Electric Corporation, and operated for approximately 38 years (NRC 2010b). It was permanently disconnected from the national power grid on April 30, 2006. During this period, approximately 26.4 effective full-power years of reactor operation were accumulated and the highest fluence on the reactor vessel internals was estimated to be 58 dpa. A number of other plants that have ceased operations have been identified as potential sources of material for harvesting and include Kewaunee and San Onofre Generating Station (both units). At the same time, a limited amount of harvesting has been attempted at several other plants, usually in conjunction with a repair or replacement activity.

4.1.2 Cable Harvesting Experience

4.1.2.1 Background

The nuclear power cable community has long recognized the value of aged cable samples. For instance, EPRI developed a Cable Harvesting Users Guide website[(1)] that continues to accept recommendations from the community and provides guidelines to maximize the value of harvested cable. The guide indicates that the purpose of harvesting is to determine present condition, remaining life, and allow forensic analysis for insight into actual field-aging mechanisms and determine their influence on long-term performance. The guide is intended to benefit the utility in the following ways:

- If a utility identifies cables that are judged to be limiting by use, type, and/or operating environment, and the cables are shown to be acceptable with adequate remaining life, that utility may be able to demonstrate that work required by the regulatory authorities for other cables may be deferrable.

(1) EPRI. 2014. *Plant Engineering: Field Guide for Harvesting Service-Aged Cable (Cable Harvesting Guide) Version 2014*. EPRI Report 3002002994, Electric Power Research Institute (EPRI), Palo Alto, California. EPRI members may access this software at http://cableharvest.epri.com.

- Evaluation of service-aged cables is one strategy for determining the limits of remaining life for NPP cables. Equally important to understanding and managing aging of in-service cables is to gain practical insight into those cable material and construction systems that can be demonstrated to have performed well.

Key candidates for removal and harvesting are:

- Cables that have experienced unanticipated in-service failures
- Cables with observed aging degradation under specific service conditions
- Cables from systems identified by the plant as those with specific concerns (e.g., high safety significance or particular vulnerability)
- Cables from systems with plant-unique service or environmental conditions (e.g., salt water infiltration or water immersion, high operating temperature, high radiation)
- Cables that are examples from a large installed base; may include cables of particular construction and materials, from a single manufacturer, or of a single manufacturing vintage.

While it is recognized that cable harvesting may occur in conjunction with an environment where the task is secondary to either returning a plant to service or plant dismantlement, recognition of a best-practice removal protocol is helpful to maximizing the value of the harvested cable. Recommended cable removal protocol includes:

- Clearly identifying the cable to be removed
- Photographing the cable environment prior to removal
- Tagging or somehow unambiguously identifying the cable prior to or just after removal.

As long a section of cable as possible should be removed. Terminations, splices, and cable accessories should be retained as much as possible.

Identification of interesting parameters associated with the cable can include and should consider:

- Cable physical description
  - Cable category (instrumentation and control, low voltage, medium voltage)
  - Construction (configuration, number of conductors)
  - Manufacturer/date
  - Materials (jacket, insulation, conductor jacket)
  - Cable lengths and segments
- Service parameters
  - System
  - Service application
  - Current and voltage
  - Duty factor
  - Safety and maintenance rule significance
  - Age in service

- Installation data
  - Installation location (building, outside, buried)
  - Terminations
  - Supporting structures or conveyances
- Stressors
  - Installation
  - In-service mechanical and structural
  - Environmental degradation
  - Other damage potential
- Plant fleet cable experience
  - Testing interval and history
  - In-service failure or degradation
  - Other

4.1.2.2 Known Naturally Aged Harvested Cable Examples

On May 19, 2016, Zion Solutions harvested and placed into six steel drums, four sets of Zion Unit 2 cables with lengths up to 30 ft. of XLPO, low- or high-density polyethylene, EPR, silicone, Hypalon, etc., in collaboration with the NRC. Cables were harvested from:

- Accumulator discharge motor operated valve cabling, outside the missile barrier (OMB), lower level of containment
- Instrumentation cables – instrument racks, OMB, lower-level containment
- Air-operated valve cabling, OMB, lower level of containment
- Cables in electrical penetrations, OMB, containment; elevation 617 ft.

A test plan for these cables has been developed and tests such as EAB and additional aging/qualification tests have been initiated (as of the writing of this report).

Harvesting of cables was also recently performed at the Crystal River Unit 3 plant, which was shut down in 2009 for refueling and an uprate. The construction efforts caused damage to the containment structure that was ultimately determined to be too costly to repair. In 2013, it was announced that Crystal River Unit 3 would not restart and decommissioning activity was begun. Cables were harvested from the plant in 2015. Photographs were taken for many of these cables inside the plant just prior to their removal. Some of these cables have asbestos filler between the jacket and insulation; however, this is a recognized hazard that can be managed with minimal additional precautions as long as testing does not include jacket removal. A research plan has been developed for harvested high-priority cables (Fifield 2016) and is currently being executed.

Several cables were also removed from service from the Fermi nuclear station in 2015 for forensic examination. The cables were:

- 5C/#16AWG, 600V, Rockbestos XLPE/Neoprene (~ service from 1978–2010; 32 years)
- 4C/#12AWG, 600V, Okonite EPR-Neoprene/ Hypalon (~1977–2010; 31 years)

All XLPE insulations were determined to be like new based on indenter modulus and EAB. Neoprene jackets were approaching embrittlement level. The EPR-Neoprene/Hypalon jacket showed signs of aging based on both indenter modulus and EAB (Anandakumaran and Auler 2015).

In contrast to cables removed from (now closed) plants, there have been a number of examples of naturally aged cables harvested from storage. For instance, several warehouse-aged cables that had been purchased and stored for more than 20 years but not placed in service were made available to EPRI by the Palo Verde plant for evaluation. Testing at EPRI confirmed that cable insulation degradation when not exposed to severe environmental or operation stresses was limited.(1)

A third source has been cables removed from service due to failure of the cable (generally based on failing one or more tests conducted in the field). While such failures appear to be relatively rare in the field, removal of cables to prevent a future failure may occur after visual or electrical testing indicates a potential problem. In 2015, a 1000V three-phase cable with cracked Neoprene jacket and EPR insulation was removed from service at the Beaver Valley NPP after failing electrical test acceptance criteria. Forensic examination of the cable revealed tensile stresses in excess of ultimate yield strain. Chlorine and its compounds (probably hydrochloric and chloric acid) were found to contaminate the cable surface including crack walls, forming a conductive path between cable conductor and ground (Fryszczyn 2015). Several cables were also removed from the Kewaunee turbine building and sent to Analysis and Measurement Services Corp. for forensic evaluation in 2015. Cables included Boston Insulated Wire two-conductor 12 AWG CSPE jacket/CSPE insulation cable; Kerite three-conductor 12 AWG XLPO jacket/XLPO insulation cable; and Okonite four-conductor, 14 AWG Neoprene jacket/cloth wrap/EPR-Neoprene insulation. Of three naturally aged cables tested, two showed no signs of aging degradation and one showed signs of significant degradation for only the jacket (Toll 2015).

Several other harvested cables (from a number of plants) contributed to a series of reports on medium-voltage cable aging failure mechanisms mainly on butyl rubber and different types of EPR cables. It has been observed that the cables do not degrade homogeneously in water, but in discrete locations, enabling operators to isolate the degraded cable section, remove it, and splice in a new section (EPRI 2015).

4.1.3 Harvesting of Internals

4.1.3.1 Background

In recent years, OE has identified several examples of cracking in internal components, including baffle bolts, jet pump risers, core shroud, etc. A number of mechanisms are of interest, including IASCC. Given that the vessel internal components see some of the highest fluences, the acquisition of materials from these components is likely to provide a great deal of information about the behavior of these materials at high fluences. Some specific topics that are of interest include:

- Quantifying materials performance in the presence of irradiation-induced processes such as segregation, swelling, and precipitation
- Crack initiation and growth rates in the presence of irradiation-induced processes

(1) Andrew Mantey (EPRI), Personal communication.

4.1.3.2 Known Examples

A number of harvesting efforts have been initiated in the United States and elsewhere to acquire vessel internal components. In the United States, recent efforts have included the harvesting of baffle-former bolts. The harvesting, in this case, was focused on acquiring bolts that were withdrawn from service (and replaced with improved materials) for the purposes of post-service examination (Leonard et al. 2015). These were primarily used for laboratory studies to determine the degradation mechanism and if evidence of IASCC existed with some or all of the bolts.

Similar harvesting efforts are underway at Zorita (Hiser et al. 2015), with the objective being to acquire and test materials that have experienced a range of fluences. Planned studies in this case include mechanical testing of the samples as well as testing to determine crack initiation and growth rates. In the case of Zorita, the focus is on baffle plate materials and core-barrel weld materials. These materials have been exposed to different levels of irradiation, and welds and heat-affected zone. Additional studies are planned with post-harvesting irradiation of selected specimens.

Other baffle-bolt harvesting efforts have been based on industry OE (EPRI 2017; NRC 2017c; Smith and Burke 2017).

4.1.4 Harvesting of RPV Materials

4.1.4.1 Background

RPV-related materials harvesting has a long history in the nuclear power community. The harvesting has generally been to address several questions related to the performance of the pressure vessel in the presence of irradiation and assess its likely performance under abnormal conditions. RPV materials must withstand a harsh operating environment, including neutron irradiation and time at temperature, given their function as part of the pressure boundary. Specific questions that have been raised about RPV materials include:

- Improving understanding of mechanisms driving embrittlement in RPV steels and reducing predictive uncertainties for embrittlement
- Quantifying loss of fracture toughness due to irradiation embrittlement
- Quantifying fabrication and service-induced flaws (if any) in RPV materials
- Developing techniques for mitigating embrittlement.

Clearly, the harvesting of RPV material from an operating plant is unlikely. Instead, a significant amount of studies have focused on the use of surveillance specimens that are placed inside the reactor vessel and harvested during periodic plant refueling outages. This approach also allows for supplemental capsules to be inserted into an operating reactor for a relatively short time and still get meaningful results. The exception to this is harvesting materials from terminated or cancelled plants. These are briefly summarized below.

4.1.4.2 Known Examples

A number of specimens from the beltline weld region were harvested from cancelled or terminated plants, such as the Shoreham plant. In these instances, fabricated components (especially the RPV) were accessed for the harvesting effort. These were selected specifically for studies around fabrication flaw density in the beltline weld region, and knowledge gained on fabrication flaw size and distribution in

RPVs played a role in the development of 10CFR50.61a. The harvesting priorities in these cases were driven by the specific needs of the research and included sufficient material on either side of the weld to enable studies on the weld and adjacent material.

In recent years, harvesting from the Zion Unit 1 RPV has been the focus of the U.S. Department of Energy's effort (Rosseel et al. 2016b). An appropriate segmentation plan has been developed for the RPV to gather material from the beltline weld region, between the upper and lower vertical welds. Both base-metal regions and beltline weld regions are included in the harvested sections and are planned for use in laboratory studies. Comparisons with fracture toughness of surveillance specimens are expected to provide insights into the changes in fracture toughness over time.

4.1.5 General Lessons Learned from Harvesting Examples

The ability to harvest field-aged materials has generally proven to be successful, but a number of lessons can be learned from these experiences.

In general, information on the exact environment in which the material was operating may not be available. Often, all that is available (especially after a plant has closed and is in the decommissioning phase) is the total number of years the material was used while the plant was in operation and a general idea of the environment based on its location. While the environmental conditions for some components (such as RPV or internals) can be calculated relatively precisely based on plant operational data, the lack of such information can be problematic for components exposed to localized extreme environments. For instance in the case of cables, the possibility of localized hot spots (from uninsulated piping close by) may be a contributor to significant local thermal aging. This type of information is more readily available when the cable is harvested from an operating plant and additional measurements of environmental conditions may be taken prior to harvesting (for instance, through infrared thermography measurements).

Recent experiences (such as Zion and Crystal River Unit 3) showed the process of harvesting can be expensive. A related challenge was the complexity of securing engineering and labor support for a forensic harvesting task when the primary contractor in charge of the operation is primarily focused on dismantling the plant.

While harvesting materials with known degradation issues is always useful, in the case of harvesting post-plant closure, it may also be a challenge. Such information may not be readily available without performing some form of inspection. Given the challenges associated with securing engineering and labor support for harvesting, obtaining the necessary support is likely to be difficult.

4.2 Harvesting Plans General Requirements

With the experience to date harvesting materials from plants and the associated lessons learned, several best practices may be identified for future strategic harvesting exercises. Prior to developing a harvesting plan, the following will need to be addressed:

- Clearly identifying the need for harvesting the material. This will require defining the knowledge gaps that will be addressed and how these gaps are relevant to SLR.
- How the harvested material will be used. This will require development of a research plan (even if at a high level initially) that will be executed with the harvested material and how the studies are expected to close the knowledge gap. Several excellent examples exist for research plans (for instance, Leonard et al. 2015; Fifield 2016).

- Determine the necessary resources for harvesting. Use the justification and prioritization for harvesting to secure the necessary engineering/labor support prior to beginning the procedure. In discussions with technical staff who have been involved in harvesting activities, this was the number one item raised, especially when the harvesting activity is an adjunct to decommissioning the plant. In this case, the decontamination and decommissioning activities take precedence and the harvesting activity will need to accommodate any changes in schedules necessary to ensure that the primary activity is completed on schedule.
- Timeline for harvesting. A fall out of the resource planning issue above is the need for developing the harvesting plan, and, in consultation with plant personnel, a notional schedule for the harvesting.
- Post-harvesting receipt of material. The plan should also include information on where the material will be sent and in what form (complete component, segmented into smaller pieces, etc.), condition of the material after harvesting (contaminated, if cleaned to what extent, etc.).
  - Should include information on additional locations to which the material may be sent from its primary storage/use location to ensure appropriate planning can be initiated at the primary recipient facility as well as at any secondary recipient facilities.
  - A requirements document is mandatory that covers receiving and working with the material. In particular, if the material is to be handled as radioactive material, additional precautions will need to be taken for both shipping, storage, and use in research. Activated and/or contaminated material may require hot-cells for storage and use.
  - Note: Depending on the material and its condition (contaminated, activated), regulations for shipping (U.S. Department of Transportation regulations) will vary and need to be accounted for in scope, schedule, and budget for the harvesting activity.
  - Depending on its eventual end-use location, necessary approvals should be in place prior to executing the harvesting plan.
- Waste handling. Depending on the material and research plan for its use, provisions will need to be made to handle any waste streams generated during the process. This includes not only the waste generated during harvesting but subsequently during research. Specimens created from harvested material may need to be stored for longer terms, and provisions are necessary for long-term storage of the material if necessary.

Note the prioritization approach described earlier in this document provides a potential pathway to identifying the knowledge gaps, relevance to SLR, and defining the priority for harvesting the specific material. The associated research plan should include, in addition to a description of the specific research and expected outcomes that close the technical gaps, a pathway to using the information in a practical manner for addressing SLR needs. This may happen, for instance, through propagating the technical findings into the relevant technical literature and codes and standards.

A number of elements need to be kept in mind as the harvesting plan is developed. These include:

- Clearly identifying the component/material to be removed. Labels, tags, etc. are possible ways in which the component (or location on a component, if only a portion is being harvested) can be identified. Given the need to potentially coordinate the harvesting activity with other activities at the site, such identification can reduce the potential for mistaken harvesting of material.
- Documenting the environment in the vicinity of the component prior to removal. This includes not only the temperature, radiation, etc., but also the presence of other components in close proximity and how they interact with the component being harvested. For instance, vibration from a nearby pump may play a role in accelerating degradation in the component being harvested.

  - Radiation surveys of materials may be needed before and after harvesting to determine if the material is contaminated or can be free-released. This also provides information on necessary decontamination activities that may be needed.
  - The level of contamination and activation of the material will dictate the actual harvesting approach to meet ALARA requirements.
- Information about the condition (degradation and aging) should be documented if available. If possible, additional measurements should be taken before or after harvesting to confirm the condition of the material prior to its use in any aging-related studies.
- As large a section of material as possible should be removed. Note that this may be constrained by budget or dose to personnel. Any special features (such as terminations, splices, and cable accessories for the case of cable harvesting; welds, heat-affected zone, and base metal for similar and dissimilar welds) should be identified in the harvesting plan, and if necessary, retained.

Parameters that will need to be documented (if available) during this process include:

- Physical description
  - Category (examples: nozzle weld, instrumentation and control cable, medium voltage cable, baffle bolt)
  - Construction information (configuration, special processes used)
  - Manufacturer/date
  - Materials comprising the component to be harvested or composition
  - Dimensions and special features
- Service parameters
  - System
  - Service application
  - Usage parameters (how often was it used if intermittently used)
  - Safety/maintenance rule significance
  - Age in service
- Installation data
  - Installation location (containment, auxiliary building, other building, outside, buried)
  - Connected components
  - Supporting structures or conveyances
- Stressors
  - Installation
  - In-service mechanical and structural
  - Environmental degradation: temperature, pressure, fluence, humidity
  - Other damage potential
- Plant/fleet experience
  - Testing interval and history

– In-service failure or degradation

– Available data on inspections for degradation

Note that generating all the necessary harvesting plan information is time consuming and, where possible, should be assembled before any opportunities arise for harvesting. Critical details that will require knowledge about the harvesting plant/location are who will perform the harvesting, when will harvesting be performed, where is the material, what is its condition, and how much should be harvested? Having the rest of the information pre-assembled will provide a significant advantage towards speeding up the procedure. For this purpose, having the necessary information available, perhaps in a searchable database, will facilitate the process.

5.0 Information Tools for Harvesting Planning

The previous sections dealt primarily with approaches for prioritizing the needs for harvesting of materials from plants for addressing one or more issues. Identification of technical gaps and development of a harvesting plan to address some of these gaps will require other information. Such information can include the state of knowledge about materials performance, availability of materials for harvesting, and operational experience.

Key to efficient use of this information is an integrated tool set that will enable rapid assessment of technical gaps and well-informed decisions on harvesting. This section briefly describes a potential tool suite for this purpose.

5.1 Reactor Reliability and Integrity Management Library

5.1.1 Overview

The Reactor Reliability and Integrity Management (RRIM) Library is envisioned as a suite of integrated tools (Figure 1) that focus on providing decision makers with necessary information to deliver informed recommendations based on the available data. The following tools have been identified as critical to development of the RRIM Library:

- Generic plant framework
- Knowledge repository
- Harvesting management

Each of these tools is described below in greater detail. It is important to note that these are only envisioned tools at this time. As harvesting needs increase, it is likely the tool sets described here will be augmented or modified to account for emerging requirements for a decision-making tool suite in this area.

5.1.1.1 Generic Plant Framework

Generic aging lessons learned plans are categorized by plant type (PWR or BWR), structure and/or component, material, environment, and aging effect/mechanism. From a RRIM tool suite perspective, this information is assigned to the Generic Aging Management Plans block in Figure 1; this block is merely intended to illustrate that the aging management plans are informed by insights from GALL as well as a variety of other literature sources on materials degradation. This categorization provides a construct that may be used to align information from other sources to define a high-level categorization of the various elements that are of concern in a plant. This construct will be the basis for the generic plant framework in RRIM. Input from subject matter experts (SMEs) will be needed to map the knowledge elements to the framework, as each of the sources provides differing levels of granularity on the descriptions of the structure and/or components, environment, and materials. The framework will be used to further align data from other sources, which may have varying levels of detail, into a similar higher level categorization. Sources of information include the PMDA and EMDA documents.

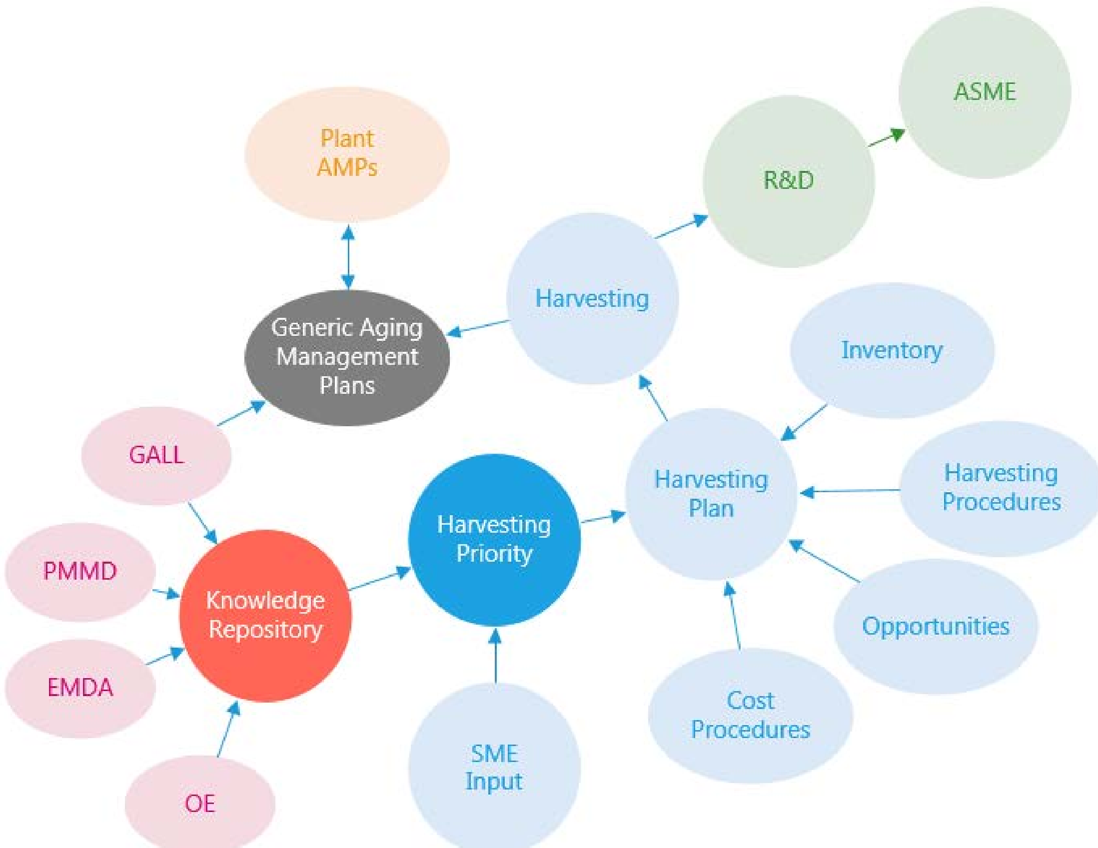

Figure 1. Reactor Reliability and Integrity Management Library Concept

5.1.1.2 Knowledge Repository

The knowledge repository will enable the correlation of a variety of information sources by mapping the data to the generic plant framework and providing searching capabilities.

The tool is envisioned to contain static content, such as information from the PMDA or EMDA. For example, the current proactive management of materials degradation tool (http://pmmd.pnl.gov) provides searching capabilities to visualize the susceptibility, confidence, and knowledge and search by the parts and degradation mechanisms as defined in the document; however, EMDA defines the parts differently.

The knowledge management tool will align the content of sources such as the EMDA and PMDA and map them into to a common structure and component list that would enable searching across both documents. The tool will also contain capabilities to automatically extract information from publicly available relevant sites, such as the Licensee Event Report, so that new information (particularly about relevant operational experience) is automatically added. The system will provide a best attempt at mapping to the generic plant framework; however, SME input may be required to validate these mappings.

5.1.1.3 Harvesting Management

As described earlier, harvesting has several phases, including determining the priority, developing a plan to complete the harvesting, conducting the actual harvesting of materials, and eventual use of the material (including the dissemination of results from research conducted on the material). The harvesting management tool is envisioned to support the lifecycle of the process.

This tool can be used to facilitate the harvesting prioritization as shown in the previous sections. We envision the tool as being capable of generating the unique combinations of materials, degradation mechanisms, and environments to create an entry for each unique combination within the harvesting management tool. The tool is expected to include the capability for automatically augmenting the entries with knowledge from the repository. After harvesting priorities have been determined by an SME, the tool will identify new knowledge that may impact the priorities. The tool will provide a mechanism to facilitate development of a justification, which is a key element in the preparation of harvesting plans.

The tool will also need mechanisms to capture costs, inventory, procedures, and opportunities related to harvesting. This information, augmented with priority and justification, will be the elements that provide the basis for the decision to develop a plan. The tool is also expected to facilitate capturing the results, including images and observations about the materials harvested.

5.1.2 Work to Date

A demonstration website[(1)] was set up to model what the knowledge repository may look like (Figure 2). The demonstration site only contains OEs as a sample data set; SME expertise would be needed to incorporate documents such as the proactive management of materials degradation tool, EMDA, and GALL into discrete knowledge elements. The visualization below provides an example of publicly available information about plant OE, along with the ability to search and sort the information (from more than one source, including public websites and a subset of EMDA information) by SSC type, material, environment, and degradation mechanism. The demonstration site for the knowledge repository would be one starting point for a detailed analysis of the required capabilities for the RRIM tool suite described earlier.

[1] http://hagar.pnl.gov/srs/dev/latest/v3/src/nrc/. Note: Website is only available to NRC.

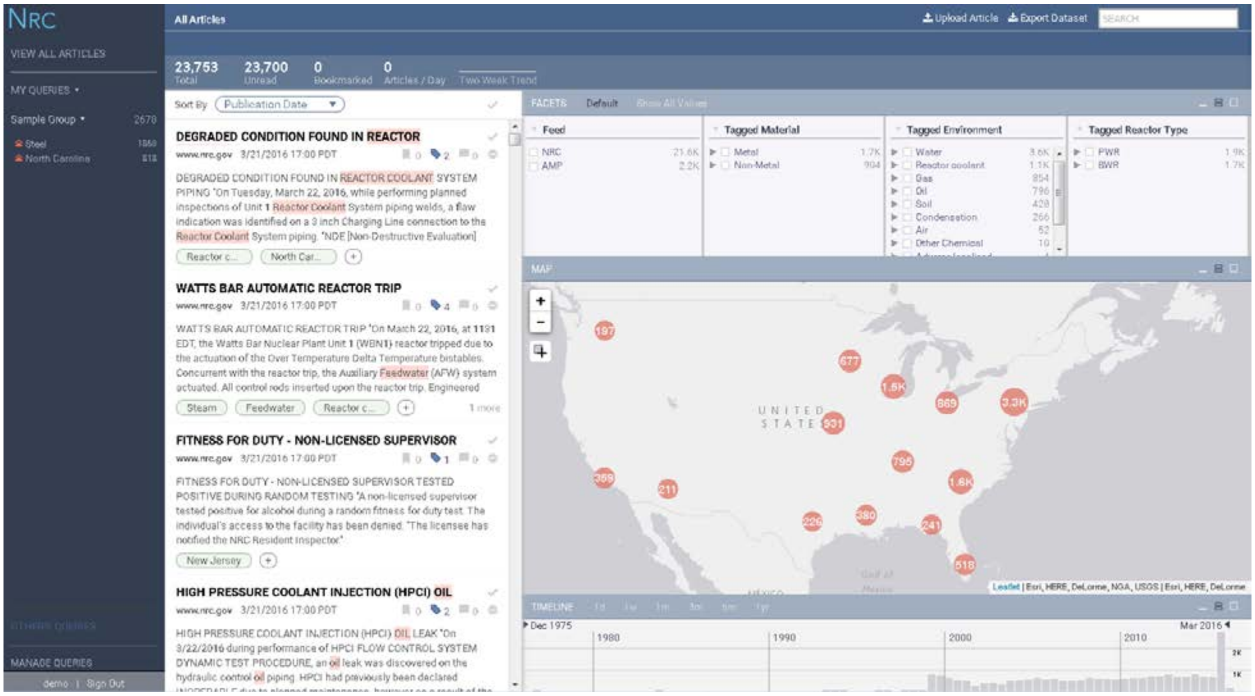

Figure 2. Example Visualization of Knowledge Repository to Support Harvesting Decision-Making

6.0 Summary and Path Forward

Addressing many of the remaining technical gaps identified in the EMDA for SLR may require accessing materials sampled from plants (decommissioned or operating). Such materials may be used to better understand actual material property changes with plant age and improve understanding of the initiation and growth of degradation mechanisms of relevance to SLR. Evaluation of material properties in SSCs from actual decommissioned NPPs will also provide a basis for comparison with results of laboratory tests and calculations.

Given the costs associated with any harvesting effort, potential approaches will need to prioritize materials using a number of criteria, including:

- Unique field aspects that drive the importance of harvesting the material
- Ease of laboratory replication of material and environment combination
- Applicability of harvested material for addressing critical gaps (dose rate issues, etc.)
- Availability of reliable ISI techniques for the material
- Availability of an inventory for harvesting.

These criteria help define the specific problems that will be addressed and the knowledge gained and technical gaps closed through the use of the harvested materials. A number of other factors (such as access to the material for harvesting, ability to work with the potentially contaminated material, and the plan for research using the material) play a role in defining the harvesting plan. A number of lessons may be learned from previous campaigns and these lessons can be used to develop a generic harvesting plan that can be customized for the specific needs and opportunities at hand.

A number of open questions remain in this context and will need to be addressed in follow-on research. These include:

- Requirements definition for an information tool such as RRIM. In the near term, such a tool can help as a searchable repository for identifying technical gaps. In the longer term, the tool can also assist as a repository of harvesting opportunities and with the prioritization using the criteria defined.
- Gaps assessment with respect to applying harvested materials for research and development.

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U.S. DEPARTMENT OF
ENERGY

Environmental Pillar
working for a sustainable future

Submission to the Transboundary Consultation on Sizewell C

From the Environmental Pillar

And

the Environmental Law Officer of the Irish Environmental Network.

Version Final

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Introduction

This consultation response is directed both to Local Authorities in Ireland, and to the UK Authorities on the matter of the transboundary consultation on Sizewell C Nuclear Power Plant.

Made on behalf of the Irish Environmental Pillar the advocacy coalition of Irish eNGOs and the Environmental Law Officer of the Irish Environmental Network, the coalition of national eNGOs in Ireland, and

We naturally respect the UK's sovereign right to pursue its own energy mix, but Irish citizens and eNGOs are also conscious of the UK's legal obligations to consult on the transboundary impacts of projects like Sizewell C, and indeed its future operation and decommissioning. We have serious concerns in respect of the conduct of the consultation and the materials and conclusions provided by the UK authorities on which we are expected to engage. This is in particular in respect of the totally inadequate consideration in respect of airborne and water transmission of impacts to Ireland, and in the context of the consequential risks arising from pursuit of this project, and the emergence of risks which are not adequately assessed particularly in the context of Brexit.

Specific Call to Irish Local Authorities and the current Irish Government

In the first instance I wish **to highlight the critically important role Irish Local Authorities** have in raising concerns in the wider public interest over the totally inadequate assessment of likely significant transboundary impacts on Ireland from the Sizewell C project proposal, both direct and indirect impacts. **We are urging you therefore in your engagements with the relevant Irish Ministers, and directly with the UK Authorities, to call unequivocally on the UK to conduct:**

a) A full Environmental Impact Assessment in accordance with its obligations under international law and the UNECE Convention on Environmental Impact Assessment in a Transboundary Context, (the Espoo Convention);
b) A full Environmental Impact Assessment, (EIA) in accordance with the UK's obligations during the transition period prior to Brexit with the EU Directive, 2011/92/EU as amended by 2014/52/EU, known generally as the Environmental Impact Assessment Directive, and in such circumstances where the Secretary of State conducts this post Brexit – under UK regulations which reflect the concerns raised here, and

We are deeply conscious that the UK are maintaining a position that there are no likely impacts to Ireland, and have effectively conducted a without prejudice transboundary consultation for the purposes of the Espoo Convention. This has potentially very significant legal implications. Under Article 3 of the Espoo convention this mean the extent to which the UK will/will not oppose the need to conduct an EIA under the Espoo Convention is unclear. This is particularly significant, given the UK's departure from the EU Environmental acquis in the context of Brexit. Consequential uncertainty arises on the extent it will be caught by and/or otherwise apply obligations arising from the EU EIA Directive to the development consent procedure to determine the application for permission for Sizewell C. It also brings uncertainty to the extent of recourse Ireland will have to the EU Commission and EU Court of Justice for failures in that regard. **Therefore the importance of your call as detailed in red and at (a) and (b) above is key.**

No cause for complacency:

It is welcome that the Irish Environmental Protection Agency, (the EPA) in assessing the potential for impacts to Ireland – clearly disagree with the UK assessment of no risk of impacts to Ireland, have made clear that transboundary impacts cannot be ruled out[1].

The simple undisputable fact is that accidents by their very nature are accidental. No one remembers the probabilities associated with Fukishima Daicii, Chernobyl or Three Mile Island. But we do know for certain they happened, and such events no matter how remote, cannot be excluded in all practicality, as the UK presumes by its regulation and design. Fallout from Chernobyl of course also impacted Ireland, and it is much further afield than Sizewell C.

However even though the EPA's assessment is welcome, in terms of its view on the probability and risk, it relies on an now very outdated report done by the then Radiological Protection Institute of Ireland, in 2013. This in no way adequately or at all addresses many of the further knowledge and newly emergent risk considerations which have emerged since, including ones arising consequent on Brexit and how that has evolved in the years subsequently. This submission highlights some of such robust and recent further considerations, as does the submission from Nuclear Free Local Authorities adopted here and appended to this submission.

Failures by the Irish Authorities:

It is also of very particular concern that the Irish Department of Housing, Local Government and Heritage website page on the transboundary consultation, gives greater prominence to the UK authority's position, over that of our own EPA. The Department reflect at length in the main body of their webpage the UK Secretary of States conclusions of no impacts to this state, Ireland. Whereas, the very contrary view taken by our own EPA, only becomes apparent when one scrolls through the page and identifies the link and opens the relevant document[2].

This most recent failure by the Department of Housing Local Government and Heritage and also the Department of Climate Change and Energy to put front and centre Ireland's interests has to be seen in the context of relatively recent concerning significant failures for

[1] https://www.housing.gov.ie/sites/default/files/attachments/2020-07-20-_epa_opinion_re_nte_sizewell_c_application_for_development_consent_0.pdf
[2] ibid

the Irish Government and the relevant Government Departments with responsibility for Planning and Local Government and also separately with responsibility for Climate Change and Energy. In brief on a number of occasions have failed to act adequately to ensure Ireland's consultation rights, and those of our citizens on recent nuclear developments and initiatives in the UK are upheld.

