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1: Baseline data:

1:1 Introduction: Acquisition of baseline data is of the greatest importance when assessing the risks attached to any major development involving the proposed deposition/dumping of large volumes of radio-active sediments which might be radio-toxic to the environment or deleterious to public health.

1:2 Baseline data provides information on the current levels of such material in the immediate “receiving” environment and those “downstream” areas likely to be impacted in the intermediate or long term. Such information enables both the assessment of current environmental concentrations of the radio-active materials and the monitoring and analysis of trends following the disposal/dump of the radioactive materials.

1:3 Full and detailed baseline data on the radio-activity in the sedimentary material proposed for the disposal/dump will permit a fuller understanding of the potential risks, potential pathways of exposure and potential doses of radio-activity to the public.

1:4 Baseline data on the fate and behavior of sediments, and their associated pollutants, dumped at the Cardiff Grounds site is similarly vital for the identification of those regional inter-tidal and sub-tidal deposits (mud flats, salt marsh etc) where marine sediments, suspended in the water column after being dumped at the Cardiff Grounds site, will eventually be deposited.

1:5 Baseline data would provide highly relevant information on the significance (to the Bristol Channel, Welsh coastal zone) of those sea to land transfer mechanisms reported to be occurring on the north and west coasts of Wales (coastal flooding, inland penetration of sea spray and marine aerosols).

1:6 The texts of the Campaign’s Petition to the National Assembly listed the Campaign’s concerns and included reference to a number of issues relating to the absence of baseline environmental and radiological data and requested that the National Assembly seek to arrange for the clarification, and data improvement re such issues.

The Senedd Petitions Committee first meeting (21st Nov) appeared to support that position and to express agreement with the need to acquire more information and clarification.

1:7 After many weeks of public discussion, followed by presentations to, and cross examination by, the Senedd Petitions Committee, there are still a number of outstanding issues about which EDF, the proposers of the “Dump/disposal”, have supplied none of the requisite” baseline” data.

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2: The Precautionary Principle (PP) is detailed in Article 191 of the Treaty on the Functioning of the European Union. The PP aims at ensuring a higher level of environmental protection through preventative decision-taking in the case of risk. In other words, prevention is better than cure, also called the “preventative principle”.

2:1 A twenty-nine page Communication on the PP issued by the European Commission (EC) in February 2000 provides detailed guidelines on when recourse to the PP should be triggered. The Communication defines the PP as a risk management tool which is to be applied only after a scientific evaluation of the available risk data (i.e., risk assessment). **The Communication describes two outputs from this risk assessment that are necessary to justify recourse to the precautionary principle.**

2:2 The risk assessment must

A: identify potentially negative effects resulting from the product or activity, and/or

B: the available scientific data must be so insufficient, inconclusive, or imprecise as to make it impossible to "determine with sufficient certainty the risk in question." (*Ref: European Commission, Communication for the Commission on the Precautionary Principle (2000). Mossman & Marchant: Precautionary Principle & Radiation Protection*)

2:3 In the context of the Linear Non Threshold effect (i.e. that no dose, to humans, of radioactivity is absolutely without impact) a major component of the Campaign's concern about the proposed dump is the widely supported view **that the available data is so insufficient, inconclusive, or imprecise as to make it impossible to determine, with sufficient certainty, the risk in question.**

In that context, the Campaign also asserts that there **may be potentially negative effects resulting from the activity proposed by EDF.**

Therefore the campaign invokes the Precautionary Principle until such time as the scientific data is suitably **sufficient, conclusive and precise as to "determine with sufficient certainty the risk in question."**

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3: Bristol Channel hydrodynamics

3:1 Water body movements in the Bristol Channel: The "general" movement of the water column is as follows: Marine/oceanic water, derived in part from the N/.Atlantic Drift current enters the Channel, in an eastward flowing direction, along the English coasts of Devon, Somerset and Avon. In the Severn Estuary sector this water body crosses to the south coast of Wales and then moves westward along that coastline towards the Pembroke peninsula before entering the Irish Sea via the Cardigan Bay.

