Nuclear Free Local Authorities

new nuclear monitor

Number 29, November 2012

Joint submission to Environment Agency's draft decisions & draft radioactive waste permits for the proposed Hinkley Point nuclear reactor, Somerset

(Ref: EPR/ZP3690SY/A001)

1. Introduction

The Nuclear Free Local Authorities (NFLA) has organised a joint submission response with the Stop Hinkley Campaign, Friends of the Earth Cymru and CND Cymru to the Environment Agency's draft radioactive waste permit and draft decisions for the proposed Hinkley Point nuclear reactor in Somerset.

The response follows on from two detailed submissions that the same groups sent to the Environment Agency in December 2011 and which can be found on the NFLA website – New Nuclear Monitor 25, which considered marine discharges; and New Nuclear Monitor 26, which considered air discharges. These should be read in consideration with this updated submission –
http://www.nuclearpolicy.info/docs/nuclearmonitor/NFLA_New_Nuclear_Monitor_No25.pdf
http://www.nuclearpolicy.info/docs/nuclearmonitor/NFLA_New_Nuclear_Monitor_No26.pdf

This updated response focuses on marine discharges, given the NFLA's particular concern on the lack of engagement from the Environment Agency to the issues it had raised in its December 2011 submission. The 2011 NFLA submissions to the Environment Agency remain its fundamental policy towards environmental concerns for new nuclear build at Hinkley Point – ***both*** marine and airborne discharges. This submission highlights the lack of consideration that the Environment Agency has made to either of the original responses.

2. The Environment Agency consultation

This consultation refers to **applications** it has received from EDF Energy's and Centrica's joint venture company, **NNB Generation Company Limited** (NNB GenCo), for their proposed new nuclear power station development at **Hinkley Point**. This second Environment Agency consultation responds to some of the comments made to the first consultation and provides its draft permits and draft decisions.

If allowed the permits would allow the new nuclear power station to:

- Discharge and dispose of radioactive wastes
- Discharge cooling water and liquid effluents into the Bristol Channel
- Operate standby power supply systems using diesel generators

The application can be found at EDF's website:
http://hinkleypoint.edfenergyconsultation.info/home
The closing date for submissions is the 9th November and submissions should be emailed to: NNB@environment-agency.gov.uk.

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Analysis of, and Response to specific marine issues reported in the:
Environment Agency's Draft Decision Document (EPR/ZP3690SY/A001)

This submission has been prepared for Nuclear Free Local Authorities, Stop Hinkley Campaign, CND Wales / Cymru, Friends of the Earth Wales / Cymru by the independent marine pollution consultant, Tim Deere-Jones.

Contents:

Joint Submission Executive Summary

Original consultation -

a. In respect of the permits to Discharge and Dispose of Radioactive Wastes and Discharge Cooling Water and Liquid Effluents to the Bristol Channel, the Environment Agency opened a consultation process in 2011.

b. In December 2011 four groups (NFLA, Stop Hinkley, Friends of the Earth Cymru and CND Cymru) supported the production of a joint submission Consultation Response to NNB Genco's "Radioactive Substances Regulation Submission Hinkley Point". For the rest of this briefing this will be referred to as the 'Joint Submission'.

c. In accord with the consultation principle outlined by the Environment Agency (i.e. to seek views on "any errors or omissions as well as any relevant information we may not have considered.") the Joint Submission 2011 Consultation Response consisted of an extensively referenced, 64 page, 31 chapter, report which drew attention to a number of scientific and technical errors, omissions, and relevant information, which the Environment Agency had not considered.

d. The Joint Submission reviewed the latest research on Bristol Channel / Bridgewater Bay hydrodynamic and sediment regimes and associated pollution movements, warned that researchers had identified significant and major data gaps in at least 5 areas of relevance to Bristol Channel regimes, and concluded that, therefore, the behaviour and fate of radioactive wastes discharges into the Bristol Channel was still uncertain.

e. The Joint Submission reviewed the NNB Genco submission on aqueous radioactive waste discharges from Hinkley C and identified weaknesses and flaws in the NNB Genco understanding of the behaviour and fate of radioactive wastes in the Bristol Channel, the proposed management of the discharges and the proposed marine and coastal sampling and monitoring programmes.

f. The Joint Submission also reviewed the data on the behaviour and fate of radioactivity in the Bristol Channel and identified both a lack of intermediate or far field behaviour and impacts data, and that the current knowledge of near field effects was flawed because of poor methodology based on a lack of understanding about the behaviour and fate of marine radioactivity.

g. The Joint Submission concluded that, in the context of the flawed and/or absent data referenced above, the accuracy and veracity of all hypothetical modelling processes, was questionable.

h. The Joint Submission concluded that: "In the context of these flaws the proposed development in its current form should be rejected outright."

i. Following the 2011 consultation process the Environment Agency reported that it was considering consultation responses and in due course it produced its 2012 "Draft decision document for environmental permitting EPR/ZP3690SY/A001" which set out the Agency's conclusions on the NNB Genco submission.

j. The Draft Decision document stated that it had considered a number of factors including "The matters raised by consultees". The Draft Decision document stated that the Environment Agency's "overall conclusion at this stage is that there are no reasons why we should not issue a permit".

Draft permits second consultation -

a. The four groups who sponsored the Joint Submission 2011 Consultation Response have studied the Environment Agency's 2012 Draft Decision document and subsequently supported the production of a second document "Joint Submission to Environment Agency: Analysis of, and Response to, specific marine issues reported in the Environment Agency's Draft Decision Document (EPR/ZP3690SY/A001)" hereafter referred to as "this Response."

b. This Response reviews the Environment Agency Draft Decision document with specific reference to the Environment Agency's consideration of the multiple scientific and technical issues raised by our detailed 2011 Joint Submission document.

c. This Response has reached the following principal conclusions with regard to the Environment Agency Draft Decision document and the consultation process which has preceded it:

- With regard to those unique hydro-dynamic and sedimentary regime parameters that moderate and govern the behaviour and fate of radio-active wastes discharged to the Bristol Channel marine environment;
- With regard to the understanding of aspects of the behaviour and fate of radioactive wastes discharged to the Bristol Channel marine environment;
- With regard to the historical and (proposed) future sampling and monitoring of the distribution and concentration or radioactive waste discharged into the Bristol Channel;
- With regard to the modelling of calculations of environmental concentrations of radioactive wastes in the Bristol Channel and the assessment of their radiological impacts on the public;

the Environment Agency Draft Decision document -

- did not address the great majority of the issues raised by the Joint Submission;
- where it has addressed issues, it has done so by re-iterating statements made in GDA or interim approvals, but in no case has it specifically, and in appropriate detail, responded to issues raised.

and that the Environment Agency either -

- does not wish to respond to the Joint Submission's concerns;
- has no answer to the Joint Submission's concerns;
- is unable to respond to the Joint Submission's concerns.

This Response concludes that the Consultation process failed to take into account, or consider the information, advice or opinion about "errors or omissions as well as any relevant information" which the Joint Submission had raised.

This Response concludes that, with respect to marine issues, there remain a wide range of important and unresolved questions about the behaviour and fate of liquid radioactive wastes discharged into the Bristol Channel and thus there can be no confidence in the scientific rigour of the assessment and decision making process underpinning the Environment Agency's Draft Decision assessment.

1. Introduction

1.1 In December 2011 the Nuclear Free Local Authorities (NFLA), the Stop Hinkley Campaign, Friends of the Earth Wales/Cymru and CND Wales/Cymru made a joint submission to the Environment Agency's consultation on the NNB Genco application.

1.2 The joint submission consisted of a (65 page) technical Consultation response, which addressed a number of issues related to the fate, behaviour and possible impacts of liquid radioactive waste discharges to the Bristol Channel marine environment and a number of other issues. The joint submission Consultation response contained detailed scientific information and was extensively referenced.

1.3 In 2012 the Environment Agency (EA) published their Draft Decision Document (EPR/ZP3690SY/A001) setting out the Environment Agency conclusion on NNB Genco's application to discharge and dispose of radioactive wastes from the proposed new Hinkley C Power Station on the Bristol Channel coast of Somerset.

1.4 This report is a Formal Response to the EA's Draft Decision Document (EPR/ZP3690SY/A001). This Report is also a joint submission by, and on behalf of, the Nuclear Free Local Authorities, Stop Hinkley Campaign, Friends of the Earth Wales/Cymru and CND Wales/Cymru.

1.5 In para 14 (page 6) of the Environment Agency's document "Consultation on our draft decisions Summary document", the EA:

- provide some detail of the responses they had received;
- record the fact that they had identified over 100 separate issues from these responses;
- state that "We have addressed the issues raised in our Draft decision document".

1.6 In para 5 (Executive Summary) of the full decision document EPR/ZP3690SY/A001 the statement recorded in 1.5 (above) is modified to "We have …….endeavoured to address all comments in this document".

1.7 This consultants report offers an analysis of, and response too, the (marine issues) contents of EPR/ZP369OSY/A001 and seeks to identify the level of accuracy of the statement in para 3 (above) as it relates to the joint submissions previously made by NFLA et al' (hereafter referred to as "the Joint Submission".

