UK Health Security Agency

Review of potential nuclear risks to the populations of the Bailiwicks of Guernsey and Jersey

Contract report

RCEHD-RAD-2023-01A

Introduction

The Channels Islands Emergency Planning Office commissioned UK Health Security Agency (UKHSA) to review potential nuclear risks to the populations of the Bailiwicks of Guernsey and Jersey.

We looked at the following risks:

- radioactive waste dumped in Hurd Deep in the 1950s and 1960s
- transport of nuclear materials by ship in the seas around the Channel Islands
- Orano La Hague nuclear fuel reprocessing site
- Flamanville nuclear power station
- Cherbourg naval dockyard

Based on what we learned, we have made some recommendations to help the Emergency Planning Office review their plans.

Figure 1 The Channel Islands, and nuclear facilities on the Cotentin peninsula

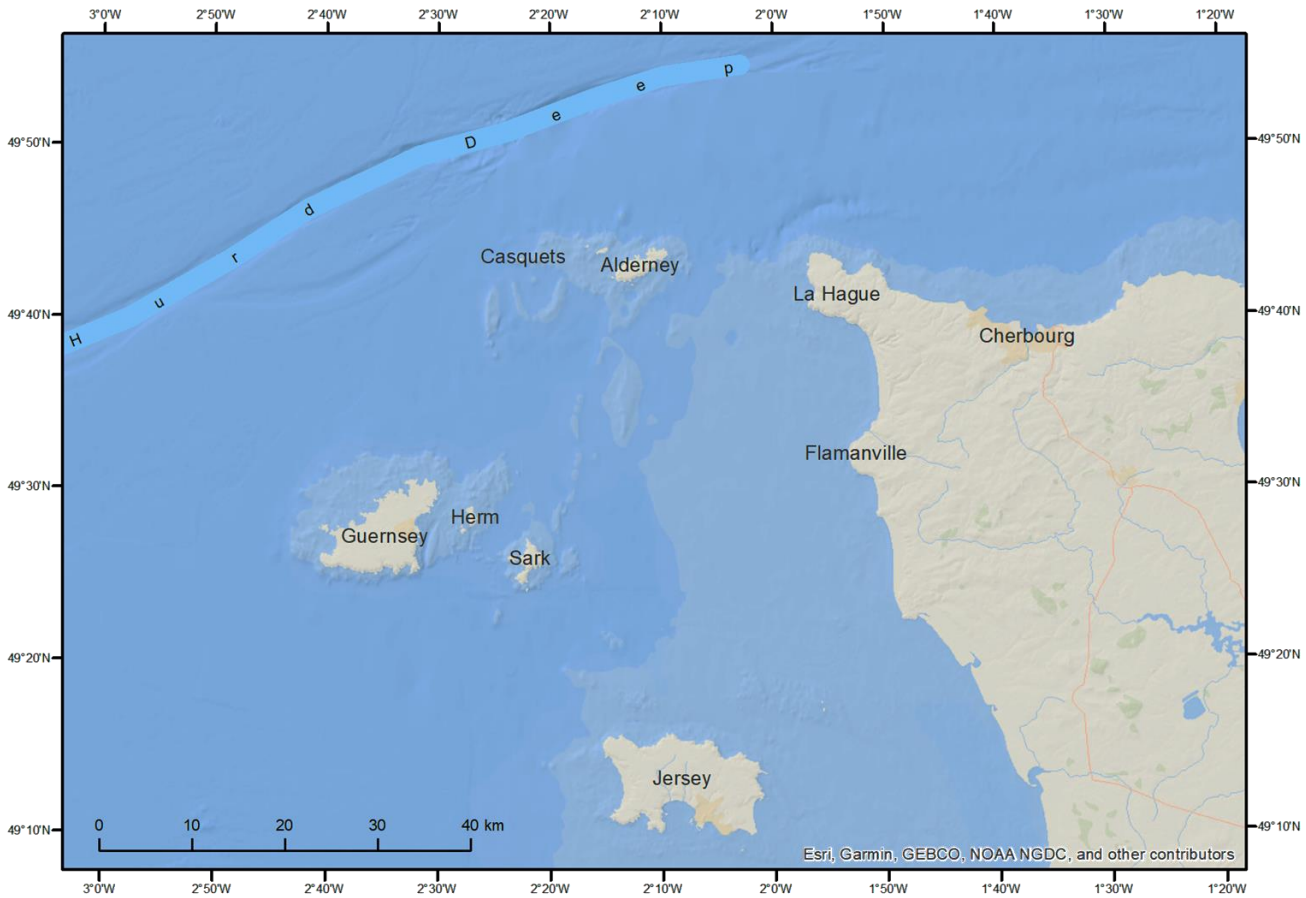

Table 1 Approximate distances (km) from nuclear sites to the Channel Islands

	Alderney	Herm	Sark	Guernsey	Jersey
Cherbourg	38	62	57	65	55
La Hague	20	46	43	49	50
Flamanville	29	41	36	45	36