3:2 This general water body movement is subject to modification by wider sea area, and more localized, natural phenomena such as spring/neap cycles, super tides, storm surges, gales and fluvial inputs moderated by rainfall. On occasion these factors may be so powerful as to temporarily disrupt the established flow for time periods reflecting the duration of the phenomena. (*REF: "Atlas of the Seas around the British Isles". Directorate of Fisheries Research. Ministry of Ag', Fish and Food (MAFF) 1981. Chapter/page 2:16*)

3:3 It is universally noted that the Bristol Channel/Severn estuary has the second most extreme tidal range in the world and that tidal influences are unusually active and relatively powerful. It is also widely understood that the Inner sections of the Bristol Channel, and all of the Severn Estuary coastline are characterized by shallow water, and extensive inter-tidal and near shore sub-tidal deposits of fine sediment, while the offshore/central zone of the Bristol Channel is characterized by deeper water channels with a largely rocky seabed

3:4 General sediment movement in the Bristol Channel: There is a strong consensus that the movement of fine sediments, suspended in the water column, is a major factor in the behavior and fate of pollutants because many toxic substances (including radioactivity) associate with fine sediments, which are potentially the most mobile sedimentary fraction under all sea conditions. (*REF: A Review of Sediment Dynamics in the Severn Estuary: Influence of Flocculation" Marine Pollution Bulletin 2010. Vol 61, Issues1-3: pps 37-51 (Para 1: introduction)*)

3:5 This review noted that "despite its high mobility, the exchange of fine suspended particulate material between the (*Severn*) estuary and the open sea occurs at relatively low rates **with a minimum retention time of at least ten years**", i.e. a long life span of fine sediments and their associated pollutants **within** the Bristol Channel sea area. (*REF: A*

Review of Sediment Dynamics in the Severn Estuary: Influence of Flocculation” Marine Pollution Bulletin 2010. Vol 61, Issues1-3: pps 37-51 (Para 3:1)

3:6 Tracer studies using “marked” fine sediments indicate that the most significant areas for deposition of fine sediments along the south coast of Wales are the coastal fringing, inter-tidal mudflats of the Gwent levels (from Cardiff eastward to the Severn Crossings), the estuaries of the Wye and Usk, and a few offshore sites such as the Newport Deep and the Nash Passage. At greater distances are the fine sediment deposits in Swansea and Carmarthen Bay and their associated river estuaries. ***(REF: A Review of Sediment Dynamics in the Severn Estuary: Influence of Flocculation” Marine Pollution Bulletin 2010. Vol 61, Issues1-3: pps 37-51 (Para 3:2)***

3:7 The review highlighted a number of significant **unknowns** with regard to the behaviour of fine sediments in the inner regions of the Bristol Channel and stated that **“With respect to current understandings of the sediment dynamics and physical processes, much of the research and data collection was undertaken several decades ago”** and comments that **“ A better understanding of these features and their linkages would improve management options for the system”**

In which context, the study lists the following research necessary in order to understand the behavior of Bristol Channel sediments and their associated pollutants

- a: investigate how flocculation (aggregation, followed by deposition) of suspended sediments responds to different degrees of turbulent mixing
- b: develop better sediment transport models to quantify the settling of flocs, erosion of bed sediments, and the settling of sediments during different tidal conditions
- c: examine how the mineralogical composition of muddy sediments influences their capability to both generate flocs and adsorb and release pollutants
- d: provide representative distributions of both suspended sedimentary matter and salinity through seasonal and neap/spring tidal cycles and time scales
- e: determine the extent to which biological processes affect the behaviour of sediments and the bio-availability of sediment associated pollutants”.