1.8 In the body of the following report the EA Draft Decision will be referred too as "the Draft Decision", specific points in the EA decision will be identified by their Chapter headings and numbers.

1.9 In the body of the following report, this report will be referred to as "this Response."

1.10 Issue specific and Chapter specific Response conclusions will be found in each Chapter set out in ***Bold Italics***

2. Bristol Channel marine environmental parameters:

2.1 The Joint Submission provided a fully referenced scientific and technical analysis (Chapters 1-6) of those Bristol Channel marine and estuarine environmental parameters relevant to the fate and behaviour of those radioactive materials to be discharged into it from the proposed new build NPS. This analysis covered Bristol Channel water body movements, the nature and behaviour of seabed and suspended sediments and the movement and short, medium and long term fate of those sediments.

2.2 The Joint Submission's analysis noted that scientific studies had indicated that Bridgwater Bay is "the major long term source of fine sediment" to the Bristol Channel marine and estuarine environment.

2.3 The Joint Submission's analysis also noted that scientific studies proposed that the most significant sinks (areas of deposition) for the Bridgwater Bay originating fine sediments were (other than Bridgwater Bay itself) the peripheral areas of the Parrett and Avon (English Coast estuaries), the Wye and Usk (Welsh coast estuaries) and their associated salt marshes, and few offshore sites such as the Newport Deep and the Nash Passage (Welsh offshore zone).

2.4 The Joint Submission quoted a 2010 review (from the peer reviewed Marine Pollution Bulletin), which stated that, in the case of the Bristol Channel:

a. "hydro-dynamics also directly influence (and perhaps dominate) the dispersion of discharges"
b. "A better understanding of these features and their linkages would improve management options for the system" and, in the context that flocculation (the aggregation of particles) is "a principal mechanism which controls how fine sediments, and thus contaminants, are transported"
c. "the interpretation of the significance of this process is only just beginning to emerge."

2.5 The Joint Submission further noted that the 2010 review had stated the need to

a. investigate how flocculation of suspended sediments responds to different degrees of turbulent mixing;
b. develop better sediment transport models to quantify settling of flocs, erodability 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 flocculate and adsorb/release pollutants;
d. Map the extent and magnitude of salinity intrusions and the turbidity maximal, including depth profile measurements in order to provide representative distributions of both suspended sedimentary matter and salinity on seasonal and neap/spring tidal cycles and time scales;
e. to determine the extent to which biological processes affect the behaviour of sediments and the bioavailability of sediment associated contaminants

2.6 On the basis of the analysis summarised above, the Joint Submission stated that:
Research studies conclude that hydrodynamics may be the dominant influence on erosion, deposition and transport of sediments in the Bridgwater Bay but warn that there remain some significant and major data gaps in at least 5 areas of relevance to the Bristol Channel and Bridgewater Bay hydrodynamic and sedimentary regimes.

2.7 ***This Response fully supports that statement and points out, that in:***

a. the context of both the fate and behaviour of the high number of radio nuclides proposed for discharge into Bristol Channel marine environment;
b. the context of the wide range of environmental fates and behaviours exhibited by those nuclides;
c. the context of the very broad consensus that the fate and behaviour of many radio nuclides in the marine environment is closely associated with hydro-dynamics and the sedimentology.

These data gaps are highly significant. The implication plainly being that such data gaps should be filled PRIOR to any further discharge being permitted.

2.7 ***This Response notes that the Environment Agency's Draft Decision fails to acknowledge or address the issue of inadequate data relating to hydro-dynamics and sedimentology, despite the Joint Submission having drawn attention to it.***

2.8 ***This Response concludes that the Draft Decision has been made, in the absence of appropriate date, as if there were no such data gaps and as if the marine environmental parameters governing the fate and behaviour of discharged radioactivity were fully understood.***

2.9 ***This Response further concludes that the Draft Decision document has no answer to the Joint Submissions concerns.***

3. Generalised issues of fate and behaviour of radioactivity in marine environments

3.1 The Joint Submission (chapters 7-11) provided a detailed, referenced scientific and technical analysis of issues related to the fate and behaviour of radioactive wastes discharged to marine and estuarine environments.

3.2 This analysis reviewed the fate and behaviour of both soluble nuclides and insoluble nuclides (which adsorb onto the outer surface of fine particles in the water column). The analysis noted that both soluble and insoluble radioactivity could travel over extended distances and time scales and subsequently be deposited in areas many miles from their source, where due to their affinity to fine particles, concentrations of such nuclides could increase markedly (relative to ambient seawater) in coastal and estuarine fine sediment deposits such as mud flats and salt marshes.

3.3 The Joint Submission's analysis reviewed issues related to the re-concentration of marine radioactivity by a number of mechanisms. The analysis highlighted the massive Enrichment Factors of radioactivity recorded as a result of these re-concentration mechanisms.

3.4 The Joint Submission provided a review of aspects of the sea to land transfer of radioactive wastes. The Joint Submission reviewed work carried out by UKAEA and noted that UKEA researchers had concluded that although the studies had demonstrated that the phenomenon was indeed occurring and that high Enrichment Factors were observed, the technology used to study this phenomenon was:

a. "believed to be not very efficient for the relatively large particles"
b. should be used "only as a qualitative tool to compare relative concentrations of actinides" (i.e. it should not be used a quantitative tool)

3.4 The Joint Submission carried out a review of other work on sea to land transfer carried out by Local Authorities and other independent (i.e. non-industry, non-governmental, non-regulator bodies) which had studied the phenomenon by measuring the concentrations of sea derived radioactivity in the terrestrial zone and recording such radioactivity at least 10kms inland (mainland) and apparently ubiquitously present in island environments.

In the context of those findings the Joint Submission noted the entry of this sea to land transferred radioactivity into terrestrial human food chain pathways

3.5 The Joint Submission reached a series of conclusions on this subject, which because of their importance are repeated in full below:

Inferences to be drawn from Sea to Land transfer studies -

11.1 There is a problem due to the lack of accessible historical data. While much information is available from peer reviewed journals, other data produced by government agencies and nuclear industry bodies can rapidly disappear from public access.

A case in point (though not the only one) is the following paper: Ould-Dada, Z. 2000. "Sea to land transfer of radio nuclides. How much do we know?" (Proceedings 2nd Radrem-Tesc Workshop. London: Jan 21.1999. DETR/RADREM/00.001 DETR London) which has been much referenced, in recent annual RIFE reports and other documents, which state that sea to land transfer is of low radiological significance.

Regrettably, applications for a copy of this paper, made to the libraries of DETR, CEFAS, DEFRA, DECC and even the author himself (now working for the DECC) have been met with the reply that it is no longer available. Thus it is not possible to carry out an analytical review of this, or similar, papers.

11.2 However, there is plainly an evidence based consensus that:

- *a. man-made radioactive wastes discharged to sea do transfer across the surf line from the sea to the land*
- *b. however, the studies of some of the mechanisms reviewed in Chap 10 above make it plain that attempts to quantify the magnitude and significance of sea to land transfer via aerosol and sea spray pathways are inherently flawed because BOTH of the two tools (muslin screens and high volume air samplers) used for the task are inefficient and that, in the case of muslin screens that inefficiency has been calculated to increase markedly as sea to land wind speeds increase*
- *c. these 2 available tools are unlikely to be able to provide appropriate sampling of "enriched spray fronts" because even in Force 5 winds such fronts are believed to be about 10 metres high (and possibly higher in stronger winds)*

11.3 Sellafield marine discharged actinides (such as Pu and Am) are shown to be enriched in sea spray and marine originating aerosols, to transfer across the surf line and to be deposited in Cumbrian terrestrial environments where concentrations decrease with distance from the coast.

In Cumbrian estuarine environments sea to land transfer of actinides and Technetium 99 are regularly shown to have contaminated a wide range of terrestrial wild and cultivated foodstuffs.

11.4 Similar phenomena have been recorded in North Wales where Pu alpha, originating from Sellafield sea discharges, was detected in terrestrial soil samples, having transferred from the sea to the land either by direct inundation or by sea spray/aerosol pathways.

11.5 In south west Wales an independent study commissioned by Dyfed County Council has demonstrated the presence of Sellafield sea discharged Caesium 137 in pasture grass (at 10 Km inland of Cardigan Bay coasts) where it was shown to be entering the dairy/beef/sheep-meat food chain and therefore also available for entry into other terrestrial food stuff pathways (potatoes, vegetable, fruits etc). (Ref 31)

11.6 Independent work in the Hebrides has also demonstrated significant entry of Sellafield sea discharged Caesium 137 into almost the entirety of small island terrestrial and marine ingestion pathways, producing an average islander dietary dose (from Cs 137 alone) of 13.7 microSv, which is higher than some (multi nuclide) dietary doses received by the most exposed Critical Groups living around some UK nuclear power stations. (Ref 32)

11.7 Government agency and nuclear industry research programmes on aerosol and sea spray pathways of sea to land transfer have focussed exclusively on:

- *a. Sellafield derived actinides (Pu and Am etc)*
- *b. the northern and eastern basin of the Irish Sea*

11.8 However, the independent work, described above, clearly demonstrates that:

a. the "soluble" nuclides such as Caesium also transfer from the sea to the land

b. that such Cs has the potential to make significant contributions to dietary dose

c: that in the case of Cs at least, this process can occur at distances of at least 200 Kms from point of discharge.

