Hinkley Point Site Stakeholder Group

Report on Radioactive Discharges and Environmental Monitoring at Hinkley Point A Site and Hinkley Point B Power Station During 2015

Presented June 2016

To	Members of the Hinkley Point Site Stakeholder Group	
Title	Report on Radioactive Discharges and Environmental Monitoring at Hinkley Point A Site and Hinkley Point B Power Station During 2015	
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EXECUTIVE SUMMARY

This joint report by EDF Energy Nuclear Generation Limited and Magnox Limited is presented to the Hinkley Point Site Stakeholder Group (SSG) and provides data covering radioactive discharges, solid radioactive waste disposals and environmental monitoring at Hinkley Point A site and Hinkley Point B power station for 2015. Historic data is available from the previous years' reports, and graphs are provided here to show the trends for the past six years.

There is also additional information about the environmental management systems in place at Hinkley Point A and Hinkley Point B.

All radioactive discharges from both sites are made under the terms of the authorisations granted by the Environment Agency. The disposal of radioactive waste from nuclear sites is regulated under the Environmental Permitting (England and Wales) Regulations 2010 (EPR). The authorisations are set after considering the actual quantities of radioactivity that both sites need to discharge but with consideration of the overall requirement to keep the levels as low as reasonably practicable and to keep doses to the public below the internationally recognised limits. During 2015, there were no variations to the permit for either Hinkley Point A or Hinkley Point B.

During 2015, the levels of radioactivity in liquid and gaseous effluents discharged to sea and air, together with transfers of solid radioactive low-level waste to the Low Level Waste Repository (LLWR) and other locations, remained below the authorised limits set by the Environment Agency. Although releases of radioactivity to the environment are controlled at source, a condition of the authorisations is that a programme of environmental monitoring is maintained. Such monitoring provides reassurance by demonstrating that the controls used to limit radioactive releases are satisfactory, and that there is no chronic accumulation of radioactivity in the environment. Hinkley Point B carries out the environmental monitoring programme on behalf of both sites.

The monitoring programme showed that radiological discharges have minimal impact on the environment. There is no evidence of any long-term accumulation of radioactivity resulting from the operation of Hinkley Point B power station, or from work to decommission the Hinkley Point A site. Radiation doses to members of the public from the discharges, and from direct radiation from both sites, were less than the UK legal limit and within the 1000μSv per year dose level recommended by the International Commission on Radiological Protection (ICRP). In 2014, the total dose to members of the public from the all pathways of exposure was 22μSv (RIFE 20, 2015), which is 2% of the dose limit and well within the public dose constraint value of 300 μSv per year from a 'single site', recommended by Public Health England.

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PART 1 GENERAL ENVIRONMENTAL MANAGEMENT INITIATIVES

1.1 ISO 14001:2004

ISO 14001:2004 is an International Standard that provides the elements for an effective Environmental Management System. This system enables us to work and act responsibly towards the environment and it applies to all of the environmental aspects which an organisation has control or influence over. The Standard is integrated with other management requirements to help the stations achieve their environmental goals.

Three significant benefits are gained by adopting this standard:

- A formal mechanism to apply Company Environmental Policy at site level
- A formal requirement for continual environmental improvement
- Independent verification of Company environmental protection standards

Both Hinkley Point A and B operate under an ISO 14001:2004 certification. Regular reviews and audits are carried out to ensure that the requirements of the standard are being met. ISO14001:2004 is a fleet wide certification for EDF Energy, therefore any non-conformities identified at any site must be addressed at all other sites. This more vigorous approach will continue to improve the stations environmental performance.

1.2 Environmental Permitting Regulations 2010

Hinkley Point A and B hold permits under the Environmental Permitting (England & Wales) Regulations 2010 (EPR 2010). The permits cover:

- Discharges to air and sea
- Combustion plant
- Sewage treatment plant
- Greenhouse gas emissions
- Radioactive waste management
- Operation of the waste facilities

1.3 Magnox Environmental Policy

The Magnox Limited Environment, Health and Safety (EH&S) policy applies at Hinkley Point A site namely *seeking continual improvement, to achieve and maintain excellence in EH&S as an integral part of our activities.*

It is of paramount importance to us that no harm to people or the environment should result from our activities and that we will be respected and trusted by our workforce, the public and our stakeholders. In pursuing this and with specific reference to Environmental performance, we will work in partnership with employees, contractors and tenants, and will strive to:

- Develop controls and set objectives to manage potentially significant environmental aspects;
- Prevent pollution and minimise waste and the use of natural resources as part of our contribution to sustainability and environmental improvement;

- Manage waste according to good industry practice ensuring safe and environmentally sound storage and disposal of radioactive and other waste;
- Achieve and sustain an excellent safety and environmental culture, consistently reinforcing appropriate behaviours;
- Learn the lessons from events, implement corrective actions and seek out and use good practices wherever we may find them;
- Ensure that our activities, products and services are in compliance with applicable legal requirements, apply good practice and comply fully with all requirements to which the company subscribes;
- Integrate environmental management into all relevant business processes;
- Operate an integrated management system that meets the requirements of ISO 14001.

In doing this we will:

- Make adequate resources and support available;
- Consult our employees on EH&S matters of mutual interest; listen to and respond to our customers, shareholder, suppliers and neighbours;
- Openly report our EH&S performance every year;
- Work with our regulators, the rest of our industry and our customers and contractors to raise EH&S standards;
- Inform, instruct, train and develop the people who work for us and ensure that competent EH&S advice is available;
- Set improvement objectives and targets aimed at reducing risks and improving environmental performance;
- Audit the management system which flows from this policy, and set and review EH&S objectives and targets;
- Maintain high standards in the conduct of our operations, in particular by ensuring that they are adequately resourced and carried out by suitably qualified and experienced people at all times.

1.4 EDF Energy Environmental Policy

EDF Energy is committed to reducing any adverse environmental effects of its operations to a practicable minimum. Hinkley Point B has adopted the company Environmental Policy. This policy is EDF Energy's overarching environmental document agreed upon by the managing director. The policy makes sure that EDF Energy will seek continuous improvement in our environmental performance and comply with all applicable legal and other requirements. This Environmental Policy builds on the commitments of our parent company to lead the energy change and has at its core the following four areas of focus:

- Remaining the lowest carbon dioxide (CO_2) emitter among the major UK energy companies
- Adapting our assets and our offers to take into account climate change
- Actively managing our environmental impact
- Delivering low-carbon power responsibly, where nuclear and environmental safety are the highest priority

These focus areas form the basis for the 9 policy standards applied in achieving this:

- We will ensure every job will be done safely to protect the environment, employees, contract partners and the communities that could be impacted by our operations.
- We will, as a minimum, comply with all relevant environmental regulations, standards and other codes of practice.
- We will operate and maintain our assets within the bounds of permits, consents, licenses and the approved plant designs and safety margins in order to protect environmental safety, while striving to achieve best performance in our sector.
- We will ensure we identify our significant environmental impacts and we will take action to manage these and to prevent pollution or environmental damage which may occur as a result of our business operations.
- We will focus our improvements in areas where we can make a material difference, setting challenging objectives and targets for ourselves, our contract partners and supply chain. We are committed to continuous improvement of our activities, products and services.
- We will engage stakeholders with an interest in environmental issues to ensure their concerns and expectations are fully considered, and we will place environmental considerations at the heart of robust and transparent decision-making processes.
- We will openly report our performance against our Environmental Improvement Plan.
- We will continue to develop a culture of environmental responsibility among employees; contract partners and suppliers who will apply due care for the environment no matter how urgent or important the task. This includes working with our suppliers, contract partners to improve the environmental performance of our supply chain.
- We will ensure all of our employees are given appropriate environmental training and integrate environmental safety into their activities and decisions.

1.4.1 Hinkley Point B Environmental Policy Compliance

Good progress continues to be made against the objectives set down in our Environmental Policy statement and monitoring against specific performance targets is used to support this. The environmental targets set by Hinkley Point B are set out below:

1. To have zero environmental events with reporting categories of ENV01, ENV02 and ENV03A **2.** To have no more than two environmental occurrences with reporting categories of ENV03B or ENV04.	ENV 01, ENV 02 and ENV 03A are of the highest significance and associated with some environmental impact. These events are reportable due to their significance. ENV 03B and ENV 04 record breaches of permits or legislation which have no physical environmental impact. During 2015 there were no ENV01, ENV02, ENV03A, or ENV03B. There were 3 permit or regulation non compliances with no environmental impact (ENV04): • COMAH non conformance on Vaporiser Auxiliary Boiler Fuel Tanks. New tanks and bunds will be installed in 2016. • Gaseous Sampling Cubicle availability affected by hand over procedure after maintenance. Improvements have been made to the process formalising acceptance into service. • Incorrect weight recorded on Radioactive Waste Consignment to Metals Recycling Facility. The weight was over estimated. Consignment Form has been updated to include a signature with the weight of the material. The last reportable environmental event was in 2009. The station continues to work hard to maintain high environmental standards and thus minimising our impact upon the environment.
3. Send less than 2% of non-radioactive waste generated to landfill	EDF Energy aims to prevent pollution or environmental damage which may occur as a result of our business operations. Therefore a waste hierarchy has been established to utilise recycling or alternative disposal options rather than using landfill sites. During 2015, 0.9% of waste was disposed of to landfill. Ultimately the station would like to dispose of all waste sustainably and send no waste for disposal at landfill sites.

4. Have no more than 35 unplanned ESPEC entries	There were 43 ESPEC entries in 2015 against a target of 35. The main causes were component level faults within gaseous sampling cubicles. There were several entries due to issues with the handover process and blocked flow-meters. An additional flowmeter has been installed to each sampling cubicle as a diverse means of measuring flow and a handover process has been initiated for accepting sampling cubicles into service (as described above).
5. Implement improvements to the towns mains system	Work is on going to analyse water usage across HPA & HPB. Wessex Water installed flow metres in 2010 however these did not allow us to differentiate between the different sites usage. Cross site flow-meters have been installed in 2015. Hinkley Point B can now establish a baseline for the amount of towns' water used by this site. Water consumption continues to be monitored and areas for improvement have been identified. Repairs to the system were carried out in 2015 and a repair strategy is in place for other identified defects.
6. Implement improvements to surface water system	A survey of the surface water drains system was completed as part of the response to the Japanese Emergency. This identified issues with sections of collapsed drains, which were repaired. In 2015 further surveys were carried out to extend the survey across the site. A programme of inspections & repairs are planned for 2016.

1.5 Requests for Information, Complaints and Environmental Events

The two sites receive requests for information (largely for student projects) and occasionally complaints which are formally recorded under the Environmental Management System.

The open reporting of "minor events" and "near misses" at both sites remains encouraging and continues to demonstrate a greater awareness of environmental impacts amongst staff and contract partners. This openness highlights that staff are not willing to tolerate practices that may have the potential for environmental damage and allows the station to rectify potential problem areas before the environment is put at risk.

Environmental events that require reporting to regulators form one of the key performance indicators for both Magnox and EDF Energy and events are taken very seriously at all levels within both organisations.

Any environmental 'events' or 'near misses' are recorded as part of the Company's corrective action database. The events occurring in 2015 that specifically affected compliance with environmental legislation and the stations' authorisations/ consents are as follows:

Hinkley Point A:

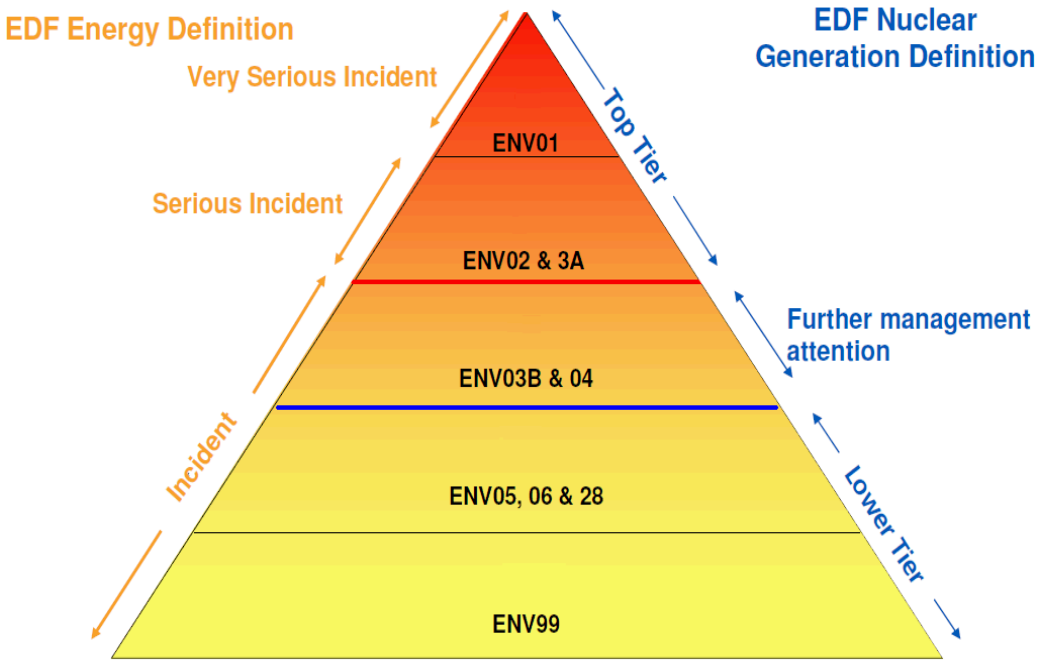
A number of lower tier events occurred during the reporting period. However, 2 events attracted specific regulator interest; both events related to process anomalies for the discharge of radioactive liquor with the resulting RASCAR highlighting a failure to apply best achievable technology (BAT) to radioactive waste disposals (CCS4) and a failure to maintain suitably qualified and experienced personnel (CCS3). Remedial action has been effected to the satisfaction of the regulator.

A number of L60iF discharge route sampler failures highlighted a lack of preventative maintenance arrangements which has now been included in the site extant arrangements and shared across sites as good practice**.**

Hinkley Point B:

In 2015, Hinkley Point B had no 'top tier' environmental events or events which required further management attention (EDF Energy Event Classification Standard, Figure 1).

FIGURE 1: Environmental Event Classification



Event Category Definition		2015
ENV01	The station has caused a pollution incident which has had a physical environmental impact	0
ENV02	A discharge limit has been exceeded or there has been an unauthorised discharge.	0
ENV03A	The station failed to comply with a requirement of environmental legislation or obtain a permit. This has resulted in an environmental impact.	0
ENV03B	As above, but there has been no environmental impact	0
ENV04	The station failed to meet a requirement of an environmental permit but there has been no environmental impact	3
ENV05	A notification level has been exceeded; there has been an unusual discharge, or there has been a potential event on permitted plant.	2
ENV06	An event or 'near miss' occurred that could have led to a higher category.	13
ENV28	There has been an unplanned entry into an ECO condition	43
ENV99	Something of environmental interest that merits recording	165

1.6 Environmental Benefits of Nuclear Power

In its simplest form, nuclear power stations use heat generated from fission, to generate steam; which then spins the turbines and thus generates electricity (*figure 2*). EDF Energy recognises that it has a duty of care to protect the environment and to minimise the effects of its operations on both the environment and the public. Both EDF Energy and Magnox Limited fulfil this duty by the implementation of their respective Environmental Policies and by the adoption of Environmental Management System Standards at each location. The continued compliance with this standard means enhanced environmental performance, independently verified by auditors at least every 12 months.

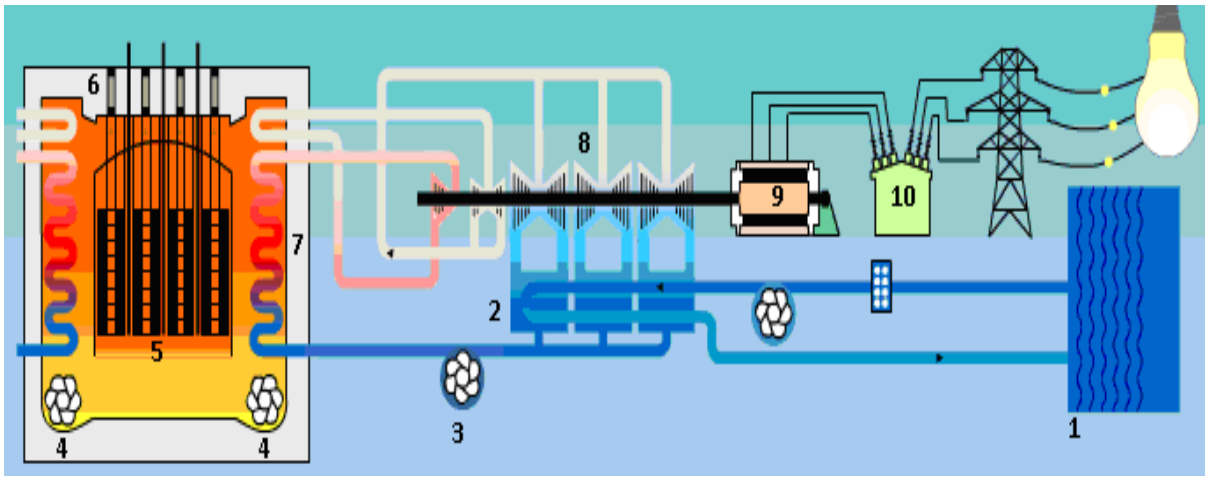
All forms of electricity generation impact upon the environment. These effects range from simple visual impacts through to discharges to air and water as well as disposals to land. But, nuclear fission produces roughly a million times more energy per unit than fossil fuels; making it the most affordable large-scale, low carbon energy source currently available. We believe that nuclear power makes a positive contribution to the protection of our environment.