For example in the context of another nuclear power plan application, that for Hinkley Point C. Following escalation of the UK's failure to consult on the Hinkley Point C nuclear power plant being raised before the compliance bodies for both the Espoo and Aarhus Conventions, (who both incidentally found the UK to be in breach of those obligations), the UK committed in fairness to conduct a remedial consultation. However the Irish authorities entirely failed to initiate this remedial consultation with the Irish public in response to the offer by the UK authorities. So finding no satisfactory response from the Irish authorities, the Environmental Pillar through the law officer of the IEN had to write[3] to escalate this failure to the Espoo Implementation Committee. The Committee then wrote to the Irish Authorities inviting them to uphold the Irish public's rights under the convention and had to further prompt then for an update. It was only then a remedial transboundary consultation was then finally conducted in Ireland, following years of battling for such a right in various legal fora by Irish eNGOs, a German politician and citizens.

Most egregiously then however following this hard won consultation on Hinkley Point C, the then Irish Government failed to insist on a remedial environmental impact assessment to be conducted under the Espoo Convention despite the express inquiries in this regard from the Espoo Implementation Committee as part of its investigations on the UK's non-compliance and the need to redress that. This failure by Ireland to seek a full EIA, turned the whole consultation exercise which had been fought for in the UK Courts and in two UNECE fora into a meaningless symbolic gesture, and entirely failed to secure in our view adequate consideration of the very significant deficiencies identified in the consideration and modelling of risks to Ireland. Such considerations included very expert analysis by Emeritus Professor John Sweeney, Maynooth University. The then Irish Government ignored entirely the calls from the public to conduct a remedial EIA and submitted it's response to the Espoo Implementation Committee on 30th April[4], indicating it was effectively satisfied and no further assessment or application of the convention was needed.

This response also completely subverted the efforts of a Joint Oireachtas Committee, for Housing Planning and Local Government who had sought an extension to respond to the transboundary consultation so it could hear from expert witnesses. Following its hearings it

[3]https://www.unece.org/fileadmin/DAM/env/documents/2020/EIA/IC/IC_restored_files/UK/40/2/Letter_to_Espoo_Implementation_Committee_EIAICCI5_08-11-2017.pdf
[4]https://www.unece.org/fileadmin/DAM/env/documents/2019/UK/5/300418_EIAICCI5_Espoo_Comm_HPC_IRELAND_30.04.2018.pdf

submitted a robust report[5] and recommendation in respect of the need to conduct a remedial EIA. But this too was effectively ignored by the Irish Government who subsequently confirmed[6] their earlier position to the Espoo Implementation Committee, after the further considerations arising were highlighted[7] to the Committee. The Committee's hands were effectively tied, given the Country probably most compromised in the whole matter, namely Ireland, did not wish to pursue a remedial impact assessment.

The Environmental Law Officer of the IEN is also in a position to highlight numerous other concerns in respect of the level of focus by Irish authorities on the status of nuclear developments in the UK.

Further considerations raised:

The very low profile which has been afforded to this consultation, has itself to be of concern. It is worth reflecting, that the fact each and every authority has been notified and is conducting a consultation, is because, the Irish Government cannot rule out effects on them and their citizens.

There is therefore no place for complacency with the Irish authorities or the UK authorities on this matter. It is absolutely essential for Local Governments to exercise extraordinary vigilance in the matter of the follow-up to these consultation responses, and to make the unequivocal calls set out at the start of this submission.

This is all the more important given the following high-level issues which are elaborated on further in this submission, including:

a) The very low profile this consultation has been afforded in Ireland in particular, and the low level of scrutiny that has been afforded in many quarters to the seriously inadequate consideration of impacts to Ireland in a highly complex and technically demanding matter, and serious modelling deficiencies and gaps particularly in respect of the airborne transport and serious accident scenairos.
b) Our proximity to the UK, and the extraordinarily serious consequences flow from the various scenarios which may emerge even from ones where there is no radioactive fallout impacting Ireland, to properly considered and informed worst case scenarios. **
c) The lack of transparency and engagement about an adequate emergency response plan in Ireland in the context of a worst case scenario modelled by the Radiological Protection Institute of Ireland, RPII back in 2013, which has not since moved to

[5] https://data.oireachtas.ie/ie/oireachtas/committee/dail/32/joint_committee_on_housing_planning_and_local_government/reports/2018/2018-05-11_transboundary-environmental-public-consultation-hinkley-point-c-nuclear-power_en.pdf
[6] https://www.unece.org/fileadmin/DAM/env/documents/2019/UK/5/290618ReplytoImp.Comm.pdf
[7] https://www.unece.org/fileadmin/DAM/env/documents/2019/ece/Restart/UK_JULY_2018/ELIG_update_for_EIC_re_HPC_Consultation_July_2nd_2018.pdf

incorporate new findings, and more robust serious accident considerations - and these are addressed further below.

d) The UK's desire to maintain a space in its energy mix for nuclear in the context of projects like this Sizewell C, is putting pressure to keep old plants running long past their sell-by date and original more robust safety protocols are being set aside to facilitate this, as we have seen in the context of Hunterston B[8], and issues highlighted by amongst others, Nuclear Free Local Authorities. This pressure on the existing plants is necessitated given the issues with advancing the new generation of nuclear plants. They are either running way behind delivery schedules, and/or are encountering significant difficulties to secure funding to support the delivery of certain of the plants proposed, and their prospects are uncertain. Thus a very explicit and credible risk arises from the existing old operations in the context of the entrenched commitment to awaiting delivery of the new plants. This is nowhere adequately expressed or even assessed, as part of this consultation, and the UK's Office of Nuclear Regulation independence in such matters has to be of core concern to us here in Ireland, particularly with the further elimination of independent oversight from Euratom with Brexit.

e) The increased risks for Ireland arising from the UK's nuclear programme in the context of Brexit and the Covid-19 pandemic. These have unclear but likely negative implications for the UK economy. We are cognisant of serious compromises and issues arising in the recent past in UK nuclear facilities at times of economic crisis, and thus the economic outlook impacts upon the overall consequential risk profile, including on indirect and consequential risks arising, and these are matters which Ireland has up to now failed to update its analysis on.

f) The increased risks for Ireland arising from the UK's nuclear programme in the context of Brexit and the UK's withdrawal from Euratom, and the lack of future independent oversight of nuclear facilities, separation of civilian and military nuclear inventories, movements of nuclear materials in and out of the UK, including close to the 12 mile limit of our territorial waters, and again these are matters which Ireland has up to now failed to update its analysis on.

g) The still as yet unresolved issue of storage of the UK's entire legacy and future nuclear waste inventory in one single repository and the consideration by the UK of the potential to transport and store this in Northern Ireland, on the island of Ireland, or to bury it under the Irish sea

h) The inadequate consideration of sea level rise at the Sizewell C site which has been acknowledged as far back as 2012 as being already at flood risk and increasing flood risk, and the consequential risks for the operation and interim storage of radioactive

[8] https://www.nuclearpolicy.info/news/nfla-publishes-report-aging-agr-nuclear-reactor-programme-time-close-hunterston-b-and-hinkley-point-b/

While it is welcome that the Irish EPA in assessing the potential for impacts to Ireland – clearly disagree with the UK assessment of no impacts, their assessment in terms of probability relies on an now very outdated report done in 2013 which in no way adequately or at all addresses many of the further knowledge and newly emergent risk considerations which have emerged since.

Further issues of concern arise in respect of the experiences we have seen in the development of HInkley Point C – where key elements of the development relied upon to avoid impacts to the integrity of Natura 2000 sites in the severn area, are now being dropped due to technical difficulties and the previous necessity for acoustic fish deterrents for the major under-sea cooling water intakes and outflows from the plant are being discounted. The UK entirely failed to meet the standards clarified by the EU Court of Justice in respect of obligations under Article 6 of the EU Habitats Directive in the Moorburg case * to prove in advance of consent the efficacy of mitigation it is relying on to avoid conclusions of adverse impacts on the integrity of Natura 2000 sites. Clearly concerns arise in respect of the credibility of proposals similarly employed in this application, and this is of concern to us as environmental eNGOs.

In previous applications it was also more transparent and easier to see details on source load and the serious inadequacies of projections of radioactive fallout which might arise, as has been highlighted previously by Austrian authorities and in submissions we* have made in respect of plants like Wylfa. We note the UK authorities have also not made publicly available submissions made by other nations on the application, this is not conducive to transparency and collective engagement to ensure our common interests in respect of a robust consultation and assessment of the project application before the UK authorities. Also previously the submissions which were required under Article 37 Euratom made clear the totally inadequate approach by the UK authorities to modelling of airborne transport of radioactivity. But again these are now an issue in the context of the approach to Sizewell C, Brexit withdrawal from Euratom etc.

2. Inadequacies in the consideration of transboundary impacts and risks in respect of flood risk and airborne transport:

While a number of indirect and consequential risks are considered later below, two primary issues with the assessment of impacts to Ireland are considered first in respect of the inadequate assessment of flood risk and airborne transport of radioactivity to Ireland

2.1 Flood risk

Serious concerns are raised here regarding the validity of flood risk calculations made for the period over which highly radioactive materials will be stored on site

Several aspects of the flood risk analysis in the Environmental Statement provided give rise for concern in terms of accident potential which could have subsequent transboundary impacts. These involve both local fluvial and coastal flood events.

In terms of fluvial flooding:

- It is clear that the Minsmere fluvial model used by Royal HaskoningDHV suffered from limited data availability and quality (Vol 5.2 Page 243) and could not be calibrated successfully.
- The conclusions regarding flooding are therefore unsound.

In terms of coastal flooding,

- It must first be recalled this was the principal cause of the Fukushima disaster.
- The table below, published in a UK national newspaper following a Freedom of Information request, confirms that knowledge concerning the flood risk at Sizewell has been available to the UK government for some time.
- A flood risk is identified by this UK report as already high by 2010 and therefore likely to become significantly higher with time.

In a report entitled: *Future of the Sea: Current and Future Impacts of Sea Level Rise on the UK* the UK Government make the following observation with respect to contingency planning for sea level rise in respect of flooding of nuclear plants:

> *"Extreme – ca. 250 cm global mean sea level rise (1990–2100). This has no equivalent within RCPs. This is the top end of the 'H++' scenario range proposed by UKCP09 for use in contingency planning where the consequences of rare events would be extreme (e.g. flooding of nuclear plants or other large-scale energy generating infrastructure; or reliability of the Thames Barrier; Environment Agency 2016a, 2016b). It was considered "very unlikely" but could not be "completely ruled out" (Lowe et al. 2009) and would require very high sensitivity of the ice sheets to climate change. "*

By the 2080s a further rise in sea level of 0.5-1m is likely. These confirmed flood risks have serious implications for the safety of spent fuel at Sizewell. It is noted that the availability of the Geological Disposal Facility will not be available to receive spent fuel from Sizewell until 2130. The flood hazard due to rising sea level would continually increase during this lengthy interval.

Nuclear power generation, waste and decommissioning sites – Summary of data

Site	New site?	Waste Store?	NDA site?	In IFP?[1]	Elev.[2]	HAT?[3]	Flood Risk 2010	Flood Risk 2020s	Flood Risk 2050s	Flood Risk 2080s	Comment
Berkeley				Edge	0 to 10	8.6	Yes (low)	Yes	Yes	Yes (medium)	Coast. Sea wall 9.72m AOD
Bradwell				Edge	0 to 5.5	3.0	Yes (low)	Yes	Yes	Yes (high)	Coast. Sea wall 4.6 to 5m AOD
Capenhurst				No	High		No	No	No	No	
Chapelcross				No	High		No	No	No	No	
Culham				No	High		No	No	No	No	
Dounreay				Small	9 to 15	3.0	No	No	No	No	Coast. Long term erosion risk
Drigg				No	High	5.3	No	No	No	No	
Dungeness				Part	2 to 6	4.2	Yes (high)	Yes	Yes	Yes	Coast. Flood and erosion risk. Relies on defences
Hartlepool				Yes		3.3	Yes (high)	Yes	Yes	Yes	Coast
Harwell				No	High		No	No	No	No	
Heysham				No		5.6	Yes (low)	Yes	Yes	Yes	Coast
Hinkley Point				Edge	10 to 14	6.8	Yes (low)	Yes	Yes	Yes (high)	Coast. Relies on defences. Flood and erosion risk.
Hunterston				No	5 to 21	2.0	No	No	No	No	Coast. Erosion risk
Oldbury				Edge	4 to 10	8.4	Yes (medium)	Yes	Yes	Yes (high)	Coast. Relies on defences
Sellafield				No	5 to 30	5.3	Yes (medium)	Yes	Yes	Yes (medium)	Coast. Flood and erosion risk to part of the site.
Sizewell				Edge	3 to 10	1.7	Yes (high)	Yes	Yes	Yes	Coast. Flood and erosion risk. Relies on defences
Trawsfynnydd				No	High		No	No	No	No	
Winfrith				No	High	1.5	No	No	No	No	
Wylfa				No	9 to 13	3.8	No	No	No	No	Coast

[1] Indicative flood plain
[2] Elevation in m Above Ordnance Datum (AOD)
[3] Highest Astronomical Tide

Source: Unpublished UK Government Report obtained by the Guardian newspaper under FoI, 2012

- **<u>It can also be concluded that the risk posed by a storm surge moving south through the North Sea, similar to that experienced in 1953, is not adequately considered.</u>**
- **<u>It is noted that the 1953 event flooded lands up to 5.6m above sea level.</u>**
- **<u>Parts of the Sizewell site are 3m above sea level.</u>**

In summary, an inadequate risk analysis is presented with key aspects not commensurate with the transboundary impacts of a potential accident situation. This further justifies Irish concerns that in the event of an accident, an over-reliance on sea defences to prevent flooding is apparent.

2.2 Airborne transport of radioactive fallout in the event of a severe accident at Sizewell as considered in the screening determination

As indicated earlier above, it is clear from a close scrutiny not just of the summary screening assessments pointed to in the letter from the UK authorities, but in particular of a review of the underlying materials – that the UK's assessment of transboundary risk fails to fully consider airborne transport of radiation in the event of a severe nuclear incident. It also includes significant reliance on UK regulation to avoid accidents, and to argue for a very low probability.

The first screening conducted by the UK Planning Inspectorate (3) on behalf of the UK Secretary of State in October 2019 indicates as follows:

> "Radiological exposure - The Scoping Report acknowledges the potential for exposure to radiation from discharges of aerial and liquid radioactive emissions and direct radiation from radioactive sources."
>
> 6.19.26 The following documents will also be used to inform the assessment:
>
> - project risk registers;
> - Outline Construction Environmental Management Plan (OCEMP);
> - Flood Risk Assessments;
> - Euratom Treaty Article 37 submission;
> - Cabinet Office National Risk Register of Civil Emergencies; and
> - European Commission's Major Accident Reporting System (eMARS) (Ref 6.77).

The scoping document relied on the Euratom report and assessment process to consider this, but it does not appear to have been done.

The second screening more recent screening assessment done following the submission of the application Environment Statement refers i.a. to Vol 2 chapter 27 of the Environmental Statement concerned with Major accidents and Hazards of the application documents.

In respect of receptors – which are effectively pathways to transmit radioactive effects Vol 2 chapter 27 says the following in respect of major accidents and hazards, (MA&D): (emphasis added):

"27.3.10 Each identified MA&D hazard and threat has been assigned an individual study area taking consideration of hazard or threat source, any identified impact pathways, potential receptors, and the reasonably foreseeable worst-case environmental consequence, if the event occurred. The study area for the identification of potential receptors differs depending on the specific hazard or threat and is determined on the basis of a worst-case impact area of a similar incident that has previously occurred, if information on this is available, or on the basis of professional judgement, if not available. The study areas are identified within the Environmental Risk Record included as Appendix 27A of this volume and range from the area within the site boundary to the catchment area modelled for flood risk (as set out in the relevant Flood Risk Assessments, Doc Ref. 5.2-5.9)."

From this it is clear that the study areas **do not include consideration for airborne transport to Ireland.**

Turning to the referred to appendix 27A to examine the receptors considered even in the context of a major nuclear incident at Sizewell C – it is notable that for MA&D Id O14 – described as: "Civil nuclear incident or major accident at Sizewell C" the only receptors considered are:

"On site: Sizewell C workers
Off-site: General public
Agricultural land
Sensitive environmental receptors (ecological, heritage sites, groundwater, surface water, marine receptors)"

Furthermore, the associated columns for this scenario on:
"Maximum study area", "Worst case severity of Harm", "Duration", "Category of Consequence" - are not completed – instead the following incomplete text is inserted:

"Separate regulatory processes are in place to assess and control the safety of UK EPR reactors for the operation of the Sizewell C nuclear power station, a detailed risk assessment is therefore not presented as part of the EIA. These hazards would be assessed in detail as part of the Nuclear Site Licensing requirements. For example, as part of Nuclear Site Licensing Regime, EDF will need to ensure the safe operation of the Sizewell C Project and protection of the workers, public and environment. This

> includes providing the Office for Nuclear Regulation with a robust Safety Case demonstrating that all hazards associated with the development or that may impact the development are well understood and adequate arrangements are in place to reduce these risks to an acceptable level. In addition, it requires appropriate emergency plans and arrangements to be established and agreed with the local authority, for the range of accidents and incidents that could occur. These processes will ensure that risks relating to Nuclear Safety are reduced to TifALARP. Furthermore the assessment of risks associated with the use and storage of…."

The remainder of the text is obscured and cannot be read.

There is therefore additionall an over-reliance on the UK's regulatory regime to ensure accidents will not happen. Accidents by their very nature are accidental. Furthermore, there is an over-reliance on what are estimated as very low probabilities for major accidents to dismiss the need for adequate consideration and assessment of impacts and preparedness of other states which might be impacted. No one recollects the probabilities associated with Fukushima Daichi or Chernobyl or Three Mile Island – all most remember about them is that they happened.

In the application documents, document ref 6.11: Volume 10 Project-wide, Cumulative and Transboundary Effects, Chapter 5 Transboundary Effects, Appendix 5A: Long Form Transboundary Screening Matrix, (Revision: 1.0 Applicable Regulation: Regulation 5(2) (a) PINS Reference Number: EN010012) the following is stated (4):

> "The UK Government believes that new nuclear power stations would pose very small risks to safety, security, health and proliferation (of nuclear materials). Government also believes that the UK has an effective regulatory framework that ensures that these risks are minimised and sensibly managed by industry (Source: White Paper on Nuclear Power, January 2008 (Ref. 1.2)). Nuclear safety is regulated by the Office for Nuclear Regulation (ONR) through a Nuclear Site Licence which places conditions on the Licensee to assure the safety of all aspects of power station construction, operation and decommissioning. This Licence must be in place ahead of construction of safety critical parts of the plant. The risk of accidents and possible radiological impacts on the airspace, land, water and humans in other EU member states is also covered by the Euratom Treaty obligations. The proposed UK EPR design of reactor has been the subject of a regulatory justification process. The

> Secretary of State (SoS) decided that the generation of electricity using the UK EPR is justified under the Justification of Practices Involving Ionising Radiation Regulations 2004. The SoS considers that the likelihood of an accident or other incident occurring at an UK EPR giving rise to a release of radioactivity is very small. The Major Accidents and Disasters assessment assesses the risk associated with hazards and threat from on-site and offsite sources during the construction and operation of the Sizewell C Project. This assessment provides details of the mitigation measures that are in place to reduce the likelihood of a risk event occurring. Further details of this assessment are provided within Volume 2, Chapter 27 of the ES."

It is entirely unclear whether the Euratom Treaty obligations relied upon in the above, have been discharged. It must also be remembered how inadequate the Euratom Article 37 submissions made by the UK have been in the past and the serious deficiencies there were in considering the impacts on Ireland in the context of Hinkley Point C in the Article 37 submission on that part.

So in summary it is clear even in the context of the most severe accident considered – **there has been a complete failure to consider the potential transport to Ireland of airborne radioactive fallout in the key Vol 2 chapter 27 assessments.**

2.3 Further considerations in respect of the inadequacies of considerations related to aerial transport of radioactivity.

While the second transboundary screening determination conducted on behalf of the UK Secretary of State, relies extensively on chapter 27 and the elements set out earlier above, a following further document which does not appear to form part of the documents in focus for the transboundary consultation but which nonetheless considers airborne transport of radioactivity from Sizewell was found and considered. The analysis therein is also considered to be inadequate.

The document in question is the following apparently from the SIZEWELL C PROJECT RSR PERMIT APPLICATION and is entitled: Sizewell C Project Combustion Activity Permit Application Appendix C Air Quality Modelling Assessment.[9] In short it seems to be from an

[9] https://consult.environment-agency.gov.uk/psc/ip16-4ur-nnb-generation-company-szc-ltd-mp3731ac/supporting_documents/SZC%20CA%20Appendix%20C%20%20Air%20Quality%20Modelling%20Assessment%20No.%20100207663.pdf

application to the environment agency as opposed to the main development consent application which is under transboundary consultation. The potential for differences in the documentation and considerations raised in respect of the same project are themselves a concern, in addition to the inadequacies in the further analysis found here.

The following analysis considers the extent to which the plume dispersion models employed provide an adequate vehicle for assessing potential atmospheric transport of hazardous material to Ireland.

The ADMS 5.2 model used in this document to model dispersion of emissions from the plant provides reliable output typically below 100kms. However long distance modelling of potential accidental releases of airborne radioactive effluents from the proposed facility are not valid based on this model. Like most pollutant dispersion models it is based on Gaussian plume principles. The long range model described in Jones (1981) from the National Radiological Protection Board is usually used for radioactivity dispersion modelling. However it does not appear to have been used in this case, though has been used in the Hinkley application. However, the same author subsequently addressed several areas of uncertainty in a series of reports concerning guidance for radionuclide dispersion (Jones, 1986). Three sources of uncertainty are acknowledged as follows:

> "The models given in the first report are intended for application to dispersion over flat terrain of uniform surface roughness and heat flux. This restriction applies not only to the terrain over which the plume is dispersing but also to the terrain for some distance upwind of the source.[iii]"
>
> "Additionally there should be no nearby large areas where the underlying surface properties are sufficiently different to change the flow conditions significantly. Such situations can occur near to the coast [i] or to large urban areas."
>
> "The models in the first report are appropriate where the airflow at and downwind from the release point is not affected by nearby buildings.[ii]" (Jones, 1986, pages 4 & 5).

These caveats are highly relevant to the assessment presented in respect of Sizewell C and serve to undermine the validity of the conclusions reached concerning risk of long range transport to Ireland.

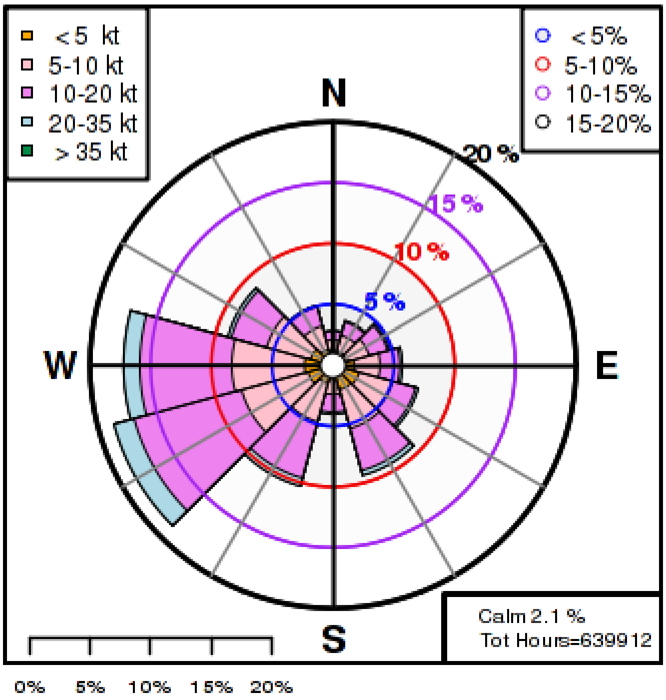
(i) Sizewell is situated on the coast,
(ii) adjacent to an existing nuclear station buildings complex

Reliance on using any Gaussian models for assessing long range transport of effluent is questionable. Long Range transport of pollution and radioactivity experience confirms this. Chernobyl radiation reached Ireland by long range transport mechanisms and resulted in contamination of soils, vegetables and milk supplies and restrictions on animal movements in upland areas for 26 years. UK sulphates reached Scandinavia in significant concentrations by long range transport mechanisms. Gaussian modelling would not have predicted, even if complex topographical and meteorological conditions were incorporated, that either could occur. Simplistic assumptions of a constant mixing layer depth and a constant wind speed are questionable and not capable of predicting worst-case outcomes in this situation.

The frequency of occurrence of Pasquil F/G classes with south easterly winds provides a useful indicator of probability of long range transport of aerial effluent to Ireland. The manner in which these were incorporated into any modelling calculations is not clear. In particular the crucial question of inversion height in relation to the height of any accidental release is not described adequately. Stability on land at Sizewell may also be very different from stability over a relatively cold marine surface during summer months and the extent to which the modelling exercise differentiated dispersal conditions on this basis is also not clear. Passage over a low friction surface such as the Irish Sea inhibits dispersion. The air over the sea passage to Ireland, especially during summer, is much more likely to be stabilised and conducive to undisturbed transport of effluent. Studies which analyse the origins of polluted airmasses over south eastern Ireland confirm that effluent from industrial sources in the UK and Europe can be carried in stratified, stable airflows over a cool Irish Sea to be mixed down to the surface on reaching eastern Ireland. Such conditions are not unusual in eastern Ireland. The wind rose for Dublin indicates that winds from the eastern quadrant occur well over 10% of the time.

The potential for significant impact for the people of Ireland arising from this proposal is largely ignored in the Environmental Statement. It is notable that the distance to territorial waters of neighbouring states (e.g. Germany 320km) is listed in Volume 10 Appendix 5A though no mention is made of Ireland which has only a slightly longer distance involved. Generally the consideration of the unlikely occurrence of a major accident on Ireland is not considered as part of the impact study, despite existing obligations to do so.

Windrose Dublin Apt 1-Jan-1942 to 31-Dec-2014



3. Further considerations in respect of assessment of transboundary risks.

While the above section 2 highlights the inadequacies of the UK's assessment, in considering the low probability determined by the Irish authorities, the following should also be considered by Irish local authorities.

Duration of a severe accident scenario.

Firstly, while the EPA at least addresses the risk of airborne transport of radiation, it was also arguably very optimistic in its report back in 2013 (see sections 5 and 7 of the NFLA submission attached as an annex to this submission) in what it considered as the most severe scenario in its impact assessment. This was in respect how long the release of radiation would last for before containment is achieved. In short, as is set out further below with references to analysis by the late nuclear engineering consultant John Large – the EPA's worst case scenario and the duration of radioactive release falls far short of what is a credible worst case scenario set out by this independent nuclear expert.

In its more recent screening the EPA does not shy away from the chilling and openly acknowledged conservative assessment by the ESRI of the effect on our economy (noted in section 8 of this response), but the EPA still fails to consider our ability to sustain the necessary extent of sheltering needed to avoid impacts in the context of the potential duration of impacts.

As will be seen later below, when considering the Sizewell application document – the UK authorities do not even include any view on durations when considering a severe accident scenario. Instead, the application merely relies on UK nuclear regulation to discount the need for consideration and the ability to manage the risk down to an acceptable level of remote probability, in as much as such management is deemed to be reasonably practicable – all encompassed by the acronym "TifALARP".

Brexit impacts and the UK's withdrawal from Euratom

It is also notable and very disappointing then that, in relying on its previous report from 2013 in assessing the risk as being "unlikely", the EPA clearly has not considered the wider implications for risk consequent on Brexit. Further risk to Ireland has arisen since the UK referendum in 2016 nearly some 3 years after the report was done. Brexit means the UK's departure not just from the EU environmental acquis, and independent oversight by the EU Commission and the EU Court of Justice in the conduct of environmental assessment, but it also departs from Euratom, the treaty for the community of nuclear states.

In departing from Euratom, the UK leaves the independent oversight of its nuclear operations, including inspection of nuclear facilities, oversight of the separation of military and civilian nuclear inventories and over of movements of nuclear inventories including in and out of the UK, bearing in mind those movements may arise as close at 12 miles off our shores, the limit of our territorial waters.

As a result of Brexit, the Euratom regime is to be replaced by the UK's Office of Nuclear Regulation. The funding for this function and the level of independence it can exercise on this matters and the adequacy of the new regime solution specified are not adequately considered.

The further pressures and risks which may arise consequent on the impact to the UK economy in the context of both Brexit are addressed elsewhere in this submission where the experience of the issues which arose previously at times of difficulty in the running of the UK's nuclear plants and Sellafield in particular.

Covid-19 pandemic and risks consequent on the economic situation

The further consequential risks which arise consequent on the impact to the UK economy because of the Covid-19 pandemic are also not reflected in the EPA's assessment and determination of likelihood. They are however also considered further in this submission, and most particularly in the context of the economics and practicalities for the running and maintenance of nuclear operations, and the issues which have arisen previously in the running of UK nuclear facilities at times of internal difficulties. The recent experience of the choices and approaches made by UK authorities in recent years in the context of Brexit and in the management of the pandemic and associated approach to issues impacting on public health also warrant some serious consideration in the context – given the implications such an approach has for the consideration and management of nuclear risk.

Delayed delivery of new plants and consequential pressure to continue existing old nuclear operations to maintain a place for nuclear in the UK's energy mix.

The EPA considers the risk and likelihood of an accident solely in the context of risks from the new plant. The EPA fails to consider the consequential risks arising from the new build programme in its assessment of nuclear impacts arising from the pressure to keep old plants running until the new builds are on stream. This creates an associated, albeit indirect risk from the new build given the increased risk potentially arising from the old plants running past their sell-by date so to speak.

The development of the UK's new nuclear build programme for these new generation nuclear power plants are all running significantly over schedule. The continued expectation that the UK will be develop new nuclear power solutions means it is staying vested in a significant nuclear element to meeting its energy needs. This is instead of bringing in alternative renewable energy sources and transitioning away from nuclear. This in turn means that pressure continues to maintain the nuclear component of its energy supply, and existing plants are being forced to run past their original period of operation, and indeed in circumstances where previous safety standards are now being revised in order to allow them continue their operations, as has been seen most recently in the context of Hunterston B in Scotland. Thus, associated with the new build there is the associated risk which arises from the associated consequential pressure to keep the old plants running to keep the nuclear slot in the UK's energy supply mix open.

Radioactive waste disposal risks

There has also been a complete failure in respect of the assessment of risk associated with the disposal of the nuclear waste arising. This must be a concern given the UK has not completely excluded consideration of Northern Ireland as a site for the geological disposal of waste, and indeed precipitated a consultation to assess the receptiveness of communities to such proposals. Though it should be noted that almost every Northern Irish Council passed a resolution opposing the hosting of such a facility. It has additionally not ruled out such sites being partially under the Irish Sea. Indeed the only Council that has so far expressed an interest in hosting such a repository, Copeland Borough Council (where Sellafield is situated), has expressly suggested a partial under-sea site may be a possible solution for it. In the context of an as yet undefined and unspecified solution and location for the waste, and the lack of clarity on the technologies for storage and the transport mechanisms to be employed and associated risks – it is not appropriate to discount transboundary risks for Ireland, where such solutions may arise on this island or in the seas surrounding us, and/or involve transport close to our shores.

Furthermore, Sizewell C will produce the equivalent of about 80% of the total radioactivity already created in the UK by existing nuclear sites. If all the proposed new nuclear reactors get built this will at least quadruple the amount of radioactive waste the country will have to deal with. (1) After three years of deliberation, the Committee on Radioactive Waste Management (CoRWM) decided that geological disposal is the best available approach for the long-term management of higher level waste, but lots of caveats and important recommendations were ignored by the Government. CoRWM specifically said it did not want its recommendations seized upon as providing a green light to build new nuclear reactors which raise different political and ethical issues when compared with wastes which already exist. In other words it might be morally defensible to look for the 'least-worst option' to bury dangerous waste already created, but we really shouldn't be creating any more. NFLA remain concerned about the real technical and scientific issues around 'deep geological disposal' for existing waste, but the potential levels of highly radioactive new build waste add a greater level of concern that alone should see a new nuclear programme halted.

Considerations raised by the Pacific Northwest National Laboratory in the US in respect of risk assessment.

We wish to refer to a document authored by the Pacific Northwest National Laboratory here in the US in Dec. 2017 on contract with the US Nuclear Regulatory Commission for the Subsequent License Renewal (60- to 80-year extension. It was publicly posted on the PNNL website as well the U.S. Department of Energy Office of Scientific and Technical Information (OSTI) and International Atomic Energy Agency and was subsequently it seems removed from all three sites by the NRC in September 2018 after questions were raised about it by civil society at an NRC meeting on the second license renewal process in the US.

In summary the thrust of the report is that, operational data of reactors alone is recognized as insufficient to project safety margins and operational reliability of systems, structures and components (SSC) during the requested license extension period. PNNL's finding is that the license renewal process "require" the "strategic harvesting" and laboratory analysis of "real world" materials (sample of base metals, weld material from vessel and internals, concrete samples, electrical cable/jacketing/insulation to inform many, many identified critical knowledge and technical "gaps" (63 references) in current age management programs projecting into the license renewal period. NRC management we understand subsequently claimed that PNNL prematurely published the report before all of the NRC staff provided comment. There is some ongoing controversy and challenge in respect of these claims we have been given to understand.

This all highlights the potential for the license renewal review process to hide and avoide a significant cost by not performing the requested harvesting/analysis for the otherwise observable and measurable science on age management using samples from real world field experience harvested from both decommissioning and operational reactors. Strategic harvesting during decommissioning can zero in resources on the harshest operational reactor environments that are otherwise inaccessible, uninspected and unmaintained, particularly for the large, irreplaceable SSC. PNNL recognized that opportunistic sampling/testing is not sufficient to address the many uncertainties.

PNNL further identifies that current computer models used in the license review process for projecting the reliability of safety-related SSC are not being calibrated by what we are calling an "autopsy" of decommissioning units. In many cases, industry is instead using virgin materials put through accelerated aging to extrapolate projected safety margins for license extension. Aging doesn't work like that in reality where the combined impact of many factors cannot be accurately simulated. PNNL agreed.

The NRC Materials Division for License Renewal took down the PNNL technical letter report (PNNL-27120), scrubbed it of all references to "gaps" and played down references that "harvesting" real time aged samples need to be required. NRC republished the sanitized version of the technical letter report as PNNL-27120 Rev. 1 in April 2018 and presently provides it as the public version on its website.