Furthermore, in this context, the observed behaviour of Caesium strongly implies the likelihood that other, equally (or more) "soluble" nuclides will exhibit the same fate and behaviour, though their distance-from-source impact will be restricted by their half-life.

11.9 The reported independent studies from southwest Wales and the Hebrides also plainly indicate the fallibility of focussing solely on the northern basin of the Irish Sea as a field study area.

This is highlighted by a comparative review of other sea area parameters, which plainly demonstrates appreciable differences in various observable parameters between sea areas.

A case in point is the suspended sediment loadings of various water bodies, which are shown to be vitally important factors in the marine environmental behaviour and fate of alpha/actinides such as Plutonium, Americium and Curium (see Chap 9 above).

11.10 Thus, Irish Sea suspended sediment loadings are significantly lower than those found in much of the Bristol Channel:

Average sediment loadings in the Eastern Irish Sea are reported as being around 2.14 mg per litre (Ref 33)

Irish Sea shallow areas with faster currents (similar to conditions found close to Cumbrian and other coastlines) are reported to have suspended sediment concentrations of average 7.6 mg per litre (Ref 34)

Compare these figures to those given for the Bristol Channel suspended sediments in Chapter 5 (above) where:

a. normal suspended sediment solid loadings for the Bridgwater Bay/Parrett Estuary area are given as 4 to 16 ***grams*** *per litre;*

b. peak concentrations can reach 200 ***grams*** *per litre;*

c. concentrations at Portishead range from 132 mg to 5 ***grams*** *per litre.*

11.11 It may therefore be postulated that, because the suspended sediment loading regime of the Bristol Channel is reported to be markedly different from that of the Irish Sea, the fate and behaviour of sediment associating radioactive wastes in Bristol Channel environments may not be a "carbon copy" of the fate and behaviour of those found in the Irish Sea, especially in respect of the range of sediment associated mechanisms such as sea surface micro layer enrichment, sediment ejection into sea sprays and marine aerosols and the sea-to-land transfer, transport and deposition of sediment associated radio nuclides.

11.12 It may also be postulated that:

a. because the organic loading of River Parrett sediments (originating as they do from the very extensive vegetation and humus rich Somerset Levels) is likely to be dies-similar to the organic loading of Sellafield coastal waters,

b. the fate and behaviour of radioactive material, whose action and magnitude is dependent upon an association with organic particles, may not (in the

Bristol Channel) be a carbon copy of their fate and behaviour as reported in the Irish Sea and Sellafield coastal waters.

11.13 There is a marked paucity (in some cases a total lack) of study of other potential marine enrichment and sea to land transfer mechanisms such as fog production, evaporation from sea surfaces and evaporation from exposed mud flats, sea to land transfer of highly actinide enriched micro organisms, transfer of marine fine particles (re-suspended from the drying surfaces of exposed inter tidal sediments), inundation etc.

3.6 ***This Response concludes that, despite the fact that the Joint Submission analysis had identified and flagged up the following points:***

a. there is a wide consensus that the fate and behaviour of radioactive wastes discharged to marine environments was strongly dependent on sea area specific ambient marine environmental parameters,

b. the great majority of the field research on the fate and behaviour of marine discharged radioactivity had occurred in the northern basin of the Irish Sea,

c. the Joint Submission had clearly demonstrated that Irish Sea and Bristol Channel marine environmental parameters were very strongly DIS-similar,

d. no relevant fieldwork had been reported for the Bristol Channel.

The Draft Decision document has not responded to these concerns.

3.7 ***This Response concludes that, as was the case with the Joint Submission's commentary on hydro-dynamic and sedimentary issues, the Draft Decision document has not responded to the Joint Submission's commentary on the wide range of issues relating to the fate and behaviour of liquid radioactivity discharged to the Bristol Channel.***

3.8 ***This Response concludes that the Draft Decision document's conclusions have been reached without an appropriate scientific and technical understanding (i.e. in ignorance) of the Bristol Channel specific environmental parameters, which govern the fate, and behaviour of those liquid radioactive wastes proposed for discharge into the Bristol Channel.***

3.9 ***This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the evidence summarised above, the Draft Decision document has no answer to the Joint Submission's concerns***

3.10 ***This Response re-iterates the Joint Submission statement that any decision process regarding the permitting of liquid radioactive waste discharges to the Bristol Channel should be taken only AFTER carrying out the relevant Bristol Channel specific work (as set out chapters 2 and 3 above)***

4. Sources and systems for aqueous discharges; Emergency Cooling Waters

4.1 Chapter 5:7:1 of the Draft Decision lists the sources and systems for aqueous radioactive discharges from the proposed reactors at Hinkley Point C. However, it is evident that this list only relates to normal (non-contingency) operation of the proposed reactors and that it contains no detail of contingency/unusual operational discharges which include discharges arising from reactor malfunction or accident scenarios.

4.2 The Joint Submission (Chapter 29) made specific and detailed reference to the liquid radioactive effluent outcomes of the Fukushima reactor and cooling pond LOCAs and the subsequent use of very high volumes (hundreds of thousands of cubic metres) of Emergency Coolant Water, which could not be contained on-site and subsequently escaped, via site drainage, into the marine environment and adjacent water courses,

generating very highly elevated concentrations of radioactivity in both the marine water column and marine biota.

4.3 The Joint Submission: (29:10): noted that:
The Nuclear Free Local Authorities (NFLA) have already submitted information to the ONR Weightman Inquiry on these issues and made the following recommendations:

a. Site drainage (with specific relevance to emergency situations including LOCA response and inundation) should be made a GDA and major planning issue and NOT be determined on a site-specific basis.

b. The GDA should review reactor basement design and construction in order to confirm that, if they are to be used for collection and storage of spilled reactor and/or cooling pond coolant and ECW, they will prevent leaching, facilitate the monitoring of the HRW and escaped coolant and be provided with appropriate equipment such as pumps, gauges etc.

c. HRW (highly radioactive water) capture/retention, storage and treatment capacity should be made a GDA issue and NOT be determined on a reactor specific or site specific basis. It should be thoroughly reviewed at Hinkley Point in the context of both:
1: the Fukushima event;
2: the potential for tsunami/flood events.

d. The storage capacity for highly concentrated wastes generated by the filtration treatment of HRW should be reviewed by the GDA with a view to ensuring that, in the event of the need to filter treat high volumes of escaped coolant and contaminated ECW, there is sufficient storage capacity for the ensuing highly concentrated radioactive waste.

4.4 ***This Response notes that the issue of both:***

a. the post LOCA leaking/escape of contaminated water from the Fukushima site and

b. the containment/storage of post LOCA contaminated water from the Fukushima site remain ongoing as of early November 2012.

4.5 ***This Response concludes that the Environment Agency's Draft Decision fails to acknowledge or address this issue despite the Joint Submission having drawn attention to it.***

5. Diagrams

Chapter 5.7.1 of the EA consultation also presents a diagram (Figure 10: page 47) to support its text on systems for the discharges of aqueous radioactive waste to the environment.

5.1 Radioactively contaminated effluents are colour coded green in the diagram and uncontaminated effluents are colour coded blue. According to the Figure 10 diagram, there are NO radioactively contaminated effluents entering the marine environment from any source or via any disposal route. This despite the fact that other text in the Draft Decision document plainly states that discharges of aqueous radioactive effluents are both expected and estimated and that the EA are proposing to permit the discharge or radioactive wastes to the environment.

5.2 ***This Response points out that the diagram is flawed and inaccurate because the "key" shows colour coded effluent streams which are wrongly labelled and thus give rise to a false impression of the fate of aqueous radioactive wastes.***

6. Gaseous discharges and the marine environment

Chapter 5.7.2 of the Draft Decision lists the sources and systems for gaseous radioactive discharges to the environment from the proposed reactors at Hinkley Point.

6.1 Chapter 12 (section 8) of the Joint Submission stated:
In the context of this, and the following sections discussing the discharge of specific nuclides/isotopes, it is highly relevant to note that all of the substances likely to be found in the liquid radioactive waste discharge streams are also likely to be discharged through Hinkley C site stacks and chimneys in gaseous and atmospheric discharge streams.

It is absolutely certain that a potentially significant percentage of these gaseous/atmospheric discharges will also enter the marine environment as a result of both:

a. direct washout and fallout from atmosphere to the Bristol Channel (during both normal and temperature inversion conditions)
b. indirect washout and fallout of material onto land surfaces and subsequent transport from land surfaces into water courses and hence into the coastal environment

None of the documents studied during the course of compiling this Report have made mention of this parameter and thus it is concluded that the contribution of this mechanism to overall marine concentrations and subsequent doses remains wholly un-quantified. Thus the available data base remains deeply flawed.