The UK Government considers nuclear power stations to be a low-carbon means of generating electricity because they produce very low levels of CO_2 during operation and over their life cycle. The carbon footprint of a nuclear power station is about 16 grams of carbon dioxide-equivalent for each kilowatt-hour of electricity it generates (gCO_2e/kWh). This is the average level of greenhouse gas emissions a nuclear power station is responsible for over its lifetime, from construction to decommissioning. Uranium extraction accounts for about 40% of emissions from nuclear power; decommissioning is responsible for about 35%, and less than 1% comes from operation. In comparison, gas-fired power stations have a carbon footprint of $487gCO_2e/kWh$, coal-fired power stations have a carbon footprint of $870gCO_2e/kWh$ and oil-fired power stations have a carbon footprint of around $650gCO_2e/kWh$.

Increasing concentrations of CO_2 is one of the main contributors to climate change. The majority of carbon emissions are produced by the burning of fossil fuels, whereas nuclear power produces much lower amounts of CO_2. Moreover, nuclear power stations discharge significantly less sulphur dioxide (SO_2) and nitrogen oxides (NOx) than conventional power stations; both of which are associated with fossil fuel generation and cause acid rain and photochemical smog.

Furthermore, liquid discharges contain no harmful pollutants and any activity is below the limits set by the regulator. Cooling water is discharged at a temperature which does not cause any detrimental effects on aquatic habitats. All gaseous discharges are below the limits set by the regulator and contain low levels of radioactive material which is diluted and dispersed to further reduce concentrations emitted. The environmental monitoring programme collects air, land, core, marine, milk and plant samples to ensure that there is no adverse impact on the area surrounding the site.

FIGURE 2: Nuclear Power Station Operation



1. Seawater is used to cool and condense steam from the turbines back into water. The seawater cooling system is separate from the boiler feed water and condensate system.

2. Steam exiting the turbine is condensed back into feedwater so that it can be reused in the boilers to generate more steam.

3. Feedwater pumps transfer up to 500 litres per second of water back to the boilers.

4. Gas Circulators pump CO_2 around the reactor to remove heat from the fuel and deposit it near the boilers to heat the water and generate steam. The reactor gas is separate from the water in the boilers, but there is heat transfer across the pipes of the boiler.

5. The core of the reactor contains a graphite moderator which slows down neutrons emitted during fission to control the reaction and to allow further fission to occur. A concrete pressure vessel encapsulates the core and provides shielding from radiation.

6. Power is controlled by raising and lowering control rods into the graphite core. The control rods absorb neutrons and control the fission process. Inserting the rods causes more neutrons to be absorbed, so less fission occurs and less heat is produced. Fully inserting the rods stops the fission process altogether.

Fuel assemblies contain uranium and provide the energy required to power the reactor.

7. Serpentine boilers have thousands of steel tubes running through the pressure vessel. These tubes act as heat exchangers and the heat from the reactor generates steam which then provides kinetic energy to the turbines.

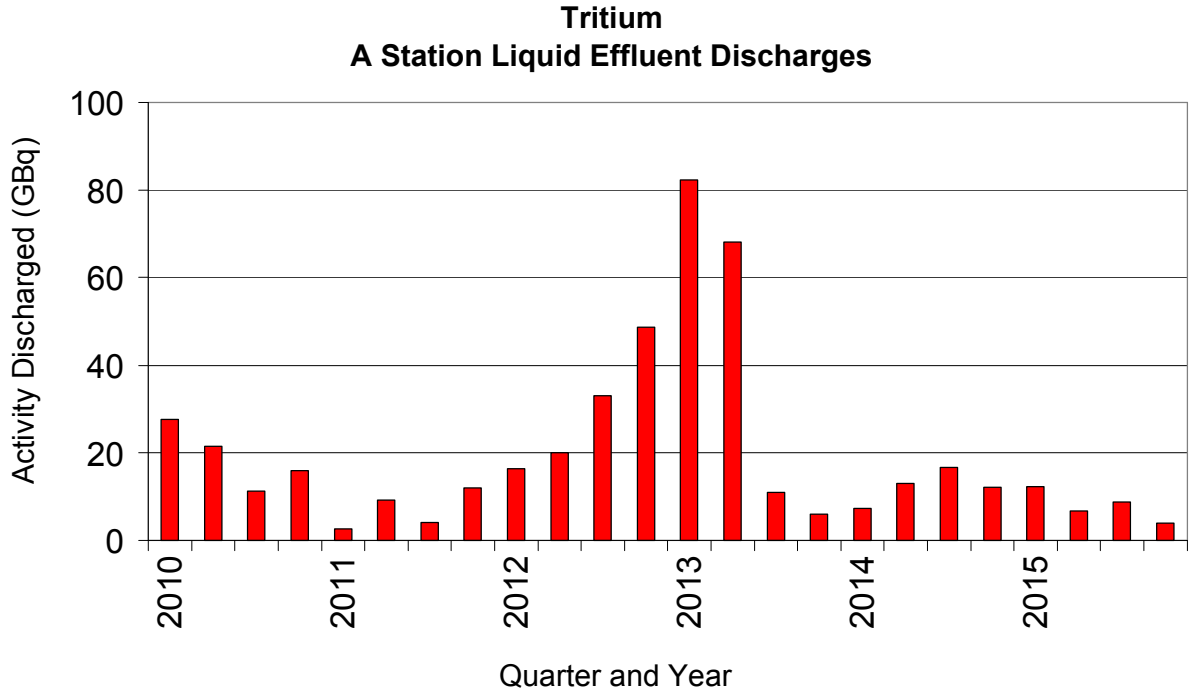
8. There is one high pressure, one intermediate pressure and three low pressure turbines running in parallel. Steam loses pressure and expands as it passes through the turbines so the blades become larger, the further the steam passes.

9. The generator consists of a magnet attached to the turbine shaft (rotor) which spins inside the stationary coils of wire (stator) to generate electricity.

10. The transformer converts 23kV to 400kV for transmission to the National Grid.

PART 2 HINKLEY POINT A LIQUID EFFLUENT DISCHARGES

Graph 2 (a)



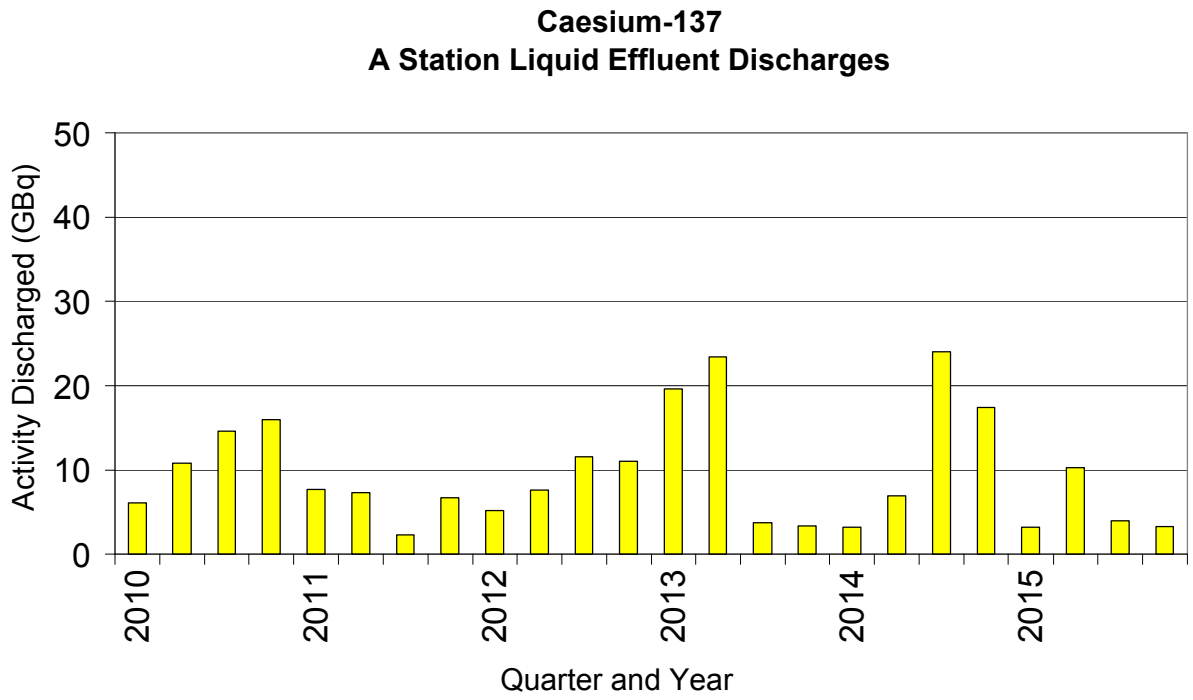
Tritium is an isotope of hydrogen and is largely present in the liquid discharge as tritiated water; it has low radio-toxicity and a radioactive half-life of about 12 years. The predominant source of the radioactive liquid discharges from Hinkley Point A site, including tritium, results from treatment of water in the former reactor fuel cooling ponds, to retain optimum conditions to minimise re-dissolution of radioactive sludge. The sludge represents the legacy resulting from corrosion of the Magnox can surrounding the fuel elements when the cooling ponds were used to store spent fuel elements before they were despatched off-site for reprocessing.

Decommissioning of the fuel ponds was completed during the latter months of 2015 including the removal of radioactive sludges to settling tanks, final drain-down of the fuel cooling ponds and sealing of the pond walls. Whilst there remains a requirement to discharge radioactive liquor from storage vaults and decommissioning processes, discharges of radioactive liquid are expected to be minimal now the decommissioning of the fuel cooling ponds is complete.

The Hinkley Point A site annual aqueous discharge limit for tritium is 1000 GBq.

The annual and monthly discharges of tritium in 2015 are listed in Table 1.

Graph 2 (b)

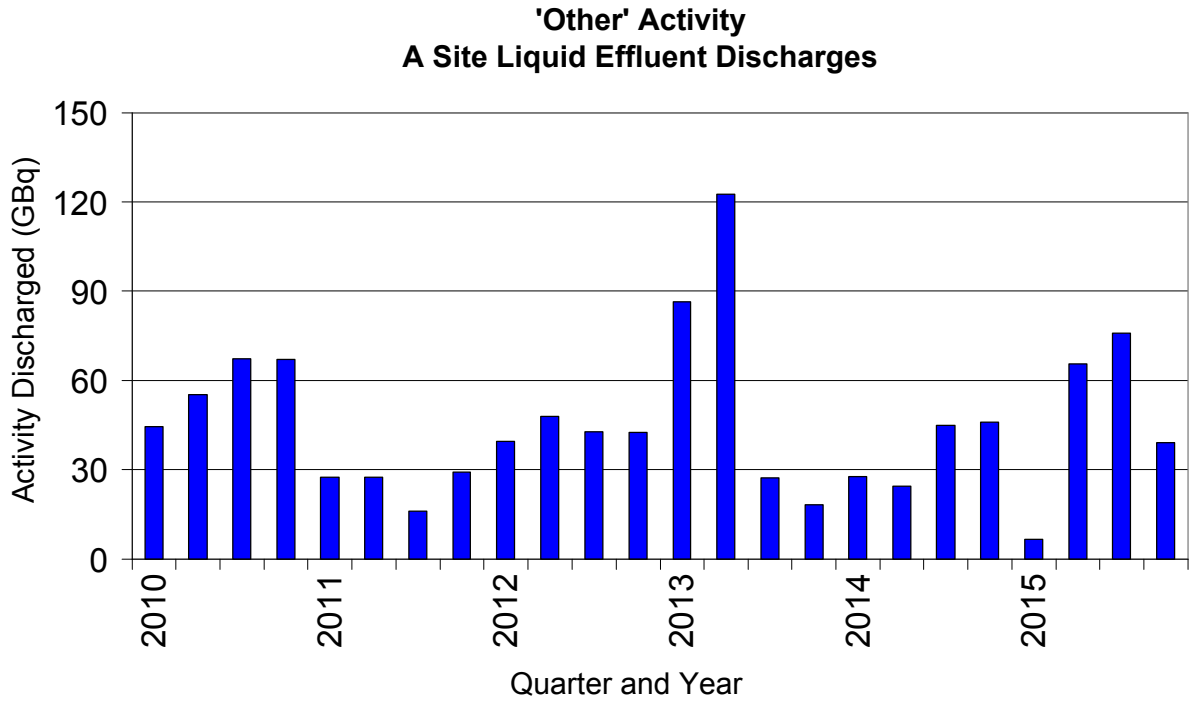


Caesium 137 is a fission product with a half-life of approximately 30 years. As mentioned previously for tritium, caesium 137 contamination exists in the pond water from past corrosion of the Magnox can surrounding the fuel elements, when fission products diffused into the pond water. The increased discharges in 2013/2014 are due to the fuel ponds being cleaned, treated and drained. This work was completed in the latter months of 2015 as discussed previously.

The Hinkley Point A site annual aqueous discharge limit for caesium 137 is 1000 GBq.

The annual and monthly discharges of caesium137 in 2015 are listed in Table 1.

Graph 2 (c)



'Other' activity is dominated by strontium 90 (in association with its short-lived daughter product yttrium 90) but also includes smaller amounts of radionuclides such as plutonium 241 and americium 241. Strontium 90 is a fission product and decays by emission of a beta particle and has a half-life of approximately 28 years. Plutonium 241 and americium 241 have half-lives of approximately 14 and 432 years, respectively.

The Hinkley Point A site annual aqueous discharge limit for 'other' activity is 700 GBq.

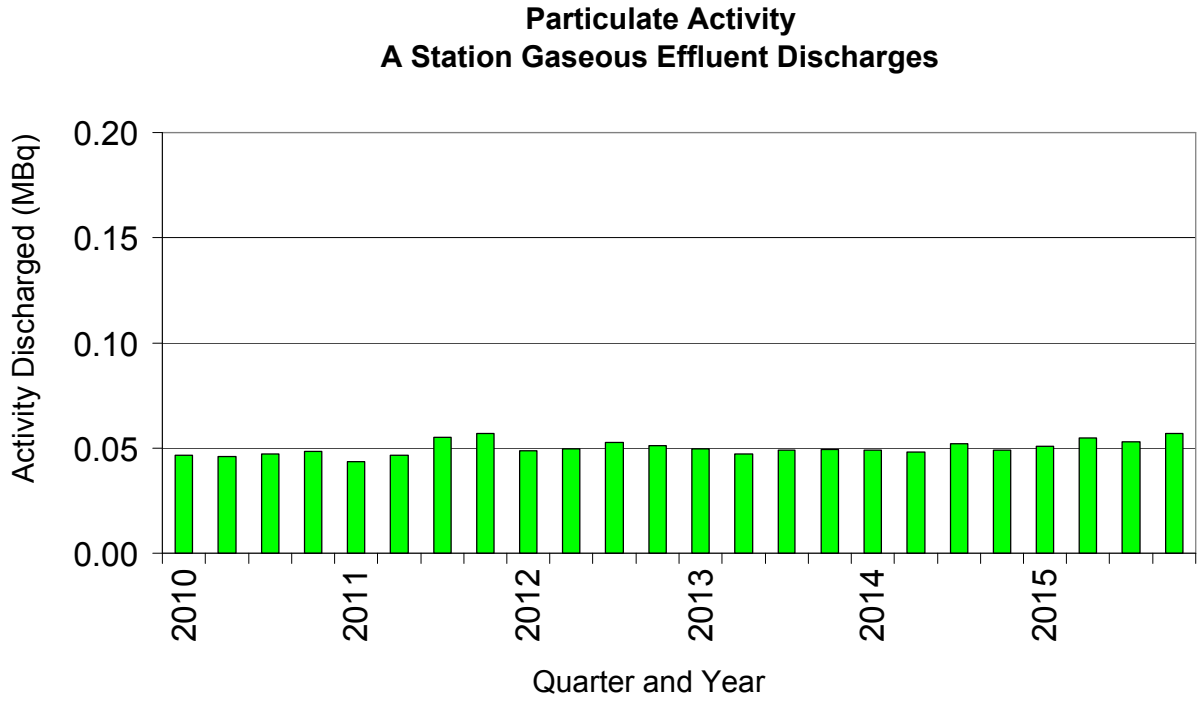
The annual and monthly discharges of 'other' activity in 2015 are listed in Table 1.

