21. Radiological

21.1 Introduction

21.1.1 This chapter provides a preliminary assessment of the potential radiological impacts on members of the public and biota during the commissioning, operation and decommissioning of the proposed Moorside Power Station and the anticipated activities to be carried out within the Moorside Site during construction, such as soil and rock excavation and dewatering activities to control groundwater. An assessment of the impact from the transport of radioactive materials to and from Moorside Power Station will also be carried out during 2016.

21.1.2 The National Policy Statement for Energy (NPS EN-1) (Reference 1: DECC) notes that various regulators play an important role in ensuring the safety, security and protection of people and the environment in relation to the design, construction, operation and decommissioning of nuclear power stations and the transport of nuclear material. The principal regulators for the nuclear aspects of the Moorside Power Station are the EA, and the ONR ("nuclear regulators").

21.1.3 As the licensing and permitting of nuclear power stations by the nuclear regulators is a separate regulatory process, NPS EN-1 states that the Examining Authority for the DCO should act on the basis that:

- the relevant licensing and permitting regimes will be properly applied and enforced; and
- it should not duplicate the consideration of matters that are within the remit of the nuclear regulators.

21.1.4 In parallel to the DCO process, NuGen is applying for a Radioactive Substances Activity (RSA) permit application under Schedule 23 of the Environmental Permitting (England and Wales) Regulations 2010 (as amended) (EPR10), known as the Radioactive Substances Regulations (RSR), for the disposal of radioactive waste from the Moorside Power Station. The RSA EPR10 permit application will contain full details of the levels of radiological releases into the environment and radiological assessments undertaken to assess the impact of the NPP on members of the public and biota. Extensive pre application discussions with the EA have been on-going in 2015 and will continue in 2016 with a permit application being made in 2017. At this time a significant amount of data and analysis has been prepared which enables a preliminary assessment to be made. Due to the on-going preparation of the RSA EPR10 permit, only a summary of the information that is being compiled for the permit is contained in this chapter of the PEIR.

21.1.5 NuGen's future application for the RSA EPR10 permit will demonstrate the use of best available techniques (BAT) and that discharges of radioactive waste and impacts on humans and the environment will be minimised in accordance with BAT. Whilst the principal regulatory regime for the management and

disposal of radioactive waste is the RSR, it is considered appropriate to include a high level summary within this PEIR, particularly in relation to radioactive waste arisings and the impact on humans and the environment.

21.1.6 Within this chapter, NuGen has provided proposed annual discharge limits and resulting dose assessment to humans and non-humans, recognising that these are preliminary in nature and will change reflecting the developing nature of the project but will be finalised by the time of the RSA EPR10 permit application submission to EA in early 2017.

21.1.7 For the purposes of the future RSA EPR10 environmental permit application a RSA EPR10 permit boundary has been defined, which will replicate the outer main perimeter security fence that relates to the Moorside Power Station and includes the two marine discharge tunnels.

21.1.8 In addition to the detailed assessment carried out to support the RSA EPR10 permit, radiological releases and the generation of radioactive wastes are being assessed as part of the Generic Design Assessment (GDA) of the AP1000® reactor design by the ONR and the EA. The GDA process enables the ONR and the EA to identify design and technical issues for the reactor designer to resolve before construction of the reactor starts. The ONR and the EA granted an interim design acceptance for the AP1000® reactor design in December 2011. Westinghouse is currently working on the outstanding GDA Issues arising from the issue of the interim design acceptance. Completion of GDA Issues in this current close out stage is expected in early 2017 when it is expected that the ONR will issue their Design Acceptance Confirmation (DAC) and the EA will issue their Statement of Design Acceptability. The AP1000® has also been subject to an affirmative Regulatory Justification Decision, which has included a high-level assessment of whether the social, economic or other benefits outweigh the potential health dis-benefits with respect to radiological exposure.

21.1.9 Under Article 37 of the Euratom Treaty, a Member State must make a submission of general data to the European Commission every time it alters the way it plans to dispose of radioactive waste, or has a new nuclear facility that may increase discharges to air, water or land. An Article 37 submission has to include enough information and data to determine whether such plans are liable to result in the radioactive contamination of the water, soil or airspace of another Member State. NuGen plans to provide information to DECC to support the Article 37 submission to the European Commission on behalf of Her Majesty's Government in early 2017.

21.1.10 No radioactive waste or radioactive emissions will be generated during construction, operation and/or decommissioning activities at the other Moorside Project Sites. There is no known existing radiochemical contamination at any of the Moorside Project Sites other than the Moorside Site. As a result, this chapter addresses radiological issues in relation to the Moorside Site and its local environment only.