6.2 ***This Response notes that the Environment Agency's Draft Decision fails to acknowledge, recognise or address this issue despite the Joint Submission having drawn attention to it.***

6.3 ***This Response thus concludes that the understanding of concentrations of all radioactive wastes entering the Bristol Channel marine environment are flawed and inadequate because no attempts has been made to estimate the isotopic range or the volume/concentration of radioactive wastes (derived from gaseous/atmospheric emissions) which must enter the marine environment via the pathways listed in preceding paragraphs.***

6.4 ***This Response notes and concludes that the Draft Decision document has not addressed this issue, nor offered a rebuttal of the Joint Submission's argument***

6.5 ***This Response therefore concludes that the Draft Decision document has no answer to the Joint Submissions concerns***

7. Pulsed aquatic discharges

Chapter 5.7.3 of the Draft Decision sets out the Environment Agency position on "pulsed discharges" to the environment. Chapter 5.7.3 confirms that the limits are based on the "normal operation" of the facility and that normal operation "takes account of operational fluctuations, trends and events that are expected to occur over the likely lifetime of the facility".

7.1 Page 51 of the Draft Decision's chapter 5.7.3 introduces the EAs decision to "set limits...on the basis of a rolling 12 month period" and to set Quarterly Notification Levels "to help us to monitor and ensure that BAT is used to minimise discharges".

7.2 In the context of the above comments, para 302 of the Draft Decision states that: "Radioactivity discharged to the atmosphere over a short period, typically less that 24 hours, can result in higher doses than the same amount of radioactivity discharged over a longer period".

7.3 Subsequent sections of chapter 5.7.3 (paras 303 to 307) discuss these short term atmospheric effects but do not address the issues of rolling limits, QNLs and short period discharges in relation to the discharges of aqueous radioactive wastes to the marine environment.

7.4 The Joint Submission (Chapters14-18, 19-20 and 23) provided detailed discussion of the potential behaviour of "short period" or PULSED discharges of aqueous radioactive wastes into the marine environment, with particular reference to Tritium, Caesium 137 and in more general terms.

7.5 The Joint Submission's Summary of Principal Technical Conclusions (page 9) stated: **"***This Report further notes that both Tritium and Caesium are to be discharged in peaks and troughs…..and that there is no review or discussion of the interaction outcomes of these intermittent concentration inputs with the behaviour and fate of warm water discharge plumes in the area adjacent to the discharge point, nor of the likely behaviour and fate of entrained radioactive wastes."*

7.6 The Joint Submission's Summary of Principal Technical Conclusions (page 10) stated:
"This Report notes that it is proposed that discharges of some radio-nuclides will be intermittent, thus delivering pulsed peaks and troughs of input.

This fact is not addressed in NNB Genco's Monitoring document NNB-OSL-REP000137. Thus it appears that there are no plans to construct the proposed marine monitoring programmes for Hinkley C in such a way as to take account of the several implications of pulsed discharges.

7.7 While of relevance to all nuclides entrained within the proposed pulsed discharges, it is particularly important in relation to Tritium because:

a. Tritium has a short half life and hence peak concentrations in environmental samples (following pulsed discharges) may not be recorded by the proposed very low number/low frequency monitoring programmes based on those already in existence.
b. Tritium is shown to very rapidly incorporate into marine samples (including foodstuffs) and thus the proposed low frequency/low number sampling programmes will not be geared towards capturing peak tritium concentrations in foodstuffs.
c. thus due to a: and b: (above) marine food pathways doses to exposed critical populations will not be effectively and accurately calculated each year, nor on a year-to-year chronological basis.

7.8 ***This Response notes that the Environment Agency's Draft Decision commentary on limiting radioactive discharges fails to acknowledge, recognise or address the issues arising from the "pulsed" discharges of aqueous radioactive wastes to the marine environment despite the Joint Submission having drawn attention to it.***

8. Tritium discharges

Chapter 5.7.4 of the Draft Decision sets out the Environment Agency position on Tritium discharges.

8.1 The Joint Submission provided a technically detailed and fully referenced discussion of issues related to the discharge of aqueous tritium to the marine environment.

8.2 Chapter 13 of the Joint Submission introduced a very brief strategic review of the volumes of reactor derived aqueous tritium discharges to the Bristol Channel both at present, and in the context of the proposed future reactor discharges to that sea area (3 AP1000 reactors at Oldbury and 2 EPR reactors at Hinkley).

8.3 The Joint Submission's comments on this specific subject were relevant in the context of

a. European Directive no: 2001/42/EC (Strategic Environmental Assessment Directive),

b. paragraph S.11.7 (page XX11) in the DECC's October 2010 document: "Appraisal of Sustainability of the Revised Draft Nuclear National Policy Statement: Main Report" which stated that: "Interactions and cumulative effects are likely where more than one new nuclear power station may be built ... This may be significant with the cluster of two sites on the Severn Estuary (Oldbury and Hinkley) and two sites (Bradwell and Sizewell) on the Outer Thames Estuary."

8.4 This Response notes that the DECC website "Strategic Environmental Assessment: UK Public Consultation for Offshore Energy Licensing" specifically reports on Marine SEAs (cumulative effect) for entire specified sea areas rather than EIAs for individual, site specific operations.

8.5 This Response notes that the DECC website quoted above contains a section "What is the SEA process: Introduction" which states that these:
"Marine SEAs (i.e. those for oil and gas licensing rounds) carry out appraisals through which environmental protection and sustainable development may be considered and factored into national and local decisions".

8.6 This Response notes that, during the research and production stage of the Joint Submission (which consisted of a detailed review of the marine specific aspects of the NNB Genco submissions and the Environment Agency's GDA Assessments for the UK EPR and the AP1000 reactors) no reference/detailed discussion of cumulative marine radiological effects was noted.

8.7 It was in this context that the Joint Submission pointed out that, allowing for the ongoing operation of existing Bristol Channel reactors in conjunction with the operation of proposed new build reactors:

a. the combined, annual liquid tritium discharge **limit** for operational discharges from all Bristol Channel nuclear power stations would rise from 653 TBq (tritium: in 2009) to 983 TBq Tritium and that this represented a **50% increase in the limit.**

b. the combined **actual** annual discharge of aqueous tritium for normal operational discharge from all Bristol Channel stations would rise from 105.4 TBq aqueous tritium (2009) to 314.6 TBq aqueous tritium and that this represented a **3 fold increase in the amount of actual discharge.**

8.8 ***This Response notes that the Environment Agency's Draft Decision commentary on limiting radioactive discharges fails to acknowledge or address any of the issues arising from the strategic and cumulative effects of discharges of aqueous radioactive wastes (from multiple reactors at different sites) on the relatively enclosed and slow flushing Bristol Channel marine environment despite the Joint Submission having drawn attention to the facts of cumulative discharges and also to the enclosed, high sediment loading and slow flushing characteristics of the Bristol Channel.***

8.9 ***This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the evidence summarised above the Draft Decision document has no answer to the Joint Submissions concerns***

9. New scientific understanding of Tritium

The Joint Submission referred to the previous industry and regulator consensus that Tritium was of little biological and radiological significance based on the hypothesis that it would dilute and disperse to infinity in the marine environment.

9.1 The Joint Submission then provided a summary of some of the latest scientific reporting of work on the fate, and behaviour of aqueous tritium when discharged to marine environments and specifically referenced research from 2000 onwards which had demonstrated that the previous consensus was deeply flawed.

9.2 The Joint Submission (Chapters 16 &17) then specifically reviewed a 2009 study, which had concluded that:

a. *"Clearly the view that tritium occurs exclusively as tritiated water and therefore dissolves to infinity should be considered cautiously.*
b. *Further research into the concept and nature of tritium partitioning in natural waters is required, and*
c. *the adoption of unit value (or sub-unit value) distribution coefficients and concentration factors that are currently recommended by the IAEA, but not supported by clearly defined measurements, may require reconsideration."*

9.3 Chapter 18:11 of the Joint Submission noted that -
"A Subchapter of NNB Genco's Radioactive Substances Regulation Submission Hinkley Point C: Chapter 12.2 says that

a. *Initial Radiological Assessments (IRA) provided by the Environment Agency have been used to determine environmental concentrations and doses to the public*
b. *the general methods used in IRA are described in the EC Guidance Document Radiation Protection 72 published in 1995 (Ref 44)*
c. *In 1998, UK Agencies (NRPB, E.A etc) initiated use of the modelling system PC CREAM 98 as a tool for carrying out radiobiological impact assessments according to the methodology detailed in "Radiation Protection 72" and this is referenced as the modelling system for the hypothetical calculation of environmental concentrations and doses to the public arising from the proposed Hinkley C liquid discharges. (Ref 45)*

9.4 In the context of the information from NNB Genco quoted above, specifically the identification of the methods provided by the Environment Agency (derived from1995 Documentation) and the use of a 1998 modelling system, Chapter 18.12 of the Joint Submission then stated that:

"To date it remains unclear whether the calculations/modelling of the behaviour and fate of tritium in the Bristol Channel environment and subsequent doses of tritium of tritium to Bristol Channel populations are based on:

a. *the use of models, methodologies and empirical data based on the most recent (2009) reported field and laboratory research and defined measurements*
b. *or on the use of models, methodologies and hypothetical data "not supported by clearly defined measurements"*
c. *or have taken regard to the recommendation that further research is required.*

9.5 ***This Response notes that, with respect to the***

a. concerns of the Joint Submission about the apparent failure to incorporate the latest scientific understanding on the fate and behaviour of aqueous tritium discharges; and
b. the Joint Submission's implicit request for clarity/confirmation on these issues;

the Environment Agency's Draft Decision commentary on limiting radioactive discharges has failed to acknowledge or address any of the issues.