TABLE 1 Hinkley Point A Site:
Liquid Effluent Discharges & Authorisation Limits in 2015

Month	Tritium Activity (GBq)	Caesium 137 Activity (GBq)	'Other' Activity (GBq)
January	7.946	2.469	5.372
February	3.420	0.711	1.330
March	0.960	0.033	0.061
April	0.245	0.034	0.029
May	1.803	2.430	22.412
June	4.752	7.826	43.228
July	2.219	1.540	28.419
August	1.424	1.082	16.843
September	5.051	1.346	30.792
October	2.982	3.090	37.958
November	0.528	0.142	0.880
December	0.448	0.077	0.428
Annual Total (2015)	**31.778**	**20.780**	**187.752**
Previous Year (2014)	49.03	51.50	143.13
Annual Authorisation Limit	1000	1000	700

PART 3 HINKLEY POINT A SITE GASEOUS EFFLUENT DISCHARGES

Graph 3 (a)



Gaseous discharges are from the extract ventilation systems servicing contamination controlled areas on site. 'Leakage' from reactor vents occurs when the air inside the steel pressure vessels expands and contracts.

The Hinkley Point A site annual discharge limit for beta emitting particulate is 50 MBq.

The annual and monthly discharges of beta emitting particulate in 2015 are listed in Table 2.

Argon 41

Argon 41 is no longer present, since the cessation of electricity generation, due to the absence of a neutron flux to produce it. Due to its short half-life (less than 2 hours), all historical argon 41 has decayed and therefore discharge sampling for this nuclide is no longer required.

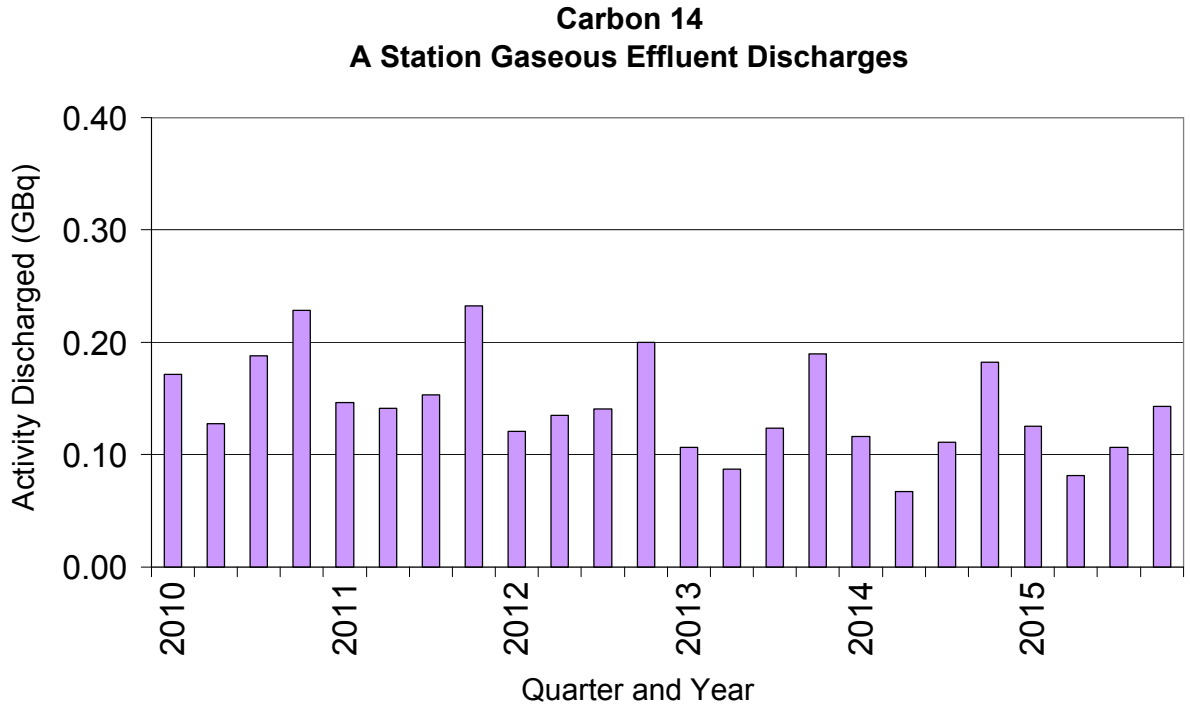
There is now no specific limit for argon 41.

Sulphur 35

Sulphur 35 has a half-life of 87 days and is no longer produced due to the absence of neutron flux. Due to its short half-life sulphur 35 is no longer present in measurable quantities and therefore discharge sampling for this nuclide is no longer required.

There is now no specific limit for sulphur 35.

Graph 3 (b)



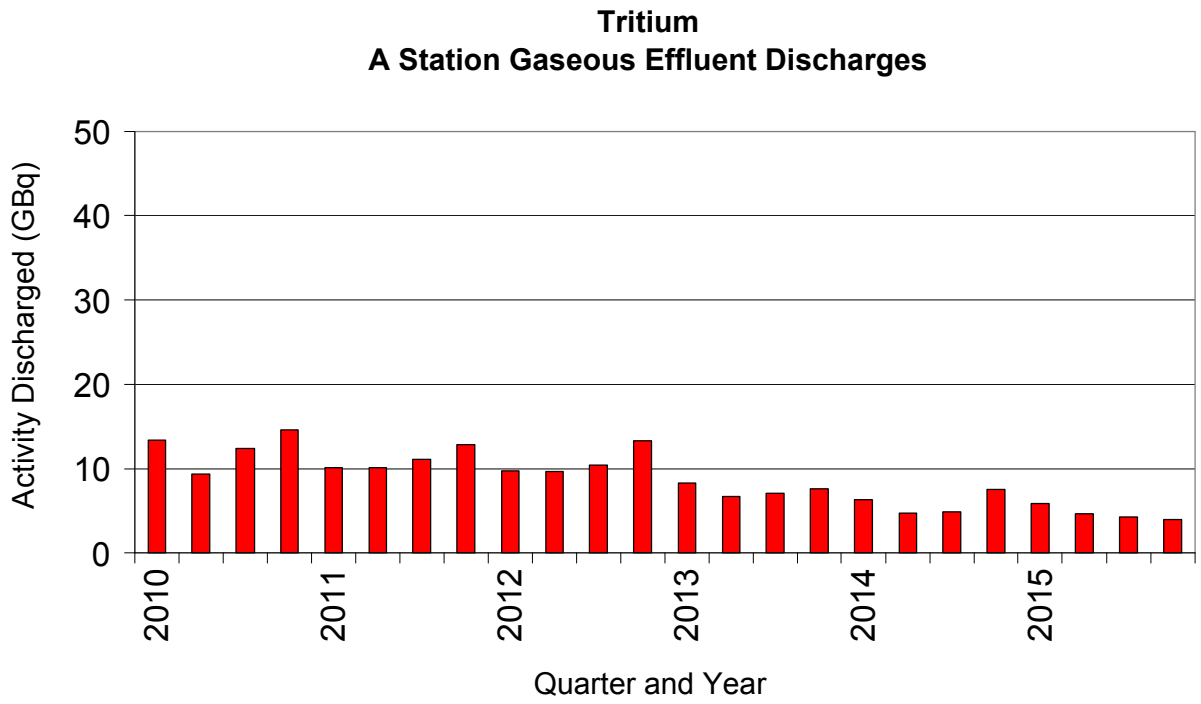
During generation, the principle source of carbon 14 was neutron activation of carbon in the graphite and reactor coolant. Carbon 14 has a half-life of 5730 years and therefore continues to be discharged to atmosphere, albeit in small amounts, via the reactor vents.

The carbon-14 profile fluctuates through the year with seasonal variation resulting in a minor 'peak' each 4th quarter of the year – the amount of carbon-14 discharged is very low and has fallen year on year since the reactor vessels were vented to air. The peak in reactor vessel temperature is around October, and not August, due to thermal inertia provided by the thick concrete biological shielding. Thus discharges of carbon-14 peak in October which lies in the quarter 4.

The Hinkley Point A site annual discharge limit for carbon 14 is 50 GBq.

The annual and monthly discharges of carbon 14 in 2015 are listed in Table 2.

Graph 3 (c)



During generation, the principle source of tritium was from neutron activation of lithium impurities that are present in small quantities in the graphite from which the reactor core is built. Tritium has a half-life of 12.3 years and therefore continues to be discharged to atmosphere, albeit in small amounts, via the reactor vents.

Extract ventilation systems for the pond buildings are currently the major source of gaseous tritium discharges from Hinkley Point A site, although this is likely to change now ponds drain and seal has been completed. Water from the fuel element cooling ponds historically contained tritium, which evaporated into the air within the buildings. The tritium levels in the pond water declined in recent years due to the absence of irradiated uranium and discharges of gaseous tritium continued to decline in 2015 as a result of ponds decommissioning.

The Hinkley Point A site annual discharge limit for tritium is 750 GBq.

The annual and monthly discharges of tritium in 2015 are listed in Table 2.

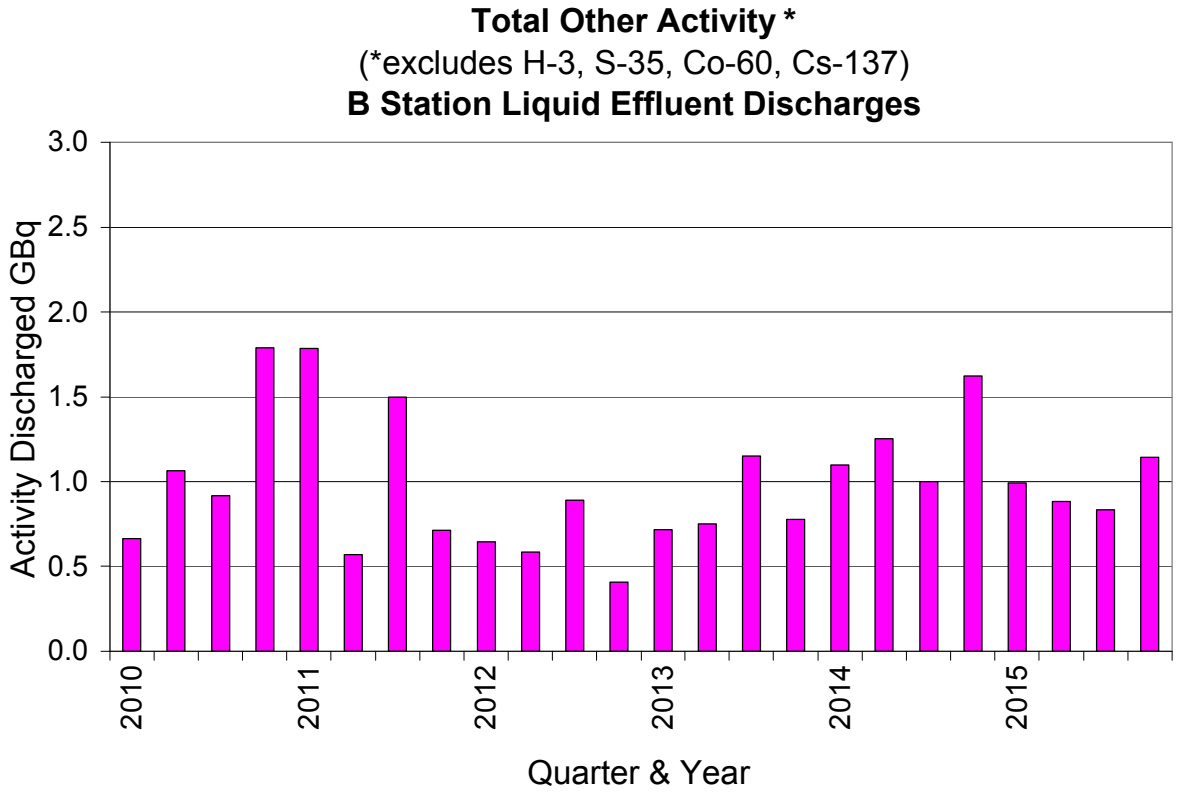
TABLE 2 Hinkley Point A Site:
Gaseous Effluent Discharges & Authorisation Limits in 2015

Month	Beta Particulate (MBq)	Carbon 14 (GBq)	Tritium (GBq)
January	0.018	0.060	2.30
February	0.015	0.036	1.90
March	0.018	0.029	1.70
April	0.019	0.023	1.50
May	0.019	0.033	1.70
June	0.017	0.025	1.40
July	0.017	0.032	1.60
August	0.018	0.030	1.30
September	0.018	0.044	1.40
October	0.019	0.044	1.30
November	0.020	0.051	1.30
December	0.018	0.048	1.40
Annual Total (2015)	**0.216**	**0.455**	**18.80**
Previous Year (2014)	0.198	0.476	23.40
Annual Authorisation	50	50	750

There are no specific limits for argon 41 and sulphur 35 as these nuclides are no longer discharged from Hinkley Point A site.

PART 4 HINKLEY POINT B LIQUID EFFLUENT DISCHARGES

Graph 4 (a)

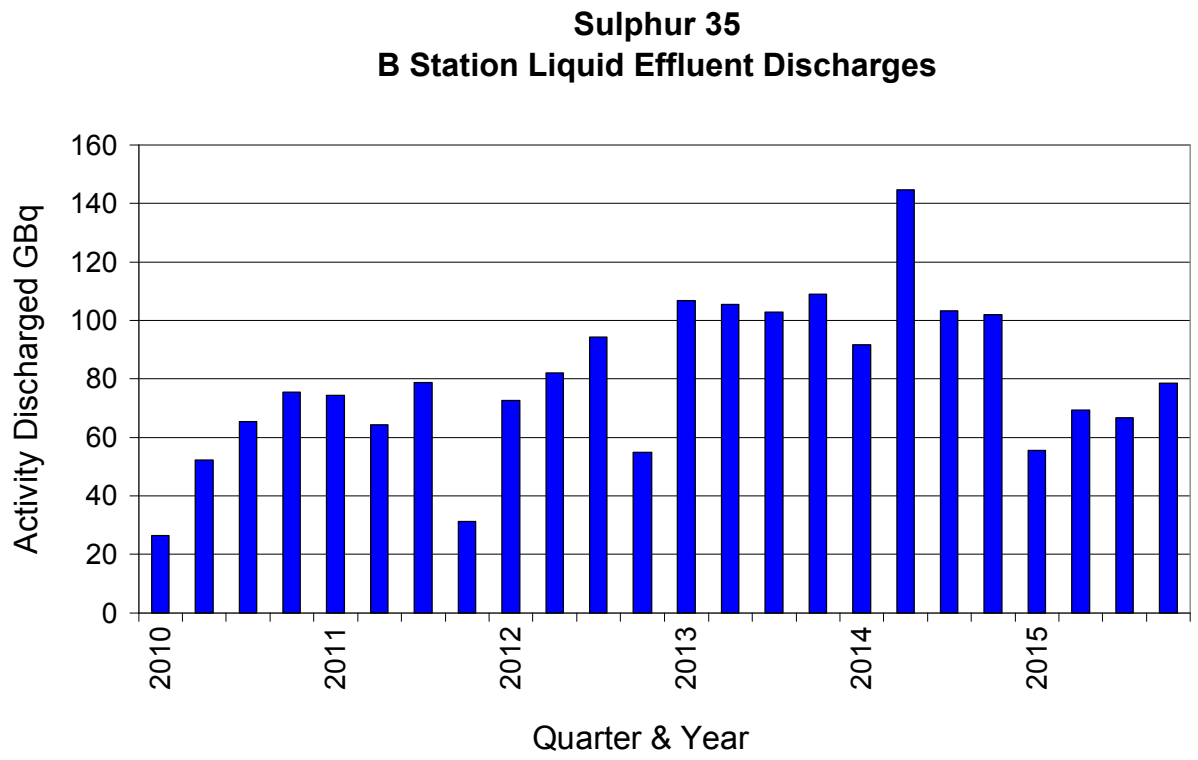


The Hinkley Point B power station annual discharge limit for 'radionuclides other than tritium, sulphur-35, cobalt-60 and caesium-137' is 80 GBq.

The 'other radionuclides' present in liquid discharges is defined as a 'gross measurement' of radioactivity present in the effluent that has not already been accounted for within the measurements for individual named nuclides below.

Table 3 gives the annual and monthly discharges for 2015.

