

Introduction

This is a summary of the detailed submission to the Natural Resources Wales (NRW) pre-application consultation on EdF's plans for more "dredging and dumping" in 2021. The submission was written by Tim Deere-Jones on behalf of CND Cymru, the Nuclear Free Local Authorities (NFLA) Welsh Forum, and Stop Hinkley, and submitted before the 18th March closing date for the consultation.

EDF has submitted its plan to NRW for the sampling and testing of the sediment from the construction site of the Hinkley Point C power station off the Somerset coast in England. NRW's role will be to determine whether the sediment, up to 600,000 m³, is suitable for disposal at sea, but will first assess the suitability of the sample plan to inform any future licence application for its disposal in Wales.

1. The discharge of "enhanced particles" from nuclear power stations

Section 1 details academic papers which report that civil reactor sites have discharged "particles" of "enhanced" radioactive material into receiving marine environments and that, at the only UK civil reactor site (Chapelcross A Magnox station) where a search for such "particles" has been carried out, they have been found in some considerable quantity. It is recorded that the "particles" found at Chapelcross all had "enhanced" and "elevated" levels of radioactivity and that some of them were identified as "particles of irradiated uranium" likely to have "come from degraded fuel".

Noting that both the Chapelcross Magnox site and the Hinkley Point A Magnox site were implicated in the production of weapons grade Plutonium, the Campaign postulates that, in the absence of evidence to the contrary, it is possible that such particles may be present in the Bridgwater Bay sediments.

Noting that the Campaign's previous submissions to NRW on this issue had received no response and NOT been acted upon, the Campaigns Consultation demands that NRW ensures that the proposed EdF sampling and analysis of Bridgwater Bay sediments must include a comprehensive analysis of ALL samples for the presence of these elevated radioactivity "particles".

2. Sampling for Plutonium isotopes

Section 2 discusses the liquid effluent discharge records, which clearly show that, during the years of UK weapons grade Plutonium production, the Hinkley Point A discharges of liquid effluent Plutonium to the Bridgwater Bay receiving environment rose rapidly and peaked at an average of 10 times the magnitude of pre-production years.

Noting that this issue had also been raised through 2017/18 but had received no response and not been acted upon, the Campaign has now demanded that NRW insist that the proposed EdF sampling and analysis of Bridgwater Bay sediments must include a comprehensive analysis of ALL samples for the presence of Plutonium isotopes.

3. IAEA assumptions on the assumed pathways to radiation exposure

Sections 3, 4 & 6 of the detailed response note that through 2017/18 NRW, EdF and CEFAS (who undertake marine sampling for the environmental regulators) were in agreement that the IAEA list of assumed pathways by which coastal populations could be exposed to radioactivity dumped into coastal waters (seafood dietary intake, external exposure to radio activity deposited on the shoreline, ingestion of beach sediment, inhalation of beach sediment and inhalation of sea spray) was exhaustive and included all relevant parameters.

Through 2017/18 the Campaign's position was, and is, that the IAEA assumptions were simplistic, based on hypothetical modelling and did not take account of the advance of empirical scientific evidence on pathways of exposure. Section 3 of the Campaign's current submission summarises the empirical data showing that a number of pathways NOT listed by the IAEA actually have greater potential radiological impact than some of those which are listed. In particular the Campaign has supplied evidence that various processes of sea to land transfer may expose coastal populations to doses of man-made radioactivity in excess of those likely to be received by populations exposed via the pathways listed by the IAEA assumptions.

These processes include coastal flooding of urban environments and coastal pastures (empirically proved exposure pathways by inhalation, contact and dietary agricultural produce), and transfer of radioactivity dissolved in water or attached to airborne, inhalable sedimentary micro particles in sea spray and micro-droplet marine aerosols (empirically proved inland penetration of at least 10 miles with dietary pathway doses of marine radioactivity [from contaminated terrestrial farm/horticultural produce] in excess of some seafood consumers, and the strong likelihood of inhalation doses).