21.1.11 Other chapters describe the environmental sampling programmes and radiological baseline assessments, namely:

- Soils, Geology and Land Quality (**Chapter 11**);
- Freshwater Environment: Groundwater (**Chapter 13**);
- Freshwater Environment: Surface Water (**Chapter 14**); and
- Marine Water and Sediment Quality (**Chapter 16**).

21.2 Limitations of the PEIR

21.2.1 Further work may be required subject to on-going site characterisation and site investigations and further project design and implementation studies which will determine the need for additional radiological assessment in relation to, for example, construction worker dose assessment for onshore and offshore development activities within the Moorside Site.

21.2.2 This chapter does not assess the radiological releases from the ultimate disposal of solid low level activity and higher activity radioactive wastes as there will be no disposal of these wastes on the Moorside Site. It does assess on-site waste management, treatment and interim storage of spent fuel and radioactive wastes with respect to potential radiological exposure during the time when such wastes may be treated and then stored on-site before they are transferred to a permanent off-site disposal location. The radiological impacts from decommissioning are expected to be less than those arising during the operational phase.

21.2.3 As discussed in **Chapter 2**, decommissioning of the Moorside Power Station itself will be considered within the ES, but at a high level given that the decommissioning activities will take place around 60 years after electricity generation from the Moorside Power Station commence, and they will be covered by a separate EIA of the activities at that time.

21.3 Policy and legislative context

Legislation

21.3.1 The key legislation relevant to the assessment of effects with respect to radiological issues is listed below (and these implement the relevant European and international legal requirements):

- Environmental Permitting (England and Wales) Regulations 2010 (as amended) ("EPR10") (Reference 2: HMSO);
- The Ionising Radiations Regulations 1999 (Reference 3: HMSO);
- The Management of Health and Safety at Work Regulations 1999;
- Health and Safety at Work etc. Act 1974 (as amended);
- Nuclear Installations Act 1965 (as amended) (Reference 4: HMSO);
- The Conservation of Habitats and Species Regulations 2010 (Reference 5: HMSO);

- Offshore Marine Conservation (Natural Habitats &c) Regulations 2007;
- Environmental Protection Act 1990 (as amended);
- Radioactive Contaminated Land Regulations (Radioactive Contaminated Land (Enabling Powers) (England) Regulations 2005, Radioactive Contaminated Land (Modification of Enactments)(England) Regulations 2006, Radioactive Contaminated Land (Modification of Enactments) (England) (Amendment) Regulations 2007, Radioactive Contaminated Land (Modification of Enactments) (England) (Amendment) Regulations 2008, Radioactive Contaminated Land (Enabling Powers and Modification of Enactments) (England) (Amendment) Regulations 2010);
- Food and Environmental Protection Act 1985;
- Water Supply (Water Quality) Regulations 2000 (as amended); and
- Water Industry Act 1991 (as amended).

Policy

21.3.2 National Policy Statement for Energy (NPS EN-1):

- Section 5.14 of NPS EN-1 advises developers on how to manage radioactive and normal waste during construction and operation of a nuclear site. Developers are required to ensure the operational handling and off-site transporting of radioactive material is safe, to ensure no radioactive material causes unnecessary harm. This section also advises that the amount of nuclear material produced at a nuclear site should be minimised.

21.3.3 National Policy Statement for Nuclear Power Generation (NPS EN-6) (Reference 6. DECC) which includes:

- Paragraph 2.11.1 to 2.11.6 explains how the Government is satisfied that effective arrangements will exist for the management and disposal of the waste produced by new nuclear power stations and that higher activity waste is expected to be stored on the site where it is produced until the final disposal site is available.
- Paragraph 2.11.6 highlights that the UK has robust legislative and regulatory systems in place for the management of all forms of radioactive waste (including interim storage and transport) and that the nuclear site licensing and environmental permitting regimes can be assumed to be properly applied and enforced.
- Paragraph 3.12.4 states that:

  "Radiation from nuclear power stations requires careful management during and beyond the operational life of the power station. However, safety systems in place in the designs of new nuclear power stations and compliance with the UK's robust legislative and regulatory regime mean that the risk of radiological health detriment posed by nuclear

power stations (both during normal operation and as a result of an unplanned release) is very small."