Graph 4 (b)

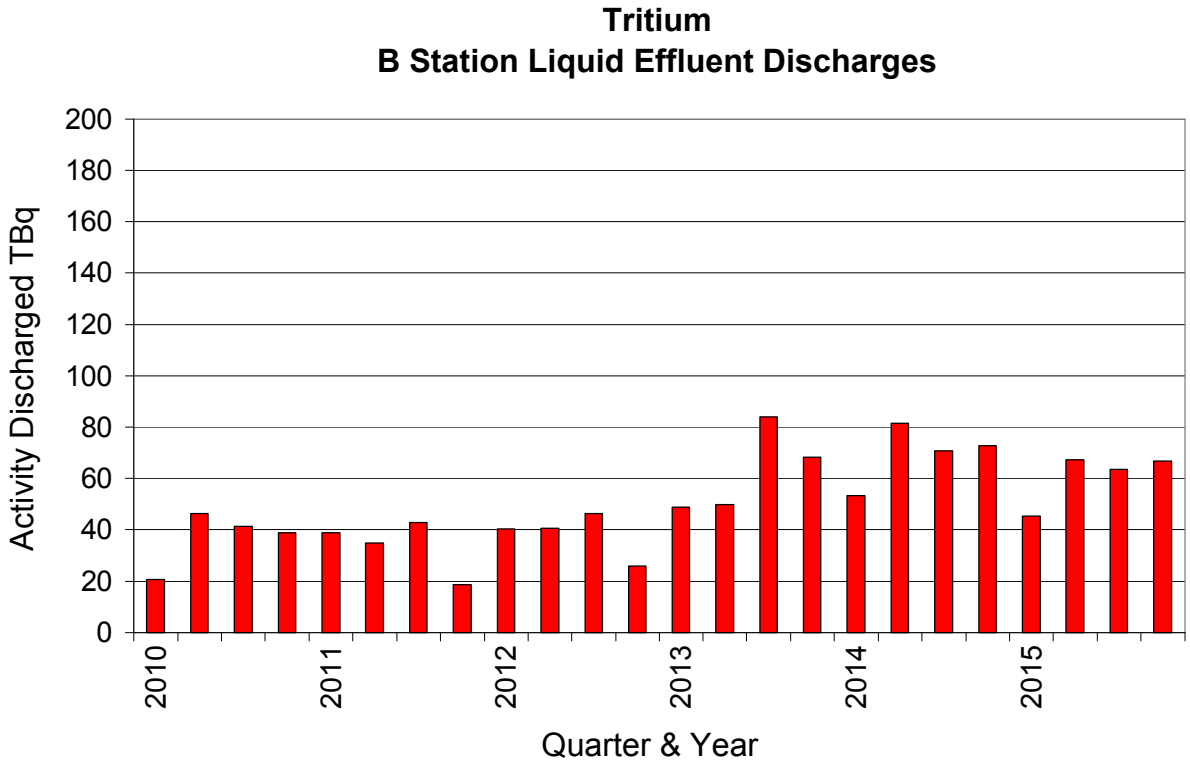


The Hinkley Point B power station annual discharge limit for sulphur 35 is 2000 GBq and the half life of sulphur 35 is 87 days.

Sulphur 35 is produced in reactors as a result of the irradiation of stable chlorine or sulphur that exists as impurities within the graphite or from oil deposits in the reactor and the gas circuits. The principle source of sulphur 35 in the reactor originates from small quantities of chlorine impurities present in the graphite core and in the sleeve of the fuel elements. The sulphur combines with carbon dioxide and carbon monoxide to produce carbonyl sulphide, which is a gas. Carbonyl sulphide exists in the gas circuit and is removed from the reactors by the gas dryers and then discharged as a liquid effluent. Table 3 gives the annual and monthly discharges for 2015.

There were higher than average sulphur-35 discharges during the second quarter of 2014 as one of the TWST discharges was above the action level after the Gas Bypass Plant was isolated for maintenance, giving rise to higher specific activity.

Graph 4 (c)



Note that the scale for this graph is TBq (1 TBq = 1000 GBq)

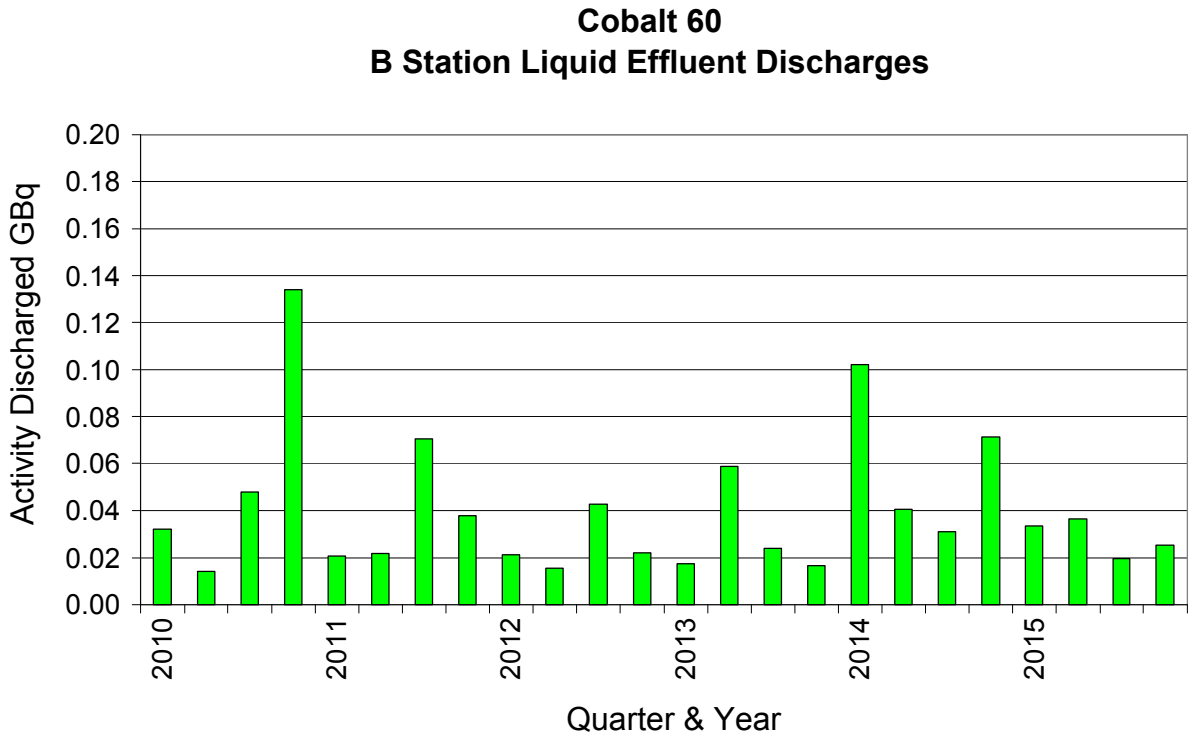
The Hinkley Point B power station annual discharge limit for tritium is 650 TBq and the half life is just over 12 years.

Tritium produced in reactors arises from the irradiation by neutrons of lithium that is present in small quantities in graphite. It is therefore produced in the core of advanced gas cooled reactors. Tritium is also produced in the fission process. The main source of the tritium discharged is from water extracted from the reactor carbon dioxide coolant gas by the gas dryers. The quantity discharged depends on the burn-up of the lithium in the core, the reactor power and operating time and the gas chemistry requirements. Tritium also occurs naturally in the environment.

The maximum reactor operating power was increased from about 1200 MW(Th) to about 1350 MW(Th) in mid 2013. Consequently there has been a proportional increase in the tritium levels discharged since then. The reduced tritium discharges in quarter 1 2014 and 2015 was due to reactor outages.

Table 3 gives the annual and monthly discharges for 2015.

Graph 4 (d)



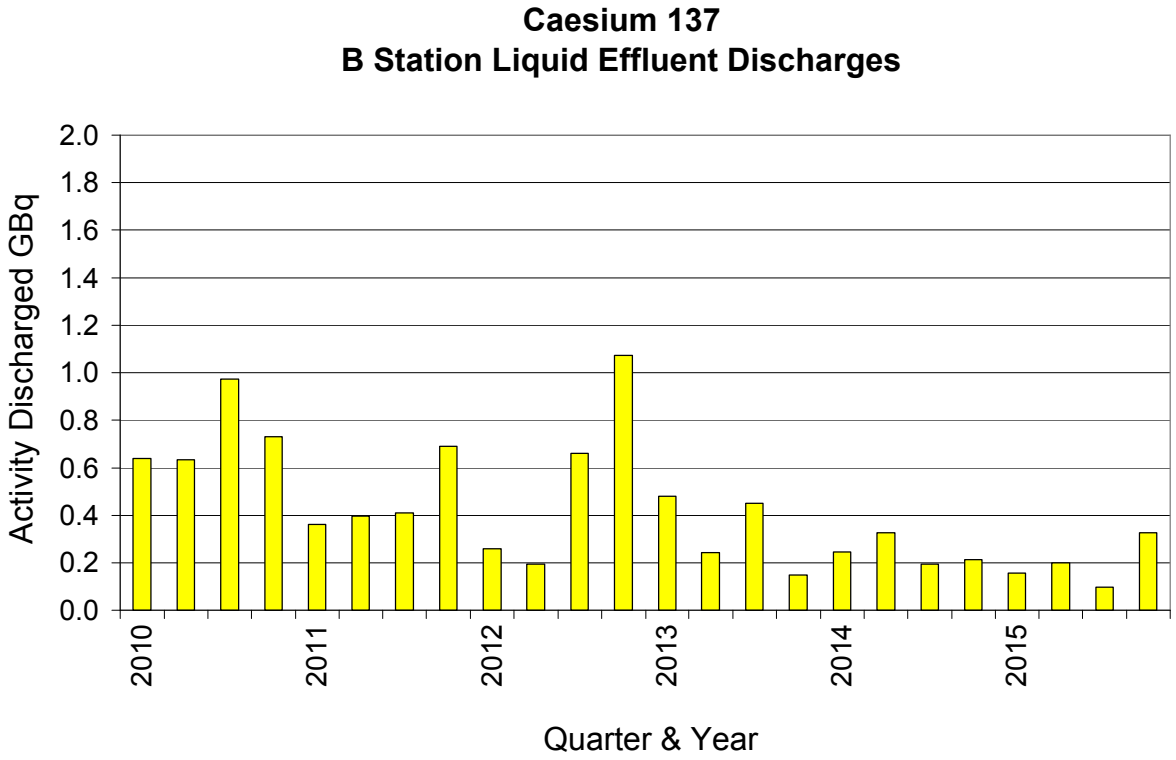
The Hinkley Point B power station annual discharge limit for cobalt 60 is 10GBq and the half life of cobalt 60 is just over 5 years.

Cobalt 60 arises mainly from pond water treatment and originates principally from surface contamination on fuel elements.

The cobalt-60 discharges have remained stable during 2015. The peaks are associated with the transfer of supernatant effluent to the final delay tanks and backwashing funda filters. The peak in quarter 1 2014 was due to pond water leaking into the backwash tank after the funda filter had been cleaned. There was also a supernatant tank discharged that month, increasing the amount of aqueous cobalt-60 discharged.

Table 3 gives the annual and monthly discharges for 2015.

Graph 4 (e)



The Hinkley Point B power station annual discharge limit for caesium-137 is 100GBq and the half life is approximately 30 years.

Caesium 137 is a fission product and the majority of caesium 137 discharges are associated with routine pond water treatment plant operations. Caesium 137 discharges have remained fairly stable throughout 2014 and 2015.

Table 3 gives the annual and monthly discharges for 2015.

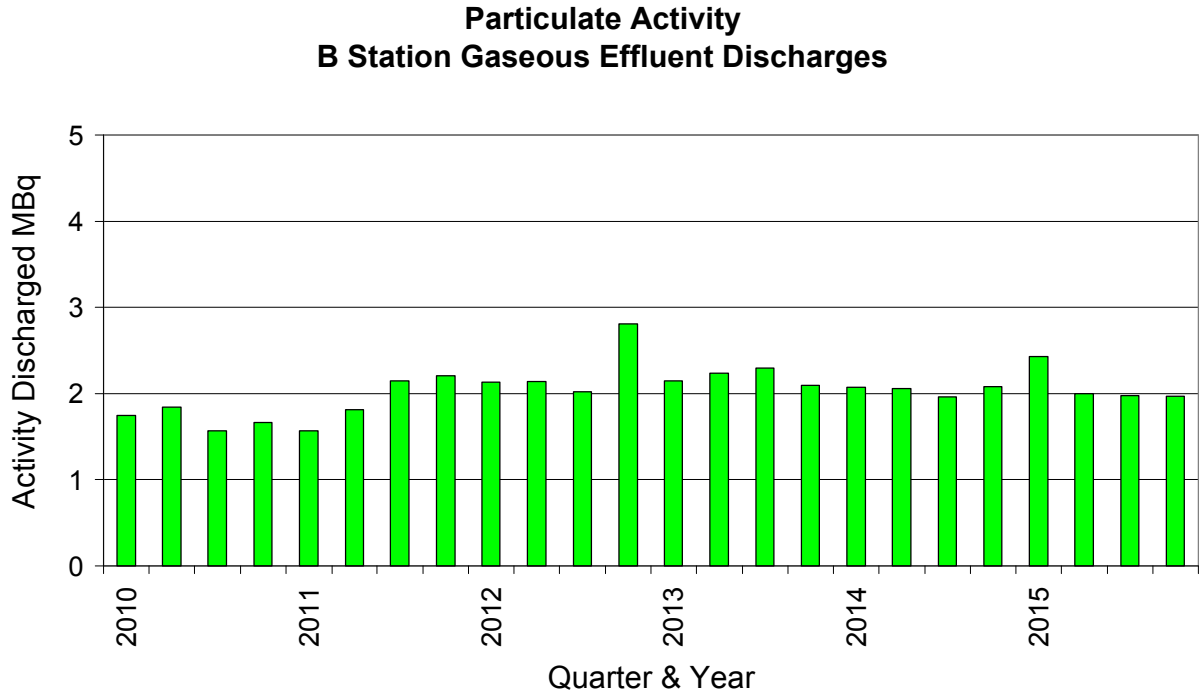
**TABLE 3 Hinkley Point B Power Station:
Liquid Effluent Discharges & Authorisation Limits in 2015**

Month	Tritium Activity (TBq)	Sulphur 35 Activity (GBq)	Cobalt 60 Activity (GBq)	Caesium 137 Activity (GBq)	Other Activity * (GBq)
January	23.10	32.60	0.014	0.055	0.469
February	14.80	17.90	0.009	0.058	0.350
March	7.44	5.01	0.011	0.043	0.174
April	14.40	11.10	0.015	0.102	0.274
May	16.00	20.10	0.010	0.049	0.206
June	36.90	38.00	0.012	0.047	0.401
July	16.90	18.50	0.006	0.055	0.226
August	23.20	24.30	0.009	0.023	0.330
September	23.40	24.00	0.005	0.020	0.278
October	15.80	15.60	0.010	0.084	0.330
November	29.60	36.20	0.013	0.170	0.536
December	21.20	26.80	0.003	0.072	0.277
Annual Total (2015)	**242.74**	**270.11**	**0.115**	**0.778**	**3.851**
Previous Year (2014)	278.33	441.40	0.245	0.979	4.972
Annual Authorisation	650	2000	10	100	80

* Total Activity excluding those nuclides listed in other columns

PART 5 HINKLEY POINT B GASEOUS EFFLUENT DISCHARGES

Graph 5 (a)



The Hinkley Point B power station annual discharge limit is 100 MBq, and is defined as 'cobalt 60 associated with particulate matter'.

All gaseous effluent discharges are filtered, hence the low level of particulate activity shown above. The levels of activity are normally very small and will vary little under normal operating conditions.

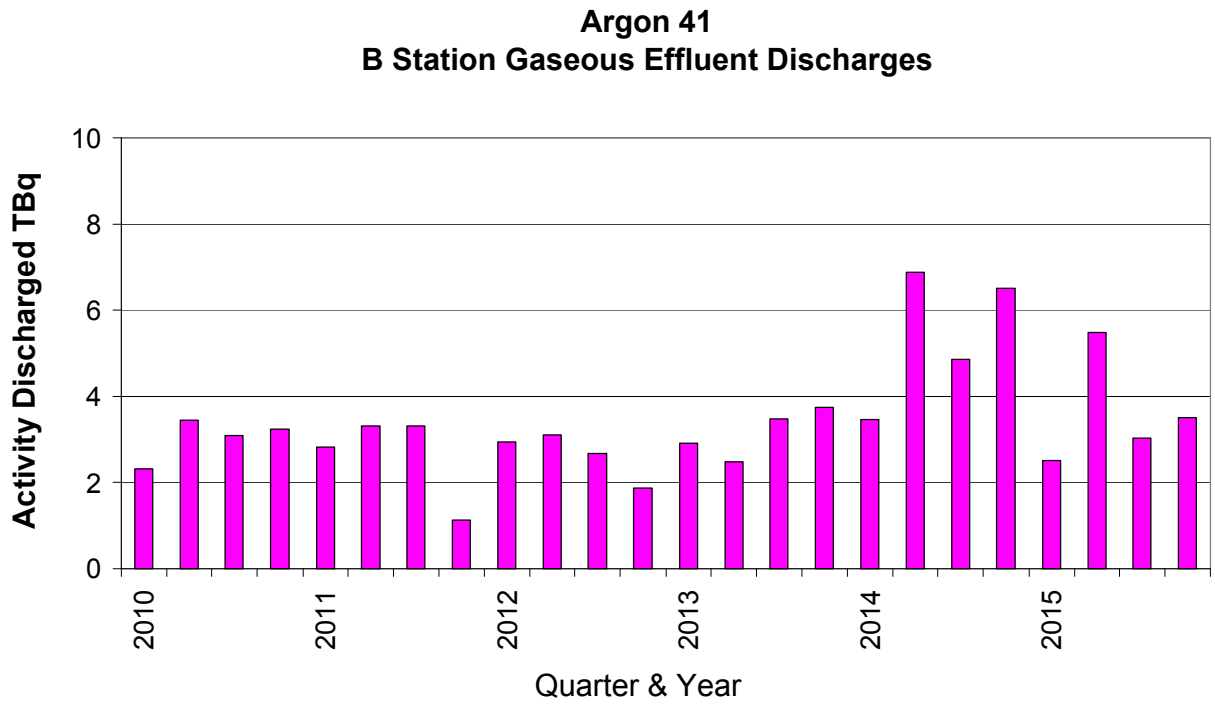
The main discharge points are:

(a) Contaminated ventilation systems, which discharge ventilation air from many places around each reactor and from the central block. This route is also used for minor carbon dioxide discharges from the reactors to adjust reactor pressures or purity of the gas coolant.

