BRIEFING:
BRISTOL CHANNEL 2022
SEDIMENT SAMPLING RESULTS

For the second year running, an independent Citizen's Science Radioactivity Survey of Somerset and South Wales shoreline sediments proves that the spread of man-made radioactivity from reactor discharges to the Bristol Channel is far more extensive and widespread throughout the region's coasts than previously reported by Government and the nuclear regulators. As with the first survey there is some evidence to support the claim that dumping of radioactive sediment from Hinkley Point nuclear power station site has increased radioactivity levels at dump sites distant from Hinkley Point and re-suspended and re-distributed radioactivity historically locked in to the Hinkley Point sediment deposit.

Both surveys were undertaken by Citizens Groups from both sides of the Bristol Channel/Severn estuary because EdF, who were dredging hundreds of thousands of tonnes of radioactive mud from the site of the proposed Hinkley C (HPC) reactors, had repeatedly refused to carry out pre-dumping surveys of the Cardiff Grounds and Portishead sea dump sites where they intended to dispose of the HPC dredge waste. The Citizens Groups recognised that the lack of such "baseline" research meant that no one had any information on the pre-dump status of radioactivity, or of the post dump impacts of the disposal of such vast quantities of radioactivity, on the South Wales and North Somerset coastal environments or the people living on the adjacent coasts and coastal zones.

The first survey was carried out in the summer of 2021 immediately prior to the proposed dump at Portishead, but three years after the dump at Cardiff Ground. The Citizens Groups carried out their second survey in 2022, collecting sediment samples from the same sites as those sampled in 2021.

Samples collected in both years were analysed by a full accredited independent radiological laboratory. Samples were analysed by gamma spectrometry using a 3 day "counting time" as opposed to the less accurate 15 hour counting time generally deployed by government sponsored monitoring agencies.

Speaking on behalf of Somerset based Stop Hinkley and Welsh based Hafren Shield and Welsh Anti-Nuclear Alliance campaigns Marine Radioactivity Researcher/Consultant Tim Deere-Jones said: "The results of this survey clearly demonstrate that there are serious grounds for concern that the Bristol Channel/Severn estuary coasts and communities had already been subjected to radiological contamination from Hinkley since the 1960s and that EdFs recent programme of dumping radioactive wastes at Cardiff Grounds and Portishead should not have been permitted by the Welsh and English Agencies in the absence of the baseline data. In the context of the widely deployed radio-protection principle that no dose of radioactivity is harmless, it is clear that 50 years of the discharge of radioactive wastes into the Bristol Channel will have caused harm to the coastal and coastal zone populations of both the south Wales and the Somerset coasts. It is equally clear that Hinkley's sea discharged radioactive waste has an extended life span in the Bristol Channel and that this will continue for the forseeable future"

In Summary the Survey:

1: found that, over 2 years survey, shoreline concentrations of 2 radio nuclides (Caesium 137 and Americium 241) typical of the effluents from the Hinkley reactors did not decline significantly with distance from the Hinkley site as Government and Industry surveys had implied,

2: noted that the presence of both Cs 137 and Am 241 are indicators of the presence of Plutonium 239/240 and 241. *(These are all fission products discharged to sea from the Hinkley reactors)*

3: found significant concentrations of Hinkley derived radioactivity in samples from all 11 sites (7 along the Somerset coast and 4 in South Wales)

4: found unexpectedly elevated concentrations in sediments from Bristol Docks, the tidal R. Avon, the Portishead shoreline, Burnham-on-Sea and Woodspring Bay

5: found that, along the Welsh coast all samples held significant (10Bq/Kg or more) concentrations of Caesium 137 and positive (i.e: not <less than) concentrations of Americium 241

6: found that the highest concentration of both radio nuclides was detected at the most westerly of the Welsh sample sites (Splott Bay: Cardiff), which is also the most distant from the Hinkley point effluent outfalls

7: concluded that the degree of concentration of radioactivity at Splott Bay, implied a possible impact from the 2018 dumping of HPC dredge wastes at the nearby Cardiff Grounds

8: demonstrated that the widely used, official method of analysing samples for only 15 hours was far less precise than analysing samples for 84 hours

9: proved that some of the sediment to be dredged from Bridgwater Bay and dumped at Portishead and Cardiff Grounds held well over twice as much Caesium 137 as the sediments around the dump sites, thus risking a localised increase in radioactivity concentrations as a result of the dumping of dredge waste

10: proved that the, much repeated, EdF PR statement that the material to be dredged and dumped “is typical of sediment found elsewhere in the Bristol Channel” was false and not even aligned with the empirical evidence provided by EdF itself.