The reffered to PPNL report is attached an annex IV.

Adoption of relevant submissions:

We wish to adopt the submissions made by the Austrian Authorities, noting their expertise and vigilance in these matters.

We also wish to adopt in full the submission and considerations and concerned raised by Nuclear Free Local Authorities in respect of the Sizewell C application which are included here in Annex I to this submission.

We also wish to rely on the submissions made in respect of the proposed Wylfa B Plant by the Environmental Law Officer of the IEN, in outlining the serious deficiencies in the UK's approach to source load modelling.

We also wish to reference and rely on the paper prepared by Professor Stephen Thomas and Alison Downes in respect of the net carbon impacts of Sizewell C – included as Annex III, and clearly climate change impacts are a major consideration in respect of transboundary impact assessment and this paper raises serious concerns in respect of this.

We finally wish to highlight that the UK Courts have recently given judgement in respect of the currency of strategic environmental assessment for energy in the UK in George Monbiots case, which highlighted how the assessment is entirely outdated in the face of significant developments in the context of renewable energy. This raises significant issues in respect of the justifications for the project and the extent of risk which is tolerable and acceptable in the context of very real, more affordable and more easily delivered and less risky projects compared to the effect of a nuclear accident.

These are matters on which we wish to rely and make available to the irish public to rely upon.

Consultation Issue:

In respect of the consultation we must also flag the Environmental Pillar made a statement at the 2017 Meeting of the Parties to the Aarhus Convention, on its desire to be formally consulted in respect of nuclear proposals in the UK. This arose in the context of the UK's failures to adhere to its obligations for consultation under the convention. A copy of this statement was sought by and provided to officials in DBEIS immediately after it was delivered in at the meeting in Montenegro. However no such request has since been respected by the UK authorities, and it falls to mere chance that the Pillar become aware of consultations, and indeed don't. The Environmental Pillar made that request in good faith. The UK's apparent approach is contrary to efforts made by people and eNGOs as the public concerned to make a clear and lasting registration of interest across all bodies, and instead creates unreasonable overheads and confusion given the complexities of the UK's national processes and the potential for lack of awareness of all the critical components. The Environmental Pillar's statement was expressly to avoid such issues, and this has not been respected.

Conclusion

We would be happy to clarify any of the above as required and please contact

Karen Ciesielski co-ordinator of the Environmental Pillar

Attracta Uí Bhroin, Environmental Law Officer of the IEN

As needed

Thank-you for your consideration of our remarks.

Founded in 1948, An Taisce is one of Ireland's oldest and largest environmental organisations. An Taisce is a charity that works to preserve and protect Ireland's natural and built heritage. We are an independent charitable voice for the environment and for heritage issues. The work of our staff is focused in three areas: Advocacy, Properties and Education.

Advocacy: The An Taisce Advocacy Unit is dedicated to promoting the conservation of Ireland's nature and biodiversity as well as its built heritage.

Properties: An Taisce owns a range of heritage properties in trust, including historic buildings and nature reserves.

Education: The An Taisce Environmental Education Unit is responsible for developing and operating some of Ireland's most popular and successful environmental programmes and campaigns.
The Environmental Education Unit is the National Operator for all international environmental education programmes of the Foundation for Environmental Education (FEE), including the Blue Flag Award for Beaches and Marinas and Green-Schools, the international environmental education programme in operation across 93% of Irish schools. It also operates a number of national programmes including: Green Campus, Neat Streets, Clean Coasts, National Spring Clean (Ireland's largest anti-litter campaign), Green Home, Green Communities, and the Irish Greening Community Award Programme.

Submission on Sizewell Nuclear Power Station

This submission is a response to the following requirement of the Department of Housing, Planning and Local Government.

"Under the terms of EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive) and the 1991 United Nations Convention on environmental impact in a transboundary context (the Espoo Convention), Member States are required to engage in transboundary public consultation in respect of projects likely to have significant effects on the environment of neighbouring States as part of the environmental impact assessment of a proposed development. For this purpose, the Member State in whose territory the project is intended to be carried out shall send to the affected State, no later than when informing its own public, a description of the project and any available information on its possible transboundary impact."

Background

An Taisce's concerns in this matter do not stem from a pro or anti position regarding nuclear power. Their concerns centre on the rights of neighbouring countries to consult their public regarding potential transboundary impacts and the rights of the Irish public to express their views to the UK in advance of a decision concerning development consent being granted.

In this application, in the view of An Taisce, transboundary impacts on Ireland were not considered to any significant extent. The unlikely occurrence of accidental release of radioactivity affecting Ireland has not been competently addressed. We have previously expressed these concerns in respect of Hinkley and mounted a Judicial Review of this decision in the courts of England and Wales, taking the matter all the way to the Supreme Court which ultimately ruled against. Subsequently, complaints were made to the Compliance Committee of the UNECE by Members of the European Parliament and various EU citizens and environmental organisations. Irish ENGOs provided supporting statements and submissions in respect of the investigations undertaken by the Compliance Committee.

An Taisce welcomes this opportunity for consultation in respect of the 8 new nuclear plants being planned for the UK, particularly the 5 to be located on the west coast facing Ireland and those being proposed for an extension of their operating lifetimes. Such rights expressed under UN Conventions are also particularly relevant post BREXIT when the UK will not be a member of the European civil nuclear regulator Euratom.

Although extremely unlikely, we do not consider it appropriate to dismiss transboundary safety concerns out of hand, as has been done for Sizewell. We consider the risk calculations made to be flawed on several grounds and not capable of providing a level of comfort for the Irish population appropriate to the potential impacts which an accident at Sizewell would impose upon them. The Economic and Social Research Institute is Ireland's independent source for evidence-based policymaking. In a report in 2016 it conservatively estimated the economic impact of a serious nuclear event anywhere in north western Europe close to Ireland as being in the region of €161B with catastrophic effects on agriculture lasting decades. In such circumstances the Irish public are highly qualified to comment on the Sizewell proposal.

An Taisce wishes to structure its submission around the following 2 topics:

1. The validity of flood risk calculations made for the period over which highly radioactive materials will be stored on site
2. The extent to which the plume dispersion models employed provide an adequate vehicle for assessing potential atmospheric transport of hazardous material to Ireland.

1. **The validity of flood risk calculations made for the period over which highly radioactive materials will be stored on site**

Several aspects of the flood risk analysis in the Environmental Statement give rise for concern in terms of accident potential which could have subsequent transboundary impacts. These involve both local fluvial and coastal flood events. In terms of fluvial flooding it is clear that the Minsmere fluvial model used by Royal HaskoningDHV suffered from limited data availability and quality (Vol 5.2 Page 243) and could not be calibrated successfully. The conclusions regarding flooding are therefore unsound.

In terms of coastal flooding, which was the principal cause of the Fukushima disaster, the table below, published in a UK national newspaper following a Freedom of Information request, confirms that knowledge concerning the flood risk at Sizewell has been available to the UK government for some time. A flood risk is identified by this UK report as being already high by 2010 and therefore likely to become significantly higher over the lifetime of this plant.

In a report entitled: *Future of the Sea: Current and Future Impacts of Sea Level Rise on the UK* the UK Government make the following observation with respect to contingency planning for sea level rise in <u>respect of flooding of nuclear plants</u>:

"Extreme – ca. 250 cm global mean sea level rise (1990–2100). This has no equivalent within RCPs. This is the top end of the 'H++' scenario range proposed by UKCP09 for use in contingency planning where the consequences of rare events would be extreme (e.g. flooding of nuclear plants or other large-scale energy generating infrastructure; or reliability of the Thames Barrier; Environment Agency 2016a, 2016b). It was considered "very unlikely" but could not be "completely ruled out" (Lowe et al. 2009) and would require very high sensitivity of the ice sheets to climate change. "

By the 2080s a further rise in sea level of 0.5-1m is highly likely according to IPCC reports. These confirmed flood risks have serious implications for the safety of spent fuel at Sizewell. It is noted that the availability of the Geological Disposal Facility will not be available to receive spent fuel from Sizewell until 2130. The flood hazard due to rising sea level would continually increase during this lengthy interval.

Nuclear power generation, waste and decommissioning sites – Summary of data

Site	New site?	Waste Store?	NDA site?	In IFP?[1]	Elev.[2]	HAT?[3]	Flood Risk 2010	Flood Risk 2020s	Flood Risk 2050s	Flood Risk 2080s	Comment
Berkeley				Edge	0 to 10	8.6	Yes (low)	Yes	Yes	Yes (medium)	Coast. Sea wall 9.72m AOD
Bradwell				Edge	0 to 5.5	3.0	Yes (low)	Yes	Yes	Yes (high)	Coast. Sea wall 4.6 to 5m AOD
Capenhurst				No	High		No	No	No	No	
Chapelcross				No	High		No	No	No	No	
Culham				No	High		No	No	No	No	
Dounreay				Small	9 to 15	3.0	No	No	No	No	Coast. Long term erosion risk
Drigg				No	High	5.3	No	No	No	No	
Dungeness				Part	2 to 6	4.2	Yes (high)	Yes	Yes	Yes	Coast. Flood and erosion risk. Relies on defences
Hartlepool				Yes		3.3	Yes (high)	Yes	Yes	Yes	Coast
Harwell				No	High		No	No	No	No	
Heysham				No		5.6	Yes (low)	Yes	Yes	Yes	Coast
Hinkley Point				Edge	10 to 14	6.8	Yes (low)	Yes	Yes	Yes (high)	Coast. Relies on defences. Flood and erosion risk.
Hunterston				No	5 to 21	2.0	No	No	No	No	Coast. Erosion risk
Oldbury				Edge	4 to 10	8.4	Yes (medium)	Yes	Yes	Yes (high)	Coast. Relies on defences
Sellafield				No	5 to 30	5.3	Yes (medium)	Yes	Yes	Yes (medium)	Coast. Flood and erosion risk to part of the site.
Sizewell				Edge	3 to 10	1.7	Yes (high)	Yes	Yes	Yes	Coast. Flood and erosion risk. Relies on defences
Trawsfynydd				No	High		No	No	No	No	
Winfrith				No	High	1.5	No	No	No	No	
Wylfa				No	9 to 13	3.8	No	No	No	No	Coast

[1] Indicative flood plain
[2] Elevation in m Above Ordnance Datum (AOD)
[3] Highest Astronomical Tide

Source: Unpublished UK Government Report obtained by the Guardian newspaper under FoI, 2012

It can also be concluded that the risk posed by a storm surge moving south through the North Sea, similar to that of 1953, is not adequately considered. It is noted that the 1953 event flooded lands up to 5.6m above sea level. Parts of the Sizewell site are 3m above sea level.

The level of coastal protection offered by sacrificial gravel barriers and hard engineered defences do not provide assurances that ingress of sea water in the vicinity of the plant will be prevented with extreme high water levels of this magnitude.

Flooding of the site will have as yet unknown effects on safety levels and whcile these are likely to primarily affect the local region, no consideration of possible transboundary effects resulting from the release of radiation in these circumstances is evident in the application.

In summary, an inadequate risk analysis is presented with key aspects not commensurate with the transboundary impacts of a potential accident situation. This further justifies Irish concerns that in the event of an accident, an over-reliance on sea defences to prevent flooding is apparent.

2. **The extent to which the plume modelling provides an adequate vehicle for assessing potential atmospheric transport of hazardous material to Ireland.**

The ADMS 5.2 model used to model dispersion of emissions from the plant provides reliable output typically below 100kms. Long distance modelling of potential accidental releases of airborne radioactive effluents from the proposed facility are not valid based on this model. Like most pollutant dispersion models it is based on Gaussian plume principles. The extent to which any significant long range dispersion models have been used to assess transboundary transport of effluent in the event of an accident is not clear in the application. The long range model described in Jones (1981) from the National Radiological Protection Board is usually used for radioactivity dispersion modelling. It does not appear to have been used in this case, though was used in the Hinkley application. Even this model is however subject to qualifications. The same author addressed several areas of uncertainty in a series of reports concerning guidance for radionuclide dispersion (Jones, 1986). Three sources of uncertainty are acknowledged as follows:

> "The models given in the first report are intended for application to dispersion over flat terrain of uniform surface roughness and heat flux. This restriction applies not only to the terrain over which the plume is dispersing but also to the terrain for some distance upwind of the source.[(iii)] "
>
> "Additionally there should be no nearby large areas where the underlying surface properties are sufficiently different to change the flow conditions significantly. Such situations can occur near to the coast [(i)] or to large urban areas."
>
> "The models in the first report are appropriate where the airflow at and downwind from the release point is not affected by nearby buildings.[(ii)] " (Jones, 1986, pages 4 & 5).

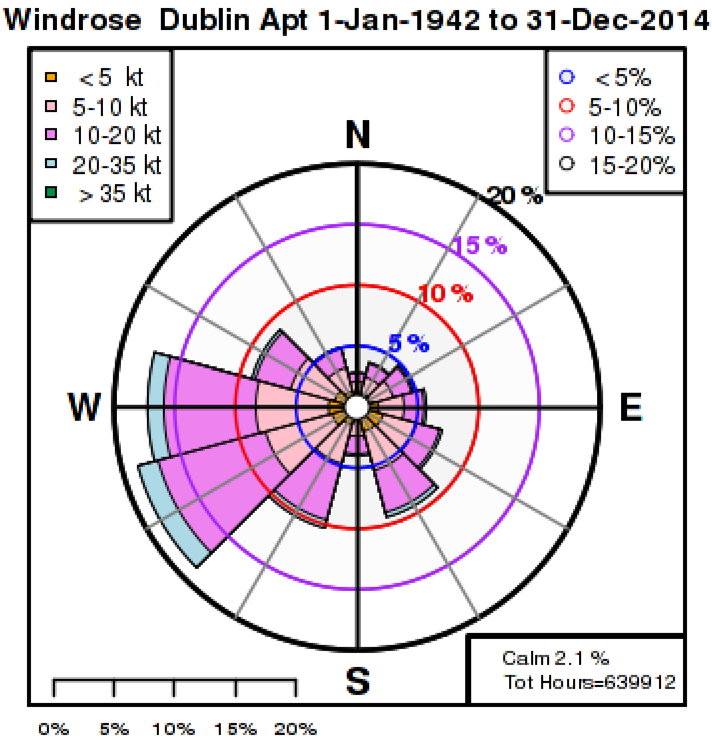
These caveats are highly relevant to the assessment presented and serve to undermine the validity of the conclusions reached concerning risk of long range transport to Ireland.

(i) Sizewell is situated on the coast. Major contrasting surface properties are clearly evident.
(ii) Sizewell is adjacent to an existing nuclear station buildings complex

Reliance on using any Gaussian models for assessing long range transport of effluent is in any case questionable. Long Range transport of pollution and radioactivity experience confirms this. Chernobyl radiation reached Ireland by long range transport mechanisms and resulted in contamination of soils, vegetables and milk supplies and restrictions on animal movements in upland areas for 26 years. UK sulphates reached Scandinavia in significant concentrations by long range transport mechanisms. Gaussian modelling would not have predicted, even if complex topographical and meteorological conditions were incorporated, that either could occur. Simplistic assumptions of a constant mixing layer depth and a constant wind speed are questionable and not capable of predicting worst-case outcomes in this situation.

The frequency of occurrence of Pasquil F/G classes with south easterly winds provides a useful indicator of probability of long range transport of aerial effluent to Ireland. Such calculations are not evident in the application and the manner in which these were incorporated into any modelling simulations is not clear. In particular the crucial question of inversion height in relation to the height of any accidental release is not described adequately. Stability on land at Sizewell may also be very different from stability over a relatively cold marine surface during summer months and the extent to which the modelling exercise differentiated dispersal conditions on this basis is also not clear. Passage over a low friction surface such as the Irish Sea inhibits dispersion. The air over the sea passage to Ireland, especially during summer, is much more likely to be stabilised and conducive to undisturbed transport of effluent. Studies which analyse the origins of polluted airmasses over south eastern Ireland confirm that effluent from industrial sources in the UK and Europe can be carried in stratified, stable airflows over a cool Irish Sea to be mixed down to the surface on reaching eastern Ireland. Such conditions are not unusual in eastern Ireland. The wind rose for Dublin indicates that winds from the south eastern quadrant occur well over 20% of the time.

The potential for significant impact for the people of Ireland arising from this proposal is largely ignored in the Environmental Statement. It is notable that the distance to territorial waters of neighbouring states (e.g. Germany 320km) is listed in Volume 10 Appendix 5A though no mention is made of Ireland which has only a slightly longer distance involved. Generally the consideration of the unlikely occurrence of a major accident on Ireland is not considered as part of the impact study, despite existing obligations to do so.



In conclusion, the transboundary aspects of this application give cause for concern. The concerns are also reflected in the submissions from other potentially affected states. An Taisce adopts the submissions made by the Austrian authorities and also adopts the position taken by the Nuclear Free Local Authorities group. Screening for Transboundary Impacts is not adequately considered in this proposal.

From:	FRANK SWEENEY (PLANNING)
To:	SizewellC
Cc:	TERESA CONWAY
Subject:	FW: Submissions received by Donegal County Council (ROI) Sizewell C transboundary EIA public consultation
Date:	20 November 2020 11:36:57
Attachments:	image001.png Robert Andrews 1 (Proof of submissions on Sizewell transboundary EIA consultation) .htm Robert Andrews 2 (part submission).htm Robert Andrews 3 RE Sizewell Transboundary Application submission.htm eNGO An Claiomg Glas (ags) 1 environmental public consultation Sizewell C Nuclear Power Station.htm eNGO An Claiomg Glas (ags) 2 (attachment) Annex 2 SZC Carbon reduction FINAL (1).pdf eNGO An Claiomg Glas (ags) 3 (attachment) Annex I NFLA_New_Nuclear_Monitor_No63_Irish_Councils_Sizewell_EIA (1).pdf Irish Environmental Network (1)Transboundary environmental public consultation Sizewell C Nuclear Power Station.htm Irish Environmental Network (2) EP and ELO submission on Sizewell C Transboundary Consultation.pdf Irish Environmental Network (3) Annex I NFLA_New_Nuclear_Monitor_No63_Irish_Councils_Sizewell_EIA (1) (2).pdf Irish Environmental Network (4) Annex III pnnl-27120_harvesting_Dec2017-1.pdf Irish Environmental Network (5) Annex 2 SZC Carbon reduction FINAL (1) (2).pdf

Planning Inspectorate,
Donegal County Council received 3 no. electronic submissions on foot of the Transboundary EIA public consultation process on the Sizewell C nuclear power station development.

These were received from

- Attracta Ui Bhroin from the Irish Environmental Network,
- eNGO An Claiomg Glas (ags)
- Robert Andrews (appears to be only part of intended submission) sent part of

I have attached all the attachments received from 3 no. parties and in accordance with Article 132(5) of the Planning and Development Regulations 2001-2020 and Article 3(8) of the Espoo Convention the Planning Authority is forwarding these submissions to you. You are advised that Mr Robert Andrew's submission appears to be only part of his intended submission however as this was received within the appropriate consultation period I have included this also.

I trust this is to your satisfaction.

Frank Sweeney
A/Senior Executive Planner
Community & Planning Services

From: JOANNE MCDAID (MILFORD) on behalf of DCCINFO
Sent: 29 October 2020 13:01
To: planning mailbox
Subject: FW:

A chara,

Please see email below received via the Council's email address for your attention. Please respond directly.

With thanks,
Customer Service Centre

Ionad Seirbhíse Custaiméara | Tithíocht, Corparáid & Cultúr | Comhairle Contae Dhún na nGall | Ionad Seirbhíse Poiblí Bhaile na nGallóglach | 074 91 53900 | ionadseirbhísecustaiméara Customer Service Centre | Housing, Corporate & Culture | Donegal County Council | Milford Public Service Centre | 074 91 53900 | customerservicecentre

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From: Robert Andrews [redacted]
Sent: Thursday 29 October 2020 12:50
To: DCCINFO
Subject:

CAUTION: This email originated from outside of Donegal County Council. Do not click links or open attachments unless you recognise the sender and are sure that the content is safe.

would like to submit my opinion on the Sizewell Nuclear Power Station. I believe there are interconnectors between the U K and Ireland one through N. Ireland and one directly from England. I would be guessing now but I believe about 20% of electricity generated in U. K. is from Nuclear Power Stations in various places in G. B. and thus 20% of all electricity bought from U. K. comes from Nuclear Power Stations in G. B. It is a bit rich Donegal County Council and the Irish Government to ask about the impact of Sizewell Nuclear Power Station. The Coal Oil and Gas power stations in Ireland cause the majority of pollution in Ireland but they also devistate the environment in Africa as the prevailing winds carry this pollution across to Africa and comes down as acid rain.
There should be more emphasis on

From: Byrne Mark <Mark.Byrne@tii.ie>
Sent: 08 September 2020 09:13
To: transboundary
Subject: RE: Transboundary Environmental Public Consultation – Sizewell C Nuclear Power Station

Categories: Purple Category

Dear Ms. Feeney,

I wish to acknowledge receipt of your email of 2 September 2020 regarding the above and advise that Transport Infrastructure Ireland (TII) has no specific observations to make in relation to the development.

Yours sincerely,

Mark Byrne
Regulatory & Administration Unit
Tel: 01-6463786
Address: Parkgate Business Centre, Parkgate Street, Dublin 8, D08 DK10
TII_Logo_150814

Irish Aviation Authority
The Times Building
11–12 D'Olier Street
Dublin 2, D02 T449,
Ireland

Údarás Eitlíochta na hÉireann
Foirgneamh na hAmanna
11–12 Sráid D'Olier
Baile Átha Cliath 2, D02 T449,
Éire

T: +353 1 671 8655
F: +353 1 679 2934
www.iaa.ie

PLANNING DEPARTMENT
22 OCT 2020
RECEIVED

Date 20th October 2020

Ms. Avril Feeney,
Planning and Property Development Department
Block 4, Floor 3,
Civic Offices,
Wood Quay,
Dublin 8.

Development: ***Transboundary Environmental Public Consultation – Sizewell C Nuclear Power Station***

Dear Avril

I refer to the above-proposed development details, of which were forwarded to the Irish Aviation Authority.

I wish to advise that we have no observations on this application.

Yours sincerely

[redacted]

Deirdre Forrest
Corporate Affairs

Tionól Reigiúnach Oirthir agus Lár-Tíre
Eastern and Midland Regional Assembly

3ú Urlár ó Thuaidh |Ionad Cathartha |An tSráid Mhór |Baile Munna |Baile Átha Cliath 9
3rd Floor North |Ballymun Civic Centre|Main Street| Ballymun| Dublin 9

Transboundary Environmental Public Consultation – Sizewell C nuclear power station

The Eastern and Midland Regional Assembly (EMRA), as a prescribed body, welcome the opportunity to make a submission in respect of the Transboundary Environmental Impact Assessment Public Consultation being undertaken in relation to the development consent application received by the UK Planning Inspectorate for the proposed Sizewell C nuclear power station, Suffolk, England, UK.

Background and relevance

The Eastern and Midland Regional Assembly (EMRA) is one of three Regional Assemblies which are part of the regional tier of governance in Ireland. The eastern and midland region covers nearly 14,500 square kilometres and 12 local authority areas and it accommodates almost half of the nation's 4.6 million inhabitants and over 1 million jobs. The main settlement is the capital city of Dublin, with over 1.2 million population, is the main global gateway to Ireland, and is supported by regional growth centres key towns and an extensive rural hinterland. The region has more than 270km of coastline from Carlingford Lough in Louth to Kilmichael Point at the Wickow-Wexford border encompassing our capital city, a number of coastal towns and villages and 10 blue flag beaches.

EMRA is focused on the formulation, adoption and implementation of the Regional Spatial and Economic Strategy (RSES), oversight and coordination of Local Economic and Community Plans, management of EU Operational Programs, EU project participation, implementation of national economic policy and additional functions working with the National Oversight and Audit Commission.

In line with the provisions of the Planning and Development Act 2000 (as amended) the Eastern and Midland Regional Assembly (EMRA) made the Regional Spatial and Economic Strategy (RSES) for the Eastern and Midland Region on the 28th June 2019. The primary statutory objective of the RSES is to support implementation of Project Ireland 2040 – which links planning and investment through the National Planning Framework (NPF) and ten-year National Development Plan (NDP) – and the economic and climate policies of the Government by providing a long-term strategic planning and economic framework for the Region. The Strategy is underpinned by three key cross-cutting principles; Economic Opportunity, Healthy Placemaking and Climate Action.

Submission

The Eastern and Midlands Regional Assembly wishes to express its concern regarding the proposed new nuclear power station development known as 'The Sizewell C Project'. Past major international nuclear accidents, such as those at Chernobyl and Fukushima, have shown significant economic consequences and impacts on health, environment and society. A potential serious accident at the proposed Sizewell C nuclear power plant could lead to an increase of radioactivity levels in Ireland which would have severe socio-economic impacts.

Attention is drawn to the attached Irish Environmental Protection Agency's Office of Radiological Protection & Environmental Monitoring report on the proposal dated 20/07/2020 which highlights relevant concerns referred to in the following two key reports:

- 'The Potential Economic Impact of a Nuclear Accident - An Irish Case Study' prepared by the Irish Economic and Social Research Institute, ESRI 2016
- 'Proposed nuclear power plants in the UK – potential radiological implications for Ireland' produced by the Radiological Protection Institute of Ireland, RPPII 2013

The ESRI report quantifies the direct and indirect effects of a nuclear accident on the Irish economy and highlights that the direct reputational effects of a nuclear accident on the tourism, agriculture and food sectors are substantial. The EPA have indicated that while there is a low probability of an accident occurring, there is the need to maintain arrangements under the national emergency plan for such an accident.

The RPII report estimates that the concentrations of radioactivity in the air and radioactive contamination on the ground on the east coast of Ireland following unit accidental releases from Sizewell C were approximately one order of magnitude lower than those from the closest power station to Ireland, located at Wylfa on the Wales coast. The EPA has warned, however, that a severe accident at Sizewell C (combined with unfavourable weather) which resulted in radioactive contamination in Ireland could also lead to food controls and agricultural protective actions being introduced with a resultant severe socio-economic impact on Ireland.

It is anticipated that the matters highlighted above will be given due consideration during the consent process.

Conclusion

EMRA welcomes further opportunities to engage with the current transboundary consultation process. It is also considered prudent that transboundary consultation continues to be a key aspect of all stages of consultation and performed by all the relevant authorities in the United Kingdom and Northern Ireland on any future development proposals of this nature.

Regards,

[redacted]

____

Jim Conway
Director
Eastern and Midland Regional Assembly

21st October 2020

Attached: Appendix A EPA Office of Radiological Protection & Environmental Monitoring report, July 2020

Application for development consent in respect of 'The Sizewell C Project': Transboundary screening

The UK Planning Inspectorate wrote to the Department of Housing, Planning, and Local Government on 8th July 2020 regarding the proposed construction of a new nuclear power station at the Sizewell C site in Leiston, Suffolk, England The Secretary of State has received an application for development consent (DCO) in respect of 'The Sizewell C Project', a new nuclear power station in Suffolk, on the East coast of England, United Kingdom (UK).

The Proposed Development has been identified as a project within the scope of paragraph 2 of Appendix 1 to the Espoo Convention and EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment ("the EIA Directive"), as implemented by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ("the EIA Regulations").

Prior to receiving the application, the Secretary of State undertook a screening assessment in October 2019 to identify if there were likely significant adverse transboundary effects on the environment in your state. This concluded that the Proposed Development is not likely to have such effects. Following receipt of the DCO application, the Secretary of State has now re-screened the Proposed Development to reconsider if there is the potential for likely significant adverse transboundary effects in your state. The Secretary of State remains of the view that the Proposed Development is not likely to have such effects.

EPA assessment:

The Sizewell C site is located on the east coast of England and is over 520 km from the east coast of Ireland. A report from the Radiological Protection Institute of Ireland (RPII) in 2013, *"Assessment of the potential radiological impacts on Ireland of the UK's proposed nuclear power plants*", concluded that the routine operation of the proposed nuclear power plants (including Sizewell C) would have no measurable radiological impact on Ireland or the Irish marine environment. In this report it was estimated that the total annual radiation dose to a person in Ireland after 50 years of constant and continuous discharges to air from the operation of a new nuclear power at the Sizewell C site (0.001 μSv/y) was well within the radiation dose limit for a member of the public (1000 μSv/y or 1mSv/y).

As well as assessing routine operations, the 2013 RPII study also assessed the radiological impact on people in Ireland from five potential accident scenarios. For this assessment the Wylfa site, being the closest of the eight locations identified by the UK Government for construction of new nuclear power plants, was identified as the accident location which would give rise to the 'worst case' in terms of radioactive contamination and radiation dose in Ireland. Apart from the amount of radioactivity released to air, weather was found to be the most significant factor in estimating the impact on Ireland. In cases where the weather conditions at the time of the accident gave rise to the radioactivity released being carried directly to Ireland it was found that food controls and/or temporary agricultural protective actions would be required for a period ranging from days and weeks to many years depending on the severity of the accident.

The Sizewell C site is over 400 km further away from Ireland than the Wylfa site. In the 2013 RPII study it was estimated that the concentrations of radioactivity in the air and radioactive contamination on the ground on the east coast of Ireland following unit accidental releases from Sizewell C were approximately one order of magnitude lower than those from Wylfa. However, a severe accident at Sizewell C (combined with unfavourable weather) which resulted in radioactive contamination in Ireland could also lead to food controls and agricultural protective actions being introduced. Indeed, the 2016 report '*Potential Economic Impact of a Nuclear Accident - An Irish Case Study*' by the Economic and Social Research Institute found that if there was an accident at a nuclear power plant in north-western Europe which resulted in no actual contamination in Ireland, there would still be an impact on Ireland in terms of reputational losses, particularly in relation to tourism and export markets, in the region of €4 billion. This indicates the need to maintain arrangements under the national emergency plan for such an accident, despite the low probability of it occurring.

Therefore, while there is no measurable radiological impact expected from the expected routine environmental releases from Sizewell C, given the potential transboundary effects in Ireland of a severe (albeit unlikely) nuclear accident at the Sizewell C site it is recommended that Ireland register as an interested party in the in the examination process.

Veronica Smith
Ciara McMahon

EPA Office of Radiological Protection & Environmental Monitoring

20/7/2020

HSE Oifig Náisiúnta um Bainistíocht Éigeandála,
Teach Darach, Páirc na Milaoise, An Nás, Co. Chill Dara. W91 KDC2
T. 045 885 591 R. trish.markham@hse.ie

HSE National Office for Emergency Management
Oak House, Millennium Park, Osberstown, Naas, Co Kildare W91 KDC2
Tel: 045 885 591 Email: trish.markham@hse.ie

Transboundary Environmental Public Consultation – Sizewell C nuclear power station

Dear Lisa,

Please accept this as the submission from the HSE, Emergency Management function.

The below points are being made in the context of ensuring that good transboundary, all Island planning and preparedness exists to achieve an effective and efficient response and recovery to any emerging incident that may take place on this plant site at Suffolk, East England.

1. Regular risk assessments are undertaken (taking into account any incidents/near misses) and that any related risk assessment findings are widely shared.
2. That ongoing exploration of alternatives options such as renewable energy is invested in.
3. That ongoing emissions, air pollution, waste risk and health risks are monitored and that triggers exist for investigations of any emerging issues (including that Public Health England work with the site and that any information is shared with the HSE, HPSC on a real time basis).
4. That the plant monitors the effects of climate change including the risk from rising sea levels and associated impacts.
5. That the site Emergency Plan incorporates a transboundary, all Island approach (that includes direct access to plant site technical teams with a marine component) and is in line with the Nuclear Regulatory Commission requirements.

If you have queries in relation to this submission, please do not hesitate to contact me.

Thanking you.

Yours sincerely,

[redacted]

Dr Trish Markham.

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

National Office for Environmental Health Services
2nd Floor, Oak House, Lime Tree Avenue
Millennium Park, Naas, Co. Kildare
W91KDC2

T: 045 880 442
ehnationaloffice@hse.ie

Planning & Property Development Department
Block 4, Floor C
Civic Offices
Dublin City Council
Wood Quay
Dublin 8

24th September 2020

Re: **Transboundary Environmental Public Consultation – Sizewell C Nuclear Power Station**

Dear Madam,

Please find enclosed the Environmental Health Service consultation report in relation to the Transboundary Environmental Public Consultation for the Sizewell C Nuclear Power Station. The following HSE departments were notified of the consultation request on 17th September 2020.

- Emergency Planning
- Estates
- Assistant National Director for Health Protection
- CHO – Kay Kennington

If you have any queries regarding this report please contact me, Marie Ryan, Principal Environmental Health Officer, Environmental Operational Unit, Adelaide Chambers, Peter St, Dublin 8.

Yours Sincerely,

[redacted]

Marie Ryan
Principal Environmental Health Officer

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

National Office for Environmental Health Services
2nd Floor, Oak House, Lime Tree Avenue
Millennium Park, Naas, Co. Kildare
W91KDC2

T: 045 880 442
ehnationaloffice@hse.ie

Transboundary Environmental Public Consultation
Sizewell C Nuclear Power Station

Introduction

NNB Generation Company (SZC) Limited has applied to the UK Planning Inspectorate for permission for a proposed Nuclear Power Station at Sizewell C, Suffolk, England. The proposed development will comprise of two modern pressurised water reactors, using nuclear fission of uranium to produce heat which is transferred to steam that powers conventional turbines and generators, giving a total output capacity of approximately 3,340MW.

The proposed development has been identified as a project within the scope of the Espoo Convention (the 1991 United Nations Convention on Environmental Impact in a Transboundary Context) and in accordance with the provisions of EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive) the UK Government has invited the Department of Housing, Planning and Local Government to undertake a transboundary public consultation in respect of environmental information relating to the Sizewell C Nuclear Power Plant.

A specific process has been set up by the Department of Housing, Planning and Local Government to co-ordinate any submissions to the UK Government which is being administrated by Dublin City Council. This submission from the Health Service Executive forms part of that consultation process and is being co-ordinated by the Environmental Health Service (EHS) Environment Operational Unit.

Env Health Rational

The EHS has assessed potential transboundary impacts to Ireland from the operation of the proposed facility as being from routine and accidental process emission or from a minor to a catastrophic accident.

The impacts would be on human health and/or socio and economic impacts.

The EHS role is to inform Competent Authorities in the planning process of any potential environment and public health issues with the proposed development.