Noting the absence of these parameters from the IAEA's pathways list, and observing that there is no legal insistence that the Welsh Government and NRW may not improve on inadequate and outdated IAEA protocols, the Campaign has demanded that NRW take note of the updated empirical data and ensure that EdF commission both baseline (pre second dump), and post second dump analysis of south Wales coastal sediments and coastal zone environments in order to identify any variations in the radiological concentrations which may arise as a result of the proposed dump.

4. Monitoring and analysis of tritium

Section 5 notes that there is a similar imperative for the monitoring and analysis of Tritium and Organically Bound Tritium (OBT) in the Bridgwater Bay sediments to be dredged and dumped at the Cardiff Grounds site.

The Campaign re-iterates the concerns it raised, during the 2017/18 Senedd Petitions Committee hearings of evidence, that the Welsh Government, NRW, EdF and CEFAS were once again "behind the curve" in respect of their appreciation of the significance of tritium discharges to the marine environment and the subsequent Organic Bonding of tritium from tritiated water. During those hearings the Campaign submitted evidence from peer reviewed journals and publications from the UK nuclear regulators, which demonstrated the very high biological accumulation of OBT through marine food webs, with massive accumulations empirically proved for apex consumers (10 Bq Kg of tritium as tritiated water in Bristol Channel water to 61,000 Bq/Kg in Bristol Channel shelduck).

The Campaign notes the recent consensus that tritium from tritiated water becomes absorbed into marine sedimentary organic material (plant debris, lipids, proteinaceous material etc) and that tritium is associated by "greater than 95% digestion in untreated estuarine particles", but also notes the absence of any detailed study of OBT in Bridgwater Bay marine sediments. The Campaign references an academic paper which reports findings that OBT in soils could probably have a lifespan of decades.

In that context, noting that the Bridgwater Bay environment is widely and consensually agreed to be a "sink" of regional fine sediments and their associated pollutants, the Campaign demands that

NRW exercise their authority (as the Welsh Environment Protection Agency and the Welsh Nuclear Regulator) and insist that EdF commission analysis of OBT in:

- South Wales coastal sediments and coastal zone terrestrial environments.
- Somerset coastal sediments and coastal zone terrestrial environments to ascertain the pre (second) dump concentrations of OBT currently present.
- The Bridgwater Bay sediments, in order to acquire a relevant suite of baseline data against which to compare and contrast the impacts of any further dredge and dump activity.

5. Comparing Sellafield experience to the Bristol Channel

Section 7 of the submission takes issue with the EdF, CEFAS and NRW assertion that the use of radiological data derived from the Sellafield experience in hypothetical models applied to Bristol Channel radiological parameters is not a scientifically rigorous approach, and does not guarantee a “conservative” outcome for Bristol Channel models.

The Campaign’s submission references academic, and peer reviewed studies, which clearly demonstrate that the Severn Estuary and, to a lesser extent, the Inner Bristol Channel, have up to 2000 times higher concentrations of water column suspended fine sediments than the Sellafield coast, and that the adsorption of radioactivity to sedimentary particles is widely recognised as a major factor in the behaviour and end fate of sediment associated radioactivity discharged to sea.

The Campaign further references academic and Nuclear Industry studies stating that concentration of alpha emitters, such as Plutonium, in sea spray and marine aerosols are “approximately proportional to the concentration of sediment in the water”.

In this context the Campaign concludes that NRW, EdF and CEFAS have a limited understanding of Severn Estuary/Inner Bristol Channel sediment parameters (due to a lack of relevant research) and demands that NRW commission empirical studies to investigate the sediment concentrations of Severn Estuary water columns, sea spray and micro-droplets from marine aerosols, in order to ascertain whether or not they have higher sediment loadings and higher adsorbed radioactivity concentrations than predicted by the use of theoretically conservative assumptions.

6. The fate of sediment radioactivity following the first dredging application

Sections 8 & 9 report on the fate and behaviour of sediment radioactivity suspended and re-distributed to the regional marine environment following EdF’s construction and dredge related activity in Bridgwater Bay.

The Campaign notes that it had raised the issue of the lack of data on the behaviour and fate of radioactively contaminated sediments dumped at the Cardiff Grounds “dispersal” site, through the Senedd Petitions Committee hearings of evidence, and had recommended and requested NRW to initiate appropriate research on that issue. The Campaign notes also that NRW did not comply with this request and thus concerns about the lack of information on the potential radiological effect of the dump remain unanswered.