(b) The Reactor Blowdown Stack used for major discharges of carbon dioxide by reactor depressurisation.

Table 4 gives the annual and monthly discharges for 2015.

Graph 5 (b)



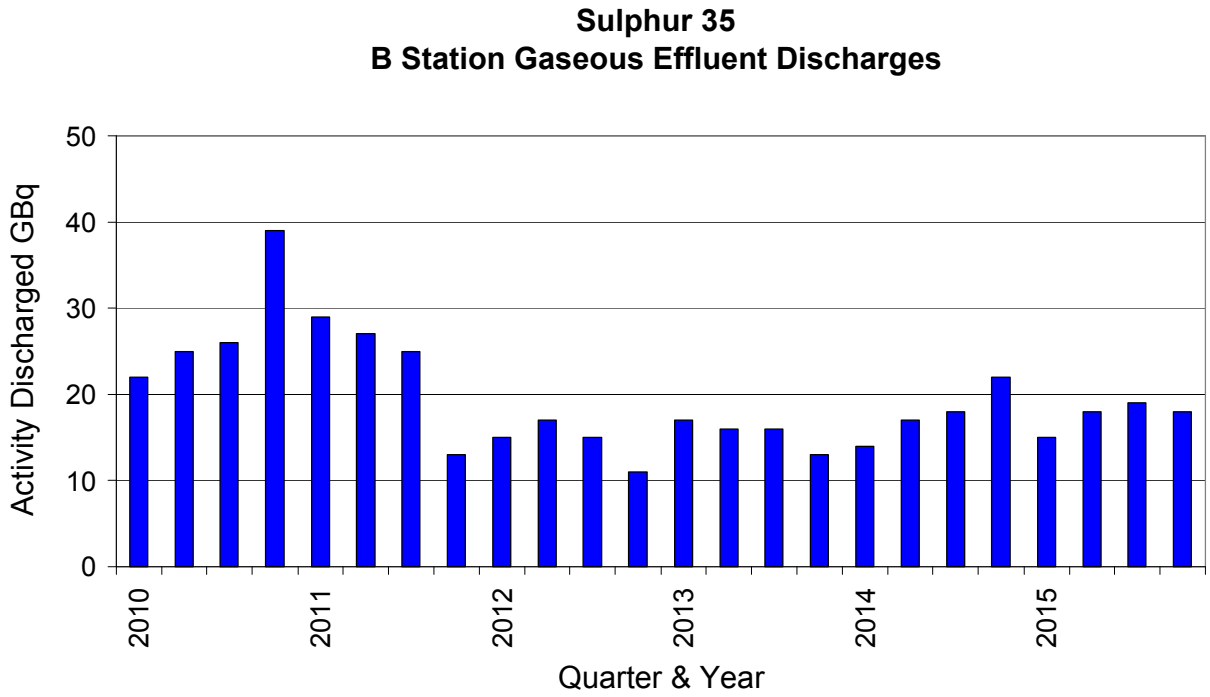
The Hinkley Point B power station annual discharge limit for argon 41 is 100 TBq and it has a half life of 110 minutes.

Argon-41 is produced in the reactor by neutron activation of naturally occurring, non-radioactive argon 40, which is present in the coolant gas as a contaminant, both from residual air and from other feed gases. Care is taken to exclude argon impurities in the coolant gas and thus to minimise potential discharges. Due to its short half-life, argon 41 discharges are directly proportional to reactor power and the amount of coolant gas being discharged (Te).

The peak during the second quarter of 2014 was due to a large reactor blowdown after the Interim outage in order to reduce elevated argon 40 and to improve employee radiation protection. Another large reactor blowdown occurred in the fourth quarter of 2014 and second quarter of 2015 for operational reasons within Reactor 3 gas bypass plant.

Table 4 gives the annual and monthly discharges for 2015.

Graph 5 (c)



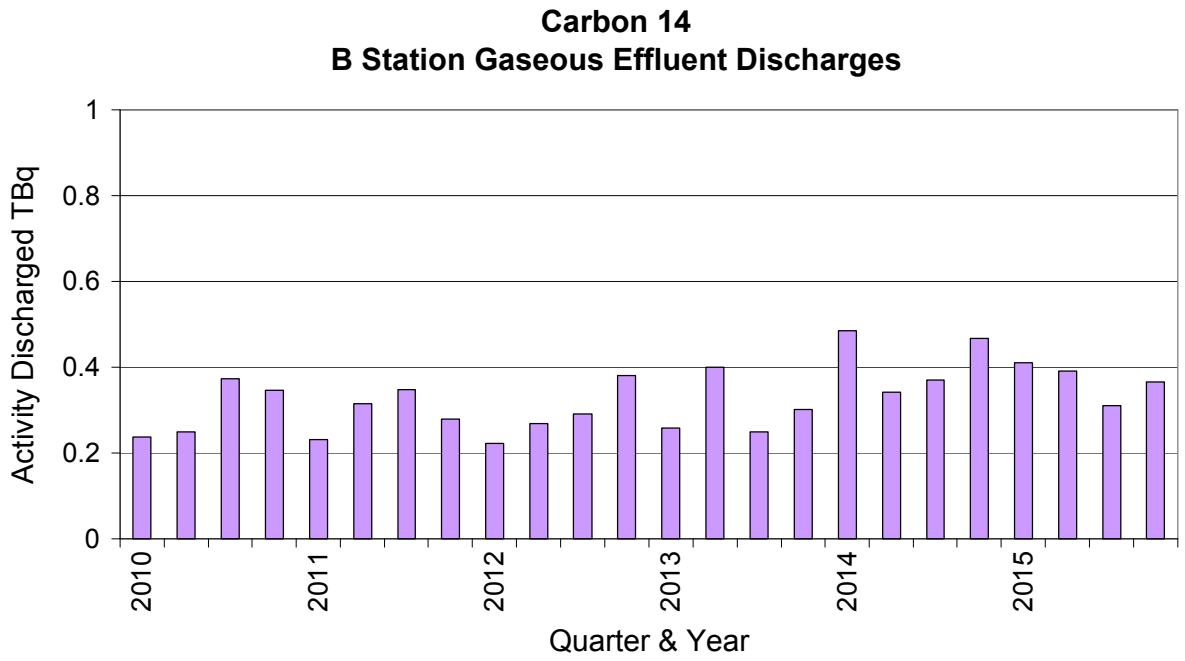
The Hinkley Point B power station annual discharge limit for sulphur 35 is 350 GBq and the half life is 87 days.

The principle source of sulphur 35 in the reactor originates from small quantities of chlorine impurities present in the graphite core and in the sleeve of the fuel elements. The sulphur combines with carbon dioxide and carbon monoxide to produce carbonyl sulphide, which is a gas. Carbonyl sulphide exists in the gas circuit and can be released from the reactors during normal reactor operations and planned blowdowns. It can also be removed from the reactors by the gas dryers and be discharged as a liquid effluent.

The results reflect baseline discharges per month for normal operation. The peaks correspond to blowdowns during outages and refuelling.

Table 4 gives the annual and monthly discharges for 2015.

Graph 5 (d)



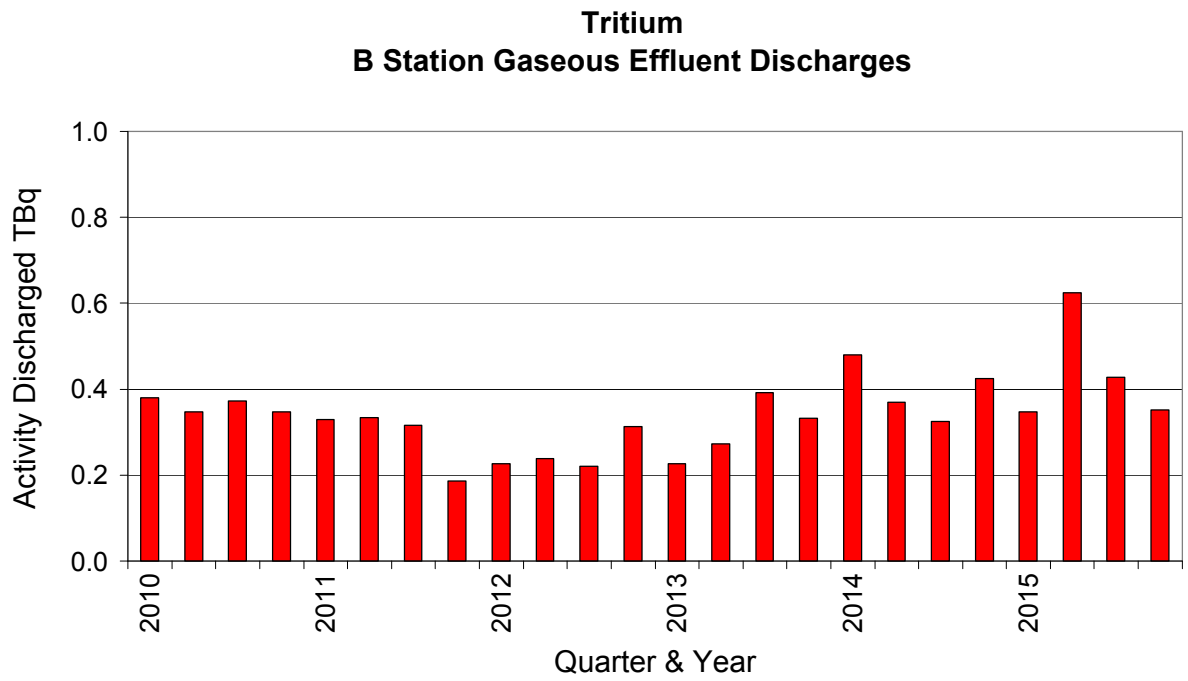
The Hinkley Point B power station annual discharge limit for carbon 14 is 3.7 TBq. Carbon 14 also occurs naturally in the environment and has a half life of 5730 years.

Carbon 14 is either produced via the neutron activation of carbon, nitrogen and oxygen in the coolant gas or via the neutron activation of carbon and nitrogen in the graphite core which is then released into the coolant gas as the graphite bricks slowly corrode. Within the coolant gas, activation of nitrogen impurities is potentially the major contributor to carbon 14 production. Furthermore, due to the continued operation, the proportion of carbon 14 in the core increases due to ongoing neutron activation.

All carbon 14 discharged to atmosphere is associated with the loss of reactor coolant gas and is discharged as carbon dioxide containing carbon 14. The peaks correspond to outage blowdowns and operational blowdowns.

Table 4 gives the annual and monthly discharges for 2015.

Graph 5 (e)



The Hinkley Point B power station annual discharge limit for tritium is 12 TBq. Tritium, also occurs naturally in the environment and has a half life of just over 12 years.

Tritium is one of the most abundant radionuclides present in the coolant gas. Tritium arises mainly from ternary fission processes inside the fuel followed by diffusion through the fuel pin cladding into the coolant gas. The production rate for tritium thus depends mainly on reactor power. As more than 99% of the tritium in the reactor gas is removed as water via the gas bypass plant, gaseous discharges of tritium are far smaller.
Liquid discharges are less radiologically significant than gaseous discharges, and thus a better environmental option.

The main chemical form of tritium is water vapour and it is therefore a filter passing gas. The quantity of tritium that exists in coolant gas at any one time is dependent on coolant chemistry. The station chemists control the ratio of moisture, methane and carbon monoxide in coolant gas to balance the rate of corrosion of the graphite core against excessive carbon deposition on the boilers.

During quarter 2 2015 there was a fault with the Gas Bypass Plant. Consequently, a blowdown was required in order to reduce moisture levels in the reactor gas. Due to the increased levels of moisture in reactor gas, there were elevated gaseous tritium discharges. The step change in tritium discharges from mid-2013 onwards is again due to the reactor power being increased (see graph 4c).

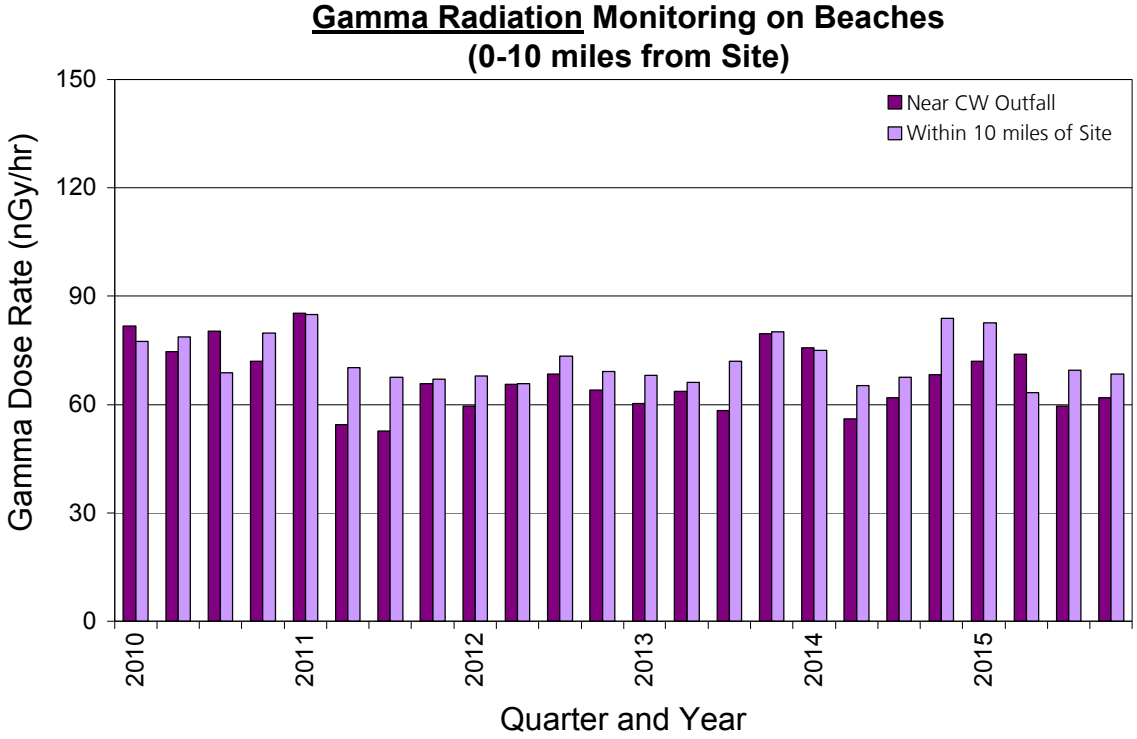
Table 4 gives the annual and monthly discharges for 2015.

**TABLE 4 Hinkley Point B Power Station:
Gaseous Effluent Discharges and Authorisation Limits in 2015**

Month	Particulate (MBq)	Sulphur 35 (GBq)	Argon 41 (TBq)	Carbon 14 (TBq)	Tritium (TBq)	Iodine 131 (MBq)
January	0.714	9	1.523	0.301	0.096	0.405
February	0.832	3	0.484	0.047	0.139	0.500
March	0.887	3	0.501	0.062	0.112	0.504
April	0.655	4	0.870	0.081	0.105	0.366
May	0.678	8	3.446	0.216	0.344	0.400
June	0.664	6	1.167	0.095	0.175	0.436
July	0.700	7	1.135	0.108	0.160	0.389
August	0.650	5	0.839	0.086	0.139	0.452
September	0.626	7	1.061	0.116	0.128	0.688
October	0.644	6	1.113	0.130	0.121	0.358
November	0.690	6	1.404	0.127	0.114	0.385
December	0.636	6	0.980	0.108	0.116	0.339
Annual Total (2015)	**8.376**	**70**	**14.523**	**1.477**	**1.749**	**5.222**
Previous Year (2014)	8.178	71	21.731	1.664	1.597	4.613
Annual Authorisation	100	350	100	3.7	12	1500

PART 6 MARINE MONITORING

Graph 6 (a)



The presence of radionuclides in sediments and soils can make a significant contribution to the total exposure of members of the public. For this reason the estimation of 'external dose' is assessed by measuring gamma dose rates at specified locations.

The first set of results provided above (dark purple) show the gamma doserate in the vicinity of the cooling water outfall on the beach at Hinkley Point. The dose rate has remained fairly stable over the past 6 years with an average doserate of approximately 70nGy/hr. The major contribution to the observed gamma dose rate is from natural sources, rather than radioactive discharges from Hinkley Point, and includes cosmic rays and naturally occurring radionuclides in the sediment and rocks. Graph 6 (e) shows the results for caesium 137 activity concentrations and provide a better indication of the impact of the liquid discharges upon beach sediment.

The second set of results provided above (light purple) show the average gamma doserate at shoreline sites, other than those in the immediate vicinity of the Hinkley Point cooling water outfall. Each value represents the mean of ten separate measurements, taken at a range of sites within 10 miles of the outfall and including locations to the east and west of Hinkley Point. Although the dose rates vary slightly between individual sites, depending on the underlying geology, there is no significant difference between the average dose rate at these points and those that are near to the outfall.