The above proposed development is subject to an environmental impact assessment procedure, the results of which are outlined in an Environmental Statement which is available at:
https://infrastructure.planninginspectorate.gov.uk/projects/Eastern/The-Sizewell-C-Project/

Sections of the Environmental Statement which are of environmental health significance have been reviewed by the EHS to help form this submission.

Project Description

The proposal at Sizewell C is to construct a new nuclear power station comprising of two Pressure Reactors with a total expected generating capacity of approximately 3,240 MW.

The main nuclear power station facility will include associated development such as:

- A worker accommodation campus and caravan site, administration offices, waste recycling facilities, perimeter and internal roads, and utilities provision including a foul water pumping station;
- Connection to the National Grid via a new 400kV substation and overhead lines;
- Cooling water infrastructure (including cooling water tunnels extending out to sea, intake and outfall headworks on the north sea bed, and the outfall associated with a fish recovery and return system);
- A Beach Landing Facility to receive deliveries of Abnormal Indivisible Loads by sea throughout the power station's operational life, and
- Flood defence and coastal protection measures.

The off-site elements of the Proposed Development include:

- Two temporary park-and-ride sites to manage additional traffic generated by the construction workforce,
- Permanent road bypasses, link roads and highway improvements to alleviate traffic and mitigate potential effects on road safety during construction and operation,
- Temporary freight management facilities during construction; and
- Temporary and permanent extensions and improvements to existing railway infrastructure.

The land area of the permanent development at the main development site would be approximately 371.7 hectares (ha). The offshore structures required for the intake and discharge of cooling water, will extend up to approximately 3km offshore. Cooling water will be drawn from and returned to the North Sea. The principal supply of water for the Sizewell C Project will come from mains water, provided by Essex and Suffolk Water.

The Proposed Development will be operational for 60 years. A separate 'Interim Spent Fuel Store' designed to store radioactive fuel until a UK Geological Disposal Facility becomes available has been designed for a lifetime of 100 years. Construction is anticipated to be undertaken in five main phases, with construction expected to last 9 to 12 years.

Results of UK Transboundary Screening

The UK Government has screened the proposal on two separate occasions, once at pre-application stage and a second time on receipt of the application. The screening assessment is available at:
https://infrastructure.planninginspectorate.gov.uk/document/EN010012-002271

The results of this screening were reviewed by the Environmental Health Service and on both occasions, the screening determination concluded that the proposed development is "*not likely to have significant adverse transboundary effects on the environment in Ireland".*

Despite reaching this conclusion this has not precluded the UK Government from including Ireland in the formal transboundary consultation process.

Environmental Impact Assessment

The methodology used in the EIA to determine the likely significant effects of the Sizewell C Project takes a standardised format.

• Define the study area and identify topic receptors.
• Establish the environmental baseline for topic receptors.
• Determine the value/sensitivity of receptors, the magnitude of change and significance of effect.

Assessment scenarios for both the construction and operational phase were carried out.

As part of the EIA process and through consultation with statutory consultees, each environmental topic has an agreed study area (or zone of influence) within which significant environmental effects could occur. All zones of influence for the impact assessments were identified in Chapter 4 of the Environmental Statement and it concluded that no zones of influence extended beyond the UK boundaries. Ireland was not identified as a receptor or in any zone of influence for any environmental topic and it was not deemed necessary by the applicant to include Ireland or Irish territorial waters in any study area for the assessment of impacts.

Volume 10, chapter 5 of the Environmental Statement presents the assessment of transboundary environmental effects associated with the construction and operation of the Sizewell C power station at the main development site and the construction, operation, removal and reinstatement (where applicable) of the associated off site developments.

The applicant has carried out a screening exercise using the matrix in Annex 1 of '*Advice Note Twelve: Transboundary Impacts and Process',* published by the Planning Inspectorate (PINS) (2018). https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2013/04/Advice-note-12v2.pdf

This is presented in Table 1.1, Appendix 5A (Vol 10, Chapter5). The scope of this assessment has been established through a formal EIA scoping process undertaken with the Planning Inspectorate.

The applicant has not identified Ireland as being at risk of impact from transboundary environmental effects and Ireland or Irish territorial waters were not included in this screening.

Production, Storage & Disposal of radioactive waste

Details relating to waste production, storage and disposal are discussed in Volume 2, Chapter 7 of the Environmental Statement. It is stated the construction and operation of the proposed nuclear facility will be subject to the UK's regulatory framework for controlling the disposal of radioactive waste from nuclear power stations and direct radiation exposure (The Radiological Substances Regulation under the Environmental Permitting (England and Wales) Regulations 2016). The Applicant must also demonstrate the application of Best Available Techniques to minimise radioactive waste generated and ensure any discharges are kept 'As Low As Reasonably Achievable'

Low level and intermediate level waste will be produced during normal operation of the Sizewell C power station. These wastes will be stored on site in secure facilities or dispatched to authorised disposal facilities in the UK.

Spent nuclear fuel removed from the reactor would initially be stored underwater in a reactor fuel pool. Following this initial storage period, the spent fuel assemblies would be transferred to the proposed separate on-site Interim Spent Fuel Store (ISFS) where they would be safely stored until a UK Geological Disposal Facility is available and the spent fuel is removed for final disposal. The ISFS would be designed for a life of at least 100 years, which could be extended if necessary. The ISFS would be designed to be capable of operating independently of other parts of the power station in recognition that its lifetime would, under current assumptions, extend beyond the operational life and decommissioning of the other facilities on-site. It is stated that the management of this waste is in line with UK Government Policy and that there is no probability of significant transboundary effects from the Production, Storage and Disposal of radioactive waste.

Radiological Effects

Volume 2, Chapter 25 of the Environmental Statement contains a summary of the radiological effects from the Sidewell power station. Effluent discharges on human and non-human biota are modelled using internationally recognised models and assessed as being well below the regulatory threshold levels. Receptors closest to the main development site have been assessed (on the basis that concentrations reduce as distance from any release increases). The results of the modelling for 'routine releases' at the closest receptors have been classed as 'miniscule' and it is stated can be discounted as being not significant. The assessment concluded that there would be no significant effects on any Natura 2000 site or other ecological receptor, designated site or representative person.

From these results the applicant concludes "*It is therefore unlikely to result in a significant effect on any EEA state given the separation distances"* and it is predicted that there will be no transboundary effects from routine releases. The Environmental Statement states that radiological exposure will meet legal requirements and will be controlled through an Environmental Permit.

Major Accidents and Disasters

An unmitigated major accident or disaster at the Sizewell Nuclear Facility could result in significant environmental effects on other neighbouring states.

This is discussed by the applicant in Volume 2, Chapter 27 of the Environmental Statement. The mitigation measures outlined by the applicant focus on compliance with legislative and regulatory processes. Nuclear safety in the UK is regulated by the Office for Nuclear Regulation through a Nuclear Site Licence which places conditions on the Licensee to assure the safety of all aspects of power station construction, operation and decommissioning. The risk of accidents and possible radiological impacts on the airspace, land, water and humans in other EU member states is also covered by the Euratom Treaty obligations. The applicant states following the implementation of the identified mitigation (as set out in ES Volume 2, Chapter 27 Major Accidents and Disasters), all risks including any potential transboundary effects are considered to be tolerable and / or as low as reasonably practicable and not significant.

Potential Impacts to Ireland of the Project

The Radiological Protection Institute of Ireland published a report: '*Proposed nuclear power plants in the UK – potential radiological implications for Ireland', 2013*

It should be noted that this is a detailed 256 page report carried out by experts in the field who considered a wide range of potential implications to Ireland from the routine operation of nuclear plants to a catastrophic accident and all situations in between.

The principal findings of the 2013 report were:

a) Given the prevailing wind direction in Ireland, radioactive contamination in the air, either from routine operation of the proposed nuclear power plants or accidental releases, will most often be transported away from Ireland.

b) The routine operation of the proposed nuclear power plants will have no measurable radiological impact on Ireland or the Irish marine environment.

c) The severe accident scenarios assessed ranged in their estimated frequency of occurrence from 1 in 50,000 to 1 in 33 million per year. The assessment used a weather pattern that maximised the transfer of radioactivity to Ireland. For the severe accident scenarios assessed, food controls or agricultural protective measures would generally be required in Ireland to reduce exposure of the population so as to mitigate potential long-term health effects. In the accident scenario with an estimated 1 in 33 million chance of occurring, short-term measures such as staying indoors would also be advised as a precautionary measure. In general, the accidents with higher potential impact on Ireland are the ones least likely to occur.

d) Regardless of the radiological impact, any accident at the proposed nuclear power plants leading to an increase of radioactivity levels in Ireland would have a socioeconomic impact on Ireland.

e) A major accidental release of radioactivity to the Irish Sea would not require any food controls or protective actions in Ireland.

f) There is a continuing need for the maintenance of emergency plans in Ireland to deal with the consequences of a nuclear accident abroad.

The assessment conclusions from accidental releases are shown in table 40, reproduced from the report below.

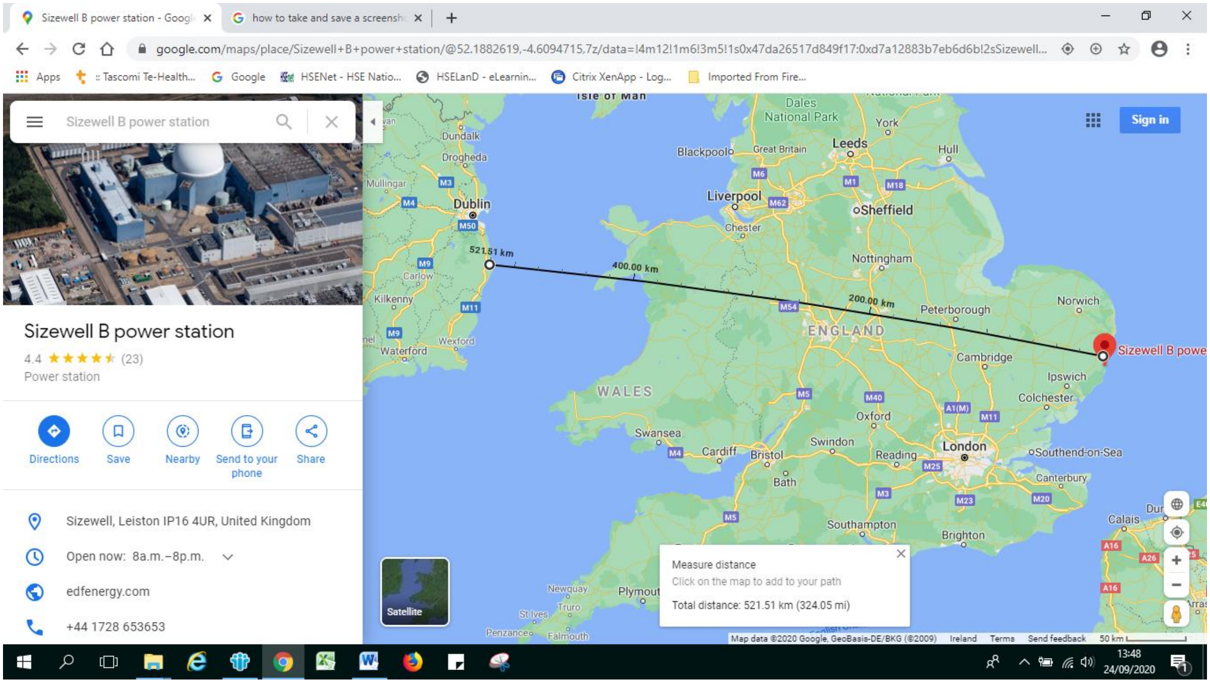
http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

Table 40. Summary of impacts on Ireland from accident scenarios considered

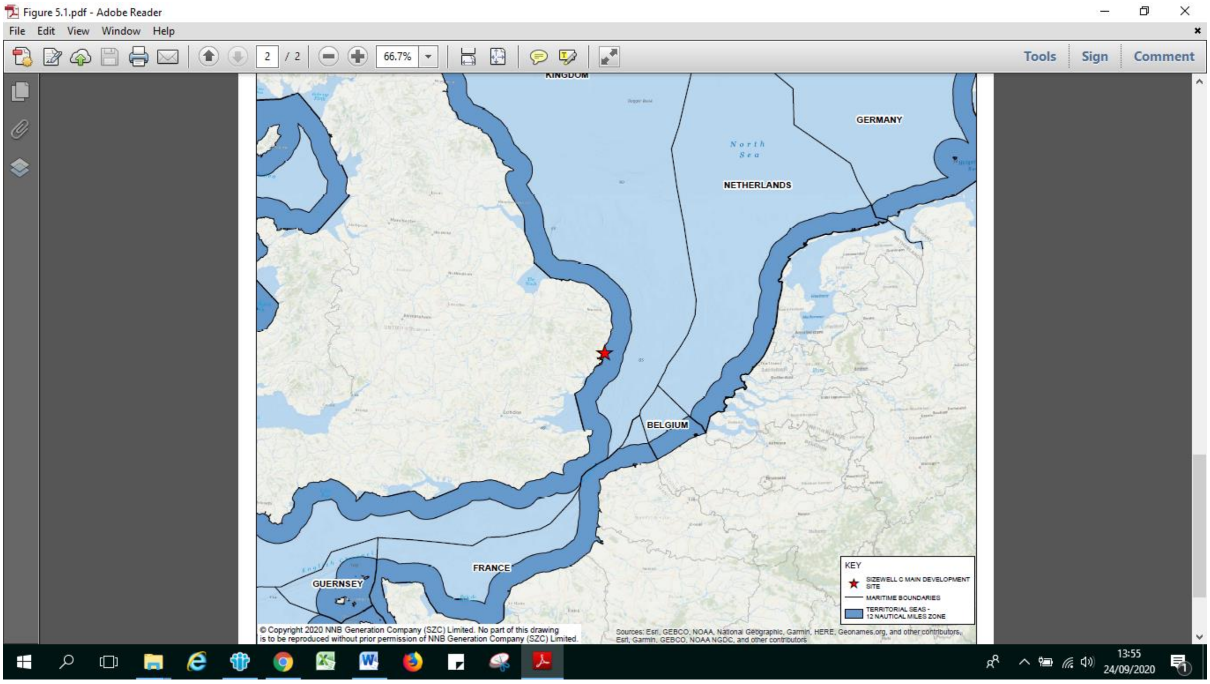
Type of accident assessed	Chance of occurrence	Health impact in Ireland	Other impacts in Ireland
ST1: Severe accident caused by loss of external power (battery backups operate safety systems for about 4 hours).	*1 in 50,000 per year*	No observable health effects	No short-term protective actions would be required Some food controls (or temporary agricultural protective actions) would likely be needed for a period of days to weeks. Additional monitoring of the environment and food required in the months following the accident.
ST2: Severe accident caused by loss of all power (battery backups also assumed to fail therefore, all safety systems quickly become inoperable).	*1 in 500,000 per year*	No observable health effects	No short-term protective actions would be required. Some food controls would be needed for a number of weeks together with agricultural protective actions for a period of months. These measures would have high socio-economic costs. Additional monitoring of the environment and food required in the months to years following the accident.
ST3: Severe accident caused by loss of power combined with bypass of the containment due to rupture of a steam generator tube.	*1 in 2.5 million per year*	No observable health effects	No short-term protective actions would be required. Some food controls would be needed for a number of weeks together with agricultural protective actions for a period of months. These measures would have high socio-economic costs. Additional monitoring of the environment and food required in the years following the accident.
ST4: Severe accident with loss of coolant combined with bypass of the containment.	*1 in 33 million per year*	Long term risk of an increase in cancer rates if the planned food controls and agriculture protective actions are not put in place	People would be advised to stay indoors as much as possible during the passage of the plume (24 to 48 hours). Food controls and/or long-term changes in farming practices would be required to ensure that long-term radiation doses from contaminated food would not reach levels that could increase cancer risks to the population. These measures would have high socio-economic costs. Additional monitoring of the environment and food required in the years to decades following the accident.
ST5: accident with loss of coolant and *core meltdown but largely functioning safety filtration systems.*	*1 in a million*	No observable health effects	No short-term protective actions would be required. No food controls or agricultural protective actions would be needed. Despite this, perceived contamination of food might lead to loss of consumer confidence in Irish food products for a period. No additional monitoring would be required beyond the immediate period after the accident for health protection reasons but could be required to support the Irish agri-food industry.

Conclusions

The proposed development site is located in Suffolk, on the south east coast of England. The Sizewell C Project is located approximately 530km from Ireland's coastline.



The nearest states outside the UK to the Sizewell C Project are Belgium, Netherlands Germany and France and the map below outlines the closest territorial waters.



Ireland or Irish territorial waters were not identified by the applicant as a receptor and were not included in the study area or zone of influence for any impact assessment for ether the construction or operation of the proposed Sizewell C nuclear facility. All zones of influence for the impact assessments identified by the applicant where within the UK boundaries.

The applicant concludes in Chapter 5 of the Environmental Statement on the assessment of transboundary environmental effects “*no environmental changes would occur in any other European Economic Area state”.*

Results of the UK government’s own transboundary screening has concluded that the proposed development is “*not likely to have significant adverse transboundary effects on the environment in Ireland”.*

The RPII published report which considered potential impacts from the building of nuclear power plants in the UK concluded that “*the routine operation of the proposed nuclear power plants will have no measurable radiological impact on Ireland or the Irish marine environment.”*

The RPII report predicts what the impacts from different accident scenarios would be and what action would be required to be taken. It should be noted that the worst case situations from catastrophic accidents predict ‘high’ socio and economic impacts, but these impacts are not quantified in the report. However the RPII predicted the likelihood of such a severe accident scenario occurring to be 1 in 33 million.

Recommendation:

The RPII identified that a lack of emergency preparedness in Ireland was evident in their assessments in the 2003 report. This remains the case to date and it is recommended that Ireland should prepare an Emergency Response Plan to cater for such a catastrophic event.

References:

Convention on Environmental Impact Assessment in a Transboundary Contex.
The Espoo (EIA) Convention sets out the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. It also lays down the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries
https://www.unece.org/env/eia/eia.html

DIRECTIVE 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, As amended by:Directive 2014/52/EU
https://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:026:0001:0021:EN:PDF

Directive 2014/52/EU Assessment of the Effects of Certain Public and Private Projects on the Environment amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment ('EIA Directive')
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052

Council Directive 92/43/EEC (Habitats Directive)
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0043

Council Directive 2009/147/EC (Birds Directive)
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009L0147

All documentation related to the development consent application for the proposed development is available to view at:
https://infrastructure.planninginspectorate.gov.uk/projects/Eastern/The-Sizewell-C-Project/

Guidance on the Application of the Environmental Impact Assessment Procedure for Large-scale Transboundary Projects, European Union, 2013
http://ec.europa.eu/environment/eia/pdf/Transboundry%20EIA%20Guide.pdf

EIA/IC/CI/5 United Kingdom
https://www.unece.org/environmental-policy/conventions/environmental-assessment/areas-of-work/review-of-compliance/committee-initiative/eiaicci5-united-kingdom.html

Proposed nuclear power plants in the UK – potential radiological implications for Ireland, EPA, 2013
http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

[redacted]

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Lisa Maguire
Environmental Health Officer

From: Aengus Ó Snodaigh [redacted]
Sent: 07 October 2020 11:53
To: transboundary
Subject: Transboundary environmental public consultation – Sizewell C Nuclear Power Station

Categories: Purple Category

A chara,

Ba maith liom cur i gcoinne aon forbairt den sort atá leagtha amach do Stáisiún ginnte fuinemah núicleach Siewell C i Suffolk, Sasana, toisc na fátha a leanas.

The Sizewell C Project, a new nuclear power station in Suffolk, on the East coast of England may be deemed to pose a lower risk to Ireland than England's other nuclear proposals along its west coast, but that is not to say that there is no risk to the Irish public.

I therefore welcome the transboundary public consultation in respect of the Sizewell C Project and its potential impacts on neighbouring States facilitated by the British Department for Business, Energy and Industrial Strategy (DBEIS) as it complies with the terms of the 1991 United Nations Espoo Convention and the 2011 EU Environmental Impact Assessment Directive.

As part of Brexit, the British Government have also concerningly opted to leave the European Atomic Energy Community (Euratom). Sinn Féin opposes nuclear energy and the use of Irish taxpayers money going towards the operating costs of Euratom, however, it does acknowledge that as a nuclear power, Britain being a member of Euratom meant that it was subject to the European Court of Justice and to a coordinated regulatory regime.

Concerns have been raised by the British nuclear regulatory body, ONR regarding Britain's readiness to leave Euratom. They have expressed concerns regarding a skills shortages to deliver a British State System of Accountancy for control of nuclear material to meet its international obligations.

ONR also expressed concerns regarding a replacement IT system to track nuclear material and whether it can be delivered on time and be effective.

They also expressed concerns regarding the long-term funding of the new nuclear regulator.

I would therefore like to express our concern that on completion of Brexit and their leaving of Euratom, the British Government will no longer be subject to legal proceedings at the European Court of Justice if they fail to comply with nuclear safety regulations.

While the chances of a nuclear incident occurring are low, the impacts of such an incident could be catastrophic and have substantial impact on human life and the economy. The Radiological Protection Institute of Ireland (RPII) recognised that even though the concentrations of radioactivity in the air and radioactive contamination on the ground on the east coast of Ireland in the event of an incident at Sizewell C would be one order of magnitude lower than if an incident occurred at the closest nuclear site, Wylfa, an incident at Sizewell C could still result in food controls and agricultural protective actions being introduced in Ireland *[www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf].*

The Economic and Social Research Institute (ESRI) study conducted in 2016- *The Potential Economic Impact of a Nuclear Incident — An Irish Case Study* estimated the potential financial losses to Ireland in the event of a nuclear incident to be as high as €160bn.

Even in the lowest risk scenario where there is no actual contamination in Ireland, the reputational losses in relation to tourism and export markets could be as high as €4bn.

Given that Ireland relies heavily on its food exports and tourism, in the event of an incident even the perception of contamination would lead to a significant economic impact.

Given the absence of access to the European Court of Justice post Brexit, the ambiguity of the long term funding of a new nuclear regulator and the potential impacts to the Irish public and their economy, I as a Teachta Dála (member of parliament) for a constituency in the capital of Ireland Dublin only just over 400 miles from the site in question would like to register my objection to the proposed development of the Sizewell C nuclear power station in Suffolk.

Aengus Ó Snodaigh TD
[redacted]

From: info@acg.ie
Sent: 28 October 2020 17:30
To: planning mailbox; Fingal.DevelopmentPlan@fingal.ie; planning@galwaycoco.ie; plandept@kildarecoco.ie; transboundarysub@laoiscoco.ie; transboundary@louthcoco.ie; submissions@wexfordcoco.ie; plandev@wicklowcoco.ie
Subject: Transboundary environmental public consultation – Sizewell C Nuclear Power Station
Attachments: Annex 2 SZC Carbon reduction FINAL (1).pdf; Annex I NFLA_New_Nuclear_Monitor_No63_Irish_Councils_Sizewell_EIA (1).pdf

Dear Sir Madame,

I wish to express extreme concern on behalf of eNGO An Claíomg Glas and in a private capacity in respect of the Sizewell C application and the inadequate consideration of transboundary impacts on Ireland.

The consideration by the UK in its screening determination is entirely inadequate and fails to consider adequately the potential for airborne transport to Ireland and inadequately details and specifies a severe nuclear incident. Further marine transport is inadequately considered particularly given the further failure to consider adequately the already extant flood risk on the site, and the increased level of sea level risk now inevitable with climate change.

Aditionally, the application fails to adequately consider the fact the UK is now obliged to revisit its strategic environmental assessment for energy, including for nuclear further to judgments from the UK Courts. This brings a material consideration to bear in respect of the justification in place for a project of this nature given the availability of alternatives which present less risk of serious accident, and indeed less problematic issues in terms of consequential risks associated with radioactive waste and its disposal, for which the UK still has no solution.

We do not hold that an Environmental Impact Assessment can be considered to be complete in the absence of the consideration of the entirety of impacts particularly such significant direct impacts as the waste arising from the operation of the plant.

We also submit that in line with the judgments of the Irish High Court in the Case of the Edenderry Power Plant in An Taisce v An Bord Pleanala, that there is a need to assess the impacts associated with the uranium needed to power the plant also.

We consider there are serious deficiencies in the risk assessment of the serious accident scenarios, and also in the context of the failure to consider risks arising given the pressure to continue to run old nuclear power plants long past their sell by date while the development of these new plants run way behind schedule. The UK's focus on maintaining a slot when there are more reasonable and less hazardous alternatives and where it involves ongoing pressure to run the old plants to maintain the space in its energy mix is creating an associated risk for Ireland as its closest neighbour and this is nowhere assessed properly in the context of this application and the screening done.

We also submit in the context of climate change - serious issues in respect of the misrepresentation of climate benefit arise with this submission and we rely on the assessment made by Prof Stephen Thomas - attached, and also given the delay the pursuit of this plant occassions to a speedier transition to renewables. We hold this is a transboundary impact assessment which is not assessed.

We wish to adopt in full the submission made by:

- The Environmental Pillar and the Environmental Law Officer of the IEN
- Nuclear Free Local Authorities in respect of Sizewell C and as submitted in the above, and separately.
- The concerns and all submissions made in respect of the inadequacy of the Environmental Statement and the inadequacy of the transboundary screening
- The submission of the Austrian Authorities to the project

We call on Irish Local Authorities to :

in your engagements with the relevant Irish Ministers, and directly with the UK Authorities, to call unequivocally on the UK to conduct:

A full Environmental Impact Assessment in accordance with its obligations under international law and the UNECE Convention on Environmental Impact Assessment in a Transboundary Context, (the Espoo Convention);

A full Environmental Impact Assessment, (EIA) in accordance with the UK's obligations during the transition period prior to Brexit with the EU Directive, 2011/92/EU as amended by 2014/52/EU, known generally as the Environmental Impact Assessment Directive, and in such circumstances where the Secretary of State conducts this post Brexit – under UK regulations which reflect the concerns raised here.

ease acknowledge receipt of this submission

Byrne, Chair ACG and in a personal capacity

3

Sean Mortalo

From:	Sean Morris <sean.morris@manchester.gov.uk>
Sent:	27 October 2020 18:01
To:	Fingal Development Plan
Cc:	Cllr David Healy (con)
Subject:	Response to the Sizewell Transboundary Response from our Chair, Fingal Councillor David Healy
Attachments:	NFLA Fingal Sizewell transboundary response.docx

Dear Fingal Planning Authority

I attach a NFLA response to the Sizewell Transboundary consultation. As our Co Chair is Fingal County Councillor David Healy we are sending it in to you as the local planning authority we can engage with.

Yours sincerely,

Sean Morris
Principal Policy Officer / UK & Ireland NFLA & Mayors for Peace Chapter Secretary

City Policy, Level 3
Town Hall Extension
Library Walk, Manchester
M60 3NY
[redacted]
Email: sean.morris4@manchester.gov.uk
Website: https: //www.nuclearpolicy.info and http://www.mayorsforpeace.org

NFLA All Ireland Sustainable Energy Forum
Councils working for a Zero Carbon Future

NFLA All Ireland Forum Secretariat
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O'Hagan House,
Monaghan Row,
Newry, BT35 8DJ
Forum Co-Chair: Councillor David Healy
Secretary: Sean Morris
[redacted]
Email: sean.morris4@manchester.gov.uk
Website: http://www.nuclearpolicy.info

Senior Executive Officer, Planning and Strategic Infrastructure, Department, Fingal County Council, County Hall, Main Street, Swords, Co. Dublin, K67 X8Y2

Emailed to: Fingal.DevelopmentPlan@fingal.ie

27th October 2020

NFLA Fingal Members Submission - "Transboundary environmental public consultation – Sizewell C Nuclear Power Station"

Dear Fingal County Council Planning Authority,

I attach below a formal response to the Sizewell C transboundary consultation on behalf of our Co-Chair, Fingal County Councillor David Healy, on behalf of the Nuclear Free Local Authorities (NFLA) All Ireland Sustainable Energy Forum.

For your information, this Forum is part of the UK & Ireland NFLA - a local authority group which is made up of Councils from across the Republic of Ireland, Northern Ireland, Scotland, England and Wales. Its Steering Committee and Secretariat are based in Manchester, and the All Ireland Forum is based in Newry. NFLA raises legitimate concerns and issues over all aspects of nuclear policy and energy policy in order to assist local government in meeting its commitment to sustainable development, energy policy development, environmental protection and public safety.

NFLA provides this response on behalf of Cllr Healy as a Fingal councillor and Co-Chair of our Forum to ensure our views can go into the consultation.

1. Specific Irish concerns on the proposed Sizewell development

The NFLA All Ireland Sustainable Energy Forum want to make Councils aware of the various practical considerations that come out of the UK Government's transboundary consultation on Sizewell C. NFLA thanks Attracta Ui Bhroin, Environmental Law Officer of the Irish Environmental Network for her helpful comments on this model response.

Ireland naturally respects the UK has the right to pursue its own energy mix, but Irish citizens and some public representatives are also conscious of the UK's legal obligations to consult on the transboundary impacts of the project and indeed its future operation and decommissioning.

In this regard it is of serious concern that there has been such a limited and inadequate consideration by the UK of the potential for transboundary impacts on Ireland. The overall messaging from the UK has been there is a very low likelihood of potential for transboundary impacts, and this was expressed clearly in the letter of 8th July 2020 from the UK Planning Inspectorate (PINS) to DHPLG and in the published transboundary screenings undertaken on behalf of the UK Secretary of State. This has been without clearly establishing how unacceptably narrow its consideration has been of the risks on us here in Ireland, and in particular the failure by the UK to adequately or at all, consider airborne transport of radiation from the UK to Ireland. These matters are set out in more detail below with reference to the application documentation.

The failure to consider potential airborne passage of radioactive fallout impacting Ireland is entirely unacceptable in both the Sizewell application documents, and in the screening of them on behalf of the Secretary of State. Radioactive fallout from Chernobyl impacted Ireland, and Chernobyl is of course much further east than Sizewell is from Ireland. It is worth remembering in the aftermath of Chernobyl in 1986, almost 10,000 upland sheep farms in Wales, Cumbria, Scotland and Northern Ireland had restrictions put on animal movement given the effects the effects of airborne radiation. The curbs, which were put in place on food safety grounds, meant that sheep had to be tested for radiation if taken to market. The last remaining post-Chernobyl restrictions on sheep movements were only lifted in 2012, some 26 years later. The consideration of potential greater levels of radiation which might result from Sizewell are also of concern as is highlighted elsewhere in this submission, and indeed the very significant impacts arising for Ireland in the event of a nuclear incident – even where no radioactive contamination impacts Ireland – and in the event it does.

It is regrettable that this message of 'no significant impacts' has been allowed to dominate the limited discourse there has been around this consultation in Ireland and to disperse any concerted focus on it here. The messaging from the UK authorities has been unchallenged or unqualified by the Irish authorities in publicising the consultation with the Irish public in both the newspaper notice advertising the consultation and in the text of the Department of Housing, Local Government and Heritage webpage for the consultation.

However by stark comparison the text of the Irish EPA in its screening assessment is buried in the Department's website, compounding the concerns over its handling of successive consultations in recent years on such matters. The EPA's screening assessment has the following contrary conclusion to that of the UK authorities – which highlights that risks, albeit unlikely, cannot be discounted:
"Therefore, while there is no measurable radiological impact expected from the expected routine environmental releases from Sizewell C, given the potential transboundary effects in Ireland of a severe (albeit unlikely) nuclear accident at the Sizewell C site it is recommended that Ireland register as an interested party in the in the examination process".

Furthermore, although it is doing little to engage or alert people to the consultation, the fact the consultation has been extended to all Irish Local Authorities also confirms that the Irish Government cannot exclude such effects. Because when considering its obligations under the Planning and Development Act, and associated regulations, the Irish Government felt obliged to extend the consultation to all Irish Local Authorities and the public in these counties on the basis it could not exclude those counties being effected by Sizewell C.

While it is welcome that the EPA and Irish Authorities have not discounted the risk – the potential for the risk to arise is arguably under-stated, and is certainly inadequately assessed for 6 main reasons:

a) Duration:

Firstly, while the EPA at least addresses the risk of airborne transport of radiation, it was also arguably very optimistic in its report back in 2013 (see sections 5 and 7 below) in what it considered as the most severe scenario in its impact assessment. This was in respect how long the release of radiation would last for before containment is achieved. In short, as is set out further below with references to analysis by the late nuclear engineering consultant John Large – the EPA's worst case scenario and the duration of radioactive release falls far short of what is a credible worst case scenario set out by this independent nuclear expert.

In its more recent screening the EPA does not shy away from the chilling and openly acknowledged conservative assessment by the ESRI of the effect on our economy (noted in section 8 of this response), but the EPA still fails to consider our ability to sustain the necessary extent of sheltering needed to avoid impacts in the context of the potential duration of impacts.

As will be seen later below, when considering the Sizewell application document – the UK authorities do not even include any view on durations when considering a severe accident scenario. Instead, the application merely relies on UK nuclear regulation to discount the need for consideration and the ability to manage the risk down to an acceptable level of remote probability, in as much as such management is deemed to be reasonably practicable – all encompassed by the acronym "TifALARP".

b) Brexit impacts and the UK's withdrawal from Euratom

It is also notable and very disappointing then that, in relying on its previous report from 2013 in assessing the risk as being "unlikely", the EPA clearly has not considered the wider implications for risk consequent on Brexit. Further risk to Ireland has arisen since the UK referendum in 2016 nearly some 3 years after the report was done. Brexit means the UK's departure not just from the EU environmental acquis, and independent oversight by the EU Commission and the EU Court of Justice in the conduct of environmental assessment, but it also departs from Euratom, the treaty for the community of nuclear states.

In departing from Euratom, the UK leaves the independent oversight of its nuclear operations, including inspection of nuclear facilities, oversight of the separation of military and civilian nuclear inventories and over of movements of nuclear inventories including in and out of the UK, bearing in mind those movements may arise as close at 12 miles off our shores, the limit of our territorial waters.

As a result of Brexit, the Euratom regime is to be replaced by the UK's Office of Nuclear Regulation. The funding for this function and the level of independence it can exercise on this matters and the adequacy of the new regime solution specified are not adequately considered.