9.6 ***This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the evidence summarised above the Draft Decision document has no answer to the Joint Submissions concerns***

10. **Pulsed tritium discharges**

At para 323 of it's Chapter 5.7.4 the Draft Decision recognizes the "pulsing" of tritium discharges, references NNG Genco's assumption that 80% of the tritium discharge occurs during a two month period at the time of refueling outage and introduces an EA hypothesis that the pulses of tritium discharge may be somewhat lower, in which they propose a lower QNL of 60 TBq rather than NNB GENCO's proposed 91.5 TBq. The relevant paras imply that the EA have reached this decision because they have made use of data from a broader suite of operating experience than that used by NNB GENCO.

10.1 This Response draws attention to the comments made in 5 (above) and repeats it's conclusion in relation to both the generality, and the tritium related specifics, of such "pulsed" discharges:
This Response notes that the Environment Agency's Draft Decision commentary on limiting radioactive discharges fails to acknowledge, recognise or address the issues arising from the "pulsed" discharges of aqueous radioactive wastes to the marine environment despite the Joint Submission having drawn attention to it.

10.2 ***This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the commentary on pulsed tritium discharges, the Draft Decision document has no answer to the Joint Submissions concerns***

11. Discharges of fission and activation products

Chapter 5.7.8 of the Draft Decision explains the Environment Agency position on permitting of aqueous discharges (containing "other fission and activation products") to the Bristol Channel marine environment.

11.1 The Joint Submission discussed aspects of this issue and made specific reference to the aqueous discharges of Caesium (Cs) 137, Cobalt 60 and actinides and alpha emitters.

11.2 *Caesium (Cs) 137:*
The Joint Submission raised a number of issues relating to the fate and behaviour of aqueous Cs 137 discharged into the marine environments.

Specifically the Joint Submission pointed out that:
a. Caesium was highly soluble in seawater
b. seawater concentrations of Cs 137 were less than 0.33 Bqs per kg
but that -
c. marine sediment concentrations of Cs 137 reached as much as 28 Bq per kg (84 times greater than ambient seawater)
and that hence -
d. the enrichment factors (EFs) of Caesium in marine/estuarine sediments are very high.

11.3 The Joint Submission noted that evidence presented in RIFE Reports appears to substantiate a link between sea-to-land transfer of Caesium 137 (via the use of seaweeds as a soil conditioner) and elevated concentrations of Cs137 in soil samples at Stolford.

11.4 Additionally, para 20:6 0f the Joint Submission referenced studies demonstrating that Cs 137 was able to transfer from the sea to the land via micro-layer enrichment, bubble burst, aerosol and/or sea spray pathways, but that no comparable work had been carried out in the sediment rich marine environments of the Bristol Channel.

11.5 The Joint Submission pointed out that the historical lack of engagement (on the part of nuclear industry and regulators) with such evidence, meant there were still a number of

significant fate and behaviour issues with regard to the sea to land transfer of Cs 137 remained unresolved..

11.6 Para 20.9 of the Joint Submission noted that RIFE Reports had identified uncertainty about the behaviour of Cs 137 in Irish Sea marine and estuarine sediments in that, despite the fact that discharges of Cs 137 "have remained at low levels", there was an identified variability "and even a suggestion of progressive increases" in Cs 137 concentrations in such sediments up to 2009.

11.7 The Joint Submission noted that RIFE Reports had advanced a hypothesis that the "likely explanation is that changes in these concentrations are due to re-mobilisation and subsequent accretion of fine grained sediments containing higher concentrations", but that there was no evidence of studies which had investigated either the observations or the RIFE hypothesis in Bristol Channel environments.

11.8 Para 2011 of the Joint Submission concluded that the NNB Genco submission had proposed peaks and troughs (pulses) of discharge for aqueous Cs 137 and that "there is no evidence that the existing marine and coastal monitoring regimes are sufficiently stringent to detect, record and analyse the effects that peaks and troughs of Cs discharge may be having on the behaviour of Cs in the environment and delivered doses to local pathways via a variety of pathways": by textual context, this conclusion was directed at the potential for the sea to land transfer of Cs 137 via the aerial pathways set out in 9:4 above.

11.9 *The Joint Submission concluded that:*
This Report notes that Cs 137 is widespread in the Hinkley local marine environment and that Cs 137 in sediments is enriched by factors of between 23 and 84 (compared to local seawater) and that low levels of Cs 137 are shown to have been transferred from the marine to the terrestrial environment by way of seaweed used as a fertiliser.

This Report concludes that about 80% of Bristol Channel environments and their associated biota, remain un-monitored and thus intermediate and far field behaviour of Cs 137 in the Bristol Channel remain unstudied and un-quantified.

This Report discusses the fact that Cs 137 has been shown to transfer from the sea to the land via sea spray / aerosol pathways in south west Wales and Hebridean environments and explains that in the latter case (200kms from discharge source), high concentrations were shown to be entered island grown produce and to generate Cs 137-alone dietary doses equivalent to (and higher than some) dietary doses received by Critical Groups identified at Nuclear Power Stations.

In this context this Report concludes that
a. a major potential impact of Cs 137 discharges to sea remains un-quantified
b. that current and historical monitoring programmes have notably failed to identify Bristol Channel fine grained sediments containing higher concentrations of Cs 137
c. and that these programmes have therefore proved incapable of delivering precise and relevant data on Cs 137 in the Bristol Channel

11.10 ***This Report also concludes that there is no evidence that the existing marine and coastal monitoring regimes are sufficiently stringent to detect, record and analyse the effects that proposed peaks and troughs of Cs discharge may be having on the behaviour of Cs in the environment and delivered doses of Cs to local populations via a variety of pathways. (Sections 19 and 20)***

11.11 ***This Response notes that the Environment Agency's Draft Decision commentary on aqueous discharges of Cs 137 fails to acknowledge, recognise or address the issues arising from the "pulsed" discharges of aqueous radioactive Caesium 137 to the marine environment despite the Joint Submission having drawn attention to it.***

11.12 ***This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the evidence about pulsed discharges of Cs 137 the Draft Decision document has no answer to the Joint Submissions concerns***

12. Cobalt 60

12.1 *On the subject of Cobalt 60, the Joint Submission concluded that:*
Cobalt 60 is shown to concentrate in marine and estuarine sediments and in marine biota. It is also shown to mobilise in association with water column mobile sedimentary particles. Co 60 has been shown to transfer from the sea to the land and to enter the terrestrial food chain in a coastal region 30 to 40 miles distant from the nearest source of discharge.

The annual aggregated Cobalt 60 liquid discharges limits from all Bristol Channel NPS (existing and proposed new reactors) will be raised from 1,000,000,000 Bqs/pa at present to 5,500,000,000 Bqs pa (i.e. increased by 5.5 times) and that the future proposed ACTUAL discharges will be higher than the current limit and about 3.37 times higher than current discharges.

This Report concludes that there is a huge discrepancy (nearly ten times) between the proposed annual "expected discharges" of Cobalt 60 and the annual limit proposed by EDF/AREVA and accepted by the Environment Agency. No explanation is offered in the GDA documentation for this discrepancy.

This Report concludes that, in the absence of any further information, and given that Co60 production is linked to corrosion of stainless steel components, this discrepancy highlights uncertainties regarding the performance integrity of stainless steel reactor and cooling system components and that further consideration and review of the integrity of reactor and cooling system steel components may be relevant. (Section 22)

12.2 ***This Response notes that the Environment Agency's Draft Decision commentary on aqueous discharges of Co60 fails to acknowledge, recognise or address the issues of concern to the Joint Submission, especially the uncertainties about performance integrity of system stainless steel components.***

12.3 ***This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the commentary of Co60 issues the Draft Decision document has no answer to the Joint Submissions concerns***

13. Plutonium, Americium and other Alpha emitting actinides

13.1 The Joint Submission noted that, neither the NNB Genco submission, nor earlier documentation from EDF, had offered a full list of the constituent actinides and alpha emitting radionuclides in the proposed discharge stream from the Hinkley C reactors. The Joint Submission then referenced other documentation which implied that the proposed reactors could give rise to liquid discharges containing possibly as many as 17 isotopes of actinides including: 6 isotopes of Plutonium, 5 of Americium, 3 of Curium, 2 of Uranium and 1 of Neptunium.