Tim Deere-Jones: (Marine Radioactivity Research & Consultancy) Dec 2021
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ADDITIONAL NOTES:
Below, we provide Table 1 results from the 2022 Citizens Science project analysis of sediment samples taken from sites increasingly distant from Bridgewater Bay which has been receiving radioactive effluents from the 4 reactors of the Hinkley Point site for over 50 years and from the recently redistributed dredge and dump wastes from the HPC site.

For comparison and discussion, we also provide Table 2 details of Government sponsored annual monitoring of Hinkley sediment radioactivity sediment analysis and additional information on EdFs sponsored analysis of the Bridgwater Bay offshore sediments which were dredged and dumped at Portishead in 2020.

TABLE 1: Campaigners Bristol Channel sediment samples 2022

English/Somerset coastal samples

Sample site	**sample type**	**Cs 137 (Bqs/Kg)**	**Am 241 (Bqs/Kg)**
Combwitch	mud	11.3	0.97
Burnham	mud	11.2	0.52
Woodspring Bay (WestonS Mare)	mud	13.2	0.70
Portishead	mud	12.5	0.54
R.Avon (Pill slip)	mud	13.0	0.64
R. Avon (Bristol central)|	mud	12.0	0.55
Welsh coast samples			
Sudbrook (Black Rock)	mud	10.5	0.80
Goldcliff	mud	7.2	0.42
St Brides lighthouse	mud	11.7	0.80
Splott Bay Cardiff 1:	mud	12.2	0.50
Splott Bay Cardiff 2:	mud	12.9	0.97

It is evident that all samples, (excepting that from Goldcliff) including those most distant from the Bridgwater Bay/Hinkley Point effluent discharge, hold in excess of 10 Bq/Kg of Cs 137 and in excess of 0.5 Bq/Kg of Am 241. These results are in marked contradiction to those produced by the official 15 hour gamma counts, which all imply a steady, and significant decline, with distance from the Hinkley Point discharge points.

It is clear that the 84 hour counting time gamma spectrometry commissioned by the Bristol Channel Campaign has generated more precise and positive Cs 137 and Am 241 outcomes than have the 15 hour gamma spectrometry analyses carried out by Government agencies on behalf of EdF, rsukts of which show generally lower Cs 137 and negative Am 241 outcomes.

TABLE 2: Campaigners Bristol Channel sediment samples 2021.

English/Somerset coastal samples

Sample site	**sample type**	**Cs 137 (Bqs/Kg)**	**Am 241 (Bqs/Kg)**
Combwich	mud	11.0	0.60
Burnham/Brue mouth	mud	12.0	0.50
Woodspring Bay (mouth of R. Banwell)	mud	14.7	0.81
Portishead (Lifeboat st'n)	mud	11.9	0.86
R.Avon (Pill ferry slip)	mud	13.1	1.50
R.Avon/Bristol Central	mud	11.3	0.56
Welsh Bristol Channel coastal samples			
Sample site	**sample type**	**Cs137 (Bqs/Kg)**	**Am 241 (Bqs/Kg)**

Sudbrook (Black Rock)	mud	10.4	0.49
Goldcliff	mud	10.2	0.72
St Brides lighthouse	mud	11.8	0.70
Splott Bay Cardiff	mud	12.7	1.10

Comment: *It is evident that all samples, including those most distant from the Bridgwater Bay/Hinkley Point effluent discharge, hold in excess of 10 Bq/Kg of Cs 137 and in excess of 0.5 Bq/Kg of Am 241. These results are in marked contradiction to those produced by the official 15 hour gamma counts, which all imply a steady, and significant decline, with distance from the Hinkley Point discharge points.*

It is clear that the 84 hour counting time gamma spectrometry commissioned by the Bristol Channel Campaign has generated more precise Cs 137 and Am 241 outcomes than have the 15 hour gamma spectrometry analyses carried out by Government agencies on behalf of EdF.

It is also clear that the 84 hour count has reduced the lower limits of detection for Am 241 and generated "positive" results for Am 241 in all Campaign samples as opposed to the <less than results reported for all RIFE samples in Table 2. The official <less than results based on the 15 hour gamma count are generally presented by industry and regulators as evidence of nil Am 241.

It is clear that the 2022 concentration of some radionuclides at some sites has increased relative to the 2021 concentrations. The 2021 samples were collected after the Cardiff Grounds dump but PRIOR to the Portishead dump.