In that context, the Campaign undertook a review of the effects of the Bridgwater Bay intertidal and subtidal construction activity through 2017 and 2018 by comparing the sediment (and other) analytical results published in the annual RIFE reports for those years and some years prior. This review took the published outcomes for the years 2013 through to 2016 (inclusive) as baseline data

and compared them to the outcomes for 2017/18 when there was reported construction activity in the Bridgwater Bay inter and sub tidal zone.

The Campaign's review of this data showed that the construction linked disturbance of previously sequestered radioactive sediments had generated an increase of the concentrations of Americium 241 and Cobalt 60 radioactivity in Bridgwater Bay shoreline intertidal sediments analysed through 2017/18, had generated elevated gamma readings above intertidal shoreline sediments, and generated a 215% increase in "total dose to the public". The Campaign's review of the data also noted that these effects were discernible for at least 12 miles downstream/down coast from the construction area.

The Campaign concludes that a similar range of effects are likely to have occurred along the south Wales coast following the 2018 dump of Bridgwater Bay dredged sediment at Cardiff Grounds and that this is likely to be followed by another similar impact following EdF's second proposed (2021) dump of Bridgwater Bay dredged waste at Cardiff Grounds.

The Campaign contends that NRW's failure to initiate appropriate baseline research prior to, and following, the 2018 dump of Bridgwater Bay dredged sediments means that there is no evidence of any malign/deleterious effect on the Welsh coast of such activity. The Campaign notes that, intentional or not, this failure may have long term negative impacts on the Welsh environment and the coastal communities of south Wales, while it can only be of benefit to EdF.

Accordingly the Campaign, demands that NRW initiate:

- a radiological analysis study of the current (post first dump) baseline for the south Wales coasts;
- a radiological analysis study into the potential future radiological impact outcomes of the proposed 2021 Cardiff Grounds dump activity.

7. The lack of data on the behaviour and fate of sedimentary data that is dumped

Section 9 additionally notes that the Campaign had submitted written evidence to the Senedd Petitions Committee highlighting the lack of any data addressing the behaviour and end fate of sedimentary material dumped at the Cardiff Grounds dispersal site. Section 9 reports that, as a result of the Campaign's submission, the Senedd Petitions Committee specifically requested that NRW and EdF supply the requested data.

Section 9 &10 note that, after repeated promptings from the Campaign and the Senedd Petitions Committee, a file of data was submitted by NRW. The Campaign's review of this material reports that it consists of a collection of papers with little relevance to the fate of sedimentary material dumped at the Cardiff Grounds and that the papers had been collated by CEFAS with no apparent input from NRW. The Campaign's review noted that NONE of the papers reported any studies directly related to the dumping of sediments at the Cardiff Grounds, that most of them were concerned with marine aggregate (sand and gravel) resources and extraction and that several of the papers commented that "the present state of knowledge is still insufficient to understand fully sediment supply and transport within such a complex system", that "much of the research and data collection was undertaken several decades ago, hence there is a requirement for further investigation" and that "the study and understanding of Bristol Channel sediments is now "additionally complicated by large scale ecosystem collapse due to climate change".

In the context of the above, the Campaign contends that NRW, EdF and CEFAS have no detailed and comprehensive understanding of the behaviour and end fate of Bridgwater Bay sediments dumped at the Cardiff Grounds dispersal site and that it is clear that prior to any further such action a long range and long term study must be initiated in order to acquire the relevant data.

Accordingly, the Campaign demands that NRW initiate such studies and reject any further proposal from EdF until such studies have been carried out, been subjected to academic peer review and consensually agreed to be a reasonable empirical and factual account of the relevant parameters.

The Campaign notes that had a thorough Environmental Impact Assessment (EIA) been insisted upon when EdF submitted their original proposals in 2012, these issues may well have been addressed at that stage.