13.2 The Joint Submission noted that the Environment Agency GDA Report on the Hinkley EPRs had stated "We will not include alpha emitters as a category for disposal limits" but had provided little scientific justification for the decision in the accompanying text.

13.3 Discussing the issue of the "significance" of proposed discharges of alpha/actinide the Joint Submission reported that Westinghouse, the manufacturers of the AP1000 reactors proposed for the proposed Oldbury NPS, had identified Pu 241 (one of the multiple actinides proposed for discharge to the Bristol Channel in the liquid waste stream) as a

"significant" isotope because it has a long half life and may persist or accumulate in the environment.

13.4 The Joint Submission agreed with the Westinghouse statement and, in addition, pointed out that Pu 241 (half life= 14 years) was also "significant" because it decays to produce Americium 241 (half life=432 yrs), an alpha and beta emitter. The decay occurs at the rate of 32 units of Pu 241 producing 1 unit of Americium 241.

13.5 The Joint Submission also noted that, historically discharged Pu 241, sequestered in marine environments, is now consensually agreed, by regulators and industry alike, to be the major source of the current, and rising, production of Am 241 in UK marine environments.

13.6 The Joint Submission noted that, with respect to their AP1000 reactor, Westinghouse had been both able, and prepared, to offer specific annual and annual maximum predictions for the discharge of Pu 241 to the Bristol Channel and that they had proposed an annual limit.

13.7 The Joint Submission further noted that several of the actinide/alpha emitting isotopes listed above, shared the following "significant" characteristics of Pu 241 e.g.

a: Persistence in the environment

b: Preferential adsorbtion to marine and estuarine fine sediments in suspension in the water column and in fine sediment deposits

c: proven ability to re-concentrate (relative to seawater concentrations) in fine marine sediment deposits, marine micro-layers and marine aerosols

d: proven ability to transfer from the sea to the land via a number of mechanisms

13:8 The Joint Submission also noted that those alpha emitters that have been sampled for in surf line sea spray and marine aerosols, have been identified in those media and are thus proved to be capable of transfer from the sea to the land across the surf line.

13.9 The Joint Submission pointed out that the study of RIFE Reports had demonstrated that:

a. monitoring/sampling for Pu 241 in Bristol Channel and near-Hinkley NPS marine environments had been virtually non-existent

b. RIFE Reports showed low (but positive) and rising concentrations of several isotopes of Pu, Cm and Am241 in Hinkley Point NPS shrimps.

13.10 The Joint Submission presented calculations to demonstrate that:

a. on the basis of the Westinghouse figures for Pu 241 (average annual) discharge from the 3 proposed Oldbury AP1000 reactors, and

b: working on a hypothesis that the 2 proposed Hinkley C EPR reactors might produce a broadly similar value of Pu 241 discharges

then:

c: the combined discharge of Pu 241 from both stations might generate as much as 900,000 Bqs of Am 241 (by decay) in the Bristol Channel. (This figure NOT including any [non-decay] Am 241 which might be discharged directly through the pipelines at both stations.

13.11 In the context of paras11:1 to 11:10 above, the Joint Submission concluded that:
in the multi-decadal time span (of the stations lifespan) *and in the context of the Bridgwater Bay parameters of*

a. very high sediment loadings,

b. relatively poor exchange with the Bristol Channel

c. the well known proclivity of these isotopes to associate with fine sediments,

d. re-concentrate in sediment deposits,

e. enrich in marine aerosols,

f. transfer from the sea to the land and

g. the very wide consensual understanding of their potential to inflict radio biological damage via inhalation and ingestion pathways

These are not negligible quantities.

13.12 Earlier in 2011, the NFLA, in consultation with the EA over the GDA comments on the EPR, submitted the following queries based on the above information:

a. what is the detection performance/threshold of the in-line detectors
b. what is the calculated quantity of alpha emitters for the UK EPR discharge
c. what is the expected isotopic content of alpha emissions for the UK EPR
d. what are the sources of the expected alpha emitters
e. what factors might lead to the presence of detectable amounts of alpha
f. if/when the in-line detectors "detect" the presence of alpha emitters, what mechanisms will "prevent" the discharge of alpha emitters

13.13 Responding to the Joint Submission's 4 pages of comment on alpha/actinide discharges, the Draft Decision offered two paragraphs of reply:

a: (para 394) states that the E.A. "have considered alpha emitters at GDA and decided that they did not need detailed consideration as the discharges and impacts were very low. We note that Pu 241 is not an alpha emitter, but does decay to americium 241. However, the quantities of both are not significant"

and -

b: (para 395) agrees with the NNB Genco statement that alpha emitters would not be detectable in liquid effluent and states that "This is in line with our assessment at GDA and, although we have not set a limit, we will require assessment for alpha emitters in bulk samples. For these samples more sensitive methods can be applied. We will require these results to be reported to us and we will make them available on the public registers."

13.14 As of yet, the questions repeated in 13:12 above, have still not been answered.

13.15 ***This Response concludes that a number of very serious issues relating to alpha/actinide discharges and monitoring have not been adequately responded to by the Draft Decision document. We note that***

a. the two paragraph response is, in effect, a re-iteration of the views expressed in the Environment Agency's earlier GDA document
b that it has not engaged with a series of major scientific and technical issues raised by the Joint Submission
c. that a series of highly pertinent questions asked by the NFLA in response to the EA's earlier GDA document, and repeated in the Joint Submission, have still not been answered nearly a year after their asking and despite their re-iteration through several stages of consultation

13.16 ***This Response concludes that, in the absence of a serious scientific and referenced rebuttal of the commentary on issues related to the discharges of alpha/actinides summarised above the Draft Decision document has no answer to the Joint Submissions concerns***

14. In-Site Monitoring (liquid waste streams): Draft Decision document (Chapter 5:10)

As discussed in Chapter 13 (above) of this Response, the Joint Submission has expressed major concerns about liquid discharge of alpha/actinide wastes to the Bristol Channel. These concerns also covered issues relating to both in-site and off site monitoring for alpha/actinide nuclides.

14.1 With regard to in-site monitoring for these substances the EAs Draft Decision document (para 439) recognises that the questions referenced in 13:12 (above) were submitted but does not answer them. The Draft Decision document merely re-iterates, in a different form,

the views the EA had put forward at GDA that "there is no expected discharge of alpha-emitters that will require in-line monitoring" and adding that "as a precaution we will require some measurements of samples for alpha emitting radionuclides"

14.2 Chapter 7.3.6 of the EAs GDA Decision Document for the UK EPR reports that alpha actinides only appear in the coolant discharge if:

a. there are fuel defects
b. if there is surface contamination of fuel pins with "tramp" uranium
c. if there are impurities in fuel cladding

14.3 Chapter 7.3.6 of the EAs GDA decision reports the EDF/AREVA position that

a. tramp uranium and impurities are not significant compared to the potential for alpha/actinide release through fuel defects
b. improvements in fuel design and manufacture now minimise fuel leaks and therefore the potential for alpha/actinide release
c. filters in the coolant systems have high removal efficiencies
d. EDF/AREVA operational experience shows that even with fuel defects they have not been able to detect alpha emitters when sampling discharge points

14.4 This Response notes that the final paragraph of the GDA decision document's Chapter 7.3.6 says "In the UK EPR the absence of gross alpha activity will be confirmed by analysis taken from……each tank of aqueous effluent discharged".

14.5 This Response notes that nowhere in the various statements is there an absolute claim that there will be NO or NIL arisings of alpha/actinides, rather that they demonstrate an expectation that there will, in fact, be SOME level of alpha/actinide arising.

14.6 This Response also notes that the GDA submissions, for both the UK EPR and the AP1000 reactors, confirm the fact that the fission product Caesium 137 is expected to occur in the liquid waste discharge streams of both reactor types, that Cs 137 discharges at Hinkley C are permitted and limited (1.9 GBqs: 1 thousand, nine hundred million Bqs) and that the Cs 137 arises as:

a. the result of the irradiation of "tramp uranium" on the outer surface of fuel pins/assemblies or
b. as a result of the irradiation of uranium leaking from within the pins/assemblies:

This Response concludes that the Environment Agency's Draft Decision document

c. plainly accepts that, as a result of those fuel failings, Caesium 137 arisings are inevitable

d. has formally permitted and limited the discharge

and that therefore some degree of fuel failure (tramp uranium and/or breaching of fuel pin/assembly integrity) is to be expected and hence alpha/actinide arisings are similarly to be expected.

14.7 This Response further notes that para 386 of the GDA Decision document confirms the positive presence of alpha/actinides and states that:
"Our assessment concluded that radioactive actinides will not contribute significantly to discharges or radiological impacts. We do not consider it proportional to assess actinides in detail and will not consider them in limit setting. The presence of actinides in discharges will be detected by the various monitoring arrangements that will be implemented for the UK EPR."