The further pressures and risks which may arise consequent on the impact to the UK economy in the context of both Brexit are addressed elsewhere in this submission where the experience of the issues which arose previously at times of difficulty in the running of the UK's nuclear plants and Sellafield in particular.

c) Covid-19 pandemic and risks consequent on the economic situation

The further consequential risks which arise consequent on the impact to the UK economy because of the Covid-19 pandemic are also not reflected in the EPA's assessment and determination of likelihood. They are however also considered further in this submission, and most particularly in the context of the economics and practicalities for the running and maintenance of nuclear operations, and the issues which have arisen previously in the running of UK nuclear facilities at times of internal difficulties. The recent experience of the choices and approaches made by UK authorities in recent years in the context of Brexit and in the management of the pandemic and associated approach to issues impacting on public health also warrant some serious consideration in the context – given the implications such an approach has for the consideration and management of nuclear risk.

d) Delayed delivery of new plants and consequential pressure to continue existing old nuclear operations to maintain a place for nuclear in the UK's energy mix.

The EPA considers the risk and likelihood of an accident solely in the context of risks from the new plant. The EPA fails to consider the consequential risks arising from the new build programme in its assessment of nuclear impacts arising from the pressure to keep old plants running until the new builds are on stream. This creates an associated, albeit indirect risk from the new build given the increased risk potentially arising from the old plants running past their sell-by date so to speak.

The development of the UK's new nuclear build programme for these new generation nuclear power plants are all running significantly over schedule. The continued expectation that the UK will be develop new nuclear power solutions means it is staying vested in a significant nuclear element to meeting its energy needs. This is instead of bringing in alternative renewable energy sources and transitioning away from nuclear. This in turn means that pressure continues to maintain the nuclear component of its energy supply, and existing plants are being forced to run past their original period of operation, and indeed in circumstances where previous safety standards are now being revised in order to allow them continue their operations, as has been seen most recently in the context of Hunterston B in Scotland. Thus, associated with the new build there is the associated risk which arises from the associated consequential pressure to keep the old plants running to keep the nuclear slot in the UK's energy supply mix open.

e) Radioactive waste disposal risks

There has also been a complete failure in respect of the assessment of risk associated with the disposal of the nuclear waste arising. This must be a concern given the UK has not completely excluded consideration of Northern Ireland as a site for the geological disposal of waste, and indeed precipitated a consultation to assess the receptiveness of communities to such proposals. Though it should be noted that almost every Northern Irish Council passed a resolution opposing the hosting of such a facility. It has additionally not ruled out such sites being partially under the Irish Sea. Indeed the only Council that has so far expressed an interest in hosting such a repository, Copeland Borough Council (where Sellafield is situated), has expressly suggested a partial under-sea site may be a possible solution for it. In the context of an as yet undefined and unspecified solution and location for the waste, and the lack of clarity on the technologies for storage and the transport mechanisms to be employed and associated risks – it is not appropriate to discount transboundary risks for Ireland, where such solutions may arise on this island or in the seas surrounding us, and/or involve transport close to our shores.

Furthermore, Sizewell C will produce the equivalent of about 80% of the total radioactivity already created in the UK by existing nuclear sites. If all the proposed new nuclear reactors get built this will at least quadruple the amount of radioactive waste the country will have to deal with. (1) After three years of deliberation, the Committee on Radioactive Waste Management (CoRWM) decided that geological disposal is the best available approach for the long-term management of higher level waste, but lots of caveats and important recommendations were ignored by the Government. CoRWM specifically said it did not want its recommendations seized upon as providing a green light to build new nuclear reactors which raise different political and ethical issues when compared with wastes which already exist. In other words it might be morally defensible to look for the 'least-worst option' to bury dangerous waste already created, but we really shouldn't be creating any more. NFLA remain concerned about the real technical and scientific issues around 'deep geological disposal' for existing waste, but the potential levels of highly radioactive new build waste add a greater level of concern that alone should see a new nuclear programme halted.

f) Flood Risk

The implications of climate change and sea level risk are regrettably becoming even clearer. In 2012 'The Guardian' reported on an unpublished UK Government report assessing flood risk at the sites of the new nuclear programme builds. Sizewell C does not perform well.
It was assessed as a "high" flood risk in 2010, and is high in 2020s, 2050s and 2080s. (2)

There is in summary no place for complacency by Irish Local Authorities in turning to examine the potential risks to their counties, and to this state and its citizens. Further consideration is given the adequacy of the assessment on the potential scale of impacts elsewhere in this submission, given the potential significance of the radioactive fallout which could result in the event of a severe accident.

Vigilance must be exercised when calling for a full environmental impact assessment to be conducted under both:

i) The UNECE Convention on Environmental Impact Assessment in a transboundary Context, "the Espoo Convention" and also
ii) Under whatever UK regulations implement the EU Environmental Impact Assessment Directive or which apply post Brexit to replace them

Matters are clearly complicated by the fact the UK is departing the EU Environmental acquis, and the extent to which the EIA for Sizewell will fall to be fully assessed under regulations reflecting the EU EIA Directive. International law obligations should continue to apply but clearly even that has become a controversial matter in recent months. However under the

Espoo Convention – the UK's position on Sizewell has complicated matters further. The UK has a position that no likely effects arise and it has merely notified Ireland and other countries as a courtesy. Therefore it does not automatically fall that a consultation and a full EIA assessment under the Espoo Convention will happen. It is thus essential that Ireland and all Local Authorities must be vigilant in an unequivocal position that:

a) Effects on Ireland cannot be ruled out
b) A full Impact Assessment needs to be conducted, including under the Espoo Convention.

Local Authorities are urged to make this clear to both the Irish and the UK Authorities.

2. Airborne transport of radioactive fallout in the event of a severe accident at Sizewell

As indicated above, it is clear from a close scrutiny not just of the summary screening assessments pointed to in the letter from the UK authorities, but in particular of a review of the underlying materials – that the UK's assessment of transboundary risk fails to fully consider airborne transport of radiation in the event of a severe nuclear incident. It also includes significant reliance on UK regulation to avoid accidents, and to argue for a very low probability.

The first screening conducted by the UK Planning Inspectorate (3) on behalf of the UK Secretary of State in October 2019 indicates as follows:
"Radiological exposure - The Scoping Report acknowledges the potential for exposure to radiation from discharges of aerial and liquid radioactive emissions and direct radiation from radioactive sources."

6.19.26 The following documents will also be used to inform the assessment: • project risk registers; • Outline Construction Environmental Management Plan (OCEMP); • Flood Risk Assessments; • Euratom Treaty Article 37 submission; • Cabinet Office National Risk Register of Civil Emergencies; and • European Commission's Major Accident Reporting System (eMARS) (Ref 6.77).

The scoping document relied on the Euratom report and assessment process to consider this, but it does not appear to have been done.

The second screening assessment done refers to Chapter 27 of the application documents. In respect of receptors – which are effectively pathways to transmit radioactive effects chapter 27 says the following in respect of major accidents and hazards, (MA&D): (emphasis added):

"27.3.10 Each identified MA&D hazard and threat has been assigned an individual study area taking consideration of hazard or threat source, any identified impact pathways, potential receptors, and the reasonably foreseeable worst-case environmental consequence, if the event occurred. The study area for the identification of potential receptors differs depending on the specific hazard or threat and is determined on the basis of a worst-case impact area of a similar incident that has previously occurred, if information on this is available, or on the basis of professional judgement, if not available. The study areas are identified within the Environmental Risk Record included as Appendix 27A of this volume and range from the area within the site boundary to the catchment area modelled for flood risk (as set out in the relevant Flood Risk Assessments, Doc Ref. 5.2-5.9)."

From this it is clear that the study areas do not include consideration for airborne transport to Ireland.

Turning to the referred to appendix 27A to examine the receptors considered even in the context of a major nuclear incident at Sizewell C – it is notable that for MA&D Id O14 – described as: "Civil nuclear incident or major accident at Sizewell C" the only receptors considered are:

"On site: Sizewell C workers

Off-site: General public
Agricultural land
Sensitive environmental receptors (ecological, heritage sites, groundwater, surface water, marine receptors)"

Furthermore, the associated columns for this scenario on "Maximum study area", "Worst case severity of Harm", "Duration", "Category of Consequence" are not completed – instead the following incomplete text is inserted:

"Separate regulatory processes are in place to assess and control the safety of UK EPR reactors for the operation of the Sizewell C nuclear power station, a detailed risk assessment is therefore not presented as part of the EIA. These hazards would be assessed in detail as part of the Nuclear Site Licensing requirements. For example, as part of Nuclear Site Licensing Regime, EDF will need to ensure the safe operation of the Sizewell C Project and protection of the workers, public and environment. This includes providing the Office for Nuclear Regulation with a robust Safety Case demonstrating that all hazards associated with the development or that may impact the development are well understood and adequate arrangements are in place to reduce these risks to an acceptable level. In addition, it requires appropriate emergency plans and arrangements to be established and agreed with the local authority, for the range of accidents and incidents that could occur. These processes will ensure that risks relating to Nuclear Safety are reduced to TifALARP. Furthermore the assessment of risks associated with the use and storage of...."

The remainder of the text is obscured and cannot be read.

There is additionally an over-reliance on the UK's regulatory regime to ensure accidents will not happen. Accidents by their very nature are accidental. Furthermore, there is an over-reliance on what are estimated as very low probabilities for major accidents to dismiss the need for adequate consideration and assessment of impacts and preparedness of other states which might be impacted. No one recollects the probabilities associated with Fukushima Daichi or Chernobyl or Three Mile Island – all most remember about them is that they happened.

In the application documents, document ref 6.11: Volume 10 Project-wide, Cumulative and Transboundary Effects, Chapter 5 Transboundary Effects, Appendix 5A: Long Form Transboundary Screening Matrix, (Revision: 1.0 Applicable Regulation: Regulation 5(2) (a) PINS Reference Number: EN010012) the following is stated (4):

"The UK Government believes that new nuclear power stations would pose very small risks to safety, security, health and proliferation (of nuclear materials). Government also believes that the UK has an effective regulatory framework that ensures that these risks are minimised and sensibly managed by industry (Source: White Paper on Nuclear Power, January 2008 (Ref. 1.2)). Nuclear safety is regulated by the Office for Nuclear Regulation (ONR) through a Nuclear Site Licence which places conditions on the Licensee to assure the safety of all aspects of power station construction, operation and decommissioning. This Licence must be in place ahead of construction of safety critical parts of the plant. The risk of accidents and possible radiological impacts on the airspace, land, water and humans in other EU member states is also covered by the Euratom Treaty obligations. The proposed UK EPR design of reactor has been the subject of a regulatory justification process. The Secretary of State (SoS) decided that the generation of electricity using the UK EPR is justified under the Justification of Practices Involving Ionising Radiation Regulations 2004. The SoS considers that the likelihood of an accident or other incident occurring at an UK EPR giving rise to a release of radioactivity is very small. The Major Accidents and Disasters assessment assesses the risk associated with hazards and threat from on-site and offsite sources during the construction and operation of the Sizewell C Project. This assessment provides details of the mitigation measures that are in place to reduce the likelihood of a risk event occurring. Further details of this assessment are provided within Volume 2, Chapter 27 of the ES."

It is entirely unclear whether the Euratom Treaty obligations relied upon in the above, have been discharged. It must also be remembered how inadequate the Euratom Article 37 submissions made by the UK have been in the past and the serious deficiencies there were in considering the impacts on Ireland in the context of Hinkley Point C in the Article 37 submission on that part.

So in summary it is clear even in the context of the most severe accident considered – there has been a complete failure to consider the potential transport to Ireland of airborne radioactive fallout in the key chapter 27 assessments.

4. Sizewell C and severe nuclear accident scenarios

A severe accident scenario, such as the one suggested by the Radiological Protection Institute of Ireland (now part of the Environmental Protection Agency), (5) would involve a loss of coolant combined with a bypass of the containment. In this scenario core damage would be initially delayed by actions of the plant operators, but eventually take place after 12.75 hours. The release of fission products to the environment starts 12.8 hours after reactor shutdown, and lasts for 35.2 hours eventually stopping 48 hour after reactor shutdown.

Nuclear engineer, the late John Large, expanded on this type of scenario pointing out that the fuel core would completely melt after about 16 hours and the corium mass slumps to the bottom of the Reactor Pressure Bessel (RPV), thereafter burning through the RPV steel shell to fall and slump onto the primary containment floor. At this point in time, the hydrogen gas in the RPV circuit is released into the primary containment whereupon it reacts with the air in the containment, deflagrating and exploding with sufficient might to breach the containment surety and, with this, the first phase release of radioactivity to the atmosphere for dispersion and deposition further afield commences. He said this scenario is very similar to the events at Fukushima. (6)

According to EDF Energy's Environmental Statement for Hinkley Point C (Appendix 7E "Assessment of Transboundary impacts"), the likely impacts of an accident do not extend beyond the county of Somerset and the Severn Estuary. In contrast a report for the Austrian Environment Agency says severe accidents at HPC with considerable releases of caesium-137 cannot be ruled out, although their probability may be low. There is no convincing rationale why such accidents should not be addressed in the Environmental Statement (ES) for the proposed Sizewell C reactor; quite to the contrary, it would appear rather evident that they should be included in the assessment since their effects can be widespread and long-lasting. (7)

The EPA / RPII Severe Accident Scenario suggests a radioactive release of I-131 and Cs-137 amounting to 610,000TBq which is quite a bit larger than Fukushima. Cs-137 has a half-life of 30 years, whereas I-131 only has a half- life of 8 days. So Cs-137 is much more important in the longer term. With its longer half-life Cs-137 is around for much longer. Having said that I-131 distribution after an accident is important when looking at the incidence of thyroid cancer. Austria had the second highest average I-131 deposition density, outside Belarus, Ukraine and Russia, after Chernobyl. (As ever, whether there was an increase in thyroid cancer in Austria after Chernobyl is controversial – see TORCH 2016).

Table 1 Comparison of Source Terms for Cs-137

Largest release from HPC suggested in UK Article 37 Submission	0.0447TBq (8)
EIA for the planning Dukovany NPP (Czech Republic)	30TBq (9)
EIA for the planned Hanhikivi NPP (Finland)	100TBq (10)
RPII ST4 severe accident scenario	10,000TBq (11)
Austrian analysis severe accident at Hinkley Point C	53,180TBq (12)
Severe accident in the HPC spent fuel pool	1,780,000TBq (13)
Fukushima disaster, 2011	12,000TBq (14)
Chernobyl disaster, 1986	80 – 85,000TBq (15)

5. Spent Fuel Storage

Unlike spent fuel generated by existing UK nuclear reactors, it is not the intention of future reactor operators to reprocess spent fuel from new nuclear reactors. As a result, spent fuel will almost certainly remain on-site for decades, rather than being transported off-site to Sellafield as it is at the moment at most sites, apart from Sizewell B. Although it is possible that spent fuel might start to be transported off site during the 60 year lifetime of new reactors, prospective operators generally take the view that it is prudent to plan to store all of the lifetime arisings of the planned reactors on-site probably in spent fuel storage ponds. At Hinkley Point C, EDF is planning to be able to extend the life of the storage ponds for up to 100 years after the reactors close. (16)

A recent study in the US detailed how a major fire in a spent fuel pond "could dwarf the horrific consequences of the Fukushima accident." The author Frank von Hippel, a nuclear security expert at Princeton University, who teamed with Princeton's Michael Schoeppner on the modelling exercise said "We're talking about trillion-dollar consequences." (17) This would clearly involve major transboundary radioactive releases much larger than those suggested in the RPII scenario, because the spent fuel store could contain up to 60 years' worth of spent fuel.

According to the Austrian Analysis PSA 2 results (in the Pres-Construction Safety Reports by EDF and Areva) show that a possible severe accident in the spent fuel pool could result in a release of 1,780,000 TBq of Cs-137. (18)

In other words, the greatest risk is one that could remain in place until at least 2130.

6. EPA / RPII Severe Accident Scenario (ST4)

According to the UK Government's Article 37 submission to the European Commission on Hinkley Point C, a severe accident would only release 0.0447TBq of radioactivecaesium-137. Given the proposed Sizewell C reactor would be a carbon copy of the Hinkley Point C reactor, the figure for it will be comparative.

The RPII (now the EPA) looked at the impact of a severe accident at a new nuclear station at Wylfa on Anglesey. This concluded that up to 10,000TBq could be released. The EPA should consider conducting a similar report for Sizewell C.

Doses to adult inhabitants of Dublin:

Total radiation dose to an adult in Dublin from inhalation, cloudshine and groundshine	Amount in sieverts
After the plume passage	18,084 μSv
Cumulative after a week	19,834 μSv
Cumulative after a year	43,794 μSv

Intervention levels have been established for emergencies by the International Atomic Energy Agency. These suggest that sheltering should be recommended if the dose is expected to reach over 10,000 μSv over a two day period.

In the scenario the radiation dose during plume passage is predicted to exceed the intervention level for sheltering, thus people would be advised to remain indoors during the passage of the plume (approximately 24 hours in a particular weather scenario). The intervention levels for iodine prophylaxis (iodine tablets) or evacuation is not exceeded. A radiation dose of just over 9000 μSv (9mSv) from inhalation of iodine-131 was predicted. While this is below the intervention level of 50,000 μSv (50mSv) for administration of iodine tablets (and was based on the assumption that people were outside during the passage of the plume), the RPII notes that staying indoors could reduce this radiation dose significantly. However the 50,000 μSv intervention level is very high. It would certainly be worth taking potassium iodate tablets if a 9,000 μSv was in prospect and these tablets will not do you any harm. (19)

The radiation doses from the table above do not include ingestion doses. The reason given by RPII for this is:
"These radiation doses were treated separately as in an emergency this pathway is extremely amenable to significant reduction. Indeed, the appropriate use of food controls and agricultural measures can substantially reduce the transfer of radioactivity to the food-chain."

If no action is taken the ingestion dose resulting from the accident scenario could be as high as 275,000 μSv, bringing the total dose to almost 320,000 μSv. RPII comments:

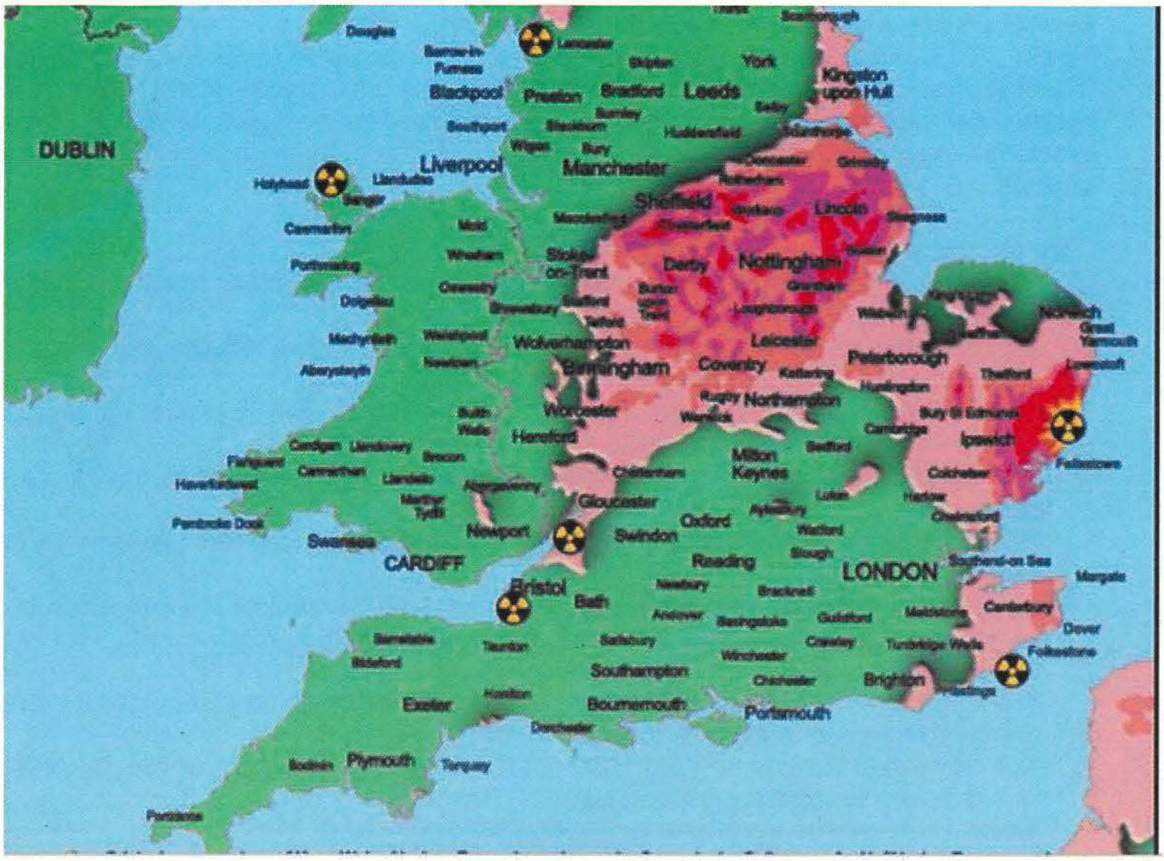
"If no protective actions were taken, a dose of this magnitude might be expected to result in an observable increase in cancers in the decades following the accident. For comparison, the annual average radiation dose from all sources of radiation received by members of the Irish public is estimated to be 3950 μSv."

RPII also notes that:
"In the absence of any protective actions having been taken to reduce or eliminate the contamination of food and animal feed, all of the food types would exceed the Maximum Permitted Levels for a period of at least two months (for meat and root vegetables even after one year, the radioactivity concentrations were predicted to be significantly higher that the permitted levels in the scenario studied)."

RPII notes in passing that while the protective actions could be highly effective in reducing radiation doses, their implementation may not always be straightforward. Obviously the disruption to the Irish agricultural industry could be considerable. In addition, experience of food contamination issues elsewhere suggests that, even in cases where the EU Maximum Permitted Levels are not exceeded, the economic consequences from loss of market due to the 'perception' that food is contaminated can be considerable.

Obviously for the people of central England, an accident at Sizewell C would have a much greater impact in comparison to the impact of an accident at Wylfa on Dublin. With Sizewell we do not have the benefit of 100 kilometres of sea between the accident and the nearest centre of population.

By superimposing the fallout map from Chernobyl onto a map of the area around Sizewell it is possible to get an idea of what the impact a severe accident might look like, depending on the wind direction. The red shading represents the area which would have required compulsory resettlement in Belarus and Russia and the pink are where additionally compulsory resettlement would be compulsory in the Ukraine.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Birmingham
Coventry
Leicester
Peterborough
Northampton
Worcester
Hereford
Milton Keynes
Ipswich
Gloucester
Oxford
Swindon
Newport
CARDIFF
Swansea
Bristol
Bath
Reading
LONDON
Southampton
Bournemouth
Portsmouth
Brighton
Exeter
Plymouth


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Northampton
Worcester
Hereford
Milton Keynes
Norwich
Ipswich
Gloucester
Oxford
Swindon
Newport
CARDIFF
Swansea
Bristol
Bath
Reading
LONDON
Southampton
Bournemouth
Portsmouth
Brighton
Exeter
Plymouth
Original map courtesy of Keep Wales Nuclear Free - dynamic map by CampaigningOnline.com for No2NuclearPower.org.uk

7. **Economic costs of a nuclear accident to Ireland**
Finally, NFLA notes an important report by the Economic and Social Research Institute – 'The Potential Economic Impact of a Nuclear Accident – an Irish cast study'. (20) NFLA had pushed for this report to be developed through its representative to the Environment Protection Agency Radiation Issues Committee, Dr Paul Dorfman from the UCL Energy Institute.

Core headline figures from this study include:

- In the worse-case scenario, a nuclear disaster from a nuclear reactor in northwest Europe could cost Ireland €161 billion.
- Agricultural production would grind to a halt, with the tourism industry and exports also incurring substantial financial damage.
- Even under the most benign scenario considered by ESRI, where no radioactive contamination occurs - total loss is estimated at €4 billion.
- The report analysis may actually underestimate the true extent of its cost to the Irish economy.
- Health risks from high levels of contamination could put a significant strain on the health service.
- Total cost of a low-level contamination scenario, which requires the imposition of food controls to reassure the public, would cause restrictions on food imports from Ireland, would be €18 billion.
- The impact on tourism would also be significant, with long-term reputational damage resulting in an economic cost of as much as €80 billion.
- Not only would exports be decimated but the need to import much of the country's food would lead to far higher domestic costs.
- There could also be significant emigration from the island.

Such costs should be of alarm to all Irish Councils and the Irish Government and needs to be fully taken into account when considering transboundary impacts to Ireland in the event of a nuclear accident from any UK or French nuclear reactor.

8. **Conclusion**
This response outlines some of the core concerns of the NFLA All Ireland Sustainable Energy Forum around trans-boundary impacts to Ireland should there be an accident at the Sizewell C, or for that matter any UK new or existing nuclear reactor.

New nuclear reactors, like the one being put forward by EDF Energy for Sizewell C, have many serious local impacts to the population of the south east of England. They also though have alarming impacts in the event of a severe accident taking place. Whilst that may remain a low risk, in the event it happens, there are clear risks and damage to Ireland should a severe accident take place.

Those issues are multi-faceted – environmental, reputational and economic. They are serious enough for Irish respondents to fairly object to the development of the proposed Sizewell C reactor, or any new nuclear reactor developed across the Irish Sea.

If you have any queries with this submission please contact Sean Morris, the NFLA Secretary using the details on the top of this letter.

Yours sincerely,

Councillor David Healy
Co-Chair of the NFLA All Ireland Sustainable Energy Forum and Fingal County Councillor

9. **References**

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Re: Transboundary environmental public consultation – Sizewell C Nuclear Power Station

To Whom it May Concern,

Please find attached the submission from Councillor Martina O'Connor and Councillor Niall Murphy, of Green Party, Ireland, to the proposal for the Sizewell C Nuclear Reactor proposed in Sufflok, England.

1. Resolution passed by Irish Regional Assemblies in reference to the transboundary consultation on Sizewell C

As part of encouraging Irish Councils to consider developing a local response to this consultation, the NFLA has, on the request of a number of councillors, issued a model resolution to a number of Regional Assemblies. It has now, for example, been passed by the Northern and Western Regional Assembly. The resolution summarises our core concern with the transboundary environmental impacts of the proposed Sizewell C nuclear reactor, which is developed further in the coming sections of this model response. It is the core summary of the concerns Irish Councils should express through the consultation.

The resolution passed by the Regional Assembly is as follows:
"This Assembly calls upon the Government's Minister for Housing, Planning and Local Government and the Minister for Communications, Climate Action and Environment to object in the strongest possible terms to the proposed construction of two EPR-type nuclear reactors at Sizewell in Suffolk in the UK on the grounds that a severe accident, however remote the possibility, could have a devastating impact on the island of Ireland, and such a possibility has not been properly considered.

This Assembly also calls on the Government to seek a full Environmental Impact Assessment (EIA) to be conducted by the UK Government under national regulations informed by EU law. This includes a full invocation of Ireland's call to be fully consulted and for Irish public input to be included in the EIA and Appropriate Assessment. This Assembly calls in addition for an EIA to be undertaken as part of the UNECE Espoo Convention, ensuring that transboundary impacts cannot be excluded.

A severe accident scenario, such as the one suggested by the Radiological Protection Institute of Ireland, (1) would involve a loss of coolant with a release of fission products to the environment. This Assembly notes that impacts from the Chernobyl severe accident impacted on Ireland, and it notes an ESRI report that has indicated that, even in a severe accident scenario of no radioactive fallout hitting Ireland, the discounted economic losses were €4 billion, due to reputational impacts to tourism & agriculture. (2)

Nuclear engineer, the late John Large, expanded on this type of scenario pointing out that the fuel core would completely melt after about 16 hours. This could cause an explosion and a scenario very similar to the events at Fukushima. (3) Although EDF Energy´s Environmental Statement for a similar plant to Sizewell C being built at Hinkley Point C (HPC) says the likely impacts of an accident do not extend beyond the county of Somerset and the Severn Estuary, a report for the Austrian Environment Agency says severe accidents at HPC with considerable releases of radioactive caesium-137 cannot be ruled out, although their probability may be low. There is no convincing rationale why such accidents should not be addressed in the Environmental Statement (ES); quite to the contrary, it would appear rather evident that they should be included in the assessment since their effects can be widespread and long-lasting. (4)

This Assembly also calls on cooperation with the All Ireland Nuclear Free Local Authorities (NFLA) Sustainable Energy Forum, potentially in collaboration with the Irish Environment

Network, to developing a detailed report on this matter with facilitation of a local workshop webinar on this matter, should the Assembly wish it."

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2. Specific Irish concerns on the proposed Sizewell development

The NFLA All Ireland Sustainable Energy Forum want to make Councils aware of the various practical considerations that come out of the UK Government's transboundary consultation on Sizewell C. NFLA thanks Attracta Ui Bhroin, Environmental Law Officer of the Irish Environmental Network for her helpful comments on this model response.

Ireland naturally respects the UK has the right to pursue its own energy mix, but Irish citizens and some public representatives are also conscious of the UK's legal obligations to consult on the transboundary impacts of the project and indeed its future operation and decommissioning.

In this regard it is of serious concern that there has been such a limited and inadequate consideration by the UK of the potential for transboundary impacts on Ireland. The overall messaging from the UK has been there is a very low likelihood of potential for transboundary impacts, and this was expressed clearly in the letter of 8th July 2020 from the UK Planning Inspectorate (PINS) to DHPLG and in the published transboundary screenings undertaken on behalf of the UK Secretary of State. This has been without clearly establishing how unacceptably narrow its consideration has been of the risks on us here in Ireland, and in particular the failure by the UK to adequately or at all, consider airborne transport of radiation from the UK to Ireland. These matters are set out in more detail below with reference to the application documentation.

The failure to consider potential airborne passage of radioactive fallout impacting Ireland is entirely unacceptable in both the Sizewell application documents, and in the screening of them on behalf of the Secretary of State. Radioactive fallout from Chernobyl impacted Ireland, and Chernobyl is of course much further east than Sizewell is from Ireland. It is worth remembering in the aftermath of Chernobyl in 1986, almost 10,000 upland sheep farms in Wales, Cumbria, Scotland and Northern Ireland had restrictions put on animal movement given the effects the effects of airborne radiation. The curbs, which were put in place on food safety grounds, meant that sheep had to be tested for radiation if taken to market. The last remaining post-Chernobyl restrictions on sheep movements were only lifted in 2012, some 26 years later. The consideration of potential greater levels of radiation which might result from Sizewell are also of concern as is highlighted elsewhere in this submission, and indeed the very significant impacts arising for Ireland in the event of a nuclear incident – even where no radioactive contamination impacts Ireland – and in the event it does.

It is regrettable that this message of 'no significant impacts' has been allowed to dominate the limited discourse there has been around this consultation in Ireland and to disperse any concerted focus on it here. The messaging from the UK authorities has been unchallenged or unqualified by the Irish authorities in publicising the consultation with the Irish public in both the newspaper notice advertising the consultation and in the text of the Department of Housing, Local Government and Heritage webpage for the consultation.

However by stark comparison the text of the Irish EPA in its screening assessment is buried in the Department's website, compounding the concerns over its handling of successive consultations in recent years on such matters. The EPA's screening assessment has the following contrary conclusion to that of the UK authorities – which highlights that risks, albeit unlikely, cannot be discounted:

"Therefore, while there is no measurable radiological impact expected from the expected routine environmental releases from Sizewell C, given the potential transboundary effects in Ireland of a severe (albeit unlikely) nuclear accident at the Sizewell C site it is recommended that Ireland register as an interested party in the in the examination process".

Furthermore, although it is doing little to engage or alert people to the consultation, the fact the consultation has been extended to all Irish Local Authorities also confirms that the Irish Government cannot exclude such effects. Because when considering its obligations under the Planning and Development Act, and associated regulations, the Irish Government felt obliged to extend the consultation to all Irish Local Authorities and the public in these counties on the basis it could not exclude those counties being effected by Sizewell C.

While it is welcome that the EPA and Irish Authorities have not discounted the risk – the potential for the risk to arise is arguably under-stated, and is certainly inadequately assessed for 6 main reasons:

a) Duration:

Firstly, while the EPA at least addresses the risk of airborne transport of radiation, it was also arguably very optimistic in its report back in 2013 (see sections 5 and 7 below) in what it considered as the most severe scenario in its impact assessment. This was in respect how long the release of radiation would last for before containment is achieved. In short, as is set out further below with references to analysis by the late nuclear engineering consultant John Large – the EPA's worst case scenario and the duration of radioactive release falls far short of what is a credible worst case scenario set out by this independent nuclear expert.

In its more recent screening the EPA does not shy away from the chilling and openly acknowledged conservative assessment by the ESRI of the effect on our economy (noted in section 8 of this response), but the EPA still fails to consider our ability to sustain the necessary extent of sheltering needed to avoid impacts in the context of the potential duration of impacts.

As will be seen later below, when considering the Sizewell application document – the UK authorities do not even include any view on durations when considering a severe accident scenario. Instead, the application merely relies on UK nuclear regulation to discount the need for consideration and the ability to manage the risk down to an acceptable level of remote probability, in as much as such management is deemed to be reasonably practicable – all encompassed by the acronym "TifALARP".

b) Brexit impacts and the UK's withdrawal from Euratom

It is also notable and very disappointing then that, in relying on its previous report from 2013 in assessing the risk as being "unlikely", the EPA clearly has not considered the wider implications for risk consequent on Brexit. Further risk to Ireland has arisen since the UK referendum in 2016 nearly some 3 years after the report was done. Brexit means the UK's departure not just from the EU environmental acquis, and independent oversight by the EU Commission and the EU Court of Justice in the conduct of environmental assessment, but it also departs from Euratom, the treaty for the community of nuclear states.

In departing from Euratom, the UK leaves the independent oversight of its nuclear operations, including inspection of nuclear facilities, oversight of the separation of military and civilian nuclear inventories and over of movements of nuclear inventories including in and out of the UK, bearing in mind those movements may arise as close at 12 miles off our shores, the limit of our territorial waters.

As a result of Brexit, the Euratom regime is to be replaced by the UK's Office of Nuclear Regulation. The funding for this function and the level of independence it can exercise on this matters and the adequacy of the new regime solution specified are not adequately considered.