The Campaign demands that NRW and the Welsh Government initiate a full and detailed EIA, scoped by an independent panel of experts NOT including those who may benefit from the permitting of the proposed 2021 dredge and dump exercise

8. Radiological Analytical Methods – Technical Issues

Sections 11 to 17 of the joint detailed response consider some of the technical issues around the methods for analysing the data of marine samples.

The Campaign has, through the Senedd Petitions Committee hearings of verbal and written evidence, submitted a considerable body of evidence reviewing and critiquing the analytical methodology employed by CEFAS on behalf of EdF.

Sections 11,12 & 13 of the Campaign's submission notes that during Senedd Petitions Committee hearings of evidence, Committee member Neil McEvoy AM's asked EdF: "in effect if all the man-made radionuclides were tested for through that process?" EdF's Peter Bryant confirmed EdF's position by replying "Yes". In response to EdF's position, the Campaign's contends that EdF have "mis-spoken" because the Gamma spectrometry used by CEFAS can only identify radionuclides which give off gamma rays.

The Campaign cites a statement (from the CEFAS reporting of 2017 analysis of Bridgwater Bay sediments by Gamma Spectrometry) that "in addition to the nuclides detected by gamma spectrometry, sediments are also known to contain ... Plutonium radionuclides" (alpha emitters which do not give off gamma rays) and that CEFAS had carried out hypothetical calculations to achieve "derived" "estimates" of the three Plutonium nuclides on the assumption that their activity was proportional to one of the detected gamma emitters. The Campaign notes that this statement is in contradiction to the EdF claim cited in the previous paragraph.

In support of its contention that Gamma Spectrometry cannot possibly have identified all of the radio nuclides present in the Bridgwater Bays sediments, the Campaign's submission provided several paragraphs of fully referenced academic discussion and reporting of the performance of gamma, beta and alpha radio analysis. The Campaign's submission also provided a list of 10 nuclides known to be present in the Hinkley Point A and B liquid effluent discharges which would not be detected by gamma spectrometry because they do not give off gamma rays.

In the context of the above, the Campaign concludes that NRW, EdF and CEFAS do not have a full knowledge or understanding of the number of concentration of man-made radionuclides present in

the Bridgwater Bay sediments, which were dumped at Cardiff Grounds during 2018, and which are proposed for dumping in the second round of activity in 2021.

Section 14 of the Campaign's submission addresses the Gamma spectrometry "less than" analytical outcomes presented by EdF/CEFAS in tables of results for three Bridgwater Bay/Hinkley sediment reports (2009, 2013 and 2017) and noted that such "less thans" are claimed by nuclear monitoring and regulating agencies to occur as a result of the "limitations" of the equipment and methodologies deployed during analytical investigations.

The Campaign's notes the widely disparate outcomes across surveys, where the same equipment and methodologies were being used on all samples. A 2013 survey of the alpha and gamma emitting Americium 241 in 17 samples recorded 14 results as "less than" and 3 as positive. "Less than" results varied widely, with the lowest sample reported as "less than" 0.66Bq/Kg and the highest as "less than 1.71 Bq/Kg, with the maximum twice as high as the minimum.

The Campaign's submission notes that, of the 3 positive Americium 241 results, one was reported as 0.63 Bq/Kg and another as 0.97 Bq/Kg, both of which were higher readings than most of the "less thans". The Campaign noted that similar outcomes were reported in 2009 and 2017 for both Americium 241 and Cobalt 60 analyses.

The Campaign concludes that using a methodology with such inherent "limitations", for the analysis of Bridgwater Bay sediments has generated contradictory and confusing outcomes. The Campaign is not convinced that such methodologies and equipment are of the highest quality and representative of the best available techniques. The Campaign demands that NRW initiate gamma, beta and alpha analytical methods to the best available standards in order to generate the most accurate representation of total concentrations and hence the most precise dose estimates.

Section 15 of the Submission offers a review of recent (post 2000) fully referenced, peer reviewed studies which make it clear that a crucial factor in gathering truly accurate data on the concentration of radioactivity in samples is the duration of the "counting time". Having obtained the "raw" data of the CEFAS gamma spectrometry analysis of Bridgwater Bay sediments, the Campaign can confirm that the counting time employed by CEFAS was approximately 55,000 seconds or about 15 hours.