TABLE 3: Government/Industry sponsored RIFE sediment sampling (RIFE-26: 2020 latest available data)

Sample site	**sample type**	**Cs137 (Bqs/Kg)**	**Am 241 (Bqs/Kg)**
Pipeline	sediment	50	<1.30
Stolford	sediment	9.3	<1.30
Steart Flats	sediment	7.2	<0.78
River Parrett (estuary)	sediment	14	<0.84
R. Parrett (B'water town)	sediment	7.9	<0.90
Burnham-on-Sea	sediment	0.75	<0.49
Weston-Super-Mare	sediment	2.4	<1.20

No data gathered for Portishead, Bristol Avon or Welsh coast by Government Agencies

Comment:

N.B. We note that the RIFE sediment sample taken from the site named "pipeline" is remarkably high compared to recent years data: not since 1997 has Cs 137 concentration in sediments from the near Hinkley samples exceeded 50 Bqs/Kg.

RIFE -26 has failed to discuss this analytical outcome and makes no attempt to offer an explanation for the very large year on year increase from around the upper "teens" which has been the norm for the last decade.

However RIFE-26 does report that HPB suspended power generation in June 2020 to undertake "extensive inspections and maintenance operations". It would be interesting to know when this sample was taken (before or after the suspension of power generation).

However, The RIFE sediment analysis results for 2020 are mostly representative of RIFE work over recent years. Only 2 of the 7 samples (43%) analysed by RIFE in 2020 had Cs 137 concentrations of 10 Bq/Kg or above. All of the samples were recorded as having < less than concentrations of Am 241.

Compared to the results of the Citizens Science sample analyses (Table 1) the RIFE results are anomalously low. We propose that this is a function of 2 flawed aspects of the official sampling and analytical methodology:

1: The short "counting time" (15 hours) of the RIFE/Government Agency favoured gamma spectrometry methodology which, according, to a number of peer reviewed academic reports, does not produce the most precise or accurate radiological data.

It is clear that the Table 1 (Citizens Science) longer "count times" provide notably less Am 241 "<less thans" than the Table 2 (Government) outcomes. When the shorter count-time methodology has been used, there are no "positive" results for Am 241, and the overall outcome has provided no useable or representative data for that nuclide. We note that many observers treat such outcomes as implying negative/nil Am 241 concentrations in the samples thus described.

Similarly, the RIFE Report's low (and declining with distance from the HPC site) reported concentration of Cs 137 may also be attributed to the short count time. In that context, it is possible that the RIFE maximum Cs 137 results would be higher, had a longer "count time" been used.

We conclude that it is evident that the analytical methodology used by Government Agencies to produce RIFE radiological data over many decades has provided the public with incomplete and inaccurate data.

2: The RIFE reports provide only the descriptor "sediment" of the samples. In marine science terminology "sediment" is a broad term used to define "natural unconsolidated granular material with sediment density greater than water". This term thus includes anything from very fine silty mud material through to sand, pebbles and cobbles. There is a very broad scientific consensus that higher concentrations of these radio nuclides are closely associated with the increased presence of fine particles, while lower concentrations are found in association with coarser particles.

Our review of technical data on the sedimentology of the Inner Bristol Channel and Outer Severn estuary confirms that the majority of the regional inter-tidal zone is composed of fine sediments and that these are therefore most representative of the sediments likely to hold highest concentrations of man-made radioactivity. We propose that the low (and declining with distance from HP) concentrations of Cs137 and Am 241 recorded by RIFE may be a function of poor choice of sediment sampling sites and that sites chosen for RIFE sampling produce mixed grain size sediments (added sand shingle etc) rather than high % of fine sediment "mud" or "silt"

In this context it is postulated that the lower Cs 137 concentrations reported by the RIFE (Table 3) report are a function of the presence of coarser sediments in the samples which are poorly described and do not consist of only the finer sediments. We conclude that RIFE reporting is indicative of poor methodology and does not provide either an accurate, or a conservative description/quantification of the radiological status of regional and dump-site adjacent sediments.

We note that the RIFE Report's sample analytical outcome for Cs 137 at Burnham (0.75 Bqs/Kg) in a sample, described imprecisely as "sediment", is also clearly anomalous in comparison to our Citizens Science Cs 137 outcome for the Burnham samples (12 and 11 Bq/Kg), precisely described as mud. This represents a percentage increase of 1,500%.

We conclude that the official RIFE methodology is a further example of a combination of poor site choice (larger sediments) and short count times.
We conclude that it is evident that the analytical methodology used by Government Agencies to produce RIFE radiological data over many decades has provided the public with incomplete and inaccurate data and left coastal zone communities in ignorance of the long-term radiological exposures from contact, diet and inhalation doses they have been receiving from marine radioactivity.