Guidance

- Radioactive Substances Regulation – Environmental Principles Regulatory Guidance Series (Reference 7: EA);
- Radioactive Substances Regulation – The regulation of radioactive substances activities on nuclear licensed sites (Reference 8: EA);
- Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs (Reference 9: EA);
- Principles of optimisation in the management and disposal of radioactive waste from radioactive substances activities;
- Criteria for setting limits and levels on discharges of gaseous and aqueous radioactive waste from nuclear licensed sites in England and Wales;
- Principles for the Assessment of Prospective Public Doses arising from Authorised Discharges of Radioactive Waste (Reference 10: EA);
- Environmental Protection Act 1990; Part IIA Contaminated Land radioactively contaminated land Statutory Guidance. This guidance does not apply to a site for which a nuclear site licence has been granted which would be the case for the Moorside Power Station location prior to the commencement of operations (Reference 11: DECC);
- Impact Assessment of Ionising Radiation on Wildlife (Reference 12: EA);
- Habitats assessment for radioactive substances: better regulation science programme science report (Reference 13: EA);
- UK Strategy for Radioactive Discharges, DECC, July 2009;
- UK Strategy for the Management of Solid Low Level Waste from the Nuclear Industry dated 10 February 2016; and
- White Paper Implementing Geological Disposal DECC July 2014.

21.4 Data gathering methodology

Study Area

21.4.1 The study area for the radiological assessment includes:

- the Moorside Site;
- residential communities and individual residential dwellings within a radius of approximately 5 km from the centre of the Moorside Site; and

- ecological habitats of interest in the vicinity of the Moorside Site including terrestrial habitats and marine habitats in the intertidal and subtidal zones of the marine environment.

21.4.2 The Accommodation Sites and the Additional Sites have not been included within the assessment scope as no radiochemical contamination relating to historical land use activities are anticipated and no radionuclide emissions are anticipated during the construction and operation of the facilities on these sites.

Desk study

21.4.3 The radiological desk study is based on the following sources of data:

- UK AP1000® Environment Report (Reference 14: WEC). The UK AP1000® Environment report has been written specifically for the AP1000® reactor design as part of the Westinghouse Generic Design Assessment (GDA) submission;
- Sellafield Ltd. Annual reports on Discharges and Monitoring (the most recent annual report covers 2014 (Reference 15: Sellafield Ltd);
- Habitats Regulations Assessment of the revised draft Nuclear National Policy Statement: Main Report (Reference 15: Sellafield Ltd);
- The Habitats Regulations Assessment: Site Report for Sellafield (Reference 16: DECC). The Habitats Regulations site report describes an assessment of sensitive European sites within 20 km of the nominated site;
- Radioactivity in Food and the Environment annual reports (RIFE) (the most recent RIFE report covers 2014 (Reference 17: EA *et al.*); and
- Habit data for members of the public in the vicinity of Sellafield (References 20 and 21: Cefas).

21.4.4 The purpose of the desk study has been to collate the data on the radiological impact of the AP1000® design presented at GDA stage, data on the relevant characteristics of the Moorside Site as well as the potential for any existing contamination to be present within the Moorside Site. Other areas of the desk study have provided some of the input data for the dose assessment calculations, for example representative habit data for human receptors.

Environmental monitoring – baseline data

21.4.5 Everyone is exposed to ionising radiation to a varying degree from natural as well as man-made sources as a part of everyday life. Exposure includes natural sources of radiation from the radioactive gas radon, ingestion of naturally occurring radionuclides in food, cosmic radiation from the sun and gamma radiation from rocks and soils. Man-made sources include medical exposure to radiation (e.g. X-rays), occupational exposure for persons working with ionising radiation, fallout from the testing of nuclear weapons, exposure to products containing radioactivity (e.g. smoke detectors) and discharges from the nuclear industry. The extent of natural and man-made sources vary

according to location, lifestyle and occupation. The average radiation exposure for individuals in the UK has been assessed to be 2,700 microsieverts per year (μSv/y) (The sievert (symbol Sv) is a unit of ionising radiation dose in humans. 1 μSv = 0.000001 Sv). Over 80 % of most of the UK population's radiation exposure is from natural sources, with the majority of the man-made component due to medical exposure. The contribution from radioactive discharges from the nuclear industry is less than 0.1 % of the total (Reference 20: PHE).

21.4.6 The annual monitoring undertaken by Sellafield Ltd (Reference 15: Sellafield Ltd) and the annual RIFE studies (Reference 17: EA *et al.*), have identified that a number of radionuclides were detected at very low levels in environmental samples taken at locations near the Sellafield Site. The results from the last five years will be used to assess existing background levels in West Cumbria to envelope areas which are relevant in terms of potential discharges from the Moorside Power Station.

Generic design information

21.4.7 The Generic Design Assessment (GDA) is the process which is being used by the relevant regulatory bodies (ONR and EA) to assess new nuclear reactor designs. The process allows the regulators to assess the safety, security and environmental implications of new reactor designs, separately from applications to build reactors at specific sites. By assessing a reactor design before it is built at any particular site, any potential "generic" issues related to the design can be identified and highlighted so they can be addressed by the reactor designer.