Radiation

Materials that emit radiation are called radionuclides. When a radionuclide emits radiation, its activity, measured in becquerels (Bq), decreases – a process known as radioactive decay. The time it takes for a radionuclide's activity to decrease by half is known as its half-life. For example, the radionuclide iodine-131 has a half-life of about 8 days, caesium-137 has a half-life of about 30 years, and plutonium-239 (^{239}Pu) has a half-life of 24110 years.

When radiation passes through matter, it deposits energy and electrically interacts with the material. When passing through the body, ionising radiation, as it is called, has enough energy to cause damage to cells that can increase the risk of cancer later in life. However, in most circumstances, these health risks are low. In fact, radiation is widely used in medicine. The amount of energy that is deposited by the radiation per unit mass is called the dose and can be measured in millisieverts (mSv).

On average, people in the UK are exposed to a radiation dose of about 2.7 mSv a year. This dose comes from a number of sources, most of which are natural. For example,

- radon gas seeps out of the ground into buildings, where people live and work.
- naturally occurring radioactive materials in the ground can enter the food chain.
- you will receive a dose of radiation if you have an x-ray.

In common with some areas in the UK, radiation doses to people in the Channel Islands may be slightly larger than the UK average, owing to the radon gas that comes from the Islands' granite rocks. For more information about radon, visit: Radon (gov.je) or Radon (gov.gg) or UKradon.

Hurd Deep

Hurd Deep is a trench in the English Channel that lies north of the Channel Islands (see Figure 1). Based on data collated by the International Atomic Energy Agency, over

15 thousand tonnes of radioactive waste were dumped into the deepest part of the trench between 1950 and 1962. Sea dumping of radioactive waste is now banned[1].

The waste was dumped in steel drums that may now have begun to degrade. Because radioactivity could disperse into the wider environment, monitoring has been regularly carried out.

An ongoing programme of monitoring fish, shellfish, seawater and seaweeds has continued to find that there is no evidence of significant releases of radioactivity from the Hurd Deep site, and that any radioactivity in the environment around the Channel Islands continues to be of negligible radiological significance[2].

Marine transport of nuclear materials

The Orano La Hague site receives and reprocesses spent nuclear fuel from around the world. Some of this spent fuel arrives by ship via the port of Cherbourg. To ensure the material is carried safely, the ships, the way they are operated, and the casks in which the fuel is transported must comply with international codes and regulations. For example, the ships must be resistant to damage and fire[3], and the fuel casks must pass mechanical, thermal and immersion tests[4]. The ships and casks are very robust. Even if there is an accident, the probability that radioactive material will leak into the environment is very low.

To see what would happen if there was an accident, we imagined that a ship carrying spent nuclear fuel was somehow wrecked on the Casquet rocks, west of Alderney (see Figure 1). The fuel casks are scattered over the seabed, a small fraction of their contents begin to leak into the environment, but the casks are recovered a year later. We used a computer model to track where the radioactive material might go, and how people might be affected. We found that the leaked material would be quickly dispersed in the sea, meaning that concentrations would soon be low, and most people would not be affected.

After such an accident, there would likely be a temporary ban on the collection of seafood, accompanied by a programme to monitor the levels of radiation in the environment. We

[1] The London Convention (1972) on the Prevention of Marine Pollution by Dumping of Wastes and other Materials. See International Maritime Organization webpages (accessed March 2023): https://www.imo.org/en/About/Conventions/Pages/Convention-on-the-Prevention-of-Marine-Pollution-by-Dumping-of-Wastes-and-Other-Matter.aspx

[2] Environment Agency, Food Standards Agency, Food Standards Scotland, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Environment Protection Agency (2022). Radioactivity in Food and the Environment, 2021. RIFE-27.