Table 5 gives details of the 2015 gamma dose data.

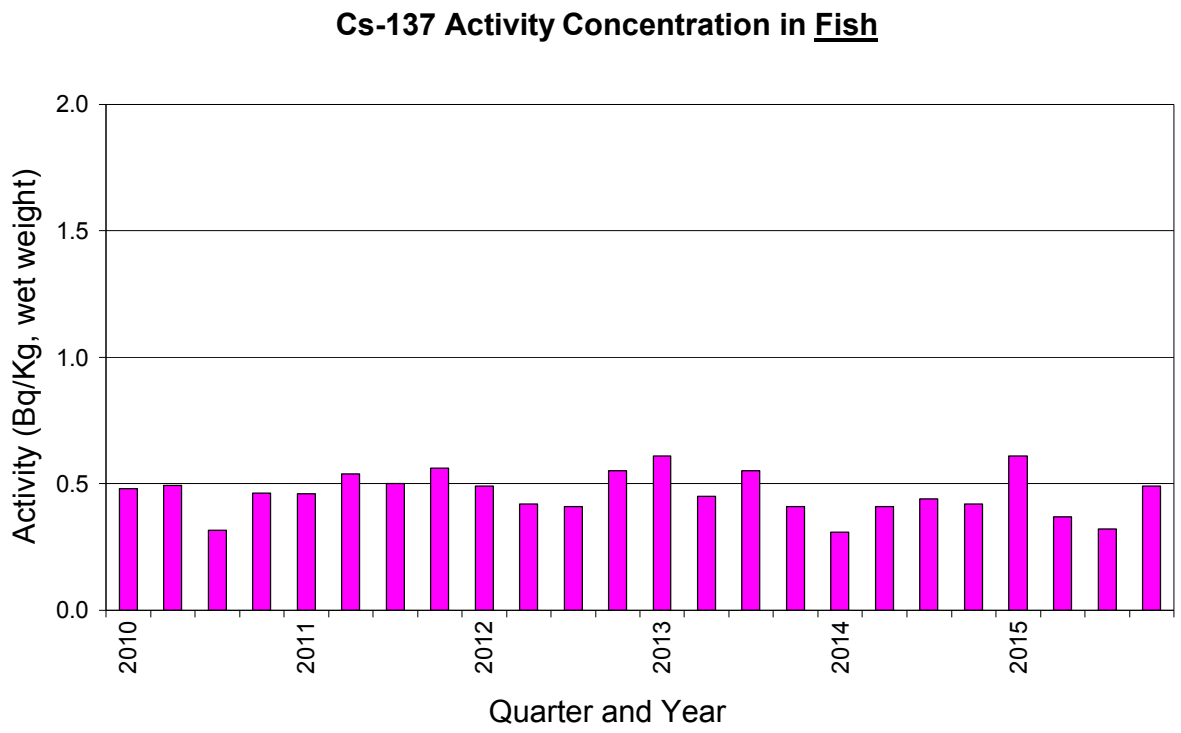
TABLE 5 Average Beach Gamma Dose Rates for 2015

SITE	No. Of Observations	Mean Gamma Dose Rate (nGy/Hr)
47	4	74
49	4	64
50	4	63
51	4	58
52	4	70
53	4	62
54	4	87
56	4	79
58	4	62
59	4	82

The average doserates measured close to the outfall are similar to the ambient background due to the reduction in direct radiation since the shutdown of the reactors on Hinkley Point A site. More specifically, the contribution from caesium 137 (assuming a typical activity concentration of 40 Bq/kg) is just 4.5nGy/hr or less than 10% of the observed dose rates. This illustrates that the majority of the gamma doserate is due to background cosmic radiation combined with the presence of natural series radionuclides in the sediment.

The critical group for external exposure over inter-tidal sediment is a small number of fishermen who work on the beaches. The annual dose is a function of estimated occupancy time (1300 hours) and the estimated contribution from caesium 137 (4.5 nGy/hr). Their annual dose due to liquid discharges from Hinkley Point would have been less than 10 μSv in 2015.

Graph 6 (b)



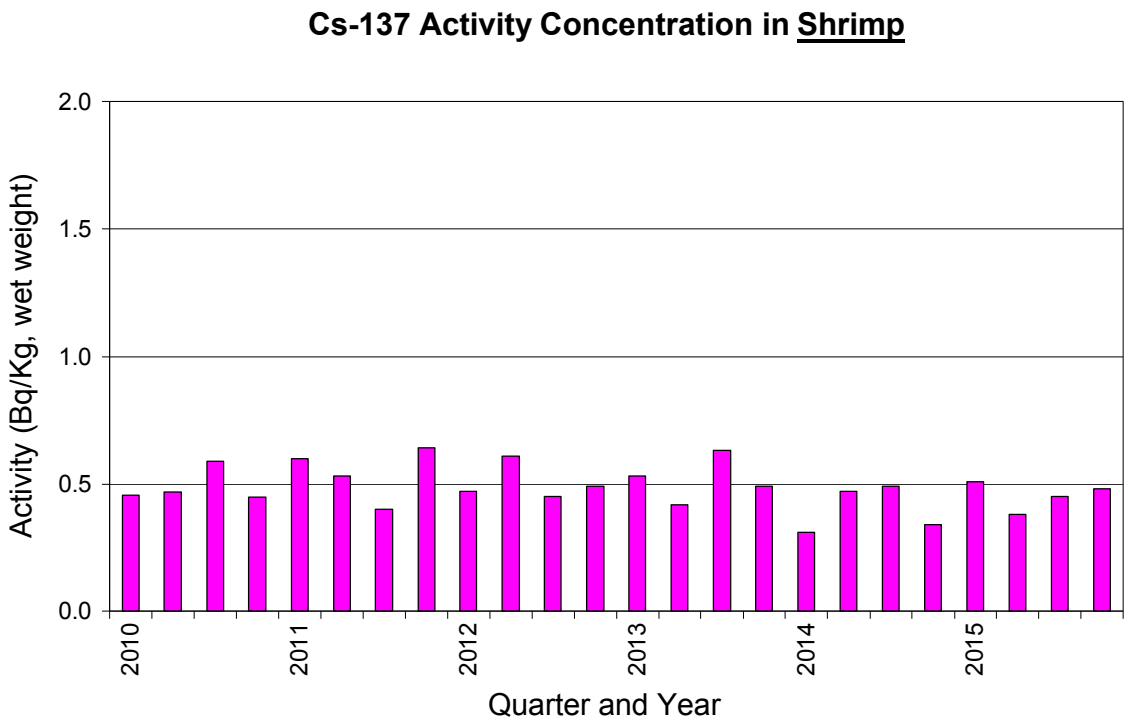
This graph shows data for the activity concentration of the single gamma emitting artificial radionuclide caesium 137, that is positively detected in demersal (bottom feeding) fish, caught close to Hinkley Point. Moreover, in some samples the activity was below the limit of detection (typically 0.3 Bq/kg wet weight) and hence the values provided here represent maximum estimates. The activity concentration appears broadly stable over the past 6 years and the slight decline in activity corresponds to a reduction in the amount of caesium 137 discharged from Hinkley Point A site.

Measurements are also carried out to assay total beta activity in fish, for reassurance purposes. The predominant contribution to the total beta activity is provided by the naturally occurring radionuclide potassium 40. In 2015, values for gross beta activity were in the range ~ 73 to 114 Bq/kg wet weight (i.e. considerably greater than those for caesium 137).

When samples are available, pelagic fish (free swimming) are also included in the analysis programme. The maximum result for pelagic fish for this period was ~0.49 Bq/kg (wet) for caesium 137 and 67 Bq/kg (wet) for gross beta. The results were similar to those for demersal fish.

Table 6 gives details of the 2015 data.

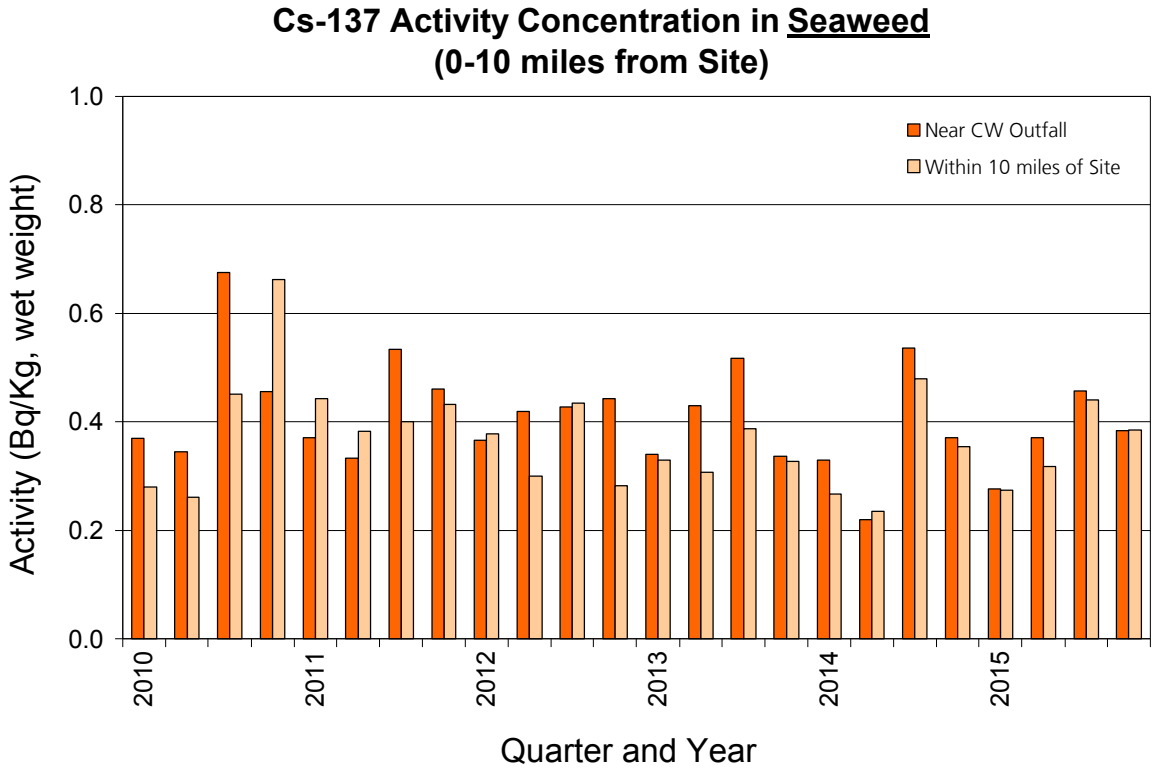
Graph 6 (c)



The sole gamma emitting artificial radionuclide that was positively detected in shrimps caught close to Hinkley Point was caesium 137. The data shown above indicates broadly similar caesium 137 activity concentrations to those observed in fish samples (graph 6b). Measurements of gross beta activity are also carried out for reassurance purposes and were in the range of 48 to 68 Bq/kg (wet weight). The predominant contribution was due to the presence of potassium 40 which is a naturally occurring radionuclide, with levels being considerably greater than those for caesium 137.

Table 6 gives details of the 2015 data.

Graph 6 (d)




Bladderwrack

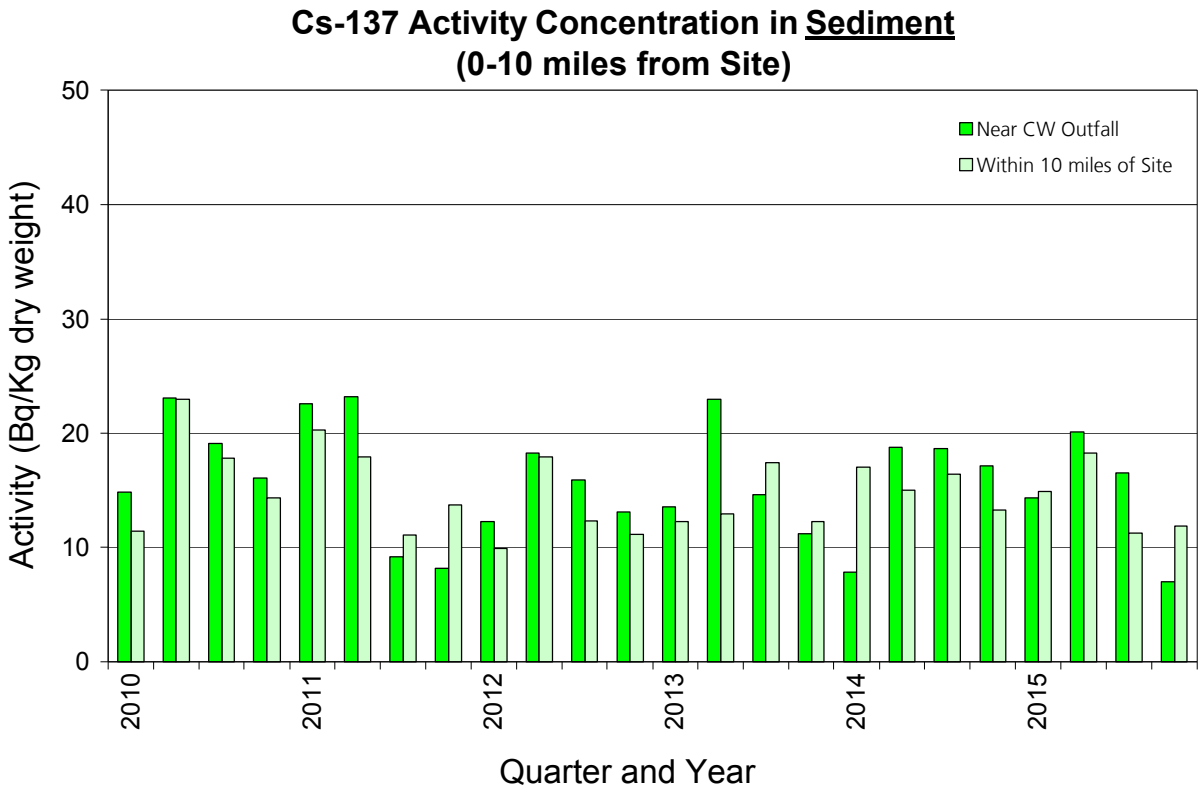
Samples of Bladderwrack seaweed (*Fucus Vesiculosis*) are collected from 3 locations near the cooling water outfall (dark orange) and from beaches within 10 miles of site (light orange). In addition to occasional use in foods and as fertilisers, seaweeds are useful as indicator materials in an environmental monitoring programme because they effectively concentrate radionuclides.

The sole gamma emitting artificial radionuclide that was positively detected in seaweed was caesium 137. Measurements of gross beta activity are also assessed for reassurance monitoring. The gross beta activity in seaweed close to the cooling water outfall in 2015 was in the range of 98 to 244 Bq/kg (wet weight). The predominant contribution was due to the presence of potassium 40 which is a naturally occurring radionuclide, with levels being considerably greater than those for caesium 137.

The caesium 137 activity concentration appears broadly stable over the period considered here albeit that, due to the low levels, there is significant scatter in the data. Although maximum activity concentrations have been observed in samples obtained closest to the outfall, there is no consistent trend apparent within the inevitable scatter inherent in a series of low level data and both sets of results are similar.

Table 6 gives details of the 2015 data.

Graph 6 (e)



Like seaweed, sediment is a useful indicator material in an environmental monitoring programme because it effectively concentrates radionuclides. The presence of radionuclides in sediment can make a significant contribution to the total exposure of members of the public, via the external exposure pathway. The sole gamma emitting artificial radionuclide that was positively detected in sediment in the vicinity of Hinkley Point was caesium 137. There is significant variability in the data. And one reason for the variability is that activity concentrations are typically greater in silt than sand. It is sometimes very difficult to find silt at the sampling positions, and hence the radioactivity levels in sediment are variable since they depend on the relative proportions of sand to silt in each sample.

Samples of sediment are collected from 3 locations near the cooling water outfall (dark green) and from beaches within 10 miles of the Hinkley Point cooling water outfall (light green). The results provided above show the average caesium 137 concentration in sediment. The range of activity concentrations is broadly similar for both sets of samples, although the actual activity in the samples within 10 miles of site is generally less than the activities present at the cooling water outfall; which is to be expected.

Sediment samples are also analysed for strontium 90 (a beta emitting radionuclide). Levels were significantly lower than caesium 137 and below the limit of detection in about half of the samples. Measurements of gross beta activity are also undertaken for reassurance monitoring and values for sediment close to the cooling water outfall in 2015 were in the range of 458 to 821 Bq/kg (dry weight). The predominant contribution was due to the presence of natural radionuclides including potassium 40 and beta emitters in the uranium 238 and thorium 232 series.