(REF: A Review of Sediment Dynamics in the Severn Estuary: Influence of Flocculation” Marine Pollution Bulletin 2010. Vol 61, Issues1-3: pps 37-51 (Para 5: pps 13 &14)

3:8 Physical empirical observation (satellite photography) clearly shows that the coastlines of the Inner Bristol Channel and the Severn Estuary (especially the estuaries and the inter-tidal zone of the south Wales coast east of Cardiff) hold major deposits of sedimentary material and that the sea area from the tidal reaches of the Severn Estuary west of the Lavernock Point/Brean Down line, is characterized as a maximum turbidity zone where the suspended sediment load is very high, with some of the highest loadings found in the UK

3:9 However, there is a consensual view that data for many of the relevant parameters at the local and regional level is incomplete and some cases weak. Certainly there is not enough observational, empirical data to provide more precise information on the movement of sediments within the Bristol Channel/ Severn estuary at large, let alone locally and at the site specific level.

3:10 Scientific reports have also commented on the lack of useful data covering such parameters in the Bristol Channel. In the absence of appropriately detailed data sets the bulk of the information currently available is reliant upon numerical/computer modeled information using inputs of whatever empirical data is available.

Thus we find that “modeling studies have been performed to investigate the hydrodynamics, sediment transport system and coastal processes in the Bristol Channel to develop the understanding of the sediment regime and be able to

differentiate sediment transport cells” (REF: “*Bristol Channel Marine Aggregates: Resources and Constraints Research Project*” Final Report: August 2000: Volume 2 : Technical Appendix 06: Section1, Page 1. DETR et Al’.)

3:11 Models clearly demonstrated that sediments were carried eastwards and inland, along the Bristol Channel coastal margins and into and up the Severn estuary on flooding tides. Stronger prevailing winds (from generally western directions) tended to increase the magnitude of the effect. Sediments thus transported consisted of fine particles suspended in the water column through to heavier particles carried closer to, or on, the seabed. Strong winds from other directions were shown to have a modifying effect on the phenomenon. (REF: “*Bristol Channel Marine Aggregates: Resources and Constraints Research Project*” Final Report: August 2000: Volume 2 : Technical Appendix 06: Section4:3, Pages25 & 26. DETR et Al’.)

3:12 The outcome of the modeling exercise clearly implies that radioactively contaminated sedimentary material from the Hinkley site, dumped at the Cardiff Grounds, would be transported eastwards and inland into the coastal margins of South Wales between Cardiff and the River Severn.

However, the Report in question warns **that the absence of empirical data means that modeled outputs should be taken as “purely qualitative rather than quantitative due to the lack of any coherent long-term sediment transport data”** (REF: “*Bristol Channel Marine Aggregates: Resources and Constraints Research Project*” Final Report: August 2000: Volume 2 : Technical Appendix 06: Section4:3, Page 28. DETR et Al’.)

3:13 Conclusion:

No reference is made to these perceived data gaps in the EDF dredge & dump proposal, or any of the EDFs recent submissions. Similarly, no reference has been made to these major uncertainties by the regulating agencies (Natural Resources Wales and the UK Env Agency), nor by the UK Marine Management Organization (who licensed the “dredge”) or by CEFAS.

In such a context it remains uncertain whether those organizations are actually even aware of these scientifically identified, and very significant, data gaps.

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4: Behaviour and fate of Bristol Channel radioactivity:

4:1 It is notable that the documentation submitted by EDF, the proposers of the Cardiff Grounds dump, has failed to address a range of baseline data issues relating to the potential radiological impact of the proposed action as follows:

- a: incomplete data on the radiological constituents of the dredged material (exactly how many of the 50+ radio-nuclides discharged from the Hinkley site are present in the sediments to be dredged and dumped?)
- b: incomplete (and now contradictory) information on “the “aggregated” radio-activity content of the 300,000 tonnes of sediment to be dumped
- c: incomplete data on the “sub-surface” radio-activity of the dredged material
- d: no data on the post-dump maritime transport of the dredged material once placed into the marine environment, (movement and final deposition of the sediments)
- e: no empirical data on the current status/concentrations of man-made radioactivity (from contemporary and historical Bristol Channel nuclear power stations: *Oldbury, Berkeley and Hinkley*) in Welsh coastal waters, welsh coastal/estuarine inter-tidal and sub-tidal sediment deposits
- f: no empirical data on the current status/concentrations of man-made radioactivity (from contemporary and historical Bristol Channel nuclear power stations: *Oldbury, Berkeley and Hinkley*) in the coastal zone (up to 10 miles inland) of south Wales

4:2 **incomplete data on the radiological constituents of the dredged material** The Campaign has consistently referenced this issue in the context of 50+ radio-nuclides known to have been constituents of the liquid radioactive waste discharges from the Hinkley nuclear sites (A & B stations) and therefore also likely to be associated with the sedimentary material to be dredged.