[3] INF Code: International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on board ships. See International Maritime Organization webpages (accessed March 2023): https://www.imo.org/en/OurWork/Safety/Pages/INF-Code.aspx

[4] IAEA (2018). Regulations for the Safe Transport of Radioactive Material. 2018 Edition. International Atomic Energy Agency, Vienna (Austria), Specific Safety Requirements No. SSR-6.

found that the people most exposed to the radiation would be those who, despite the ban, might continue to eat large amounts of seafood, collected from the local area, on a daily basis. Eating contaminated molluscs, such as mussels, would give people the largest radiation doses. However, if people heed the ban, then we estimated that their doses would be well below the UK public dose limit.

Nuclear facilities on the Cotentin peninsula

We considered three French nuclear sites:

- Orano La Hague nuclear fuel reprocessing site[5]
- Flamanville nuclear power station
- Cherbourg naval dockyard

The biggest risks to the populations of Channel Islands would come from the release of radioactive material into the air from these sites. So, we focussed on that type of scenario.

To assess the risk if an accident were to occur, we needed to know the following information:

- the size of potential releases, and what radioactive material might be released,
- and if an accident did happen, how likely would it be for the wind to blow a large amount of radioactive material to one or more of the Channel Islands.

Likelihood and consequences

We looked at the consequences of radioactive releases from the nuclear sites if they were to happen. We did not look at the likelihood of these releases actually happening. Nuclear accidents are fortunately very rare, and so it is difficult to work out how likely they are. The French authorities will have investigated this for their nuclear sites, but this information is not available to the public, to UKHSA or to the Channel Island authorities.

A range of potential accidents might occur, and we concentrated on the largest ones – the ones that could have the greatest impact on the Channel Islands. This approach matches that chosen by the UK Government in the UK National Security Risk Assessment (NSRA), which considers all sorts of emergencies, not just nuclear ones.

[5] The Andra La Hague site (*Centre de stockage de la Manche*) stores various radioactive wastes. It began receiving waste in 1969 but was closed for new storage in 1994. It has now entered a long-term monitoring phase. If a release did occur, it would be considerably smaller than what could be released from the reprocessing site so therefore we did not consider it further.

Weather

Any plume of radioactive material leaving one of the nuclear sites would be affected by the weather. The wind direction is important. If the wind isn't blowing towards the Islands when the release of material happens, then the population won't be affected. The type of weather also matters. For example, if it rains over the Islands when the plume passes by, then more of the radioactive material will be washed down on to the land than if it was dry.

To consider the variability in the weather, we used a computer model to see how the Islands would be affected if the releases happened at different times. The UK Met Office told us what the weather was like over a period of 5 years. We ran the model at over 850 different times within that 5-year period, making sure that we chose times during the day and at night, and in the different seasons of the year, so that we could see what happened to the plumes in all sorts of weather.

We found that for a lot of the time, the wind would be unlikely to blow a plume towards the Channel Islands. The prevailing wind is from the west and southwest, i.e. away from the Islands.

Plume arrival

As a radioactive plume travels in the air, it will be affected by various atmospheric processes. The wind won't always blow in a straight line. Sometimes the plume will be narrow and concentrated. Sometimes it will be wide and dispersed. So even if a plume begins travelling towards the Islands, it might change direction before it gets there, or be so dispersed by the time it arrives that any radiation doses will be low.

The worst case happens if a narrow plume blows directly towards one of the Islands. In this case the plume could arrive within one hour, which would give the Channel Islands' authorities minimal time to alert the population to take action. However, on average, we found that plumes take longer to arrive than this - between 4 and 12 hours - which would give people a little longer to prepare.

For some types of accident, radioactive material is not released immediately. There may be a period of forewarning. If the French authorities are able to notify the Channel Islands swiftly then there would be more time to prepare before the release happens and before the plume arrives.

Protective actions

To protect people from a plume of radioactive material, urgent protective actions need to be taken quickly: preferably before any plume arrives. They remain in place for periods of hours or days to protect people from material in the air or which lands on the ground.

The best option is for people to “shelter-in-place”. This involves people going inside buildings, closing doors and windows, and turning off ventilation fans and air conditioning. Whilst a plume of radioactive material is passing overhead, sheltering will reduce the amount of radioactive material that people breathe into their bodies. The walls and roof of the building will help stop the radiation from penetrating inside. The more solidly-built the building, the more radiation it will stop. Although it is good at protecting people from the radiation, sheltering might affect people’s health and well-being, particularly if they have to shelter for a long period of time, if they can’t obtain any medical care or assistance they need, or if they are not sheltered at home and are separated from their families.