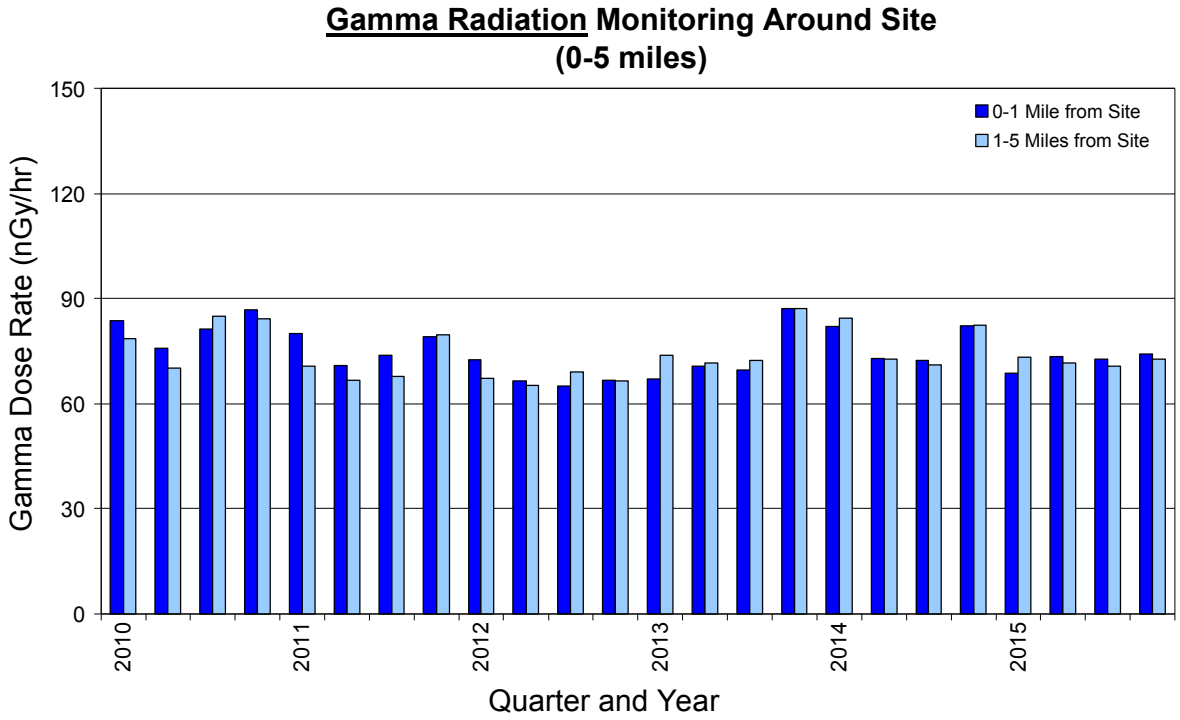
Table 6 gives details of the 2015 data.

TABLE 6 Average Activity Concentrations in Marine Samples for 2015

Sample	Location	Units	No of Observations	Beta	Caesium 137	Strontium 90
Fish	51	Bq/kg wet	4	88.34	0.45	N/A
Shrimps	51	Bq/kg wet	4	58.93	0.46	N/A
Sediment	47	Bq/kg dry	4	435.70	6.09	0.91
Sediment	49	Bq/kg dry	4	807.00	20.96	0.87
Sediment	50	Bq/kg dry	4	787.10	16.40	1.17
Sediment	51	Bq/kg dry	4	719.50	14.68	0.97
Sediment	52	Bq/kg dry	4	857.50	18.23	0.81
Sediment	53	Bq/kg dry	4	547.75	9.88	0.96
Sediment	54	Bq/kg dry	4	839.00	13.99	0.68
Sediment	55	Bq/kg dry	4	737.25	15.86	0.86
Sediment	56	Bq/kg dry	4	645.50	11.72	0.73
Sediment	58	Bq/kg dry	4	799.00	17.99	0.80
Sediment	59	Bq/kg dry	4	811.59	13.15	1.05
Seaweed	47	Bq/kg wet	4	169.45	0.38	N/A
Seaweed	49	Bq/kg wet	4	155.60	0.38	N/A
Seaweed	50	Bq/kg wet	4	178.50	0.36	N/A
Seaweed	51	Bq/kg wet	4	147.58	0.29	N/A
Seaweed	52	Bq/kg wet	4	180.95	0.38	N/A
Seaweed	54	Bq/kg wet	4	199.05	0.28	N/A
Seaweed	55	Bq/kg wet	4	213.93	0.47	N/A

PART 7 TERRESTRIAL MONITORING

Graph 7 (a)

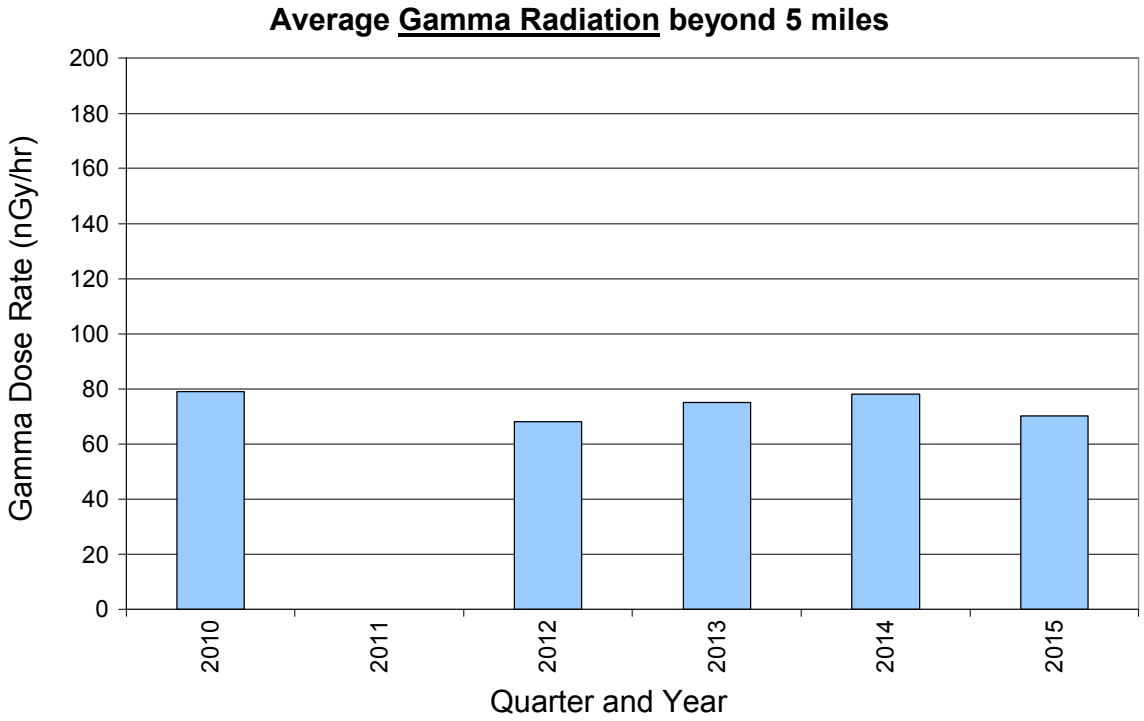


The results provided above show the gamma doserate at terrestrial (land) sites within 1 mile (dark blue) of Hinkley Point. These results are compared with doserates between 1 and 5 miles (light blue) of Hinkley Point. The radiation dose-rate readings shown here represent the average values from fourteen sites (seven sites within 1 mile and seven sites 1-5 miles from Hinkley Point) - each being read quarterly. Doserates have remained broadly stable over this 6 year period and there is no significant difference between the average doserate at up to 5 miles away, and those that are close to Hinkley Point.

However, the inevitable variation between readings at individual sites is because the gamma doserate above soil depends in part on the water content of the soil. High water content reduces gamma background resulting in a consequent reduction in doserate. Conversely during a period of abnormally low rainfall it is to be expected that a corresponding increase in the outdoor environmental gamma-ray doserate would be observed. Additionally, during periods of heavy rainfall after a dry spell, doserates can show a transient increase as a result of the washout of radon daughters from the air. Consequently, variations in individual readings are to be expected as a result of variable weather conditions.

Table 7 gives details of the 2015 data.

Graph 7 (b)



The results provided above show the average gamma doserate at terrestrial sites furthermost from Hinkley Point (i.e. more than 5 miles away). Each value shown here represents the mean of readings from up to thirty two separate sites. Measurements are recorded at least once a year, but for the majority of years there have been 2 sets of measurements. Measurements of gamma radiation beyond 5 miles are no longer a formal requirement and no measurements were taken during 2011 due to adverse weather and operational requirements. Once again, although the doserates vary slightly between individual sites, depending on the underlying geology, there is no significant difference between the average dose rate at these points and those that are close to Hinkley Point. During 2015, measurements were taken at all 32 sites.

Table 7 gives details of the 2015 data.

TABLE 7 Average Terrestrial Gamma Doserates for 2015

Zone	No. of Observations	Mean Gamma Dose Rate (nGy/hr)
Inner (0-1 mile)	28	72
Outer (1-5 miles)	28	72
Ring Roads (5+ miles)	32	70

Exposure Figures at the Perimeter Fence during 2015

The average annual accumulated gamma dose at positions on the inner security fence for both Hinkley Point sites, as measured by quarterly thermoluminescent dosemeter (TLD), was 795 $\mu Sv.y^{-1}$. As part of an impact assessment, natural background exposure at locations in the local area have also been measured by TLD. The annual accumulated gamma dose was 930$\mu Sv.y^{-1}$ in Nether Stowey, 755$\mu Sv.y^{-1}$ in Bridgwater and 747$\mu Sv.y^{-1}$ in Holford. The background exposure measured some distance from Hinkley Point is consistent with exposure measured at the site perimeter.

Table 8 Radioactivity in Tacky Shade Collectors for 2015

The sensitivity of the monthly measurements at 14 different sites is shown below. This represents typical Minimum Detectable Activity values (MDA) for each reported nuclide.

Nuclide	Typical MDA (Bq/shade)
Cobalt 60	< 0.06
Niobium 95	< 0.09
Zirconium 95	< 0.12
Ruthenium 106	< 0.58
Antimony 125	< 0.16
Caesium 134	< 0.07
Caesium 137	< 0.08
Cerium 144	< 0.44
Europium 154	< 0.12
Europium 155	< 0.23

TABLE 9 Radioactivity in Milk Samples for Inner Farms for 2015

Milk samples are taken once a quarter from nearby farms situated at an approximate distance of 3 km from the Hinkley Point sites. This is a total of 4 samples per quarter. Samples are measured individually for iodine 131. The individual samples are prepared each quarter (Inner Farm) and are sent to the Contracted Analytical Laboratory at Sellafield for sulphur 35 determination. The second quarter samples each year are analysed for strontium 90 and carbon 14. Individual samples are analysed every quarter for radio-caesium (caesium 137 and caesium 134).

Maximum Result from Inner Farms						
Quarter	Carbon 14 Bq/kg Carbon	Sulphur 35 Bq/m^3	Strontium 90 Bq/m^3	Iodine 131 Bq/l	Caesium 134 Bq/l	Caesium 137 Bq/l
1st	N/M	< 372	N/M	< 0.31	< 0.13	< 0.13
2nd	234	< 528	< 50.8	< 0.33	< 0.13	< 0.13
3rd	N/M	< 458	N/M	< 0.37	< 0.12	< 0.13
4th	N/M	< 583	N/M	< 0.24	< 0.12	< 0.13

N/M = Not Measured

The natural background levels of carbon 14 concentrations in the environment are approximately 250 Bq/kg of carbon. The pathway for carbon 14 into milk is via deposition on herbage from gaseous discharges.

The results in the table imply that members of the public who consume above average quantities of milk (all produced locally) would have received doses of less than 5 μSv.

The most likely source of any strontium 90 and radio-caesium is fall-out from weapons testing and the Chernobyl incident. The results for strontium 90, together with those for radio-caesium and iodine 131, are all below the threshold of detection for the respective analysis techniques.

TABLE 10 Radioactivity in Herbage Samples for 2015

Site	Sulphur 35 Bq/kg		Carbon 14 Bq/kg Carbon	Sulphur 35 Bq/kg	
	1st Quarter	2nd Quarter	2nd Quarter	3rd Quarter	4th Quarter
Nearest Location	9.58	25.2	1040	13.7	13.60
Inner Farm 20	1.85	2.61	439	3.46	2.76
Inner Farm 23	< 0.95	< 1.22	245	2.15	< 0.98
Inner Farm 24	1.65	2.20	360	2.44	1.53
Inner Farm 29	< 0.96	< 1.32	263	< 0.78	< 1.06

Herbage, usually grass, is sampled quarterly at various locations around the area and the sulphur 35 content is measured. Carbon 14 is also measured, but only on the second quarter samples.

The nearest location is the site closest to the station where grass can be sampled, but there are no edible crops grown there. The results are slightly higher at this location due to the very close proximity to the power station and the prevailing wind. There are also four farm locations where grass is sampled, but not all are milk producing farms now.

The measured carbon 14 concentrations are slightly enhanced above the natural background level of 250 Bq/kg of carbon in the environment, due to deposition from gaseous discharges.

Gamma spectroscopy of herbage is also undertaken, and traces of caesium 37 are detected consistent with national background measurements resulting from known historic events.

TABLE 11 Radioactivity in Soil Samples for 2015

Site	Total Beta Bq/kg –Dry	Caesium 137 Bq/kg – Dry	Caesium 134 Bq/kg - Dry
Inner Farm 23 (5cm depth)	1020	5.92	< 1.14
Inner Farm 23 (30cm depth)	950	5.12	< 1.67

Soil cores are taken at various locations on a rotational basis so that each site is sampled at least once every five years. The results show no evidence of build up of contamination from site emissions and instead are likely to represent the legacy of fallout from atmospheric testing of atomic weapons in the 1950's and 1960's.

PART 8 RADIATION DOSE SUMMARY

The estimated annual dose in 2014 to members of several local groups of the general public is summarised in Table 12. Full dose assessment figures for 2015 are not available to date (This data is normally provided in this report in the following year). The data shown below is taken from the Radioactivity in Food and the Environment (RIFE) Reports*.

Discharges of radioactivity from Hinkley Point A and B, and results of the environmental monitoring measurements, have shown no significant change in 2015 and therefore, it is unlikely that annual doses to members of the public will vary from the figures listed in Table 12. In each case the number of people is small.

TABLE 12 Summary of Doses from RIFE Report (RIFE Report 20, 2015)

Radiation Exposure Pathway	Exposure, μSv per year		
	2012	2013	**2014**
Total dose to the public from all pathways and sources of radiation	13	22	**22**
Fish and shellfish consumption, and exposure to external radiation over intertidal areas	13	31	**32**
Terrestrial foods, external exposure and inhalation near site	7	15	**10**

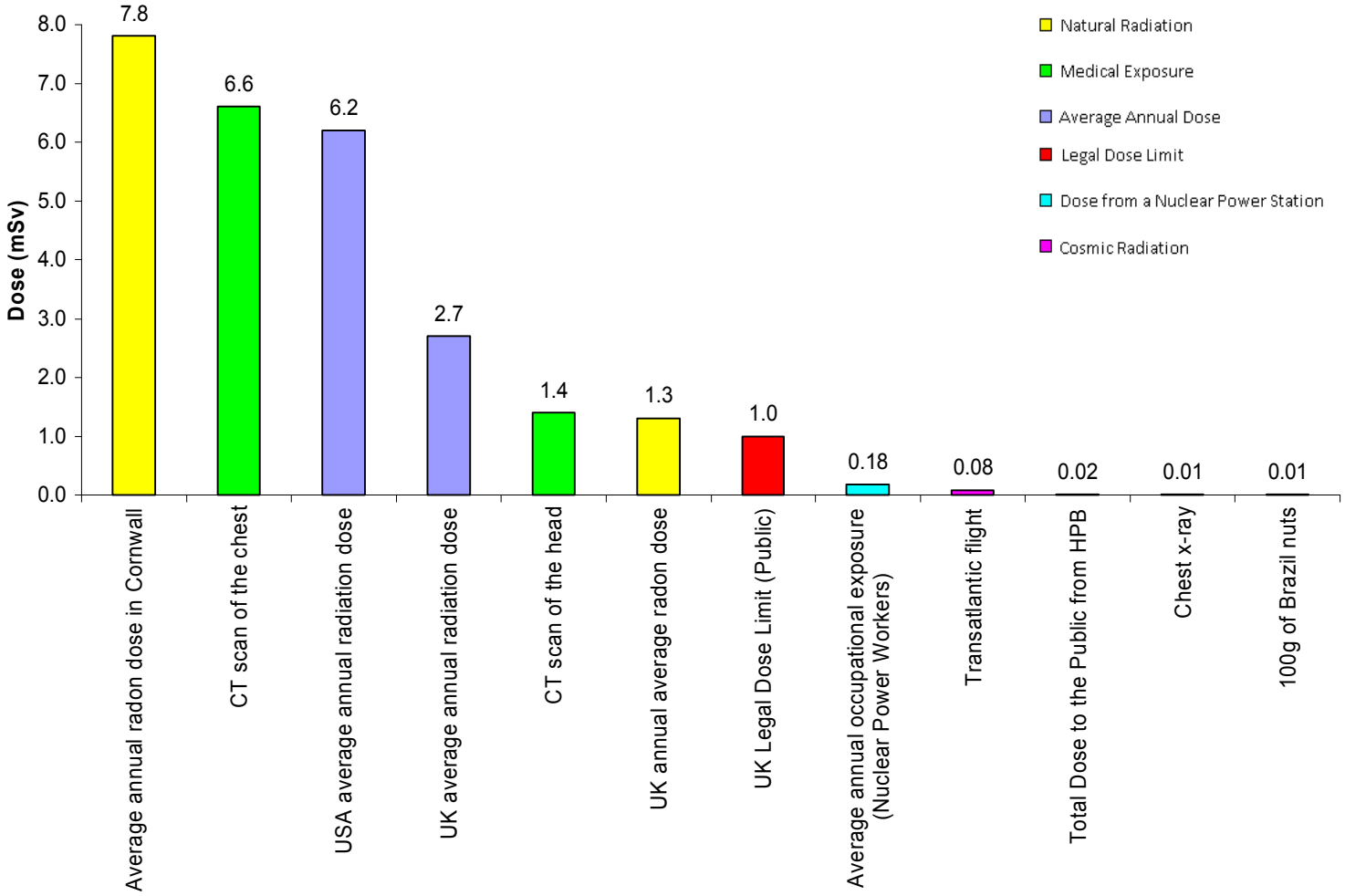
The 'total dose from all pathways and sources of radiation' was 22μSv in 2014 and this is approximately 2% of the dose limit (1000μSv). The slight increase from 2012 to 2013 was due to an increase from external exposure over intertidal areas. For comparison, the average annual radiation dose to the public in the UK from natural radioactivity is over 2000 μSv (See figure 2).