4:3 EDF have insisted that there is no evidence for the presence of any man made radioactivity other than the Americium 241, Caesium 137 and Cobalt 60 which the published CEFAS radio-analytical reports have mentioned. At the 5th Dec' meeting of the Senedd Petitions Committee EDF appeared to argue that the digital printout of the Gamma Spectrometry radio analysis demonstrated the absence of any man made radio-nuclides other than those 3.

4:4 However, given that the annual RIFE reports show that the 2016 analytical investigations of marine radioactivity around Hinkley analysed for a total of 11 man-made radio-nuclides, and in the context of the Campaigns (not refuted) claim that the site has historically discharged 50+ radio-nuclides, the Campaign remains un-convinced, and has **accordingly requested EDF and CEFAS to supply copies of the “digital read out” of the gamma spectrometry machine used by CEFAS in fulfillment of their contract with EDF to analyse the sediments.**

4:5 This request was made soon after the 5th of December meeting and specifically requested that the Gamma Spectrometry “digital read-out” be made available to us ASAP in order that our radio-activity specialists can review the data and the EDF claim, prior to the next proposed meeting of the Petitions Committee. To date (19th Dec: 2017) that request has not been fulfilled.

4:6 **incomplete (and now contradictory) information on “the “aggregated” radio-activity content of the 300,000 tonnes of sediment to be dumped:**

Two radiological analysis reports relating to the sediments proposed for the dredge and dump have been made available. **(REFs: CEFAS: “Radiological Assessment of Dredging Application for Hinkley Point C Power Station, Somerset (2013)”: and “Radiological analysis results from samples acquired using vibro-coring at Hinkley Point C in 2009”).**

4:7 The 2013 Assessment is assumed by the Campaign to have taken 17 “surface samples” only (i.e. from the top 5cm surface layer of the Bridgwater Bay sediments) and this assumption has not been challenged/refuted by EDF.

The Campaign has provided evidence that other studies (based on sediment core samples from elsewhere in the Irish Sea), indicate that samples from between 5 and 50cms depth show higher concentrations of man-made radio-nuclides than the surface samples.

As a result of this data, early on in its evidence, the Campaign warned that surface samples only were unlikely to be fully representative of the aggregated/total radioactivity in the dredged material.

4:8 **EDF has contested this assertion and argued that the 2013 surface sample results are confirmed by the 2009 core sample study. The regulating agencies (including the NRW) appear to have agreed with this statement.** In order to review the EDF statement and the regulators agreement with it, the Campaign has obtained, and reviewed, a copy of the outcomes of the 2009 Hinkley core samples study.

4:9 The Campaign’s review of the 2009 Core study reveals that only 5 cores were subjected to radiological analysis, that Core samples were taken using a 6 metre depth vibro-core, that the max depth of sediments analysed was 4.8 metres, that cores were cut into 1metre sections and that sub-samples from the top and bottom metres were taken for

radiological analysis, meaning that ten sub-samples were analysed : 2 cores [4 samples] at the proposed intake points, 1 set [2 samples] at the proposed discharge point and 2 sets [4 samples] from the proposed jetty site.

4:10 The results of the vibro-core (top metre) samples provide the following information: a: Positive results for manmade radioactivity in all “top metre” samples, b: Higher average radioactivity of 3 man made radio nuclides in 2009 “top metre” vibro-core samples (27.38 Bq/Kg) than in 2013 surface samples (23.02 Bq/Kg) c: Maximum recorded radio activity (Cs 137: 43.14Bq/Kg) was from vibrocore 2009 “top metre” sample no VCJ20R: max from 2013 surface samples (Cs 137: 32.2 Bq/Kg)

4:11 The Campaign has already presented its calculation of approx **7 Billion + Bqs of** “aggregated man-made radioactivity” contained in the 300,000 tonnes of sediment proposed for disposal at Cardiff Grounds. The Campaign notes that EDF, NRW and CEFAS have not disputed that calculation which was based on the figures given in the CEFAS 2013 surface sample report.