Stable iodine tablets reduce or prevent the uptake of radioactive iodine by the thyroid gland in your neck. The tablets have few side-effects. They are most effective if they can be taken 24 hours before the radioactive iodine is inhaled, or up to 2 hours afterwards. People should shelter as well as take the tablets. The tablets only protect against radioactive iodine, and not any of the other radioactive materials that might be in the plume. Also, they only protect against radioactive iodine that you breathe-in (or gets into your body). They have no effect on reducing the radiation from materials in the surrounding air or on surfaces. Note: radioactive iodine is only likely to be released from operating nuclear reactors, such as those at Flamanville power station or those used to power nuclear submarines docked at Cherbourg.

Evacuating people from the Islands is perhaps not realistic. It would need to be completed before the plume arrives. If people are still travelling outside, they could well be exposed to higher radiation levels than if they had sheltered. The potential for harm is likely to outweigh the benefit of attempting to reduce people’s radiation doses.

People will need advice on what they can eat and drink. Any food that is unsealed or yet to be harvested whilst the plume passes overhead might become contaminated if radioactive material falls on it. Public water supplies will likely be unaffected, at least in the short term. Monitoring of the food and water will help to decide what longer term advice is necessary and what further actions need to be taken.

For at least 50% of the plumes we modelled, the radiation doses received by people on the Channel Islands are either zero or low (less than 1 mSv) as for a lot of the time, the plumes would not pass over the Islands. Also, we found that even if a plume does pass over the Islands, the radioactive material in it might be so dispersed that radiation doses are low, and no protective actions would be necessary.

In the case of the Cherbourg scenario, we found that none of the modelled plumes that pass over the Islands would cause radiation doses big enough to require any protective actions. Also, we found that any material falling out of the plumes onto crops and farm animals would be so small that no long-term food restrictions would need to be put in place. However, a monitoring programme would be needed to confirm this.

For the Flamanville scenario, we found that for over 75% of the plumes, no sheltering or stable iodine would be needed. For the remaining plumes, we found that for the worst ones, the entire populations of individual islands would need to shelter, and consideration should

be made on the supply of stable iodine. However, out of all the plumes we modelled, we did not find one that would require the populations of all the Islands to take protective actions at the same time. We also found that for up to 25% of the plumes, food restrictions would potentially need to be put in place and some might last for several years, subject to confirmation by a monitoring programme.

For the Orano La Hague scenario, we found that sheltering would only be needed for 5% of the plumes we modelled. No stable iodine tablets would be needed because no (or very little) radioactive iodine would be released. Any radioactive iodine in the spent nuclear fuel that is reprocessed at La Hague will have decayed away to very low levels. As with the Flamanville scenario, it may be necessary to shelter one of the individual Islands, particularly those that are closer to La Hague, but we did not find a plume that would require all of the Islands to shelter at the same time. Compared with the Flamanville scenario, we found that food restrictions may cover a larger area and need to be in place for a longer time. We found that food restrictions would potentially need to be put in place for 50% of the plumes we modelled, and may have to last several decades, unless remedial action is taken. This would be confirmed with a monitoring programme.

Remember: the results above are for a very large release of radioactive material at each of the sites, which is extremely unlikely given the well-established and robust safety procedures in place. If we had modelled a smaller release, then we would get smaller results: doses would be lower and there would be less need for protective actions and food restrictions. To understand the likelihood of different sizes of release happening at the sites, the relevant French authorities would need to be consulted.

Recommendations

Based on our investigations, UKHSA has made several recommendations to assist in radiation emergency planning in the Channel Islands.

These include:

- Continue the programme of analysing marine environmental samples to provide reassurance.
- Consider plans to deal with radioactive releases to Channel Islands territorial waters.
- Continue engaging with French authorities on the safety of French nuclear sites and on emergency communications.
- Consider planning for the implementation of sheltering and stable iodine, if required, after a release of radioactive material into the air.
- Plan for communications following an emergency, particularly if no action is required. Plan for communicating with visitors to the Channel Islands.

About the UK Health Security Agency

UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation heath secure.

UKHSA is an executive agency, sponsored by the Department of Health and Social Care.

www.gov.uk/government/organisations/uk-health-security-agency

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Prepared by:
Radiation Assessments Department, part of UKHSA's Radiation, Chemical and Environmental Hazards Directorate.

Keith Mortimer, Kelly Jones, Simon Field, Wayne Oatway, Iain Brown, Tiberio Cabianca.

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For queries relating to this document, please contact:
Kelly Jones, Emergency Consequences Group Leader, Radiation Assessments Department (kelly.jones@ukhsa.gov.uk)