The further pressures and risks which may arise consequent on the impact to the UK economy in the context of both Brexit are addressed elsewhere in this submission where the experience of the issues which arose previously at times of difficulty in the running of the UK's nuclear plants and Sellafield in particular.

c) Covid-19 pandemic and risks consequent on the economic situation

The further consequential risks which arise consequent on the impact to the UK economy because of the Covid-19 pandemic are also not reflected in the EPA's assessment and determination of likelihood. They are however also considered further in this submission, and most particularly in the context of the economics and practicalities for the running and maintenance of nuclear operations, and the issues which have arisen previously in the running of UK nuclear facilities at times of internal difficulties. The recent experience of the choices and approaches made by UK authorities in recent years in the context of Brexit and in the management of the pandemic and associated approach to issues impacting on public health also warrant some serious consideration in the context – given the implications such an approach has for the consideration and management of nuclear risk.

d) Delayed delivery of new plants and consequential pressure to continue existing old nuclear operations to maintain a place for nuclear in the UK's energy mix.

The EPA considers the risk and likelihood of an accident solely in the context of risks from the new plant. The EPA fails to consider the consequential risks arising from the new build programme in its assessment of nuclear impacts arising from the pressure to keep old plants running until the new builds are on stream. This creates an associated, albeit indirect risk from the new build given the increased risk potentially arising from the old plants running past their sell-by date so to speak.

The development of the UK's new nuclear build programme for these new generation nuclear power plants are all running significantly over schedule. The continued expectation that the UK will be develop new nuclear power solutions means it is staying vested in a significant nuclear element to meeting its energy needs. This is instead of bringing in alternative renewable energy sources and transitioning away from nuclear. This in turn means that pressure continues to maintain the nuclear component of its energy supply, and existing plants are being forced to run past their original period of operation, and indeed in circumstances where previous safety standards are now being revised in order to allow them continue their operations, as has been seen most recently in the context of Hunterston B in Scotland. Thus, associated with the new build there is the associated risk which arises from the associated consequential pressure to keep the old plants running to keep the nuclear slot in the UK's energy supply mix open.

e) Radioactive waste disposal risks

There has also been a complete failure in respect of the assessment of risk associated with the disposal of the nuclear waste arising. This must be a concern given the UK has not completely excluded consideration of Northern Ireland as a site for the geological disposal of waste, and indeed precipitated a consultation to assess the receptiveness of communities to such proposals. Though it should be noted that almost every Northern Irish Council passed a resolution opposing the hosting of such a facility. It has additionally not ruled out such sites being partially under the Irish Sea. Indeed the only Council that has so far expressed an interest in hosting such a repository, Copeland Borough Council (where Sellafield is situated), has expressly suggested a partial under-sea site may be a possible solution for it. In the context of an as yet undefined and unspecified solution and location for the waste, and the lack of clarity on the technologies for storage and the transport mechanisms to be employed and associated risks – it is not appropriate to discount transboundary risks for Ireland, where such solutions may arise on this island or in the seas surrounding us, and/or involve transport close to our shores.

Furthermore, Sizewell C will produce the equivalent of about 80% of the total radioactivity already created in the UK by existing nuclear sites. If all the proposed new nuclear reactors get built this will at least quadruple the amount of radioactive waste the country will have to deal with. (1) After three years of deliberation, the Committee on Radioactive Waste Management (CoRWM) decided that geological disposal is the best available approach for the long-term management of higher level waste, but lots of caveats and important recommendations were ignored by the Government. CoRWM specifically said it did not want its recommendations seized upon as providing a green light to build new nuclear reactors which raise different political and ethical issues when compared with wastes which already exist. In other words it might be morally defensible to look for the 'least-worst option' to bury dangerous waste already created, but we really shouldn't be creating any more. NFLA remain concerned about the real technical and scientific issues around 'deep geological disposal' for existing waste, but the potential levels of highly radioactive new build waste add a greater level of concern that alone should see a new nuclear programme halted.

f) Flood Risk

The implications of climate change and sea level risk are regrettably becoming even clearer. In 2012 'The Guardian' reported on an unpublished UK Government report assessing flood risk at the sites of the new nuclear programme builds. Sizewell C does not perform well.
It was assessed as a "high" flood risk in 2010, and is high in 2020s, 2050s and 2080s. (2)

There is in summary no place for complacency by Irish Local Authorities in turning to examine the potential risks to their counties, and to this state and its citizens. Further consideration is given the adequacy of the assessment on the potential scale of impacts elsewhere in this submission, given the potential significance of the radioactive fallout which could result in the event of a severe accident.

Vigilance must be exercised when calling for a full environmental impact assessment to be conducted under both:

i) The UNECE Convention on Environmental Impact Assessment in a transboundary Context, "the Espoo Convention" and also
ii) Under whatever UK regulations implement the EU Environmental Impact Assessment Directive or which apply post Brexit to replace them

Matters are clearly complicated by the fact the UK is departing the EU Environmental acquis, and the extent to which the EIA for Sizewell will fall to be fully assessed under regulations reflecting the EU EIA Directive. International law obligations should continue to apply but clearly even that has become a controversial matter in recent months. However under the Espoo Convention – the UK's position on Sizewell has complicated matters further. The UK has a position that no likely effects arise and it has merely notified Ireland and other countries as a courtesy. Therefore it does not automatically fall that a consultation and a full EIA assessment under the Espoo Convention will happen. It is thus essential that Ireland and all Local Authorities must be vigilant in an unequivocal position that:

a) Effects on Ireland cannot be ruled out
b) A full Impact Assessment needs to be conducted, including under the Espoo Convention.

Local Authorities are urged to make this clear to both the Irish and the UK Authorities.

3. Airborne transport of radioactive fallout in the event of a severe accident at Sizewell

As indicated above, it is clear from a close scrutiny not just of the summary screening assessments pointed to in the letter from the UK authorities, but in particular of a review of the underlying materials – that the UK's assessment of transboundary risk fails to fully consider airborne transport of radiation in the event of a severe nuclear incident. It also includes significant reliance on UK regulation to avoid accidents, and to argue for a very low probability.

The first screening conducted by the UK Planning Inspectorate (3) on behalf of the UK Secretary of State in October 2019 indicates as follows:
"Radiological exposure - The Scoping Report acknowledges the potential for exposure to radiation from discharges of aerial and liquid radioactive emissions and direct radiation from radioactive sources."

6.19.26 The following documents will also be used to inform the assessment: • project risk registers; • Outline Construction Environmental Management Plan (OCEMP); • Flood Risk Assessments; • Euratom Treaty Article 37 submission; • Cabinet Office National Risk Register of Civil Emergencies; and • European Commission's Major Accident Reporting System (eMARS) (Ref 6.77).

The scoping document relied on the Euratom report and assessment process to consider this, but it does not appear to have been done.

The second screening assessment done refers to Chapter 27 of the application documents. In respect of receptors – which are effectively pathways to transmit radioactive effects chapter 27 says the following in respect of major accidents and hazards, (MA&D): (emphasis added):

"27.3.10 Each identified MA&D hazard and threat has been assigned an individual study area taking consideration of hazard or threat source, any identified impact pathways, potential receptors, and the reasonably foreseeable worst-case environmental consequence, if the event occurred. The study area for the identification of potential receptors differs depending on the specific hazard or threat and is determined on the basis of a worst-case impact area of a similar incident that has previously occurred, if information on this is available, or on the basis of professional judgement, if not available. The study areas are identified within the Environmental Risk Record included as Appendix 27A of this volume and range from the area within the site boundary to the catchment area modelled for flood risk (as set out in the relevant Flood Risk Assessments, Doc Ref. 5.2-5.9)."

From this it is clear that the study areas do not include consideration for airborne transport to Ireland.

Turning to the referred to appendix 27A to examine the receptors considered even in the context of a major nuclear incident at Sizewell C – it is notable that for MA&D Id O14 – described as: "Civil nuclear incident or major accident at Sizewell C" the only receptors considered are:

"On site: Sizewell C workers
Off-site: General public
Agricultural land
Sensitive environmental receptors (ecological, heritage sites, groundwater, surface water, marine receptors)"

Furthermore, the associated columns for this scenario on "Maximum study area", "Worst case severity of Harm", "Duration", "Category of Consequence" are not completed – instead the following incomplete text is inserted:

"Separate regulatory processes are in place to assess and control the safety of UK EPR reactors for the operation of the Sizewell C nuclear power station, a detailed risk assessment is therefore not presented as part of the EIA. These hazards would be assessed in detail as part of the Nuclear Site Licensing requirements. For example, as part of Nuclear Site Licensing Regime, EDF will need to ensure the safe operation of the Sizewell C Project and protection of the workers, public and environment. This includes providing the Office for Nuclear Regulation with a robust Safety Case demonstrating that all hazards associated with the development or that may impact the development are well understood and adequate arrangements are in place to reduce these risks to an acceptable level. In addition, it requires appropriate emergency plans and arrangements to be established and agreed with the local authority, for the range of accidents and incidents that could occur. These processes will ensure that risks relating to Nuclear Safety are reduced to TifALARP. Furthermore the assessment of risks associated with the use and storage of…."

The remainder of the text is obscured and cannot be read.

There is additionally an over-reliance on the UK's regulatory regime to ensure accidents will not happen. Accidents by their very nature are accidental. Furthermore, there is an over-reliance on what are estimated as very low probabilities for major accidents to dismiss the need for adequate consideration and assessment of impacts and preparedness of other states which might be impacted. No one recollects the probabilities associated with Fukushima Daichi or Chernobyl or Three Mile Island – all most remember about them is that they happened.

In the application documents, document ref 6.11: Volume 10 Project-wide, Cumulative and Transboundary Effects, Chapter 5 Transboundary Effects, Appendix 5A: Long Form Transboundary Screening Matrix, (Revision: 1.0 Applicable Regulation: Regulation 5(2) (a) PINS Reference Number: EN010012) the following is stated (4):

"The UK Government believes that new nuclear power stations would pose very small risks to safety, security, health and proliferation (of nuclear materials). Government also believes that the UK has an effective regulatory framework that ensures that these risks are minimised and sensibly managed by industry (Source: White Paper on Nuclear Power, January 2008 (Ref. 1.2)). Nuclear safety is regulated by the Office for Nuclear Regulation (ONR) through a Nuclear Site Licence which places conditions on the Licensee to assure the safety of all aspects of power station construction, operation and decommissioning. This Licence must be in place ahead of construction of safety critical parts of the plant. The risk of accidents and possible radiological impacts on the airspace, land, water and humans in other EU member states is also covered by the Euratom Treaty obligations. The proposed UK EPR design of reactor has been the subject of a regulatory justification process. The Secretary of State (SoS) decided that the generation of electricity using the UK EPR is justified under the Justification of Practices Involving Ionising Radiation Regulations 2004. The SoS considers that the likelihood of an accident or other incident occurring at an UK EPR giving rise to a release of radioactivity is very small. The Major Accidents and Disasters assessment assesses the risk associated with hazards and threat from on-site and offsite sources during the construction and operation of the Sizewell C Project. This assessment provides details of the mitigation measures that are in place to reduce the likelihood of a risk event occurring. Further details of this assessment are provided within Volume 2, Chapter 27 of the ES."

It is entirely unclear whether the Euratom Treaty obligations relied upon in the above, have been discharged. It must also be remembered how inadequate the Euratom Article 37 submissions made by the UK have been in the past and the serious deficiencies there were in considering the impacts on Ireland in the context of Hinkley Point C in the Article 37 submission on that part.

So in summary it is clear even in the context of the most severe accident considered – there has been a complete failure to consider the potential transport to Ireland of airborne radioactive fallout in the key chapter 27 assessments.

5. Sizewell C and severe nuclear accident scenarios

A severe accident scenario, such as the one suggested by the Radiological Protection Institute of Ireland (now part of the Environmental Protection Agency), (5) would involve a loss of coolant combined with a bypass of the containment. In this scenario core damage would be initially delayed by actions of the plant operators, but eventually take place after 12.75 hours. The release of fission products to the environment starts 12.8 hours after reactor shutdown, and lasts for 35.2 hours eventually stopping 48 hour after reactor shutdown.

Nuclear engineer, the late John Large, expanded on this type of scenario pointing out that the fuel core would completely melt after about 16 hours and the corium mass slumps to the bottom of the Reactor Pressure Bessel (RPV), thereafter burning through the RPV steel shell to fall and slump onto the primary containment floor. At this point in time, the hydrogen gas in the RPV circuit is released into the primary containment whereupon it reacts with the air in the containment, deflagrating and exploding with sufficient might to breach the containment surety and, with this, the first phase release of radioactivity to the atmosphere for dispersion and deposition further afield commences. He said this scenario is very similar to the events at Fukushima. (6)

According to EDF Energy´s Environmental Statement for Hinkley Point C (Appendix 7E "Assessment of Transboundary impacts"), the likely impacts of an accident do not extend beyond the county of Somerset and the Severn Estuary. In contrast a report for the Austrian Environment Agency says severe accidents at HPC with considerable releases of caesium-137 cannot be ruled out, although their probability may be low. There is no convincing rationale why such accidents should not be addressed in the Environmental Statement (ES) for the proposed Sizewell C reactor; quite to the contrary, it would appear rather evident that they should be included in the assessment since their effects can be widespread and long-lasting. (7)

The EPA / RPII Severe Accident Scenario suggests a radioactive release of I-131 and Cs-137 amounting to 610,000TBq which is quite a bit larger than Fukushima. Cs-137 has a half-life of 30 years, whereas I-131 only has a half- life of 8 days. So Cs-137 is much more important in the longer term. With its longer half-life Cs-137 is around for much longer. Having said that I-131 distribution after an accident is important when looking at the incidence of thyroid cancer. Austria had the second highest average I-131 deposition density, outside Belarus, Ukraine and Russia, after Chernobyl. (As ever, whether there was an increase in thyroid cancer in Austria after Chernobyl is controversial – see TORCH 2016).

Table 1 Comparison of Source Terms for Cs-137

Largest release from HPC suggested in UK Article 37 Submission	0.0447TBq (8)
EIA for the planning Dukovany NPP (Czech Republic)	30TBq (9)
EIA for the planned Hanhikivi NPP (Finland)	100TBq (10)
RPII ST4 severe accident scenario	10,000TBq (11)
Austrian analysis severe accident at Hinkley Point C	53,180TBq (12)
Severe accident in the HPC spent fuel pool	1,780,000TBq (13)
Fukushima disaster, 2011	12,000TBq (14)
Chernobyl disaster, 1986	80 – 85,000TBq (15)

6. Spent Fuel Storage

Unlike spent fuel generated by existing UK nuclear reactors, it is not the intention of future reactor operators to reprocess spent fuel from new nuclear reactors. As a result, spent fuel will almost certainly remain on-site for decades, rather than being transported off-site to Sellafield as it is at the moment at most sites, apart from Sizewell B. Although it is possible that spent fuel might start to be transported off site during the 60 year lifetime of new reactors, prospective operators generally take the view that it is prudent to plan to store all of the lifetime arisings of the planned reactors on-site probably in spent fuel storage ponds. At Hinkley Point C, EDF is planning to be able to extend the life of the storage ponds for up to 100 years after the reactors close. (16)

A recent study in the US detailed how a major fire in a spent fuel pond "could dwarf the horrific consequences of the Fukushima accident." The author Frank von Hippel, a nuclear security expert at Princeton University, who teamed with Princeton's Michael Schoeppner on the modelling exercise said "We're talking about trillion-dollar consequences." (17) This would clearly involve major transboundary radioactive releases much larger than those suggested in the RPII scenario, because the spent fuel store could contain up to 60 years' worth of spent fuel.

According to the Austrian Analysis PSA 2 results (in the Pres-Construction Safety Reports by EDF and Areva) show that a possible severe accident in the spent fuel pool could result in a release of 1,780,000 TBq of Cs-137. (18)

In other words, the greatest risk is one that could remain in place until at least 2130.

7. EPA / RPII Severe Accident Scenario (ST4)

According to the UK Government's Article 37 submission to the European Commission on Hinkley Point C, a severe accident would only release 0.0447TBq of radioactivecaesium-137. Given the proposed Sizewell C reactor would be a carbon copy of the Hinkley Point C reactor, the figure for it will be comparative.

The RPII (now the EPA) looked at the impact of a severe accident at a new nuclear station at Wylfa on Anglesey. This concluded that up to 10,000TBq could be released. The EPA should consider conducting a similar report for Sizewell C.

Doses to adult inhabitants of Dublin:

Total radiation dose to an adult in Dublin from inhalation, cloudshine and groundshine	Amount in sieverts
After the plume passage	18,084 μSv
Cumulative after a week	19,834 μSv
Cumulative after a year	43,794 μSv

Intervention levels have been established for emergencies by the International Atomic Energy Agency. These suggest that sheltering should be recommended if the dose is expected to reach over 10,000 μSv over a two day period.

In the scenario the radiation dose during plume passage is predicted to exceed the intervention level for sheltering, thus people would be advised to remain indoors during the passage of the plume (approximately 24 hours in a particular weather scenario). The intervention levels for iodine prophylaxis (iodine tablets) or evacuation is not exceeded. A radiation dose of just over 9000 μSv (9mSv) from inhalation of iodine-131 was predicted. While this is below the intervention level of 50,000 μSv (50mSv) for administration of iodine tablets (and was based on the assumption that people were outside during the passage of the plume), the RPII notes that staying indoors could reduce this radiation dose significantly. However the 50,000 μSv intervention level is very high. It would certainly be worth taking potassium iodate tablets if a 9,000 μSv was in prospect and these tablets will not do you any harm. (19)

The radiation doses from the table above do not include ingestion doses. The reason given by RPII for this is:
"These radiation doses were treated separately as in an emergency this pathway is extremely amenable to significant reduction. Indeed, the appropriate use of food controls and agricultural measures can substantially reduce the transfer of radioactivity to the food-chain."

If no action is taken the ingestion dose resulting from the accident scenario could be as high as 275,000 μSv, bringing the total dose to almost 320,000 μSv. RPII comments:

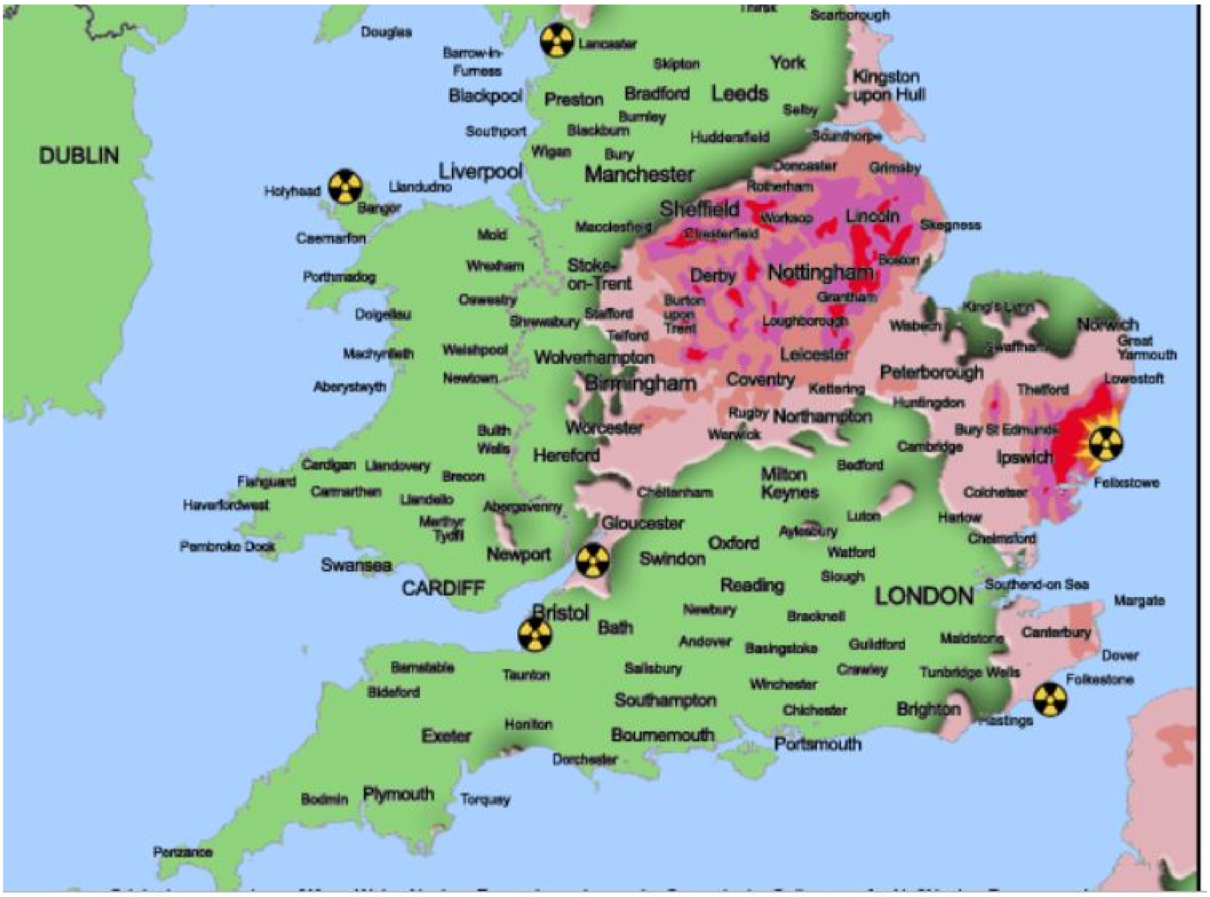
"If no protective actions were taken, a dose of this magnitude might be expected to result in an observable increase in cancers in the decades following the accident. For comparison, the annual average radiation dose from all sources of radiation received by members of the Irish public is estimated to be 3950 μSv."

RPII also notes that:
"In the absence of any protective actions having been taken to reduce or eliminate the contamination of food and animal feed, all of the food types would exceed the Maximum Permitted Levels for a period of at least two months (for meat and root vegetables even after one year, the radioactivity concentrations were predicted to be significantly higher that the permitted levels in the scenario studied)."

RPII notes in passing that while the protective actions could be highly effective in reducing radiation doses, their implementation may not always be straightforward. Obviously the disruption to the Irish agricultural industry could be considerable. In addition, experience of food contamination issues elsewhere suggests that, even in cases where the EU Maximum Permitted Levels are not exceeded, the economic consequences from loss of market due to the ‘perception’ that food is contaminated can be considerable.

Obviously for the people of central England, an accident at Sizewell C would have a much greater impact in comparison to the impact of an accident at Wylfa on Dublin. With Sizewell we do not have the benefit of 100 kilometres of sea between the accident and the nearest centre of population.

By superimposing the fallout map from Chernobyl onto a map of the area around Sizewell it is possible to get an idea of what the impact a severe accident might look like, depending on the wind direction. The red shading represents the area which would have required compulsory resettlement in Belarus and Russia and the pink are where additionally compulsory resettlement would be compulsory in the Ukraine.



8. Economic costs of a nuclear accident to Ireland

Finally, NFLA notes an important report by the Economic and Social Research Institute – 'The Potential Economic Impact of a Nuclear Accident – an Irish cast study'. (20) NFLA had pushed for this report to be developed through its representative to the Environment Protection Agency Radiation Issues Committee, Dr Paul Dorfman from the UCL Energy Institute.

Core headline figures from this study include:

- In the worse-case scenario, a nuclear disaster from a nuclear reactor in northwest Europe could cost Ireland **€161 billion**.
- Agricultural production would grind to a halt, with the tourism industry and exports also incurring substantial financial damage.
- Even under the most benign scenario considered by ESRI, where no radioactive contamination occurs - total loss is estimated at **€4 billion**.
- The report analysis may actually underestimate the true extent of its cost to the Irish economy.
- Health risks from high levels of contamination could put a significant strain on the health service.
- Total cost of a low-level contamination scenario, which requires the imposition of food controls to reassure the public, would cause restrictions on food imports from Ireland, would be €18 billion.
- The impact on tourism would also be significant, with long-term reputational damage resulting in an economic cost of as much as €80 billion.
- Not only would exports be decimated but the need to import much of the country's food would lead to far higher domestic costs.
- There could also be significant emigration from the island.

Such costs should be of alarm to all Irish Councils and the Irish Government and needs to be fully taken into account when considering transboundary impacts to Ireland in the event of a nuclear accident from any UK or French nuclear reactor.

9. Conclusion

This response outlines some of the core concerns of the NFLA All Ireland Sustainable Energy Forum around trans-boundary impacts to Ireland should there be an accident at the Sizewell C, or for that matter any UK new or existing nuclear reactor.

New nuclear reactors, like the one being put forward by EDF Energy for Sizewell C, have many serious local impacts to the population of the south east of England. They also though have alarming impacts in the event of a severe accident taking place. Whilst that may remain a low risk, in the event it happens, there are clear risks and damage to Ireland should a severe accident take place.

Those issues are multi-faceted – environmental, reputational and economic. They are serious enough for Irish respondents to fairly object to the development of the proposed Sizewell C reactor, or any new nuclear reactor developed across the Irish Sea.

10. References

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(2) The Guardian, 7th March 2012 https://www.theguardian.com/environment/2012/mar/07/uk-nuclear-risk-flooding

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(4) ibid

(5) Proposed nuclear power plants in the UK – potential radiological implications for Ireland, RPII, May 2013 http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

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(7) Becker, O, Hinkley Point C: Expert Statement to the EIA. Austrian Environment Agency, 2013 http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0413.pdf

(8) UK EPR Hinkley Point C Site Submission of General Data as Applicable under Article 37 of the Euratom Treaty, DECC 2011 https://www.whatdotheyknow.com/request/252343/response/623770/attach/4/HPC%20Article%2037%20Submission%20July%202011%20Final%20READ%20ONLY.PDF

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(11) Proposed nuclear power plants in the UK – potential radiological implications for Ireland, RPII, May 2013 http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

(12) Becker, O, Hinkley Point C: Expert Statement to the EIA. Austrian Environment Agency, 2013 http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0413.pdf

(13) ibid

(14) TORCH 2016 The Other Report on Chernobyl: An independent evaluation of the health-related effects of the Chernobyl nuclear disaster, page 12 https://www.ianfairlie.org/wp-content/uploads/2016/03/chernobyl-report-version-1.1.pdf

(15) ibid

(16) Hinkley Point C Development Consent Order Environmental Statement Volume 2. EDF Energy October 2011 para 7.67 https://infrastructure.planninginspectorate.gov.uk/wpcontent/ipc/uploads/projects/EN010001/EN0100

01-005038-4.3%20-%20Volume%202%20-%20Hinkley%20Point%20C%20Development%20Site%201.pdf
See also Chapter 6 Spent Fuel and Radioactive Waste Management Para 6.39.32
https://www.edfenergy.com/sites/default/files/V2%20C06%20Spent%20Fuel%20and%20Radioactive%20Waste%20Management.pdf

(17) Stone, R. Spent Fuel Fire on US Soil could dwarf impact of Fukushima, Science 24th May 2016
http://www.sciencemag.org/news/2016/05/spent-fuel-fire-us-soil-could-dwarf-impact-fukushima

(18) Becker, O, Hinkley Point C: Expert Statement to the EIA. Austrian Environment Agency, 2013
http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0413.pdf

(19) Personal comment Dr Ian Fairlie 12th Feb 2019

(20) Economic Social Research Institute, 'The Potential Economic Impact of a Nuclear Accident - An Irish Case Study', November 2016
http://www.dccae.gov.ie/news-and-media/Lists/Publications%20Documents/The%20potential%20economic%20impact%20of%20a%20nuclear%20accident%20-%20An%20Irish%20Case%20Study%20ESRI.pdf

Re: Transboundary environmental public consultation – Sizewell C Nuclear Power Station

To Whom it May Concern,

Please find attached the submission from Councillor Alastair McKinstry, of Green Party, Ireland, to the proposal for the Sizewell C Nuclear Reactor proposed in Sufflok, England.

1. Resolution passed by Irish Regional Assemblies in reference to the transboundary consultation on Sizewell C

As part of encouraging Irish Councils to consider developing a local response to this consultation, the NFLA has, on the request of a number of councillors, issued a model resolution to a number of Regional Assemblies. It has now, for example, been passed by the Northern and Western Regional Assembly. The resolution summarises our core concern with the transboundary environmental impacts of the proposed Sizewell C nuclear reactor, which is developed further in the coming sections of this model response. It is the core summary of the concerns Irish Councils should express through the consultation.

The resolution passed by the Regional Assembly is as follows:
"This Assembly calls upon the Government's Minister for Housing, Planning and Local Government and the Minister for Communications, Climate Action and Environment to object in the strongest possible terms to the proposed construction of two EPR-type nuclear reactors at Sizewell in Suffolk in the UK on the grounds that a severe accident, however remote the possibility, could have a devastating impact on the island of Ireland, and such a possibility has not been properly considered.

This Assembly also calls on the Government to seek a full Environmental Impact Assessment (EIA) to be conducted by the UK Government under national regulations informed by EU law. This includes a full invocation of Ireland's call to be fully consulted and for Irish public input to be included in the EIA and Appropriate Assessment. This Assembly calls in addition for an EIA to be undertaken as part of the UNECE Espoo Convention, ensuring that transboundary impacts cannot be excluded.

A severe accident scenario, such as the one suggested by the Radiological Protection Institute of Ireland, (1) would involve a loss of coolant with a release of fission products to the environment. This Assembly notes that impacts from the Chernobyl severe accident impacted on Ireland, and it notes an ESRI report that has indicated that, even in a severe accident scenario of no radioactive fallout hitting Ireland, the discounted economic losses were €4 billion, due to reputational impacts to tourism & agriculture. (2)

Nuclear engineer, the late John Large, expanded on this type of scenario pointing out that the fuel core would completely melt after about 16 hours. This could cause an explosion and a scenario very similar to the events at Fukushima. (3) Although EDF Energy´s Environmental Statement for a similar plant to Sizewell C being built at Hinkley Point C (HPC) says the likely impacts of an accident do not extend beyond the county of Somerset and the Severn Estuary, a report for the Austrian Environment Agency says severe accidents at HPC with considerable releases of radioactive caesium-137 cannot be ruled out, although their probability may be low. There is no convincing rationale why such accidents should not be addressed in the Environmental Statement (ES); quite to the contrary, it would appear rather evident that they should be included in the assessment since their effects can be widespread and long-lasting. (4)

This Assembly also calls on cooperation with the All Ireland Nuclear Free Local Authorities (NFLA) Sustainable Energy Forum, potentially in collaboration with the Irish Environment Network, to developing a detailed report on this matter with facilitation of a local workshop webinar on this matter, should the Assembly wish it."

(1) Proposed nuclear power plants in the UK – potential radiological implications for Ireland, RPII, May 2013 http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf
(2) The Potential Impact of a Nuclear Impact – An Irish Case Study, ESRI, December 2012 https://www.esri.ie/system/files?file=media/file-uploads/2016-12/BKMNEXT313.pdf
(3) John Large Witness Statement in THE QUEEN (on the application of AN TAISCE) Claimant -and-SECRETARY OF STATE FOR ENERGY AND CLIMATE CHANGE Defendant -and-NNB GENERATION COMPANY LIMITED, 12th Nov 2013, http://www.largeassociates.com/cz3222/R3122-B-12-11-13.pdf
(4) Oda Becker, Hinkley Point C: Expert Statement to the EIA. Austrian Environment Agency, 2013 http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0413.pdf

2. Specific Irish concerns on the proposed Sizewell development

The NFLA All Ireland Sustainable Energy Forum want to make Councils aware of the various practical considerations that come out of the UK Government's transboundary consultation on Sizewell C. NFLA thanks Attracta Ui Bhroin, Environmental Law Officer of the Irish Environmental Network for her helpful comments on this model response.

Ireland naturally respects the UK has the right to pursue its own energy mix, but Irish citizens and some public representatives are also conscious of the UK's legal obligations to consult on the transboundary impacts of the project and indeed its future operation and decommissioning.

In this regard it is of serious concern that there has been such a limited and inadequate consideration by the UK of the potential for transboundary impacts on Ireland. The overall messaging from the UK has been there is a very low likelihood of potential for transboundary impacts, and this was expressed clearly in the letter of 8th July 2020 from the UK Planning Inspectorate (PINS) to DHPLG and in the published transboundary screenings undertaken on behalf of the UK Secretary of State. This has been without clearly establishing how unacceptably narrow its consideration has been of the risks on us here in Ireland, and in particular the failure by the UK to adequately or at all, consider airborne transport of radiation from the UK to Ireland. These matters are set out in more detail below with reference to the application documentation.

The failure to consider potential airborne passage of radioactive fallout impacting Ireland is entirely unacceptable in both the Sizewell application documents, and in the screening of them on behalf of the Secretary of State. Radioactive fallout from Chernobyl impacted Ireland, and Chernobyl is of course much further east than Sizewell is from Ireland. It is worth remembering in the aftermath of Chernobyl in 1986, almost 10,000 upland sheep farms in Wales, Cumbria, Scotland and Northern Ireland had restrictions put on animal movement given the effects the effects of airborne radiation. The curbs, which were put in place on food safety grounds, meant that sheep had to be tested for radiation if taken to market. The last remaining post-Chernobyl restrictions on sheep movements were only lifted in 2012, some 26 years later. The consideration of potential greater levels of radiation which might result from Sizewell are also of concern as is highlighted elsewhere in this submission, and indeed the very significant impacts arising for Ireland in the event of a nuclear incident – even where no radioactive contamination impacts Ireland – and in the event it does.

It is regrettable that this message of 'no significant impacts' has been allowed to dominate the limited discourse there has been around this consultation in Ireland and to disperse any concerted focus on it here. The messaging from the UK authorities has been unchallenged or unqualified by the Irish authorities in publicising the consultation with the Irish public in both the newspaper notice advertising the consultation and in the text of the Department of Housing, Local Government and Heritage webpage for the consultation.

However by stark comparison the text of the Irish EPA in its screening assessment is buried in the Department's website, compounding the concerns over its handling of successive

consultations in recent years on such matters. The EPA's screening assessment has the following contrary conclusion to that of the UK authorities – which highlights that risks, albeit unlikely, cannot be discounted:
"Therefore, while there is no measurable radiological impact expected from the expected routine environmental releases from Sizewell C, given the potential transboundary effects in Ireland of a severe (albeit unlikely) nuclear accident at the Sizewell C site it is recommended that Ireland register as an interested party in the in the examination process".

Furthermore, although it is doing little to engage or alert people to the consultation, the fact the consultation has been extended to all Irish Local Authorities also confirms that the Irish Government cannot exclude such effects. Because when considering its obligations under the Planning and Development Act, and associated regulations, the Irish Government felt obliged to extend the consultation to all Irish Local Authorities and the public in these counties on the basis it could not exclude those counties being effected by Sizewell C.