4:12 However, in the context of the recently acquired vibrocore “top metre” data, the Campaign can state that the aggregated radioactivity figure has been re-calculated and now stands at approx **8.2 Billion Bqs , a rise of approx 18%, compared to the 2013 surface samples.**

4:13 Conclusions: **In the context of the comparison between the 2009 Core samples and the 2013 surface samples the Campaign reiterates its claim that surface samples (0 to 5 cms deep) do not provide the most comprehensive or appropriate samples for an application to dredge down to 4metres+ depth, because such an action will be exposing sub-surface and historically deposited radioactivity from 50 years worth of Hinkley sea discharged radioactive wastes, and these wastes will NOT be detected in the 0 to 5cm surface samples, but only in deeper “core” type samples.**

4:14 The Campaign therefore advises, and requests, that surface sample outcomes should be discounted as they are evidently shown to be NOT representative of the totality of the material to be dredged.

5: Total radioactivity in samples?

5:1 The Campaign has consistently argued that the presented results for both CEFAS Radiological analyses (2009 & 2013) are incomplete as only 3 man-made radio-nuclides have been reported, despite the fact that the Hinkley (A &B) liquid radioactive effluent discharges into the Bridgwater Bay sediments are reported to have contained 50+ discrete nuclides discharged for over 50 years.

5:2 The presence of Am 241 (recorded in both the 2009 & 2013 surveys) strongly implies the presence of Plutonium, as these nuclides are, in UK marine environments, inevitably found together where both are specifically investigated. Both Americium and Plutonium are fission products generated by the use of uranium based nuclear fuels inside reactors.

Similarly, the presence of Cobalt 60 (also recorded in the 2009 & 2013 surveys) strongly implies the presence of Iron 59 and Manganese 54 as all three are “activation” products created as a result of neutron bombardment of steel reactor components.

The presence of Caesium 137 in reactor liquid waste streams is usually attributed to the failure of reactor fuel pin cladding, usually as a result of poor manufacture of the cladding or of reactor malfunction and strongly implies the presence of a range of other nuclides released by fuel pin cladding failure.

5:3 From EDF submissions and answers to date, the Campaign remains unclear whether (or not) there is definitive evidence of the presence of other man made radio nuclides apart from the Am, Cs and Co reported by the 2009 & 2013 surveys.

The Campaign has written to both EDF and CEFAS asking for a copy of the digital printout of the gamma spectroscopy results for both surveys in order that our experts may study it for indications of the presence of the other nuclides discharged into the sediments through the 50 year history of the Hinkley site.

5:5 EDF has now responded that they do not have copies of the digital printouts for either survey and that that material was in the hands of CEFAS. The Campaign is surprised to discover that this is the case, especially in the context of the EDF witnesses description of the interpretation of such data, which appeared to imply that EDF had actually interpreted such data themselves, rather than not having seen it all.

5:6 The Campaign has now asked both EDF and CEFAS to arrange for the Campaign to access copies of these printouts **BEFORE** the proposed next petitions Committee meeting on 9th Jan 2018, in order that both the Campaign and the Committee are able to review that data.

5:7 Conclusion

a:

Application of the Precautionary Principal is strongly indicated because there is a major lack of detailed data on the radioactivity content of the Bridgwater Bay/Hinkley sediments and this lack of data strongly militates against any attempt to construct appropriate dose estimates for the coastal and coastal zone populations of the south Wales coast.

6: Baseline radioactivity data: Cardiff Grounds and south Wales coast.

6:1 There is, and has been, no comprehensive survey of environmental radioactivity along the south Wales coast or within the south Wales coastal zone. Some short term radiological work was carried out by individual south Wales County Councils (e.g. Gwent) during the 1980s, but recent attempts to access copies of that work have not been successful to date. Individual non industry/non governmental surveys have also been carried out in Wales, but unfortunately none of them have investigated south Wales coastal parameters.