14.8 This Response concludes that perhaps the most crucial concept in the EDF/AREVA/Environment Agency commentary on alpha/actinides is that of the "significance" of the alpha/actinide arisings. This Response further notes that the Environment Agency has failed to provide a definition of "significant" in this context.

14.9 However, previous submissions by the NFLA to this consultation process have drawn attention to the fact that Westinghouse have offered such a definition, i.e. that "the "significance" of nuclide/isotope arisings are defined by the amount of radioactivity and that "insignificant" amounts are defined as "negligible" and that the definition of negligible is "values less than 37,000 Bqs per reactor per year" (otherwise 1 Curie per year).

14.10 This Response proposes that, in the context of the proposed 2 reactor Hinkley C station with a proposed 60 year working life, such an arising could generate as much as 4,440,000 Bqs over the working lifetime of the station which is not an "insignificant" amount of alpha/actinide arising.

This Response additionally notes that some of those alpha/actinides undergo decay processes that generate yet more alpha radioactivity and that they also have extremely long environmental half lives.

14.11 In the context of the evidence laid out above, this Response wishes to re-iterate the points made in the Joint Submission:

a. that a series of highly pertinent questions related to alpha/actinide monitoring asked by the NFLA in response to the EA's earlier GDA document, and repeated in the Joint Submission, have still not been answered nearly a year after their asking and despite their re-iteration through several stages of consultation the unanswered questions about alpha/actinide monitoring

b. the Joint Submission's concerns about the "significance" of alpha/actinide discharges have not been addressed by the Draft Decision document.

This Response notes that, in the context of rising levels of alpha/actinide activity recorded in Hinkley shellfish by various RIFE reports, and in the context of the widely reported rising levels of Am 241 in UK west coast marine environments, the issue of the monitoring of alpha discharges is one of major significance.

14.12 In the context of rising levels of alpha/actinides reported by RIFE reports for Hinkley shellfish, and the consensually agreed rising levels of Am 241 in UK west coast marine environments, this Response wishes to remind the Environment Agency of the following:

a: The Draft Decision (Chapter 5:11) states that its radiological assessment work is "consistent with the Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges to the environment" issued by the DECC.

b: That this DECC document references the *UK Strategy for Radioactive Discharges 2001-2020 as follows* "10. The objectives of the 2009 UK Strategy are to achieve progressive and substantial reductions in:

• radioactive discharges;

• concentrations of radionuclides in the marine environment resulting from radioactive discharges, such that by 2020 they add close to zero to historic levels"

14.13 This Response concludes that, in the context of

a. the historical evidence for the INCREASING concentrations of alpha/actinides in Bristol Channel samples,

b. the evidence set out above that alpha/actinide discharges to the Bristol Channel WILL be taking place,

c. the widely understood fact that alpha/actinides are generally extremely persistent in the environment

d. the well understood fact that the Pu241 decay product (Am 241) is also an alpha emitter,

It appears inevitable that those objectives of the 2009 Strategy will not be met. Nothing in the Environment Agency Draft Decision document offers any explanation of how those objectives can be met in the context of alpha/actinides.

15. Off-Site Monitoring (liquid waste streams): Draft Decision document (Chapter 5:10)

The Joint Submission made a series of closely argued scientific and technical points on issues related to the marine environmental monitoring programmes employed at the Hinkley NPS.

15.1 The Joint Submission argued that the Hinkley fin fish sampling programme (as reported in the annual RIFE reports) was flawed in both its methodology and it's reporting because:

a. the RIFE reports only describe the sampling of 1 sample each of 2 pelagic fish species (living and feeding in the water column away from the seabed: i.e. not feeding from the seabed) and that this does not represent a legitimate or adequate sample base for the regional fin fisheries nor of regional fish consumption.

b: the RIFE reports fail to clarify whether the sample fish (cod and bass) were actually CAUGHT at Stolford or merely landed at Stolford having been caught elsewhere and that this is highly relevant because both species are migratory and the simple fact of their capture does not guarantee that the samples had fed on local prey species for any specific time period.

In the context of the work discussed above, this Response concludes that the claim that monitoring these fin fish "essentially samples" the local water and marine food chain cannot be justified, lacks scientific rigour and is false.

The Joint Submission advised that monitoring/sampling of demersal flatfish species would be a far more efficient and accurate way of "essentially sampling the local water and marine food chains" for radioactivity.

This Response notes that the Draft Decision document has failed to address these issue and therefore concludes that, in the absence of a rebuttal of (or indeed any comment on) the evidence summarised above the Draft Decision document has no answer to the Joint Submissions concerns

15.2 The Joint Submission argued that the Hinkley C shellfish sampling programme (as reported in annual RIFE reports) was also flawed in both methodology and reporting because

a. it was based on only 2 samples of shrimps and 1 sample of limpet, both attributed to Stolford. Once mature both species are sessile with a relatively small home range.

b. in this context there is no evidence to suggest that 1 sample of limpet and 2 of shrimp can provide an accurate record of the representative radioactivity concentrations found in locally caught shellfish across the entirety of the impact zone of Hinkley liquid waste stream

15.3 On this basis the Joint Submission argued that the shellfish sampling and monitoring programme for the existing Hinkley A and B stations does not provide a useful or accurate record of the representative radioactivity concentrations to be found in locally caught shellfish, hence the dietary dose calculations for locally caught shellfish are flawed.

The same flawed methodologies for sampling and monitoring programmes are proposed for deployment in respect of Hinkley C and will thus similarly fail to provide a useful and accurate record of radioactivity concentrations from the proposed EPR reactors in locally caught shellfish.

15.4 Chapters 1 to 11 and 25 of the Joint Submission presented fully referenced scientific and technical data which demonstrated the close relationship between sediment particle size, adsorbtion of radioactivity onto marine sedimentary particles, elevated concentrations of radioactivity associated with fine sediments and the transport of radioactivity in association with marine suspended particulates and hence the prime importance of identifying precise sediment particle sizes.

15.5 The Joint Submission noted that NNB documentation had stated that monitoring should "provide representative data about the levels of radioactivity in the local area and ensure that locations where higher results might be found are sampled."
It also pointed out that in the context of 15:4 (above) collection of such data would require the identification and sampling of fine sediment environments.

15.6 The Joint Submission noted that:

a. it was unclear what type of sediment the RIFE reports have been monitoring at 8 of the 9 sample sites
b. that sample sites had been chosen on the basis that they were "evenly located" and "at appropriate distances" across the Hinkley coast and there was no evidence that the choice of sample sites was informed by grain size analysis in order to identify the finest particle sedimentary deposits
c. in the context of the approx' 25 miles of coastline covered by the Hinkley sediment monitoring programme the sample base was strikingly small which militated against a precise understanding of the range of radioactivity concentrations
d: because of the lack of supporting data about the monitored sediments the radioactivity concentrations recorded represented little more than a collection of random results with geographical location the only common factor
e: that the annual "brief-period" spot sampling of sediments could not be claimed to be representative of the entirety of seasonal and annual conditions that would be experienced at those sample sites

15.7 The Joint Submission noted that without grain size analysis, marine, coastal and estuarine sample site choice is an essentially hit or miss operation which is not based on scientific rigour and incapable of providing the required "representative data about the levels of radioactivity in the area" and "locations where higher levels might be found."

15.8 The Joint Submission further noted that the monitoring programme was only gathering near field data (maximum of about 13 miles from the site) and thus that the impacts of Hinkley radioactivity on the vast majority of the Bristol Channel coastlines was unknown : this issue is particularly relevant in -

a. the context of the latest scientific understanding of Bristol Channel parameters set out in Chap 3 above.
b. the fact that the Bristol Channel is an enclosed sea area with a slow flushing time and a prolonged residence time for sedimentary particles and their associated adsorbed pollutants.

15.9 In the context of the ignorance of far field effects, the Joint Submission advised that it is legitimate to state that there is a wide swathe of ignorance concerning the radiological impact of existing NP stations on the entirety of the Bristol Channel environment and that unless the monitoring programme is radically improved this will carry on in the case of the proposed Hinkley Point C. Accordingly, the Joint Submission advised that: "It is thus imperative that, at the very least a wide ranging and detailed baseline survey of radioactivity in the south Wales and Avon sedimentary and water column environments be carried out prior to the initiation of discharges of radioactive wastes from the proposed new reactors."

It also commented: "Similarly, it is imperative that an ongoing sampling/monitoring programme should be maintained in order to check on the ongoing effects of those proposed new discharges of radioactive wastes in far field environments" of the Bristol Channel.

15.10 The Draft Decision document's answer to these concerns is dismissive and ill informed in the extreme. Chapter 5.10.2 (para 444) responds to the issue of far field (South Wales/Avon etc) impacts of discharges by stating that as "the impacts close to the site have been assessed and are very low" then the impacts further away would be "even lower" and

based on this monitoring in those areas would not be expected, but that NNB GENCO would be expected to consider these concerns in it's monitoring proposals and perhaps to include more frequent and geographically widespread sampling during the early years of operation.

15.11 The Joint Submission had identified a number of significant flaws in the near field monitoring as set out in the earlier paragraphs of Chap 15 above.