The Campaign notes that the IAEA and UNSCEAR agree that "Better average values can be obtained by acquiring data over longer time periods" and "for the analysis of environmental samples ... a relatively long counting time is required e.g. 1-2 days to obtain accurate and precise results" (thus contradicting one aspect of EdF's claim that every aspect of the analysis has the full support of the IAEA).

The Campaign reviews a number of scientific and academic studies which demonstrate that lowest errors in outcomes may be achieved by deploying "counting times" of 36 to 72 hours and notes that some commentators indicate that the use of a 15 hour count time, rather than a 36 to 72 hour count time, is based in part on financial considerations.

The Campaign has little faith in the accuracy or veracity of the data produced for EdF by CEFAS using such methodologies and "counting times". The Campaign demands that NRW ensure that all proposed 2020 Bridgwater Bay sediment samples are subjected to the most effective counting times (at least 3 days duration) in order to achieve the lowest possible errors and provide the most

accurate concentration data for each radio nuclide in order to generate the most accurate dose estimates for workers and coastal populations.

Sections 16 & 17 review EdF's alpha analysis proposals for the Bridgwater Bay sediments and notes that CEFAS have proposed, on EdF's behalf, that only 2 of 35 samples should be subjected to alpha analysis for Plutonium 239/240 and Americium 241. This is a vitally important issue because of the close relationship between Plutonium and Americium and (by adsorption) marine fine sediments

The Campaign notes that there are four sectors of Bridgwater Bay where dredging of fine sediment is scheduled, and reviews scientifically referenced, peer reviewed papers reporting that major spatial variability of grain size (across sediment rich UK coastal regions) had been recorded at the 100x 12 metre scale (with a 66% range difference between radiological dose rates) and that more recently it had been reported that the variation within a 1 metre square was perhaps "greater than the larger scale".

The Campaign contends that, in order to acquire data generating a full understanding of the distribution of anthropogenic radioactivity across the Bridgwater Bay dredge environments, NRW must insist that the number of sample points within the identified dredge areas should be at least doubled, so that samples are no more than 50 metres apart and that ALL proposed samples should undergo grain size analysis. Additionally, the Campaign demands that borehole samples should not be analysed on a bulk basis, but should be sub-samples in relatively short sections (20cms) in order to identify those depths, and sediment types, with the highest concentrations of fine sediments and radioactivity concentrations.

9. EdF dredge and dump activity in the context of the 1992 Rio Declaration

Section 18 considers the EdF dredge and dump activity and the associated past and (proposed) future sampling and analytical programmes in the context of the 1992 Rio Declaration (on the sustainable use of the environment) and expresses concern that the Welsh Government and the NRW may have denied the communities and individuals of the south Wales coastal zone a suite of information relevant to their physical and psychological health and the health and wellbeing of current and future generations, in breach of various "rights" encapsulated by the Rio Declaration. The Campaign demands that the Welsh Government and the NRW comment on these issues and publish the detailed opinion of their legal advisors.

10. Legal issues around the Cardiff Grounds use as a dispersal site

Sections 19 & 20 examine the question of whether the Cardiff Grounds dispersal site is situated in a "sea, a marine environment or an estuary and offers a review of various environmentally based definitions of the term "estuary" and a brief review of a legal paper discussing the difference between estuaries and the sea. The Campaign demands that the Welsh Government and the NRW comment on these issues and make public the full opinion of their legal advisors.

The Campaign's submission also includes technical annexes and has been supplemented by a Legal Framework Submission from the Environmental Law Group of the Cardiff University Law School which sets out a series of legal frameworks and concludes that:

"If satisfactorily complied with, the above legal framework should see that decisions relating to the Hinckley C site are safe for the environment and public health. When the results of the sampling are obtained, it will be possible for an environmental impact assessment of the dumping proposal to be carried out, based on fuller knowledge of the risks and issues. It is vital that the sampling process is

transparent, and that any advisory group with input into decision making is inclusive of a wide range of expertise, including that within the group of objectors to the proposal.”