While it is welcome that the EPA and Irish Authorities have not discounted the risk – the potential for the risk to arise is arguably under-stated, and is certainly inadequately assessed for 6 main reasons:

a) Duration:
Firstly, while the EPA at least addresses the risk of airborne transport of radiation, it was also arguably very optimistic in its report back in 2013 (see sections 5 and 7 below) in what it considered as the most severe scenario in its impact assessment. This was in respect how long the release of radiation would last for before containment is achieved. In short, as is set out further below with references to analysis by the late nuclear engineering consultant John Large – the EPA's worst case scenario and the duration of radioactive release falls far short of what is a credible worst case scenario set out by this independent nuclear expert.

In its more recent screening the EPA does not shy away from the chilling and openly acknowledged conservative assessment by the ESRI of the effect on our economy (noted in section 8 of this response), but the EPA still fails to consider our ability to sustain the necessary extent of sheltering needed to avoid impacts in the context of the potential duration of impacts.

As will be seen later below, when considering the Sizewell application document – the UK authorities do not even include any view on durations when considering a severe accident scenario. Instead, the application merely relies on UK nuclear regulation to discount the need for consideration and the ability to manage the risk down to an acceptable level of remote probability, in as much as such management is deemed to be reasonably practicable – all encompassed by the acronym "TifALARP".

b) Brexit impacts and the UK's withdrawal from Euratom
It is also notable and very disappointing then that, in relying on its previous report from 2013 in assessing the risk as being "unlikely", the EPA clearly has not considered the wider implications for risk consequent on Brexit. Further risk to Ireland has arisen since the UK referendum in 2016 nearly some 3 years after the report was done. Brexit means the UK's departure not just from the EU environmental acquis, and independent oversight by the EU Commission and the EU Court of Justice in the conduct of environmental assessment, but it also departs from Euratom, the treaty for the community of nuclear states.

In departing from Euratom, the UK leaves the independent oversight of its nuclear operations, including inspection of nuclear facilities, oversight of the separation of military and civilian nuclear inventories and over of movements of nuclear inventories including in and out of the UK, bearing in mind those movements may arise as close at 12 miles off our shores, the limit of our territorial waters.

As a result of Brexit, the Euratom regime is to be replaced by the UK's Office of Nuclear Regulation. The funding for this function and the level of independence it can exercise on this matters and the adequacy of the new regime solution specified are not adequately considered.

The further pressures and risks which may arise consequent on the impact to the UK economy in the context of both Brexit are addressed elsewhere in this submission where the experience of the issues which arose previously at times of difficulty in the running of the UK's nuclear plants and Sellafield in particular.

c) Covid-19 pandemic and risks consequent on the economic situation

The further consequential risks which arise consequent on the impact to the UK economy because of the Covid-19 pandemic are also not reflected in the EPA's assessment and determination of likelihood. They are however also considered further in this submission, and most particularly in the context of the economics and practicalities for the running and maintenance of nuclear operations, and the issues which have arisen previously in the running of UK nuclear facilities at times of internal difficulties. The recent experience of the choices and approaches made by UK authorities in recent years in the context of Brexit and in the management of the pandemic and associated approach to issues impacting on public health also warrant some serious consideration in the context – given the implications such an approach has for the consideration and management of nuclear risk.

d) Delayed delivery of new plants and consequential pressure to continue existing old nuclear operations to maintain a place for nuclear in the UK's energy mix.

The EPA considers the risk and likelihood of an accident solely in the context of risks from the new plant. The EPA fails to consider the consequential risks arising from the new build programme in its assessment of nuclear impacts arising from the pressure to keep old plants running until the new builds are on stream. This creates an associated, albeit indirect risk from the new build given the increased risk potentially arising from the old plants running past their sell-by date so to speak.

The development of the UK's new nuclear build programme for these new generation nuclear power plants are all running significantly over schedule. The continued expectation that the UK will be develop new nuclear power solutions means it is staying vested in a significant nuclear element to meeting its energy needs. This is instead of bringing in alternative renewable energy sources and transitioning away from nuclear. This in turn means that pressure continues to maintain the nuclear component of its energy supply, and existing plants are being forced to run past their original period of operation, and indeed in circumstances where previous safety standards are now being revised in order to allow them continue their operations, as has been seen most recently in the context of Hunterston B in Scotland. Thus, associated with the new build there is the associated risk which arises from the associated consequential pressure to keep the old plants running to keep the nuclear slot in the UK's energy supply mix open.

e) Radioactive waste disposal risks

There has also been a complete failure in respect of the assessment of risk associated with the disposal of the nuclear waste arising. This must be a concern given the UK has not completely excluded consideration of Northern Ireland as a site for the geological disposal of waste, and indeed precipitated a consultation to assess the receptiveness of communities to such proposals. Though it should be noted that almost every Northern Irish Council passed a resolution opposing the hosting of such a facility. It has additionally not ruled out such sites being partially under the Irish Sea. Indeed the only Council that has so far expressed an interest in hosting such a repository, Copeland Borough Council (where Sellafield is situated), has expressly suggested a partial under-sea site may be a possible solution for it. In the context of an as yet undefined and unspecified solution and location for the waste, and the lack of clarity on the technologies for storage and the transport mechanisms to be employed and associated risks – it is not appropriate to discount transboundary risks for Ireland, where such solutions may arise on this island or in the seas surrounding us, and/or involve transport close to our shores.

Furthermore, Sizewell C will produce the equivalent of about 80% of the total radioactivity already created in the UK by existing nuclear sites. If all the proposed new nuclear reactors get built this will at least quadruple the amount of radioactive waste the country will have to deal with. (1) After three years of deliberation, the Committee on Radioactive Waste Management (CoRWM) decided that geological disposal is the best available approach for the long-term management of higher level waste, but lots of caveats and important recommendations were ignored by the Government. CoRWM specifically said it did not want its recommendations seized upon as providing a green light to build new nuclear reactors which raise different political and ethical issues when compared with wastes which already exist. In other words it might be morally defensible to look for the 'least-worst option' to bury dangerous waste already created, but we really shouldn't be creating any more. NFLA remain concerned about the real technical and scientific issues around 'deep geological disposal' for existing waste, but the potential levels of highly radioactive new build waste add a greater level of concern that alone should see a new nuclear programme halted.

f) Flood Risk

The implications of climate change and sea level risk are regrettably becoming even clearer. In 2012 'The Guardian' reported on an unpublished UK Government report assessing flood risk at the sites of the new nuclear programme builds. Sizewell C does not perform well.
It was assessed as a "high" flood risk in 2010, and is high in 2020s, 2050s and 2080s. (2)

There is in summary no place for complacency by Irish Local Authorities in turning to examine the potential risks to their counties, and to this state and its citizens. Further consideration is given the adequacy of the assessment on the potential scale of impacts elsewhere in this submission, given the potential significance of the radioactive fallout which could result in the event of a severe accident.

Vigilance must be exercised when calling for a full environmental impact assessment to be conducted under both:

i) The UNECE Convention on Environmental Impact Assessment in a transboundary Context, "the Espoo Convention" and also
ii) Under whatever UK regulations implement the EU Environmental Impact Assessment Directive or which apply post Brexit to replace them

Matters are clearly complicated by the fact the UK is departing the EU Environmental acquis, and the extent to which the EIA for Sizewell will fall to be fully assessed under regulations reflecting the EU EIA Directive. International law obligations should continue to apply but clearly even that has become a controversial matter in recent months. However under the Espoo Convention – the UK's position on Sizewell has complicated matters further. The UK has a position that no likely effects arise and it has merely notified Ireland and other countries as a courtesy. Therefore it does not automatically fall that a consultation and a full EIA assessment under the Espoo Convention will happen. It is thus essential that Ireland and all Local Authorities must be vigilant in an unequivocal position that:

a) Effects on Ireland cannot be ruled out
b) A full Impact Assessment needs to be conducted, including under the Espoo Convention.

Local Authorities are urged to make this clear to both the Irish and the UK Authorities.

3. Airborne transport of radioactive fallout in the event of a severe accident at Sizewell

As indicated above, it is clear from a close scrutiny not just of the summary screening assessments pointed to in the letter from the UK authorities, but in particular of a review of the underlying materials – that the UK's assessment of transboundary risk fails to fully consider airborne transport of radiation in the event of a severe nuclear incident. It also includes significant reliance on UK regulation to avoid accidents, and to argue for a very low probability.

The first screening conducted by the UK Planning Inspectorate (3) on behalf of the UK Secretary of State in October 2019 indicates as follows:

“Radiological exposure - The Scoping Report acknowledges the potential for exposure to radiation from discharges of aerial and liquid radioactive emissions and direct radiation from radioactive sources.”

6.19.26 The following documents will also be used to inform the assessment: • project risk registers; • Outline Construction Environmental Management Plan (OCEMP); • Flood Risk Assessments; • Euratom Treaty Article 37 submission; • Cabinet Office National Risk Register of Civil Emergencies; and • European Commission’s Major Accident Reporting System (eMARS) (Ref 6.77).

The scoping document relied on the Euratom report and assessment process to consider this, but it does not appear to have been done.

The second screening assessment done refers to Chapter 27 of the application documents. In respect of receptors – which are effectively pathways to transmit radioactive effects chapter 27 says the following in respect of major accidents and hazards, (MA&D): (emphasis added):

“27.3.10 Each identified MA&D hazard and threat has been assigned an individual study area taking consideration of hazard or threat source, any identified impact pathways, potential receptors, and the reasonably foreseeable worst-case environmental consequence, if the event occurred. The study area for the identification of potential receptors differs depending on the specific hazard or threat and is determined on the basis of a worst-case impact area of a similar incident that has previously occurred, if information on this is available, or on the basis of professional judgement, if not available. The study areas are identified within the Environmental Risk Record included as Appendix 27A of this volume and range from the area within the site boundary to the catchment area modelled for flood risk (as set out in the relevant Flood Risk Assessments, Doc Ref. 5.2-5.9).”

From this it is clear that the study areas do not include consideration for airborne transport to Ireland.

Turning to the referred to appendix 27A to examine the receptors considered even in the context of a major nuclear incident at Sizewell C – it is notable that for MA&D Id O14 – described as: “Civil nuclear incident or major accident at Sizewell C” the only receptors considered are:

“On site: Sizewell C workers
Off-site: General public
Agricultural land
Sensitive environmental receptors (ecological, heritage sites, groundwater, surface water, marine receptors)”

Furthermore, the associated columns for this scenario on “Maximum study area”, “Worst case severity of Harm”, “Duration”, “Category of Consequence” are not completed – instead the following incomplete text is inserted:

“Separate regulatory processes are in place to assess and control the safety of UK EPR reactors for the operation of the Sizewell C nuclear power station, a detailed risk assessment is therefore not presented as part of the EIA. These hazards would be assessed in detail as part of the Nuclear Site Licensing requirements. For example, as part of Nuclear Site Licensing Regime, EDF will need to ensure the safe operation of the Sizewell C Project and protection of the workers, public and environment. This includes providing the Office for Nuclear Regulation with a robust Safety Case demonstrating that all hazards associated with the development or that may impact the development are well understood and adequate arrangements are in place to reduce these risks to an acceptable level. In addition, it requires appropriate emergency plans and arrangements to be established and agreed with the local authority, for the range of accidents and incidents that could occur. These processes will ensure that risks relating to Nuclear Safety are reduced to TifALARP. Furthermore the assessment of risks associated with the use and storage of….”

The remainder of the text is obscured and cannot be read.

There is additionally an over-reliance on the UK's regulatory regime to ensure accidents will not happen. Accidents by their very nature are accidental. Furthermore, there is an over-reliance on what are estimated as very low probabilities for major accidents to dismiss the need for adequate consideration and assessment of impacts and preparedness of other states which might be impacted. No one recollects the probabilities associated with Fukushima Daichi or Chernobyl or Three Mile Island – all most remember about them is that they happened.

In the application documents, document ref 6.11: Volume 10 Project-wide, Cumulative and Transboundary Effects, Chapter 5 Transboundary Effects, Appendix 5A: Long Form Transboundary Screening Matrix, (Revision: 1.0 Applicable Regulation: Regulation 5(2) (a) PINS Reference Number: EN010012) the following is stated (4):

"The UK Government believes that new nuclear power stations would pose very small risks to safety, security, health and proliferation (of nuclear materials). Government also believes that the UK has an effective regulatory framework that ensures that these risks are minimised and sensibly managed by industry (Source: White Paper on Nuclear Power, January 2008 (Ref. 1.2)). Nuclear safety is regulated by the Office for Nuclear Regulation (ONR) through a Nuclear Site Licence which places conditions on the Licensee to assure the safety of all aspects of power station construction, operation and decommissioning. This Licence must be in place ahead of construction of safety critical parts of the plant. The risk of accidents and possible radiological impacts on the airspace, land, water and humans in other EU member states is also covered by the Euratom Treaty obligations. The proposed UK EPR design of reactor has been the subject of a regulatory justification process. The Secretary of State (SoS) decided that the generation of electricity using the UK EPR is justified under the Justification of Practices Involving Ionising Radiation Regulations 2004. The SoS considers that the likelihood of an accident or other incident occurring at an UK EPR giving rise to a release of radioactivity is very small. The Major Accidents and Disasters assessment assesses the risk associated with hazards and threat from on-site and offsite sources during the construction and operation of the Sizewell C Project. This assessment provides details of the mitigation measures that are in place to reduce the likelihood of a risk event occurring. Further details of this assessment are provided within Volume 2, Chapter 27 of the ES."

It is entirely unclear whether the Euratom Treaty obligations relied upon in the above, have been discharged. It must also be remembered how inadequate the Euratom Article 37 submissions made by the UK have been in the past and the serious deficiencies there were in considering the impacts on Ireland in the context of Hinkley Point C in the Article 37 submission on that part.

So in summary it is clear even in the context of the most severe accident considered – there has been a complete failure to consider the potential transport to Ireland of airborne radioactive fallout in the key chapter 27 assessments.

5. Sizewell C and severe nuclear accident scenarios

A severe accident scenario, such as the one suggested by the Radiological Protection Institute of Ireland (now part of the Environmental Protection Agency), (5) would involve a loss of coolant combined with a bypass of the containment. In this scenario core damage would be initially delayed by actions of the plant operators, but eventually take place after 12.75 hours. The release of fission products to the environment starts 12.8 hours after reactor shutdown, and lasts for 35.2 hours eventually stopping 48 hour after reactor shutdown.

Nuclear engineer, the late John Large, expanded on this type of scenario pointing out that the fuel core would completely melt after about 16 hours and the corium mass slumps to the bottom of the Reactor Pressure Bessel (RPV), thereafter burning through the RPV steel shell to fall and slump onto the primary containment floor. At this point in time, the hydrogen gas in the RPV circuit is released into the primary containment whereupon it reacts with the air in the containment, deflagrating and exploding with sufficient might to breach the containment surety and, with this, the first phase release of radioactivity to the atmosphere for dispersion and deposition further afield commences. He said this scenario is very similar to the events at Fukushima. (6)

According to EDF Energy´s Environmental Statement for Hinkley Point C (Appendix 7E "Assessment of Transboundary impacts"), the likely impacts of an accident do not extend beyond the county of Somerset and the Severn Estuary. In contrast a report for the Austrian Environment Agency says severe accidents at HPC with considerable releases of caesium-137 cannot be ruled out, although their probability may be low. There is no convincing rationale why such accidents should not be addressed in the Environmental Statement (ES) for the proposed Sizewell C reactor; quite to the contrary, it would appear rather evident that they should be included in the assessment since their effects can be widespread and long-lasting. (7)

The EPA / RPII Severe Accident Scenario suggests a radioactive release of I-131 and Cs-137 amounting to 610,000TBq which is quite a bit larger than Fukushima. Cs-137 has a half-life of 30 years, whereas I-131 only has a half- life of 8 days. So Cs-137 is much more important in the longer term. With its longer half-life Cs-137 is around for much longer. Having said that I-131 distribution after an accident is important when looking at the incidence of thyroid cancer. Austria had the second highest average I-131 deposition density, outside Belarus, Ukraine and Russia, after Chernobyl. (As ever, whether there was an increase in thyroid cancer in Austria after Chernobyl is controversial – see TORCH 2016).

Table 1 Comparison of Source Terms for Cs-137

Largest release from HPC suggested in UK Article 37 Submission	0.0447TBq (8)
EIA for the planning Dukovany NPP (Czech Republic)	30TBq (9)
EIA for the planned Hanhikivi NPP (Finland)	100TBq (10)
RPII ST4 severe accident scenario	10,000TBq (11)
Austrian analysis severe accident at Hinkley Point C	53,180TBq (12)
Severe accident in the HPC spent fuel pool	1,780,000TBq (13)
Fukushima disaster, 2011	12,000TBq (14)
Chernobyl disaster, 1986	80 – 85,000TBq (15)

6. Spent Fuel Storage

Unlike spent fuel generated by existing UK nuclear reactors, it is not the intention of future reactor operators to reprocess spent fuel from new nuclear reactors. As a result, spent fuel will almost certainly remain on-site for decades, rather than being transported off-site to Sellafield as it is at the moment at most sites, apart from Sizewell B. Although it is possible that spent fuel might start to be transported off site during the 60 year lifetime of new reactors, prospective operators generally take the view that it is prudent to plan to store all of the lifetime arisings of the planned reactors on-site probably in spent fuel storage ponds. At Hinkley Point C, EDF is planning to be able to extend the life of the storage ponds for up to 100 years after the reactors close. (16)

A recent study in the US detailed how a major fire in a spent fuel pond "could dwarf the horrific consequences of the Fukushima accident." The author Frank von Hippel, a nuclear security expert at Princeton University, who teamed with Princeton's Michael Schoeppner on the modelling exercise said "We're talking about trillion-dollar consequences." (17) This would clearly involve major transboundary radioactive releases much larger than those suggested in the RPII scenario, because the spent fuel store could contain up to 60 years' worth of spent fuel.

According to the Austrian Analysis PSA 2 results (in the Pres-Construction Safety Reports by EDF and Areva) show that a possible severe accident in the spent fuel pool could result in a release of 1,780,000 TBq of Cs-137. (18)

In other words, the greatest risk is one that could remain in place until at least 2130.

7. **EPA / RPII Severe Accident Scenario (ST4)**

According to the UK Government's Article 37 submission to the European Commission on Hinkley Point C, a severe accident would only release 0.0447TBq of radioactivecaesium-137. Given the proposed Sizewell C reactor would be a carbon copy of the Hinkley Point C reactor, the figure for it will be comparative.

The RPII (now the EPA) looked at the impact of a severe accident at a new nuclear station at Wylfa on Anglesey. This concluded that up to 10,000TBq could be released. The EPA should consider conducting a similar report for Sizewell C.

Doses to adult inhabitants of Dublin:

Total radiation dose to an adult in Dublin from inhalation, cloudshine and groundshine	Amount in sieverts
After the plume passage	18,084 μSv
Cumulative after a week	19,834 μSv
Cumulative after a year	43,794 μSv

Intervention levels have been established for emergencies by the International Atomic Energy Agency. These suggest that sheltering should be recommended if the dose is expected to reach over 10,000 μSv over a two day period.

In the scenario the radiation dose during plume passage is predicted to exceed the intervention level for sheltering, thus people would be advised to remain indoors during the passage of the plume (approximately 24 hours in a particular weather scenario). The intervention levels for iodine prophylaxis (iodine tablets) or evacuation is not exceeded. A radiation dose of just over 9000 μSv (9mSv) from inhalation of iodine-131 was predicted. While this is below the intervention level of 50,000 μSv (50mSv) for administration of iodine tablets (and was based on the assumption that people were outside during the passage of the plume), the RPII notes that staying indoors could reduce this radiation dose significantly. However the 50,000 μSv intervention level is very high. It would certainly be worth taking potassium iodate tablets if a 9,000 μSv was in prospect and these tablets will not do you any harm. (19)

The radiation doses from the table above do not include ingestion doses. The reason given by RPII for this is:
"These radiation doses were treated separately as in an emergency this pathway is extremely amenable to significant reduction. Indeed, the appropriate use of food controls and agricultural measures can substantially reduce the transfer of radioactivity to the food-chain."

If no action is taken the ingestion dose resulting from the accident scenario could be as high as 275,000 μSv, bringing the total dose to almost 320,000 μSv. RPII comments:

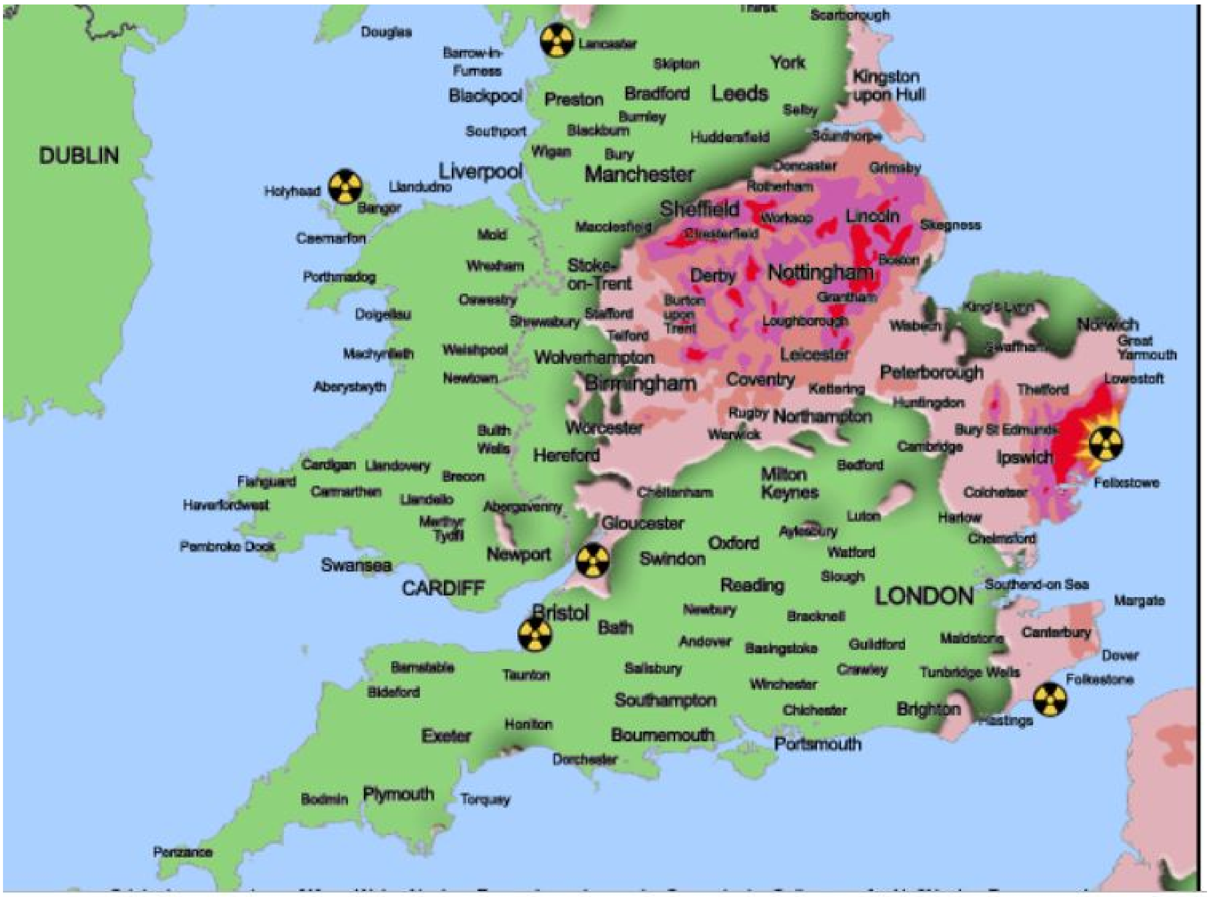
"If no protective actions were taken, a dose of this magnitude might be expected to result in an observable increase in cancers in the decades following the accident. For comparison, the annual average radiation dose from all sources of radiation received by members of the Irish public is estimated to be 3950 μSv."

RPII also notes that:
"In the absence of any protective actions having been taken to reduce or eliminate the contamination of food and animal feed, all of the food types would exceed the Maximum Permitted Levels for a period of at least two months (for meat and root vegetables even after one year, the radioactivity concentrations were predicted to be significantly higher that the permitted levels in the scenario studied)."

RPII notes in passing that while the protective actions could be highly effective in reducing radiation doses, their implementation may not always be straightforward. Obviously the disruption to the Irish agricultural industry could be considerable. In addition, experience of food contamination issues elsewhere suggests that, even in cases where the EU Maximum Permitted Levels are not exceeded, the economic consequences from loss of market due to the ‘perception’ that food is contaminated can be considerable.

Obviously for the people of central England, an accident at Sizewell C would have a much greater impact in comparison to the impact of an accident at Wylfa on Dublin. With Sizewell we do not have the benefit of 100 kilometres of sea between the accident and the nearest centre of population.

By superimposing the fallout map from Chernobyl onto a map of the area around Sizewell it is possible to get an idea of what the impact a severe accident might look like, depending on the wind direction. The red shading represents the area which would have required compulsory resettlement in Belarus and Russia and the pink are where additionally compulsory resettlement would be compulsory in the Ukraine.



8. Economic costs of a nuclear accident to Ireland

Finally, NFLA notes an important report by the Economic and Social Research Institute – 'The Potential Economic Impact of a Nuclear Accident – an Irish cast study'. (20) NFLA had pushed for this report to be developed through its representative to the Environment Protection Agency Radiation Issues Committee, Dr Paul Dorfman from the UCL Energy Institute.

Core headline figures from this study include:

- In the worse-case scenario, a nuclear disaster from a nuclear reactor in northwest Europe could cost Ireland **€161 billion**.
- Agricultural production would grind to a halt, with the tourism industry and exports also incurring substantial financial damage.
- Even under the most benign scenario considered by ESRI, where no radioactive contamination occurs - total loss is estimated at **€4 billion**.
- The report analysis may actually underestimate the true extent of its cost to the Irish economy.
- Health risks from high levels of contamination could put a significant strain on the health service.
- Total cost of a low-level contamination scenario, which requires the imposition of food controls to reassure the public, would cause restrictions on food imports from Ireland, would be €18 billion.
- The impact on tourism would also be significant, with long-term reputational damage resulting in an economic cost of as much as €80 billion.
- Not only would exports be decimated but the need to import much of the country's food would lead to far higher domestic costs.
- There could also be significant emigration from the island.

Such costs should be of alarm to all Irish Councils and the Irish Government and needs to be fully taken into account when considering transboundary impacts to Ireland in the event of a nuclear accident from any UK or French nuclear reactor.

9. Conclusion

This response outlines some of the core concerns of the NFLA All Ireland Sustainable Energy Forum around trans-boundary impacts to Ireland should there be an accident at the Sizewell C, or for that matter any UK new or existing nuclear reactor.

New nuclear reactors, like the one being put forward by EDF Energy for Sizewell C, have many serious local impacts to the population of the south east of England. They also though have alarming impacts in the event of a severe accident taking place. Whilst that may remain a low risk, in the event it happens, there are clear risks and damage to Ireland should a severe accident take place.

Those issues are multi-faceted – environmental, reputational and economic. They are serious enough for Irish respondents to fairly object to the development of the proposed Sizewell C reactor, or any new nuclear reactor developed across the Irish Sea.

10. References

(1) An overview of the differences between the 2013 Derived Inventory and the 2010 Derived Inventory, NDA 2015 https://rwm.nda.gov.uk/publication/differences-between-2013-and-2010-derived-inventory/ See Table 5

(2) The Guardian, 7th March 2012 https://www.theguardian.com/environment/2012/mar/07/uk-nuclear-risk-flooding

(3) UK Planning Inspectorate, The Sizewell C Project, 6.11 Project Wide, Cumulative and Transboundary Projects, https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-002190-SZC_Bk6_ES_V10_Ch1_Intro_Methodology.pdf

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(5) Proposed nuclear power plants in the UK – potential radiological implications for Ireland, RPII, May 2013 http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

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(9) EIA New Dukovany NPP – Summary http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0639BFZ.pdf https://translate.google.com/translate?hl=en&sl=de&u=http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0639BFZ.pdf

(10) NPP FENNOVOIMA (HANHIKIVI 1) Expert Statement to the EIA Program http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0447.pdf

(11) Proposed nuclear power plants in the UK – potential radiological implications for Ireland, RPII, May 2013 http://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

(12) Becker, O, Hinkley Point C: Expert Statement to the EIA. Austrian Environment Agency, 2013 http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0413.pdf

(13) ibid

(14) TORCH 2016 The Other Report on Chernobyl: An independent evaluation of the health-related effects of the Chernobyl nuclear disaster, page 12 https://www.ianfairlie.org/wp-content/uploads/2016/03/chernobyl-report-version-1.1.pdf

(15) ibid

(16) Hinkley Point C Development Consent Order Environmental Statement Volume 2. EDF Energy October 2011 para 7.67 https://infrastructure.planninginspectorate.gov.uk/wpcontent/ipc/uploads/projects/EN010001/EN0100

01-005038-4.3%20-%20Volume%202%20-%20Hinkley%20Point%20C%20Development%20Site%201.pdf
See also Chapter 6 Spent Fuel and Radioactive Waste Management Para 6.39.32
https://www.edfenergy.com/sites/default/files/V2%20C06%20Spent%20Fuel%20and%20Radioactive%20Waste%20Management.pdf

(17) Stone, R. Spent Fuel Fire on US Soil could dwarf impact of Fukushima, Science 24th May 2016
http://www.sciencemag.org/news/2016/05/spent-fuel-fire-us-soil-could-dwarf-impact-fukushima

(18) Becker, O, Hinkley Point C: Expert Statement to the EIA. Austrian Environment Agency, 2013
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http://www.dccae.gov.ie/news-and-media/Lists/Publications%20Documents/The%20potential%20economic%20impact%20of%20a%20nuclear%20accident%20-%20An%20Irish%20Case%20Study%20ESRI.pdf

From: Donagh Mark Killillea
To: Planning
Cc: Michael Connolly
Subject: Objection - Transboundary Environmental Public Consultation in relation to a Planning Application for a Nuclear Powerstation at Sizewell, Suffolk, England.
Date: 27 October 2020 10:46:38
Attachments: image001.png

For the Attention of Planning Galway County Council & Cllr Micheal Connolly Chair of Planning SPC

I want to bring to your attention the Transboundary Environmental Public Consultation in relation to a Planning Application for a Nuclear Powerstation at Sizewell, Suffolk, England.

Each planning authority in Ireland has received information in the form of a letter of notification from the United Kingdom's Planning Inspectorate (PINS) to the Department of Housing, Planning and Local Government (DHPLG) relating to an application for development consent (planning application) for the proposed Sizewell C Nuclear Power Station, which is to be constructed in Suffolk, England, UK.

I understand that a submission or observation in relation to the potential transboundary environmental effects of the development may be made in writing or by e-mail to the **Planning Section** Wednesday 28th October 2020.

I would like to make the following **Objection.**

Nuclear power is incredibly expensive, hazardous and slow to build. It is often referred to as 'clean' energy because it doesn't produce carbon dioxide or other greenhouse gases when electricity is generated but the reality is that it isn't a plausible alternative to renewable energy sources.

Building nuclear reactors is costly, running into billions of pounds. The UK's new Sizewell C reactor could cost over £25 billion by the time it's finished, leading it to be called "the most expensive object on Earth". Such huge sums of money would be better invested in truly clean energy, such as wind power which produces energy more cheaply. Reactors are also complicated things to build. A new reactor in Finland is at least 11 years behind schedule, thanks to problems with the reactor design Sizewell C was supposed to be producing energy by 2017, but it now isn't due until 2025 at the earliest. The nuclear industry's track record suggests it will be delayed even further. Climate change is already happening and we simply can't wait that long when wind and solar power are so much quicker to install.

"Nuclear power doesn't make sense"

Nuclear energy is also dangerous. We're still living with the legacy of accidents at Chernobyl and Fukushima which released huge amounts of radioactive material. Even without such accidents, nuclear power creates radioactive waste at every stage of production, including uranium mining and reprocessing of spent reactor fuel. Some of this waste will remain dangerously radioactive for hundreds of thousands of years, yet nobody knows of a way to safely store it so problems aren't created for future generations and its

effect on neighbouring countries. Ireland could suffer from ant after effects of such a detrimental industry.
The UK government's hopes for a new generation of nuclear power stations is crashing against the economic realities. As the cost of truly clean energy plummets and the price of nuclear energy spirals out of control, nuclear power companies are shelving their plans to build plants in the UK, thus making Sizewell a race to the bottom in efficiency and safety as lowest tenders will win a construction contract.
Instead of backing nuclear power, the uk government needs to invest in renewable energy including wind and solar/wind power. A thriving renewable energy industry will create jobs, provide cheaper electricity and help cut emissions much faster than nuclear power.

I have major concerns around the safety of such developments and in particular the effects of an accident on the people of Ireland. Due consideration must be made to England's near neighbours being Ireland and the noted response from ERSI to the economic outfall from such a development. It is estimated that any incident be it minor or major could jeopardise our tourism sector to the tune of €4 billion annually, our agricultural sector would be wiped out for years and our foreign direct investment companies would be in serious decline also and in this what financial assurances/pillars are in place to protect transboundary economy's and to what scale and payment is available for such scenario. Further to this in the event of planning permission being granted an upfront security payment of €20 Billion should be made to the Irish Government as protection for its country.

Further to my objection above I would also like Galway Co Co to make an objection under its existing planning laws/development plans relating to such power sources noting that close of observations/objections is tomorrow 28th October 2020.

Kindest Regards,

Cllr. Donagh Killilea
Member of the Planning and Envoirnmental SPC
Galway County Council

Comhairle Chontae Chill Chainnigh
Halla an Chontae, Sráid Eoin, Cill Chainnigh, R95 A39T.
Pobal agus Áiteanna Inbhuanaithe a Chruthú

Kilkenny County Council
County Hall, John Street, Kilkenny, R95 A39T.
Creating Sustainable Communities and Places

Minister Darragh O'Brien TD
Minister for Housing, Local Government and Heritage
Custom House, Custom House Quay,
Dublin 1
D01 W6X0.

3rd November 2020

RE: Sizewell C Nuclear Power Plant, UK

Dear Minister,

I wish to confirm that Kilkenny County Council wishes to express concern about the safety of the development and future operation of the Sizewell C Nuclear Power Plant in the UK.
I trust that you will take these concerns into consideration in your engagement, through the public consultation process on the matter, with the United Kingdom's Department of Business, Energy and Industrial Strategy (DBEIS).