The Draft Decision document has:

a: failed to address those near field flaws,

and then

b: used the flawed near field monitoring to dismiss the far field issues.

15.12 The Draft Decision (para 445) stated (in answer to concerns about the dispersal and accumulation of radioactivity in the environment) that "We have a considerable amount of historical data for the area around Hinkley Point and the wider environment" and commenting that this data is published in the annual RIFE reports.

15.13 Throughout it's contents, the Joint Submission had commented in depth on the range of historical data for the area around Hinkley Point making use of detailed and referenced scientific and technical data to demonstrate that since neither the nuclear industry, nor the regulators, were in possession of the full facts about the marine environment of the Bristol Channel, none of the monitoring reports could be considered fit for purpose.

This Response notes that the Draft Decision has failed to address or discus that issue. In that context, this Response concludes that the "considerable amount of historical data "claimed by the Draft Decision cannot be guaranteed to possess the desired amount of scientific rigour

15.14

a: The Draft Decision (para 446) postulates that while climate change might drive changes in the location of marine sediments: "the range of concentrations in the environment will not change significantly".

b. The Draft Decision then states that, in the context of climate change, people's behaviour may change and that these changes may be more significant

c. The Draft Decision then proposes to monitor any changes by the use of routine surveys of environment and habits.

15.15 This Response notes that the Draft Decision's answer to the concern is dismissive and ill informed because:

a. concentrations of radioactivity in marine sediments are closely related to the "fineness" of the particles in sedimentary deposits (finer particle deposits generally showing higher concentrations)

b. thus any relocation of fine particle deposition as a result of climate change factors would generate a commensurate relocation of elevated concentrations of radioactivity

c: thus monitoring of the changes "by the use of routine surveys of the environment" would not detect any change, since, even if the "routine surveys" were not deeply flawed, they would still be unfit for purpose:

(N.B routine = regular course or procedure, unvarying performance of certain acts: Concise Oxford Dictionary)

d. plainly any survey programme would have to be restructured in order to detect newly re-formed sedimentary deposits and the use of an un-varying performance would be pointless.

15.16 The Draft Decision (para448) reports a number of consultee suggestions for action to be incorporated into the Hinkley C environmental monitoring programme.

This Response notes that the Draft Decision "expects" NNB Genco "to consider these matters" in the same way that it "expects" NNB Genco to consider far field issues. This Response is also disappointed that the Draft Decision document produced by the regulators fails to apply regulatory rigour in this case, and notes that the use of the words "expects" and "to consider" in this context allow NNB Genco license and discretion to NOT adopt the actions under consideration. This Response believes that the Draft Decision should have INSISTED on the action.

16. Draft Decision document (Chapter 5.11) Radiological assessment: impact on members of the public

16.1 This Chapter of the Draft Decision presents the Environment Agency's assessment of the radiological impact on the public arising from the discharges from the Hinkley Point C proposed reactors. The Draft Decision document states that the assessment process uses "the best available science on health and environmental effects of radiation, and realistic assumptions of the behaviour and dietary patterns of representative members of the exposed public".

16.2 ***This Response notes that this Environment Agency description of the assessment process fails to specifically identify the best available science (or understanding) of the fate and behaviour of aqueous radioactive waste discharged into the Bristol Channel marine environment***

16.3 Later, at Para 454 of the Draft Decision document the EA additionally states that "radiological assessments of doses to the public from future discharges are based on the behaviour and concentrations of radio nuclides once they are in the environment"

16.4 The Joint Submission raised a number of concerns about the use of PC CREAM 98 software to carry out hypothetical calculations for the assessment of dispersion (fate and behaviour) of radio nuclides:
The Joint Submission's first concern was that the 98 version of this software had been made redundant by the introduction of PC CREAM 08 claimed by it's manufacturers/developers to be a "significant improvement to CREAM 98" and that the HPA Radiation protection division had stated that, from February 28th 2010, it would no longer be committed to providing support for the PC CREAM 98 software (after that date the PC CREAM 98 software would be effectively redundant).

16.5 In reply the Draft Decision document agrees that PC CREAM 08 uses more up to date data for transfer parameters and Kd values and a different population for collective dose, but insists that "the impact of these changes in the software are not significant".

This Response concludes these following points:

a. if the HPA state that CREAM 08 is a "significant improvement" over CREAM 98 because it "takes into account feedback from users and recent model developments" and (as the EA agree) "more up to date transfer parameters."

b. how can it be that the impact of such changes "are not significant"?

c. what was the point if it's development and subsequent introduction and presumably it's use in future scenarios?

d. and why discontinue use of, and support for PC CREAM 98?

Have not been addressed by the Draft Decision document and thus remain as outstanding issues.

16.6 The Joint Submission also noted that the DORIS marine dispersion component of the CREAM software had also been revised post 2003 and made an assumption that these revisions were NOT encapsulated in PC CREAM 98.
This Response notes that this point was not addressed by the Draft Decision document and thus remains an outstanding issue.

16.7 The Joint Submission also noted the existence of a research study with the working title "Identifying Key Parameters which Control Coastal Dispersion Modelling" which had been underway for some time and was originally proposed for publication in 2010. The Joint Submission confirmed that various agencies had agreed that the study was underway but not yet completed and that there was no confirmed date of publication.

In this context the Joint Submission concluded that the hypothetical models (CREAM and DORIS) to be used in the dispersion of Hinkley liquid radioactive waste discharges were not informed by the latest scientific knowledge on coastal dispersion n modelling. ***This Response notes that this point was not addressed by the Draft Decision document and thus remains an outstanding issue.***

16.8 The Joint Submission further commented that both versions of the CREAM software were specifically described as being suitable for the assessment of continuous uniform discharges, ***but that neither were described*** as being suitable for the assessment of the "pulsed" discharges proposed for the aquatic radioactive waste discharges from Hinkley C.
The EA Draft Decision document has responded to such concern by proposing that "we consider it" (PC CREAM 98) "suitable for providing average results from multiple discharges" and arguing that such a position is supported by the evidence from historical Hinkley related sampling programmes reported in successive RIFE reports.

This Response does not agree that this is a valid position. Furthermore, this Response has, in earlier chapters drawn attention to the Joint Submission's review of those sampling/monitoring programmes that put forward a detailed review of flaws and failings in the research outcomes described in the RIFE reports. This Response concludes that, in the absence of a rebuttal by the Draft Decision document of that review, the use of the flawed RIFE research outcomes to support the outcomes of the redundant and mis-used PC CREAM 08 model are misplaced and an inadequate response to the Joint Submission's concerns.

16.9 The Joint Submission also commented on the Environment Agency statement that the PC CREAM 98 modelling of predicted dispersion of liquid radioactive wastes was carried out on the basis of environmental data inputs derived from Irish Sea/Cumbrian waters.

The Joint Submission introduced fully referenced scientific and technical information that demonstrated demonstrable and significant dis-similarities between Irish Sea/Cumbrian waters marine environmental parameters and those pertaining in the Bristol Channel.

The Joint Submission noted that the Environment Agency and the NPS Developers had offered no scientific evidence to support/justify their use of Irish Sea/Cumbrian parameters.

This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the Joint Submission evidence on these dis-similarities, the question of the use of inappropriate environmental data inputs to the PC CREAM 98 software remains unanswered and the Draft Decision document provides no answer to the Joint Submission's concerns.

16.10 ***This Response notes that the Joint Submission (and earlier chapters of this Response) have highlighted significant (and fully referenced) "data gaps" in the scientific and technical knowledge both Bristol Channel marine environmental parameters and the behaviour and fate of radioactivity in marine environments, which demonstrate that neither the industry nor the regulators can have a clear and***

full understanding of the relevant marine environmental parameters nor of the behaviour, fate and concentrations of marine radioactivity in the Bristol Channel.

This Response notes that the Draft Decision document has failed to comment on or address these "data gaps".

This Response concludes that, in the absence of a rebuttal of (or indeed any comment on) the evidence for those data gaps, the Draft Decision document has no answer to the Joint Submissions concerns

16.11 ***This Response concludes that, in the context of:***

- ***a. the contemporary scientific evidence that there are significant data gaps in the understanding of those Bristol Channel marine environmental parameters which govern and drive the fate and behaviour of contaminants discharged to the Bristol Channel***
- ***b. the evidence that current monitoring practices do not adequately identify (and thus quantify) the distribution and concentration of radioactivity in sediments and marine foodstuffs***
- ***c. the failure of the regulators to take account of rising levels of alpha/actinides in Bristol Channel marine environmental samples of sediments and foodstuffs***
- ***d. the failure of the regulators to take account of the latest scientific work on the both the environmental and dosimetric significance of radioactive waste tritium discharges to the Bristol Channel***
- ***e. the failure of the Draft Decision document to engage with a number of perceived flaws in the modelling of the consequences of releases of aqueous liquid radioactive wastes the environment***

This Response can have no confidence in the Environment Agency's Draft Decision assessment of the radiological impacts and dose assessments to the public of the proposed discharges from the proposed Hinkley C reactors.