6:2 Regretably, the national (UK wide and Welsh) monitoring/analytical services and relevant regulatory bodies have not undertaken any such investigations. The only coherent data outcomes for the south Wales coast relate annual sampling/analysis have investigated the concentrations of marine environmental radioactivity from the liquid discharges from the Maynard Centre (medical radiological diagnostics) to sea (near the Orchard Ledges) via the Cardiff sewerage outfalls. These measurements are reported in the Annual RIFE reports: **(Ref: "RIFE 22 Radioactivity in Food and the Environment, 2016": EA. FSA.NRW. NIEA.SEPA. 2017)**

6:3 The RIFE marine samples for the Maynard Centre discharges focus on 2 areas, the sub-tidal area around the Orchard Ledges and an inter-tidal sample site at Lavernock Point. Only 2 of those samples (from close to the sewage outfall, near the Orchard Ledges) consisted of sediment, while 1 only was a seawater sample. None of the samples were analysed for any of the radio nuclides (Cs 137, Co 60 or Am 241) tested for in the Bridgwater Bay sediments proposed for dumping at Cardiff Grounds.

6:4 Therefore the RIFE analysis of the marine environment adjacent to the proposed Cardiff Grounds dump site offers no insight into the current status of Cs137, Co60 or Am241 in the Cardiff marine area. **In the absence of any other data it remains the case that there is still no baseline data for Bridgwater Bay/ Hinkley derived radioactivity in the south Wales coastal marine and terrestrial environment.**

7: Conclusion:

The Campaign contests that, in the absence of any such data for the “receiving area” i.e. the Cardiff Grounds dump site, the immediate downstream environment and the regional estuarine and inshore/coastal sediment deposits (*identified by modeling as the likely deposition end-point of dumped sediments and their associated pollutants*), it will not be possible to:

a: Construct dose assessment for coastal populations because it is plainly NOT possible to calculate the existing, pre dump doses (of Bridgwater Bay/Hinkley derived radioactivity) to south Wales coastal populations from the historical multiple marine and sea to land transfer pathways:

b: acquire any *pre dump data* against which to compare *post-dump data* (i.e. to monitor the magnitude or significance of any changes following the dump)

c: the absence of such data also confirms the Campaigns concern that there is no empirical, or even modeled, evidence to describe the behaviour and end-fate of radioactivity dumped at the Cardiff Grounds site and inform the Welsh Government and the public about where that radioactivity might end up.

7:1 In the context of the above conclusions the Campaign states that, had an Environmental Impact Assessment(EIA) been required for the proposal to dump 300,000 tonnes of radioactively contaminated sediment at the Cardiff grounds site, it is highly probable that the appropriate baseline data would have been acquired. The Campaign continues to recommend that an EIA should be initiated by the Welsh Government

7:2 The Campaign further re-iterates its concerns about the nationwide lack of data on the significance of Welsh coastal marine radioactivity, especially the frequency and magnitude of the various sea-to-land transfer mechanisms (sea spray, aerosol, coastal flooding) and the totality of their impacts in the context of the very small numbers of radio-nuclides which have been studied . This lack of data strongly militates against the construction of empirical doses, and the modeled doses routinely produced by CEFAS et alia.

7:3 In the context of the Welsh Government’s “Well being of Future Generations (WALES) Act: 2015” the Campaign and its many supporters have noted the call for sustainability, preservation of a healthy environment and the promotion of actions which benefit the population of Wales which are contained within that Act.

The Campaign and its supporters believe that the Welsh Government decision to licence the dump of 300,000 tonnes of radioactively contaminated sediments into the south Wales inshore waters, so close to Wales’s major coastal conurbations, does not fulfill the intentions of the “Well being of Future Generations (WALES) Act: 2015”

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Tim Deere-Jones: (*Marine Radioactivity Research & Consultancy*)

for “Stop the Dump of Hinkley sediments at the Cardiff Grounds”

21st Dec 2017.