3: We further note that the shoreline "surface" (0 to 5cm deep) sediment sample outcomes of the RIFE and the Campaign surveys are both dis-similar from the outcome of EdFs 2020 radiological analysis of Bridgwater Bay sediment cores from the Cooling water intake and Effluent outfall areas where dredging is necessary. In summary, EdFs 2020 data on the gamma analysis of 23 deep core (o to 5.6 metre) samples of Bridgwater Bay sediment from the dredge area, presented by CEFAS on behalf of EdF, shows the following:

Cs 137 concentrations in the *surface to 0-5 metre subsamples* of 15 sediment cores (65% of 23) exceeded 10 Bqs/Kg,
Cs 137 concentrations in the *surface to 0-5 metre subsamples* of 12 sediment cores (52%) exceeded 15 Bqs/Kg,
Cs 137 concentrations in the *surface to 0-5 metre subsamples* of 10 sediment cores (43%) exceeded 20 Bqs/Kg,
Cs 137 concentrations in the *surface to 0-5 metre subsamples* of 8 sediment cores (35%) exceeded 25 Bqs/Kg,
Cs 137 concentrations in the *surface to 0-5 metre subsamples* of 4 sediment cores (17 %) exceeded 30 Bqs/Kg,
These sample sets were from both the "outfall" and "intake" dredge sites. The maximum Cs 137 conc' recorded was 34.8 Bq/Kg.
REF: "TR533 and TR534 Radiological Assessment of Dredging Application for HINKLEY POINT C (2020)." CEFAS: Part 1 and Part 2.

It is clear from the above that a number of the referenced sediment samples (which were dredged and transported to distant dump sites at Cardiff and Portishead) held two to three times more Caesium 137 than the shorelines samples reported in all three Tables above and that this may indeed be the source of raised radioactivity levels in samples from sites adjacent to the dump sites.

It is also clear, from the above. that the, much repeated, EdF claim (made in respect of dredge sediment disposal at Portishead) that "The sediment is typical of sediment found elsewhere in the Bristol Channel" is deeply inaccurate, based on an un-evidenced EdF assumption and not even aligned with the empirical evidence provided by EdF itself.

We conclude that the EdF commentary was inaccurate and based on a total lack of Bristol Channel wide data. We conclude that the EdF statement should NOT have been made, as it is clearly yet another major mis-representation of the true radiological status of Bristol Channel/ Severn estuary environments distant from Hinkley Point

4: We note that over many years of such work in the Bristol Channel the response of representatives of successive pro nuclear UK Governments, their nuclear regulatory agencies and the nuclear industry has been to label our work "alarmist" and that our position on the impacts of Bristol Channel radioactivity flies in the face of the understanding of such matters put forward by the nuclear industry.

We respond by pointing out that that's what they would say, isn't it? We note that when the sea discharge of man-made radioactivity was first permitted it was described as both "necessary" and "experimental".

We note that many peer reviewed studies, including some undertaken by the nuclear industry itself, have demonstrated that marine radioactivity transfers from the sea to the land during conditions of onshore wind at the surf line, in the form of sea spray and fine marine aerosol that carry radioactivity inland for at least ten miles.

We note that empirical studies have clearly demonstrated that health impacting levels of radioactivity have transferred from the sea to the land during episodes of storm surge and coastal flooding. We note that regulators have informed us that Bristol Channel radiologically contaminated intertidal river sediments have been dredged and then dumped on river banks and applied to agricultural land.

We therefore conclude that it is certain that marine, intertidal and estuarine radioactivity will give rise to inhalation doses from airborne marine radioactivity across at least a ten mile strip of the coastal zone, that such material will deposit out on agricultural and horticultural produce and generate dietary/ingestion doses, that "contact" doses will also be received as a result of these processes. We note that even the nuclear industry notes that contact and ingestion doses of marine radioactivity may be received by swimmers, boaters, intertidal fishermen etc.

Finally we report that most national radiological regulatory regimes are based on the LNT (Linear no-threshold) model of dose exposure, which lies at the foundation of a postulate that all exposure to ionizing radiation is harmful, regardless of how low the dose is, and that the effect is cumulative over lifetime. The LNT model is supported by the ICRP (International Commission on Radiological Protection). Despite the wide spread support for LNT among independent scientific sources and governments, it is not surprising that the nuclear industry strongly disputes this, but has been unable to provide any empirical evidence to refute the LNT model.

Nevertheless, in a tactic reminiscent of that deployed by big tobacco, big oil and others, over recent decades the nuclear industry continues to denigrate the LNT model and has sought to persuade some of its most supporting governments (including the UK) to abandon it.

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for Bristol Channel/Severn Estuary Citizens Science Radioactive Sediment Project: May 2023.