11. Conclusion – key concerns and actions required

The core issues raised in this submission include:

- Civil reactor sites have discharged “particles” of “enhanced” radioactive material into receiving marine environments over the course of their generating life.
- NRW should ensure that the proposed EdF sampling and analysis of Bridgwater Bay sediments must include a comprehensive analysis of ALL samples for the presence of these elevated radioactivity “particles”.
- The liquid effluent discharge records clearly show that, during the years of UK nuclear weapons grade plutonium production, the Hinkley Point A discharges of liquid effluent plutonium to the Bridgwater Bay receiving environment rose rapidly and peaked at an average of 10 times the magnitude of pre-production years. NRW should insist that the proposed EdF sampling and analysis of Bridgwater Bay sediments must include a comprehensive analysis of ALL samples for the presence of Plutonium isotopes.
- The submission argues that the IAEA assumptions on assumed pathways to which coastal populations could be exposed to low levels of radiation are simplistic, based on hypothetical modelling and do not take account of the advance of empirical scientific evidence on pathways of exposure. NRW should take note of the updated empirical data and ensure that EdF commission both baseline (pre second dump), and post second dump analysis of south Wales coastal sediments and coastal zone environments in order to identify any variations in the radiological concentrations which may arise as a result of the proposed dump.
- There is a similar imperative for the monitoring and analysis by EdF of Tritium and Organically Bound Tritium (OBT) in the Bridgwater Bay sediments to be dredged and dumped at the Cardiff Grounds site.
- The submission references academic, and peer reviewed studies, which clearly demonstrate that the Severn Estuary and, to a lesser extent, the Inner Bristol Channel, have up to 2000 times higher concentrations of water column suspended fine sediments than the Sellafield coast, and that the adsorption of radioactivity to sedimentary particles is widely recognised as a major factor in the behaviour and end fate of sediment associated radioactivity discharged to sea. The submission is concerned that NRW, EdF and CEFAS have a limited understanding of such activity.
- The submission has consistently raised the issue of the lack of data on the behaviour and fate of radioactively contaminated sediments dumped at the Cardiff Grounds “dispersal” site, through the Senedd Petitionss Committee hearings of evidence. It had previously recommended and requested NRW to initiate appropriate research on that issue. Such research by NRW has not been undertaken.
- As a result, the Campaign undertook a review of the effects of the Bridgwater Bay intertidal and subtidal construction activity through 2017 and 2018 by comparing the sediment (and other) analytical results published in the annual Radioactivity in Food in the Environment (RIFE) reports for those years and some years prior. The review of this data showed that the construction linked disturbance of previously sequestered radioactive sediments had generated an increase of the concentrations of Americium 241 and Cobalt 60 radioactivity in Bridgwater Bay shoreline intertidal sediments analysed through 2017/18, had generated elevated gamma readings above intertidal shoreline sediments, and generated a 215% increase in “total dose to the public”. The Campaign’s review of the data also noted that these effects were discernible for at least 12 miles downstream/down coast from the construction area.

- The submission calls on NRW to initiate a radiological analysis study of the current (post first dump) baseline for the south Wales coasts and into the potential future radiological impact outcomes of the proposed 2021 Cardiff Grounds dump activity.
- The submission calls on NRW and the Welsh Government to initiate a full and detailed Environmental Impact Assessment, preferably scoped by an independent panel of experts.
- The submission contends that, in order to acquire data generating a full understanding of the distribution of anthropogenic radioactivity across the Bridgwater Bay dredge environments, NRW must insist that the number of sample points within the identified dredge areas should be at least doubled. The submission also requests that borehole samples should not be analysed on a bulk basis, but should be sub-samples in relatively short sections (20cms) in order to identify those depths, and sediment types, with the highest concentrations of fine sediments and radioactivity concentrations.
- The submission postulates that the Welsh Government and the NRW may have denied the communities and individuals of the south Wales coastal zone a suite of information relevant to their physical and psychological health and the health and wellbeing of current and future generations, in breach of various “rights” encapsulated by the 1992 Rio Declaration.
- A legal question has arisen over whether the Cardiff Grounds dispersal site is situated in a “sea, a marine environment or an estuary”. The submission calls on the Welsh Government and the NRW to comment on these issues and make public the full opinion of their legal advisors.