The dose to a local fisherman, who consumed large amounts of seafood and was exposed to external radiation over intertidal areas, was 32μSv in 2014. This is approximately 3% of the legal dose limit. This estimate also includes the effects of carbon 14 and tritium discharges from Cardiff.

The dose to a high-rate consumer of locally grown food was 10μSv in 2014. The decrease in dose from 2013 is mostly due to lower carbon 14 concentrations in milk, but also because the contribution of domestic fruit was not sampled by the FSA in 2014.

* The RIFE Report is produced annually by the following government organisations: Environment Agency, the Food Standards Agency, the Northern Ireland Environment Agency and the Scottish Environment Protection Agency. The report is produced independently of site operators. All reports are available via the respective internet sites for the organisations.

FIGURE 3: COMPARISON OF RADIATION DOSES
(PHE, Ionising Radiation Dose Comparisons, 2011)



In the UK, Public Health England has calculated that on average people are exposed to about 2.7mSv of radiation a year. The 2.7 mSv dose that people in the UK are exposed to comes from a number of sources. Many building materials contain low degrees of natural radioactivity and radon gas seeps from the ground into all buildings, so the largest exposure is to naturally occurring radiation in homes and workplaces. There are also significant contributions from naturally occurring radioactivity in food and from medical exposures.

PART 9a RADIOACTIVE SOLID AND NON AQUEOUS LIQUID WASTE DISPOSALS FROM HINKLEY POINT A IN 2015

Solid low level radioactive waste is transferred to the Low Level Waste Repository in Cumbria for disposal, either directly or via treatment facilities. Solid low level radioactive waste metal is also transferred to treatment operators for decontamination by melting or direct methods such as grit blasting. Combustible solid low level radioactive waste and non aqueous liquid radioactive waste is also transferred to incinerator operator at Hythe in Hampshire.

TABLE 13a Transfer to the Operator of the LLWR from Hinkley Point A

Radionuclides	Total Waste Transferred Total Activity (MBq)
Uranium	4.90
Radium 226 plus thorium 232	0.00
Other alpha emitters	7266.11
Carbon 14	112.51
Iodine 129	0.02
Tritium	233.17
Cobalt 60	183.68
Others	33755.25
Total volume of waste including primary containment (m^3)	112.00

TABLE 13b Transfer of Radioactive Metals for further treatment offsite from Hinkley Point A

Radionuclides	Total Waste Transferred Total Activity (MBq)
Uranium	0.00
Radium 226 plus thorium 232	0.00
Other alpha emitters	6.50
Carbon 14	0.02
Iodine 129	0.00
Tritium	0.03
Cobalt 60	0.03
Others	19.90
Total volume of waste including primary containment (m^3)	18.00

TABLE 13c Transfer to the Incinerator at Hythe from Hinkley Point A

Radionuclides	Total Waste Transferred Total Activity (MBq)
Uranium	0.01
Radium 226 plus thorium 232	0.00
Other alpha emitters	13.80
Carbon 14	2.62
Iodine 129	0.00
Tritium	3.75
Cobalt 60	3.96
Others	73.20
Total volume of waste including primary containment (m^3)	16.50

TABLE 13d Transfer of Non Aqueous liquids from Hinkley Point A

Radionuclides	Total Waste Transferred Total Activity (MBq)
Uranium	-
Radium 226 plus thorium 232	-
Other alpha emitters	-
Carbon 14	-
Iodine 129	-
Tritium	-
Cobalt 60	-
Others	-
Total volume of waste including primary containment (m3)	NO TRANSFERS

TABLE 13e Transfer of VLLW from Hinkley Point A

Radionuclides	Total Waste Transferred Total Activity (MBq)
Uranium	0.00
Radium 226 plus thorium 232	0.00
Other alpha emitters	0.02
Carbon 14	0.25
Iodine 129	0.00
Tritium	3.26
Cobalt 60	0.52
Others	2.21
Total volume of waste including primary containment (m^3)	4.75

PART 9b RADIOACTIVE SOLID AND NON AQUEOUS LIQUID WASTE DISPOSALS FROM HINKLEY POINT B IN 2015

TABLE 14a Transfers Offsite from Hinkley Point B in 2015

During 2015, 7 drums of solid low level waste were transferred to Inutec for off site waste processing. 4 boxes and 4 cylinders were sent to Studsvik for recycling.

Radionuclides	Total Waste Transferred Total Activity (MBq)
Uranium	0.11
Radium 226 plus thorium 232	0
Other alpha emitters	0.2
Carbon 14	0.5
Iodine 129	1.2E-07
Tritium	2.26
Cobalt 60	8.8
Others	2.8
Total volume of waste including primary containment (m^3)	11.4

TABLE 14b Transfer to the Incinerator at Hythe from Hinkley Point B in 2015

6 consignments of low level radioactive waste were also transferred to the operator of the incinerator at Hythe.

Radionuclides	Total Activity (MBq)
Tritium + carbon 14	172.8
Alpha emitters	6.6
Others	614.31
Total volume of waste including Primary containment (m^3)	50.9

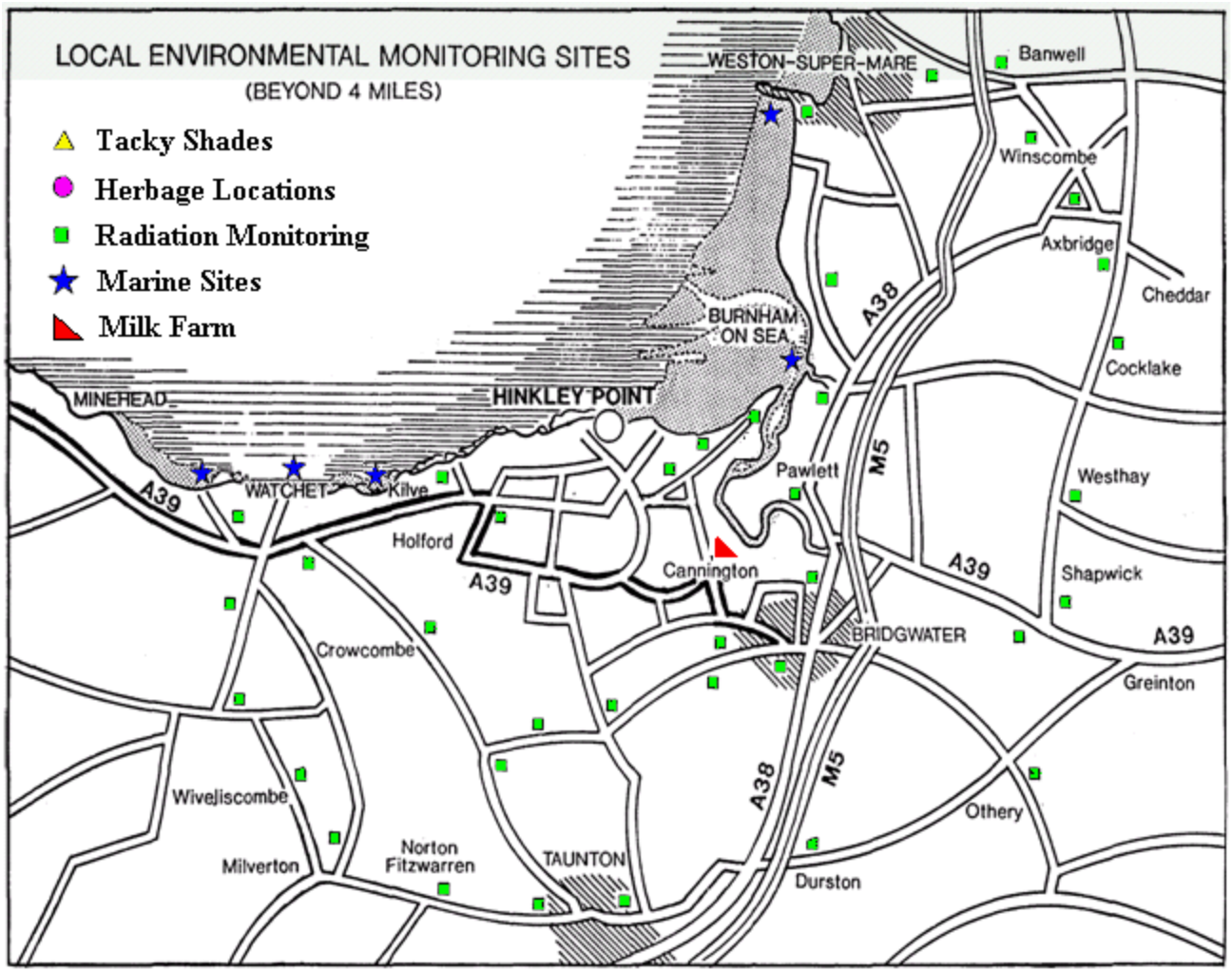
Part 10 REPORT CONCLUSIONS

During 2015 the levels of radioactivity in liquid and gaseous effluents, and solid radioactive low level waste transferred for off site processing, remained well below the authorised limits set by the Environment Agency, by both Hinkley Point A site and Hinkley Point B power station.

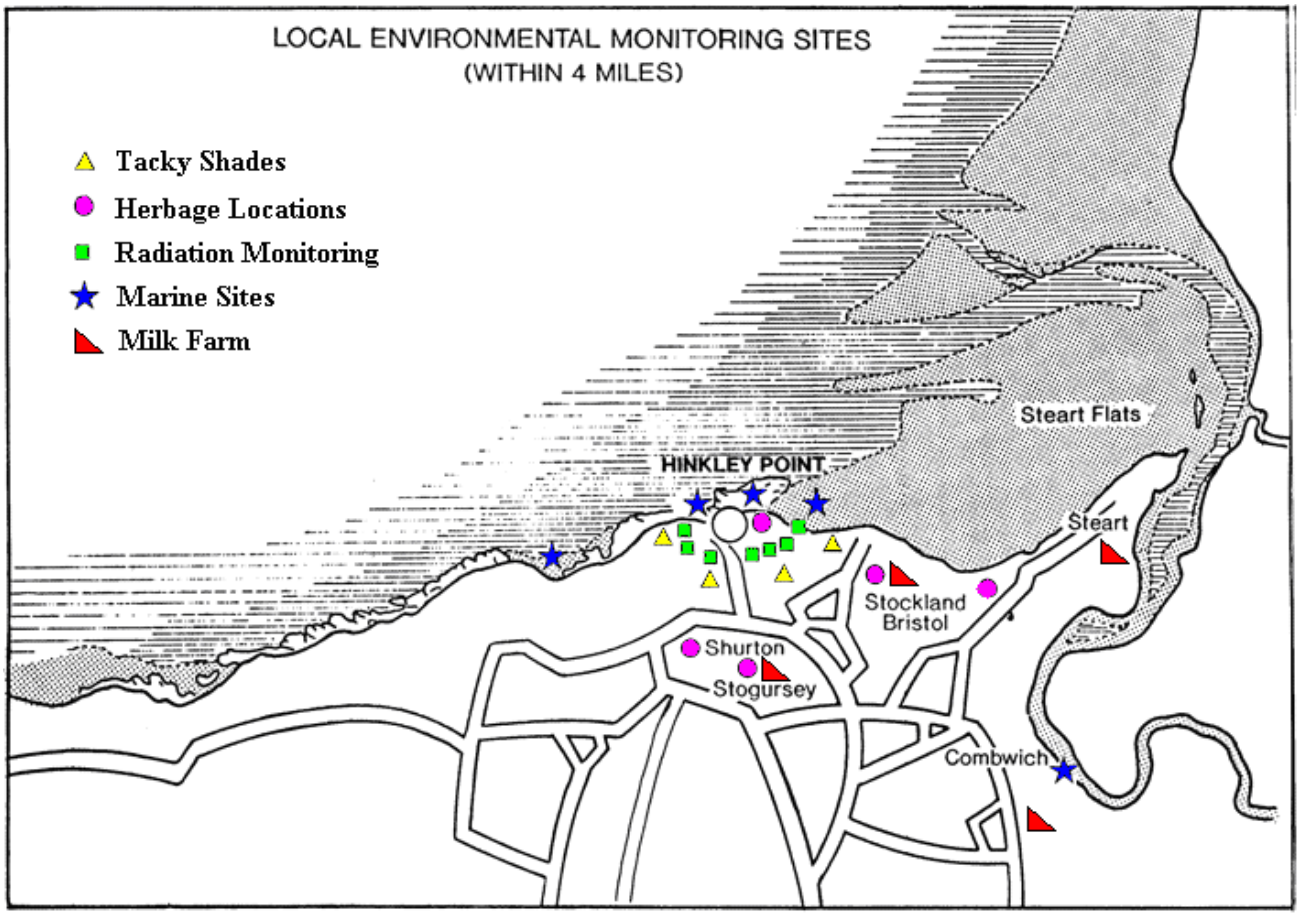
The environmental monitoring programme confirmed that there is no evidence of any long term accumulation of radioactivity resulting from the operation of both establishments. Radiation doses to members of the public from the discharges and direct radiation from the power station site is well below the UK legal limit of 1000μSv per year. Furthermore, environmental management initiatives suggest that the environment surrounding Hinkley Point is in a good state.

The total dose to members of the public from the all pathways exposure is likely to be similar to previously assessed doses of 22μSv (RIFE Report 20, 2015), which is well within the public dose constraint value of 300μSv per year from a 'single site', recommended by Public Health England.

APPENDIX 1:


LOCAL ENVIRONMENTAL MONITORING SITES
(BEYOND 4 MILES)
Tacky Shades
Herbage Locations
Radiation Monitoring
Marine Sites
Milk Farm
WESTON-SUPER-MARE
Banwell
Winscombe
Axbridge
Cheddar
Cocklake
BURNHAM ON SEA
A38
M5
HINKLEY POINT
MINEHEAD
WATCHET
Kilve
A39
Pawlett
Westhay
Holford
Cannington
Shapwick
Crowcombe
BRIDGWATER
Greinton
Wiveliscombe
Milverton
Norton Fitzwarren
TAUNTON
Othery
Durston

APPENDIX 2:


LOCAL ENVIRONMENTAL MONITORING SITES
(WITHIN 4 MILES)
Tacky Shades
Herbage Locations
Radiation Monitoring
Marine Sites
Milk Farm
Steart Flats
HINKLEY POINT
Steart
Stockland
Bristol
Shurton
Stogursey
Combwich

APPENDIX 3: GLOSSARY OF TERMS

The **BECQUEREL** (Bq) is a unit of radioactivity.

1 Becquerel = one radioactive disintegration per second.

The disintegration of a radionuclide or atom results in an emission of radiation.

1,000,000 Bq = 10^6 Becquerels = 1 Mega Becquerels (MBq)

1,000,000,000 Bq = 10^9 Becquerels = 1 Giga Becquerels (GBq)

1,000,000,000,000 Bq = 10^{12} Becquerels = 1 Tera Becquerels (TBq)

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The **GRAY** (Gy) is a unit of absorbed dose, and is used when measuring radiation.

1 gray is the special name given for one joule of energy from ionising radiation absorbed in one kilogram of a substance.

$\frac{1}{1,000,000,000}$ Gy = 10^{-9} Gray = 1 nano Gray (nGy)

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The **SIEVERT** (Sv) is a unit of Effective Dose Equivalent, and is used when measuring the radiation exposure of people from external radiation or radioactivity taken into the body. It takes into account the biological effect of the particular radiation being considered.

Dose equivalent is obtained by multiplying the absorbed dose by a factor to allow for the different effect on body tissue of types of ionising radiation that the person is exposed to.

Effective Dose Equivalent is obtained by multiplying the dose equivalent to various tissues and organs by the risk-weighting factor appropriate to each and adding up the products. The term is frequently abbreviated to dose.

$\frac{1}{1,000}$ Sv = 0.001Sv = 10^{-3} Sv = 1 milli Sv (mSv)

$\frac{1}{1,000,000}$ Sv = 0.000001 Sv = 10^{-6} Sv = 1 micro Sv (μSv)