Yours sincerely,

[redacted]

Sean McKeown
Director of Services

Comhairle Contae **Lú**
Louth County Council

Summary of submissions received by Louth County Council and Louth County Council's submission on the Transboundary EIA Public Consultation

Sizewell C Nuclear Power Station, Suffolk, England

Introduction

The purpose of this document is twofold:

1. It provides a summary of the submissions and observations received to the Transboundary Environmental Public Consultation Planning Application for proposed Nuclear Power Station at Sizewell C, Suffolk, England, UK.

2. It sets out Louth County Council's observations in respect of the same.

Transboundary Environmental Public Consultation Planning Application for proposed Nuclear Power Station at Sizewell C, Suffolk, England, UK

The Transboundary Environmental Public Consultation was advertised as follows:

In accordance with the provisions of the 1991 United Nations Convention on Environmental Impact Assessment in a Transboundary Context ("the Espoo Convention"), the Minister for Housing, Planning and Local Government received notification from the UK Planning Inspectorate ("PINS") in relation to a development consent application ("the planning application") by NNB Generation Company (SZC) Limited for a proposed Nuclear Power Station at Sizewell C, Suffolk, England.

The proposed development includes two UK European Pressurised Reactor UK EPR™ reactor units, giving a total output capacity of approximately 3,340MW, along with associated development required for the construction and operation of the Sizewell C Nuclear Power Station, including the mitigation of any potential impacts. The Sizewell C Project comprises the main nuclear power station facility and associated development in order to facilitate construction and operation of the nuclear power station including:

• Off-shore cooling water infrastructure and other marine works;

• Temporary construction areas and the relocation, demolition and replacement of certain existing ancillary facilities associated with the operational Sizewell B Nuclear Power Station;

• A number of associated development works away from the main site which are required to facilitate construction or operation, including;

- Two temporary park-and-ride sites to manage additional traffic generated by the construction workforce,

– Permanent road bypasses, link roads and highway improvements to alleviate traffic and mitigate potential effects on road safety during construction and operation,

– Temporary freight management facilities during construction; and

– Temporary and permanent extensions and improvements to existing railway infrastructure.

Construction of the new nuclear power station is anticipated to last for 9 to 12 years and the proposed development has an operational design life of 60 years.

The proposed development has been identified as a project within the scope of paragraph 2 of Appendix 1 to the Espoo Convention as implemented by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ("the EIA Regulations") (UK legislation). Consequently, the Secretary of State has twice screened the proposal, once at pre-application stage and a second time on receipt of the application. On both occasions, the screening determination specified that the proposed development is not likely to have significant adverse transboundary effects on the environment in this State. However, the Secretary of State decided to notify Ireland as if the development would be likely to have significant adverse transboundary effects on the environment in this State, as provided for in Article 3(1) of the Espoo Convention.

The screening assessment is available at: https://infrastructure.planninginspectorate.gov.uk/document/EN010012-002271. A member of the public may make a written submission or observation in relation to the potential transboundary environmental effects of the project, by sending them to his or her local planning authority, to be received by close of business on Wednesday 28 October 2020 at the latest. Submissions or observations should not be made to the Department of Housing, Planning and Local Government. Contact details for each planning authority are set out in the public consultation notice, which is available to view in the public consultation section of the website of the Department of Housing, Planning and Local Government at www.housing.gov.ie. Correspondence from the UK's PINS, digital copies of extracts from the applicant's Environmental Statement, associated documents and links provided by the UK's PINS to the full Environmental Statement and all other documentation relating to the development consent application for the proposed development. The public consultation notice is also available to view in the office of the Planning Section of each planning authority nationwide during office hours together with a printed copy of the correspondence from the UK's PINS inviting Ireland to undertake a transboundary consultation under the Espoo Convention, extracts from the applicant's Environmental Statement and associated documents that appear to be most relevant for the purpose of the consultation. A copy of these documents is available for inspection, or purchase at a fee not exceeding the reasonable cost of making a copy, during office hours at the office of each planning authority nationwide. Due to social distancing measures introduced in response to the global COVID-19 pandemic, viewing may be by appointment only in certain local authority offices. It is strongly advised to contact your local authority to clarify the position in this regard before travelling to view the documentation.

All documentation related to the development consent application for the proposed development is also available to view on the website of the UK's PINs, including any additional information accepted by the UK's PINS at: https://infrastructure.planninginspectorate.gov.uk/projects/Eastern/The-Sizewell-C-Project/

Due to the voluminous nature of an application for development consent at this scale, the Applicant has also produced a 'Navigation Document', summarising the structure of the application for development consent for the Proposed Development. This document is available from: https://infrastructure.planninginspectorate.gov.uk/document/EN010012-001619. In the interests of transparency, it should be noted that, following consultation with the Minister for Housing, Planning and Local Government, each planning authority will forward to the UK's PINS all submissions or observations it receives through this public consultation, and may also forward a summary of the submissions or observations. Submissions or observations received, or a summary of same, may be published on the website of the planning authority concerned or on a website of the UK's PINS. The DHPLG will not publish any submissions or observations or summary of same.

Part 1 Submissions/Observations submitted to Louth County Council

In total 4 no. submissions were submitted to Louth County Council within the prescribed timescale set out above.

These are summarised as follows:

1. Councilor Tom Cunningham, Louth County Council

Observations:

- Brexit and Euratom – Following Brexit and Britain's departure from the Euratom, Britain will no longer be subject to European regulation or legal proceedings at the European Court of Justice if they fail to meet with nuclear safety regulations. Concerned that Britain may not be ready in terms of skills, IT and funding to regulate for control of nuclear material to meet international obligations.

- Should there be a nuclear incident the impact of it on human life, the environment and the economy in Ireland would be substantial. Given Ireland's reliance on food export and tourism this would lead to a significant economic impact estimated by the Economic and Social Research Institute to be as high as €16bn.

2. *Imelda Munster TD, Louth County Council*

Observations:

- Brexit and Euratom – Following Brexit and Britain's departure from the Euratom, Britain will no longer be subject to European regulation or legal proceedings at the European Court of Justice if they fail to meet with nuclear safety regulations. Concerned that Britain may not be ready in terms of skills, IT and funding to regulate for control of nuclear material to meet international obligations.
- Should there be a nuclear incident the impact of it on human life, the environment and the economy in Ireland would be substantial. Given Ireland's reliance on food export and tourism this would lead to a significant economic impact estimated by the Economic and Social Research Institute to be as high as €16bn.

3. *J. Byrne, Chair ACG and in a personal capacity An Claĺomh Glas*

Observations:

- Considers that the screening determination fails to consider adequately the potential for airborne transport to Ireland, any severe nuclear incident, the existing flood risk on the site and potential increases in sea level risk associated with climate change
- Application fails to consider that UK is obliged to revisit its strategic environmental assessment for energy, including nuclear energy further to judgments from UK courts which brings a material consideration in terms of the justification for this project as opposed to alternatives with less risk
- Environmental Impact statement (EIS) is not complete in the absence of consideration of the entirety of impacts such as the impact from waste arising from the operation of the plant
- Having regard to the Case of the Edenderry Power Plant , An Taisce v An Bord Pleanála, considers that the impacts associated with the uranium to power the plant need to be assessed.

- Deficiencies in the risk assessment of serious accident scenarios and risks arising from pressures to operate old nuclear plants past their sell by dates poses an associated risk for Ireland, its closest neighbour
- Considers that climate benefit from proposal are misrepresented (references attached assessment by Prof Stephen Thomas of Nuclear Free Local Authorities)
- Adopts other submissions made by the Environmental Pillar and Environmental Law Officer of the EU; Nuclear Free Local Authorities; submissions made in respect of inadequacy of EIS and transboundary screening and the submission of the Austrian Authorities to the project. Submission also calls on Irish local authorities to call unequivocally on the UK to conduct a full EIS and a full EIA in accordance with its obligations.

4. Environmental Pillar and Environmental Law Officer of the Irish Environmental Network

Observations:

- Requests Irish local authorities and the Irish Government to call unequivocally on the UK to conduct a full EIA in accordance with its obligations. It welcomes the Environmental Protection Agency's (EPA) assessment of potential for impacts to Ireland which clearly it notes disagree with the UK assessment that there is no risk of impact to Ireland. It states that accidents by their nature are accidental and that there is no way adequately or at all to address future knowledge and newly emergent probability and risk considerations.
- Concerned that the Department of Housing, Local Government and Heritage has a different view of potential impacts on Ireland than the EPA and that the Department failed to act adequately in relation transboundary consultation in respect of Hinkley Point C.
- Considers that the consultation has been given a very low profile; has been given inadequate consideration to impacts to Ireland having regard to Ireland's proximity to the UK and has provided a lack of transparency and engagement about an adequate emergency response. It notes the UK's desire to maintain space in its energy mix for nuclear. It considers that this increases risk to Ireland from the UK's nuclear programme especially given Brexit, the current Covid-19 pandemic and UK's withdrawal from Euratom. Submission also references the unresolved issue of storage of the UK's entire legacy and future nuclear waste in one single repository and the potential to transport and store this in Northern Ireland.

- Queries the validity of fluvial flood and coastal risk calculations made for the period over which highly radioactive material will be stored on site. States that a further rise in sea level of 0.5-1 metre is likely by 2080s and that these confirmed flood risks have a serious implication for the safety of spent fuel at Sizewell. It is considered that this further justifies Irish concerns that in the event of an accident that there is an over reliance on sea defenses to prevent flooding.
- Potential transport to Ireland of airborne radioactive fallout has not been considered. Considers that there is an over-reliance on what are estimated as very low probabilities for major accidents. The assessment of such accidents are dismissed and so too is the assessment of preparedness of other states that may be impacted. The Environmental Report specifically states that a detailed risk assessment is not included on the basis that separate regulatory processes are in place.
- The model utilised to assess the aerial transport of radioactive material is inadequate as caveats are irrelevant to the location of this site are utilised. As such the potential for significant impact for the people of Ireland is largely ignored in the Environmental Report.
- The duration of a severe accident, the impact of Brexit and UK's withdrawal from the Euratom which will impact on the regulation of nuclear facilities, the impact of the Covid -19 pandemic on UK's economy and subsequent impact on the availability of the running and maintenance of nuclear operations are also considered to be risks to Ireland as too is the continued use of older nuclear operations.
- Proposal has the potential to quadruple the amount of radioactive waste the UK has to deal with and as yet it highlights that there is no solution as to where the existing higher level waste may be safely disposed of.
- References a document by the Pacific Northwest Laboratory in the US in respect of risk assessment which in summary sets out that the operational data of reactors alone is recognised as insufficient to project safety margins in relation to license renewals.
- It highlights a UK judgment in relation to the SEA for energy in the UK which raises issues in relation to the justification for the project in light of real, more affordable, more easily deliverable and less risky renewable energy developments.
- Concludes by adopting submissions made by the Austrian Authority, Nuclear Free Local Authorities, a submission in respect of Wylfa B Plant by the Environmental Law Officer of the IEN, a paper prepared by Prof Stephen Thomas and Alison Downes in respect of net carbon impacts.

PART 2

Louth County Council's Observations

Louth County Council has cogniscance to the pertinent and relatable submissions made by Councillor Tom Cunningham, Imelda Munster TD, An ClaÍomh Glas and Environmental Pillar and Environmental Law Officer of the Irish Environmental Network and welcomes the opportunity to make this submission in response to the Transboundary Environmental Consultation.

EIA Considerations

Screening Transboundary Effects

Whilst it is noted that the Secretary of State undertook two screenings to identify if there were likely significant adverse transboundary effects on the environmental in other states, it is concerning that both of these screenings concluded that the proposed development is not likely to have significant adverse transboundary effects on the environment in Ireland. The areas of particular concern relate to the lack of project details, in particular the final destination of the waste arising from the nuclear power plant, which in itself gives rise to concerns of 'project splitting'. The proposed offshore cooling water infrastructure also has the potential to have significant adverse effects on the east coast of Ireland and the cumulative effects of such infrastructure on existing projects such as offshore wind farms, marine life and associated effects on coastal defenses due to rising sea levels are all issues that directly affect the east coast of Ireland and in particular County Louth.

The EIA Directive provides that 'the effects of a project on the environment should be assessed in order to take account of concerns to protect human health, to contribute by means of a better environment to the quality of life, to ensure maintenance of the diversity of species and to maintain the reproductive capacity of the ecosystem as a basic resource for life.' As such, a proposal for a nuclear power station should at least consider the wider implications arising from construction, operational and de-commissioning stages of the proposed development. In this regard, the risks no matter how small from a nuclear power station and its potential catastrophic effects should an accident occur on human life and on terrestrial and marine wildlife, flora and fauna should be considered in detail.

Project Splitting

Louth County Council has grave concerns about 'project splitting'. This arises due to the lack of detail as to where the final site will be for the disposal of radioactive material arising from the proposed development. The distance from the reactor site to the final repository can only be determined after both sites have been identified. The full and true impacts, either direct or indirect, cannot be fully assessed in the absence of such information. In the absence of this information, how can it be possible to identify, describe and assess the potential effects of the entire project on not only the site area but the wider area where hazardous material will be required to be transported. It is therefore, also not possible at this juncture to mitigate against any such proposals.

Other environmental considerations

Nuclear facilities use more water than any other power source, and as such any consequential impacts and effects on already threatened aquifers should be carefully considered. The cooling process produces more heated water into the sea with potentially damaging environmental impacts near their outflows. The transboundary effects arising from the use of offshore cooling waters needs to be considered and carefully managed to ensure that the proposed development does not contribute to a progressive increase in climate change through rising sea levels due to temperature increase in sea waters, changes to marine eco-systems and habitats due to change in sea temperatures.

Costs of Nuclear Energy

Climate change is a global issue and as such is driving the global response in seeking more sustainable and reliable energy supply with neutral carbon emissions. Nuclear energy will not solve the energy affordability and reliability issues that we are facing. Nuclear energy has a higher levelised cost of energy (LCOE) than renewable (Bloomberg New Energy Finance 2018), and has a long lead time to development, construction and operation of plant. Better options for affordability include the deployment of more wind and solar generation, in combination with battery storage.

Appropriate Assessment Considerations

County Louth contains numerous European Sites which form part of the Natura 2000 network of core breeding and resting sites for rare and threatened species, and some rare natural habitat types which are protected in their own right. Dundalk Bay, Special Protection Area (004026) and Dundalk Special Area of Conservation (000455) are one of the largest of these protected sites and support a significant number and range of protected species and habitats along the east coast of Ireland. The qualifying interests for these sites are available on www.npws.ie.

Dundalk Bay is a large open shallow sea bay with extensive saltmarshes and intertidal sand/mudflats, extending some 16 km from Castletown River on the Cooley Peninsula, in the north, to Annagassan/Salterstown in the south. The extensive sand flats and mud flats have a rich fauna of bivalves, molluscs, marine worms and crustaceans which provides the food resource for most of the wintering waterfowl. The outer part of the bay provides excellent shallow-water habitat for divers, grebes and sea duck. In summer, it is thought to be a major feeding area for auks from the Dublin breeding colonies. The bay is used at night for roosting by wintering flocks of Greylag Goose, Greenland White-fronted Goose and Whooper Swan from Stabannan/Braganstown (inland of Castlebelligham) and other inland sites. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Great Crested Grebe, Greylag Goose, Light-bellied Brent Goose, Shelduck, Teal, Mallard, Pintail, Common Scoter, Redbreasted Merganser, Oystercatcher, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Black-headed Gull, Common Gull and Herring Gull. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds. The site is of international importance because it regularly supports an assemblage of over 20,000 wintering waterbirds. It also qualifies as a site of international importance for supporting populations of Light-bellied Brent Goose (370), Knot (9,710), Black-tailed Godwit (1,100) and Bar-tailed Godwit (1,950) - all figures, unless stated otherwise, are five year mean peaks for the period 1995/96 to 1999/2000. A variety of other species occur in numbers of national importance, i.e. Great Crested Grebe (303), Greylag Goose (435), Shelduck (522), Teal (538), Mallard (765), Pintail (117), Common Scoter (581 - five year mean peak for the period 2000/01 to 2004/05), Red-breasted Merganser (121), Oystercatcher (8,746), Ringed Plover (151), Golden Plover (5,967), Grey Plover (204), Lapwing (4,892), Dunlin (11,518), Curlew (1,264) and Redshank (1,659). Other wintering species which occur include Red-throated Diver, Great Northern Diver, Cormorant, Grey Heron, Little Egret, Mute Swan, Wigeon, Goldeneye, Greenshank and Turnstone.

A focused and detailed impact assessment of the implications of the proposed Nuclear Power Station on the integrity of these European Sites in view of their conservation objectives has not been recorded and reasoned to dispel reasonable scientific doubt regarding potential effects on the integrity of these European sites. As such doubt about adverse direct or indirect effects of this project may not be dispelled and on the basis of the information provided with the EIS, Louth County Council cannot be satisfied that the proposed development individually, or in combination with other plans or projects, such as the disposal of waste, would not be likely to have a significant effect on Dundalk Bay, Special Protection Area (004026) and Dundalk Special Area of Conservation (000455), or any other European site, in view of the site's Conservation Objectives.

Conclusion

Louth County Council requests that all of the above submissions are fully considered in the assessment of transboundary environmental effects of the proposed Nuclear Power Station at Sizewell C, Suffolk.


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Halla an Bhaile
Sráid Crowe
Dún Dealgan
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Cuirfear fáilte roimh chomhfhreagras Gaeilge - Correspondence in Irish is welcome

Comhairle Contae **Lú**
Louth County Council

Louth County Council
3 0 SEP 2020
Customer Services
Dundalk

Councillor Tom Cunningham

.OUTH (
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Louth County Council
Planning Section
Crowe Street
Dundalk, Co Louth
transboundary@louthcoco.ie

29th September 2020

A chairde,

Transboundary Environmental Public Consultation – Sizewell C Nuclear Power Station

Although the Sizewell C Project, a new nuclear power station in Suffolk, may pose a lower risk to Ireland than England's other nuclear proposals along its west coast that does not mean that there is zero risk to the Irish public and wish to submit this observation under the terms of the 1991 United Nations Espoo Convention and the 2011 EU Envirnonmental Impact Assessment Directive which facilitates transboundary public consultation.

Brexit & Euratom

It is very concerning that as part of Brexit, the British government has opted to leave Euratom, the European Atomic Energy Community. Membership of Euratom would ensure that Britain would have been subject to the European Court of Justice and to a coordinated regulatory regime.

Concerns have been raised by the British nuclear regulatory body, ONR regarding Britain's readiness to leave Euratom and also regarding a skills shortage to deliver a British State System of Accountancy for control of nuclear material to meet its international obligations.

ONR also expressed concerns regarding a replacement IT system to track nuclear material and whether it can be delivered on time and be effective. Concerns have also been expressed about the long-term funding of the new nuclear regulator.

I am deeply concerned that following Brexit and their departure from Euratom, the British Government will no longer be subject to legal proceedings at the European Court of Justice if they fail to comply with nuclear safety regulations.

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Comhairle Contae **Lú**
Louth County Council

Councillor Tom Cunningham

Nuclear Incident

I am opposed to Nuclear power in principle and feel that governments have a responsibility to explore more eco-friendly and safer ways of generating power. Should there be a nuclear incident/accident, the impact on human life, the environment and ultimately the economy would be quite substantial. The knock-on effect in Ireland could be result in food controls and agricultural protective actions being introduced in Ireland.

The Economic and Social Research Institute (ESRI) study conducted in 2016- *The Potential Economic Impact of a Nuclear Incident — An Irish Case Study* estimated the potential financial losses to Ireland in the event of a nuclear incident to be as high as €160bn.

Even in the lowest risk scenario where there is no actual contamination in Ireland, the reputational losses in relation to tourism and export markets could be as high as €4bn.

Given that Ireland relies heavily on its food exports and tourism, in the event of an incident even the perception of contamination would lead to a significant economic impact.

Conclusion:

Given the absence of access to the European Court of Justice following Brexit, the ambiguity of the long term funding of a new nuclear regulator and the potential impacts to the Irish public and their economy, I would like to register my objection to the proposed development of the Sizewell C nuclear power station in Suffolk.

Is Mise,

[redacted]

Cllr Tom Cunningham

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IMELDA
MUNSTER TD
Sinn Féin Spokesperson for Media, Tourism and Sport
STANDING UP FOR
LOUTH & EAST MEATH

Louth County Council
Planning Section
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Planning Section
Crowe Street
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8th October 2020

A chairde,

Transboundary Environmental Public Consultation – Sizewell C Nuclear Power Station

Although the Sizewell C Project, a new nuclear power station in Suffolk, may pose a lower risk to Ireland than England's other nuclear proposals along its west coast that does not mean that there is zero risk to the Irish public and wish to submit this observation under the terms of the 1991 United Nations Espoo Convention and the 2011 EU Envirnonmental Impact Assessment Directive which facilitates transboundary public consultation.

Brexit & Euratom

It is very concerning that as part of Brexit, the British government has opted to leave Euratom, the European Atomic Energy Community. Membership of Euratom would ensure that Britain would have been subject to the European Court of Justice and to a coordinated regulatory regime.

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I am deeply concerned that following Brexit and their departure from Euratom, the British Government will no longer be subject to legal proceedings at the European Court of Justice if they fail to comply with nuclear safety regulations.

My office is open full time Monday – Friday 9.30am-5.00pm.
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Is mise le meas

[redacted]

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Transboundary Environmental Public Consultation - Sizewell C Nuclear Power Station

The Environmental Protection Agency (EPA) is an independent public body in Ireland established under the Environmental Protection Agency Act 1992. The EPA has responsibilities for a wide range of licensing, enforcement, monitoring and assessment activities associated with environmental protection and protection of people from the harmful effects of ionising radiation, both natural and man-made

The EPA welcomes this opportunity to participate in the transboundary Environmental Impact Assessment public consultation being undertaken in relation to the development consent application received by the UK Planning Inspectorate for the proposed Sizewell C nuclear power station in Suffolk, UK.

A summary of the Environmental Statement reviewed by EPA is provided in section 1 of this document. EPA's assessment of the potential impact on Ireland from this development is provided in section 2.

1. Introduction

NNB Generation Company (SZC) Limited is proposing to build a new nuclear power station, known as Sizewell C, to the north of the existing Sizewell B power station in East Suffolk. The development consists of two UK European Pressurised Reactor (EPR) units with an expected net electrical output of approximately 1,670 megawatts (MW) per unit, giving a total site capacity of approximately 3,340MW. This UK EPR reactor design has been assessed and approved by the Office for Nuclear Regulation and the Environment Agency through the UK Generic Design Assessment process.

The power station, together with the proposed associated developments, referred to as the "Sizewell C Project" comprises other permanent and temporary development to support the construction and operation of the two new reactors. An application for development consent has been submitted for the Sizewell C Project to the UK Planning Inspectorate. Consent for the project would take the form of a Development Consent Order and would be granted by the Secretary of State for Business, Energy and Industrial Strategy, following a public examination of the application. Construction of the Sizewell C power station is likely to take 9-12 years and upon completion it is expected to have an operational life of 60 years. The Interim Spent Fuel Store which will be constructed onsite to store spent fuel from the reactors is designed for a lifetime of 100 years.

1.1. Methodology for the Environmental Impact Assessment

The Environmental Impact Assessment (EIA) considers the potential for likely significant effects to occur on the environment and people as a result of the proposed development. The scope and methodology of the EIA was discussed with the UK Planning Inspectorate through a process called EIA scoping. The main stages of the EIA process for the Sizewell Project include:

- establishing characteristics of the baseline environment at the site and in the surrounding area;
- assessing the impacts and likely significant environmental effects predicted to occur as a result of the proposed development;
- identifying mitigation measures to avoid, reduce or manage any adverse environmental effects;
- assessing cumulative effects which may occur due to a combination of the Sizewell C Project and other projects and plans; and
- identifying residual effects that remain after the introduction of all mitigation.

The results of the EIA are documented in the Environmental Statement (ES) which, due to its size, is comprised of several volumes[1].

1.2. Radioactive Waste and Decommissioning

Operation and decommissioning of the Sizewell C nuclear power station would result in the generation of radioactive waste and spent fuel. A permit from the UK Environment Agency will be required for the disposal of radioactive waste from the site. This permit would include limits on the radioactive materials that could be disposed of from the site and the conditions that the operator would need to comply with, including the requirement to undertake monitoring, recording and reporting of discharges and their impacts.

It is currently assumed that a maximum of 90 spent fuel assemblies would be removed every 18 months of operation from each reactor unit, giving rise to an estimated 6,800 fuel assemblies over the expected operation lifetime of 60 years. The on-site Interim Spent Fuel Store is designed to hold 7,378 fuel assemblies to allow for extra storage capacity.

Spent fuel removed from the reactors would initially be stored underwater in a reactor fuel pool. Following this initial storage period, the spent fuel assemblies would be transferred to the Interim Spent Fuel Store where they would be stored until a UK Geological Disposal

[1] https://www.housing.gov.ie/planning/other/transboundary-environmental-public-consultation-sizewell-c-nuclear-power-station

Facility is available and the spent fuel is removed for final disposal. All radioactive waste despatched from the site would need to comply with applicable UK and international legislation at the time of despatch, including the relevant requirements of the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (as amended), or equivalent. Each consignment would undergo the required contamination monitoring and external radiation measurements before leaving the site.

Decommissioning of the new reactor units at Sizewell C would be subject to a new EIA procedure. The reactor units have been designed to minimise the amount of radioactive waste to be managed at decommissioning. The estimated time it would take to achieve decommissioning is estimated to be 25 years of the end of generation. The Interim Spent Fuel Store would continue to operate until a Geological Disposal Facility is available in the UK and the spent fuel is ready for disposal.

1.3. Major Accidents and Disasters

The Environmental Statement (ES) presents an assessment of the major accidents and disasters that have the potential to arise during the construction and operation of the Sizewell C power station. The scope of assessment considers the likelihood and the reasonably foreseeable worst-cast environmental consequence of potential hazards and threats that could occur during construction and the operation of the facility. These included a civil nuclear incident or major accident at Sizewell C (including nuclear incidents, internal hazards, aircraft crash, major leaks and spillage). The EIA also considered hazards and threats from natural sources such as extreme weather events and geological hazards, sources within the site and sources off-site.

As stated in the ES, the major accidents and disasters assessment has a number of limitations, including the fact that no modelling or detailed calculations were undertaken as part of the assessment process. Therefore, while the second transboundary screening undertaken by the UK Planning Inspectorate in June 2020, on behalf of the Secretary of State following acceptance of the application, concluded that the proposed development of this new nuclear power station is not likely to have a significant effect on the environment in any other EEA State, the EPA believes that this EIA does not sufficiently address the transboundary implications of a severe accident.

It is noted that prior to the start of operation SZC Limited will be required to identify all events that have the potential to cause an emergency, and then evaluate the range of possible on and off-site consequences for the range of events identified so that emergency planning zones can be established to enable the local authority to alter existing or develop and implement effective and proportionate emergency response plans. In addition, a detailed assessment of site-specific nuclear safety and security risks would be undertaken as part of the nuclear site licensing regime.

1.4. Climate Change Impacts

The EIA addressed the potential impact of climate change. Suffolk is predicted to experience an increased frequency and severity of flooding, sea level rise, more frequent and stronger storms, increasingly wet winters and drier summers. The consideration of increased frequency and severity of natural hazards due to climate change, was included in the assessment, and no significant effects were identified provided mitigation was in place to take account of the likely changes to climate variables. These include a specified minimum platform height to reduce the risk of the main platform and access to it from being flooded and the provision of a continuous hard coastal sea defence feature which would tie into Sizewell B sea defences.

2. EPA Assessment of the Potential Impact on Ireland from Sizewell C

The Sizewell C site is located on the east coast of England and is over 520 km from the east coast of Ireland. Routine discharges to air and water, under permit from the UK Environment Agency, would occur during operation of the plant including the discharge of long-lived radionuclides which would remain present in the environment after the plant ceases to operate. Such emissions would be subject to controls through the UK Environmental Permitting regime. A report from the Radiological Protection Institute of Ireland (RPII) in 2013, *"Assessment of the potential radiological impacts on Ireland of the UK's proposed nuclear power plants*"[2], concluded that the routine operation of the proposed nuclear power plants (including Sizewell C) would have no measurable radiological impact on Ireland or the Irish marine environment. In this report it was estimated that the total annual radiation dose to a person in Ireland after 50 years of constant and continuous discharges to air from the operation of a new nuclear power at the Sizewell C site (0.001 μSv/y) was well within the radiation dose limit for a member of the public (1,000 μSv/y).

As well as assessing routine operations, the 2013 RPII study also assessed the radiological impact on people in Ireland from five potential accident scenarios. A number of severe accident scenarios that could cause significant radiological impacts to Ireland were identified in this study. While the likelihood of occurrence of such accidents may be low, if they were to occur they could result in a significant transboundary impact on Ireland. In the 2013

[2] https://www.epa.ie/pubs/reports/radiation/Potential_radiological_impact_Ireland.pdf

assessment the Wylfa site, being the closest of the eight locations identified by the UK Government for construction of new nuclear power plants, was identified as the accident location which would give rise to the 'worst case' in terms of radioactive contamination and radiation dose in Ireland. Apart from the amount of radioactivity released to air, weather was found to be the most significant factor in estimating the impact on Ireland. In cases where the weather conditions at the time of the accident gave rise to the radioactivity released being carried directly to Ireland it was found that food controls and/or temporary agricultural protective actions would be required for a period ranging from days and weeks to many years depending on the severity of the accident.

The Sizewell C site is over 400 km further away from Ireland than the Wylfa site. In the 2013 RPII study it was estimated that the concentrations of radioactivity in the air and radioactive contamination on the ground on the east coast of Ireland following unit accidental releases from Sizewell C were approximately one order of magnitude lower than those from Wylfa. However, a severe accident at Sizewell C (combined with unfavourable weather) which resulted in radioactive contamination in Ireland could also lead to food controls and agricultural protective actions being introduced. Indeed, the 2016 report "*Potential Economic Impact of a Nuclear Accident - An Irish Case Study"*[3] by the Economic and Social Research Institute found that if there was an accident at a nuclear power plant in north-western Europe which resulted in no actual contamination in Ireland, there would still be an impact on Ireland in terms of reputational losses, particularly in relation to tourism and export markets, in the region of €4 billion. This indicates the need to maintain arrangements under the national emergency plan for such an accident, despite the low probability of it occurring.

3. Conclusion

While there is no measurable radiological impact expected from the operation and routine environmental releases from Sizewell C, a previous assessment from the RPII has shown that there is the potential for significant transboundary effects in Ireland if a severe (albeit unlikely) nuclear accident occurred at the Sizewell C site. A severe accident at the site in conjunction with unfavourable weather conditions could give rise to radioactive contamination in Ireland and necessitate the introduction of food controls and agricultural protective measures to minimise the radiation dose to people in Ireland. In addition, a recent study by the ESRI has shown that a severe nuclear accident occurring anywhere in north-western Europe would

[3] https://www.dccae.gov.ie/en-ie/news-and-media/publications/Pages/The-Potential-Economic-Impact-of-a-Nuclear-Accident.aspx

impact Ireland's economy even where no radioactive contamination is deposited in the country.

Veronica Smith

Ciara McMahon

22 October 2020

Transboundary environmental public consultation – Sizewell C Nuclear Power Station",

The Sizewell C Project, a new nuclear power station in Suffolk, on the East coast of England may pose a lower risk to Ireland than England's other nuclear proposals along its west coast but that is not to say that there is zero risk to the Irish public.

Therefore, Sinn Fein welcomes the British Department for Business, Energy and Industrial Strategy (DBEIS) compliance under the terms of the 1991 United Nations Espoo Convention[1] and the 2011 EU Environmental Impact Assessment Directive[2] in its facilitation of a transboundary public consultation in respect of the Sizewell C Project and its potential impacts on neighbouring States.

Brexit & Euratom

As part of Brexit, the British Government have also opted to leave Euratom[3], the European Atomic Energy Community. Sinn Féin opposes nuclear energy and the use of Irish taxpayers money going towards the operating costs of Euratom, however, it does acknowledge that as a nuclear power, Britain being a member of Euratom meant that it was subject to the European Court of Justice and to a coordinated regulatory regime.

Concerns have been raised by the British nuclear regulatory body, ONR regarding Britain's readiness to leave Euratom. They have expressed concerns regarding a skills shortages to deliver a British State System of Accountancy for control of nuclear material to meet its international obligations.

ONR also expressed concerns regarding a replacement IT system to track nuclear material and whether it can be delivered on time and be effective.

They also expressed concerns regarding the long-term funding of the new nuclear regulator.

Sinn Féin would therefore like to express our concern that on completion of Brexit and their leaving of Euratom, the British Government will no longer be subject to legal proceedings at the European Court of Justice if they fail to comply with nuclear safety regulations.

Nuclear Incident

While the chances of a nuclear incident occurring are low, the impacts of such an incident are substantial both on human life and the economy. The Radiological Protection Institute of Ireland (RPII) recognised that even though the concentrations of radioactivity in the air and radioactive contamination on the ground on the east coast of Ireland in the event of an incident at Sizewell C would be one order of magnitude lower than if an incident occurred at the closest nuclear site, Wylfa, an incident at Sizewell C could still result in food controls and agricultural protective actions being introduced in Ireland.[4]

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[1] https://www.unece.org/fileadmin/DAM/env/eia/documents/legaltexts/Espoo_Convention_authentic_ENG.pdf

[2] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:026:0001:0021:EN:PDF

[3] http://www.onr.org.uk/safeguards/euratom.htm

[4] https://www.epa.ie/pubs/reports/radiation/RPII_Proposed_Nuc_Power_Plants_UK_13.pdf

The Economic and Social Research Institute (ESRI) study conducted in 2016- *The Potential Economic Impact of a Nuclear Incident — An Irish Case Study*[5] estimated the potential financial losses to Ireland in the event of a nuclear incident to be as high as €160bn.

Even in the lowest risk scenario where there is no actual contamination in Ireland, the reputational losses in relation to tourism and export markets could be as high as €4bn.

Given that Ireland relies heavily on its food exports and tourism, in the event of an incident even the perception of contamination would lead to a significant economic impact.

Conclusion:

Given the absence of access to the European Court of Justice post Brexit, the ambiguity of the long term funding of a new nuclear regulator and the potential impacts to the Irish public and their economy, Sinn Féin would like to register our objection to the proposed development of the Sizewell C nuclear power station in Suffolk.

5 https://www.esri.ie/publications/the-potential-economic-impact-of-a-nuclear-incident-an-irish-case-study