21.4.8 The AP1000® reactor design has been submitted for GDA by Westinghouse Electric Company LLC. Although the GDA has not been completed, an interim Design Acceptance Confirmation (iDAC) (Reference 21: ONR) and interim Statements of Design Acceptability (iSoDA) (Reference 22: EA) have been issued by the regulators in 2011.

21.4.9 Initial radiological assessments have been completed for the GDA process for a generic AP1000® station in the UK; these have been presented in the UK AP1000® Environment Report (Reference 14: WEC). The predicted prospective dose, including the contribution from direct exposure, is 13 μSv/y. These prospective dose assessments relate to a single reactor on a generic site in the UK.

21.4.10 The Environment Agency's iSoDA for the AP1000® reactor design (Reference 22: EA) states that:

"*Westinghouse has made an adequate assessment of the impact of the discharges which assumes the AP1000® is located at a coastal location. The estimates of dose to members of the public are well below the UK constraint for any single new source of 300 μSv/y*".

21.4.11 The UK AP1000® Environment Report (Reference 14: WEC) also included an assessment of the radiological impact on non-human species (biota). The predicted prospective dose is 25 μGy/h. The report states that the maximum

predicted gaseous releases and aqueous discharges for an AP1000® at a generic site are unlikely to pose a risk to non-human species.

21.4.12 Furthermore, the Environment Agency, iSoDA states:

"We conclude that at the GDA stage we consider that the maximum predicted gaseous releases and liquid discharges for an AP1000® at the generic site are unlikely to pose a risk to non-human species. We consider that the assessment is suitably conservative at this stage of the GDA process. A detailed site-specific assessment of the radiological impact from the AP1000® will be required for any site where the AP1000® is proposed."

Survey work

21.4.13 A radiological sampling campaign started in late 2014 and has been carried out for the purpose of establishing a radiological baseline. It includes the following media:

- surface freshwater;
- groundwater;
- soils;
- marine water; and
- marine subtidal and intertidal sediments.

21.4.14 Detailed information on the survey work is included in the following Chapters:

- **Chapter 11** for Soils, Geology and Land Quality;
- **Chapter 13** for Freshwater Environment: Groundwater;
- **Chapter 14** for Freshwater Environment: Surface Water; and
- **Chapter 16** for Marine water and sediment quality.

Consultation

21.4.15 Further to the details outlined in **Chapter 3** regarding the consultation that has taken place to date, it should be noted that consultation received from the following organisations has been used to inform the scope of the assessment and to gain views on the key radiological issues which they consider to be important; summarised details of which are outlined in **Table 21.1** and **Section 21.5** below:

- Environment Agency;
- Sellafield Ltd;
- Public Health England;
- Office for Nuclear Regulation;
- Copeland Borough Council;

- Cumbria County Council; and
- Allerdale Borough Council.

Table 21.1 Consultation responses received

Issue raised	Consultees	Response
The assessment methodology for the radiological effects from solid and effluent waste streams requires the provision of further information	Copeland Borough Council, Environment Agency	The assessment is progressing and further information has been provided in this chapter. The full details of the assessment methodologies, input data and results will be reported in the EPR10 RSA permit application.
Please provide details on cumulative effects of the operational phase of the Moorside Station	Copeland Borough Council	A discussion of the cumulative effect is provided in **Section 21.10** of this PEIR.
There is the potential for radiological contamination beyond localised areas of the Moorside main site given the local industrial history.	Environment Agency	A desk study has been carried out for each of the Accommodation Sites and Additional Sites and no radiochemical contamination relating to historical land use activities are anticipated.
Solid radioactive wastes should be addressed at least in general terms as part of the wider assessment of waste management to provide an overview of impacts and issues	Environment Agency	The impact from the processing and interim storage of the solid waste on site has been assessed as part of the operational dose assessment. The impact of the ultimate disposal of these wastes will be assessed as part of the decommissioning assessments.
There is no reference to the use of "Habitats assessment for radioactive substances: better regulation science programme science report: SC060083/SR1". The absence of this data source could mean that the risks to the environment are not fully assessed.	Environment Agency	The reference has now been included and a review of the report undertaken. It can be confirmed that the guidance in the habitats assessment report was followed in the Moorside biota assessment.
It appears that in relation to Natura 2000 freshwater, coastal or terrestrial sites/species, the radiological assessment is using a far higher threshold to identify no adverse effects than currently agreed by Statutory Nature Conservation Bodies	Environment Agency	The higher threshold of 400 µGy/h previously reported was based on the 2009 GDA assessment. This has now been reviewed and corrected to 40 µGy/y.

Issue raised	Consultees	Response
No mention is made of the impact on nearest Member State (Ireland) – Article 37 submission is being covered elsewhere, but should be noted here.	Sellafield Limited	A mention of the forthcoming Article 37 submission has been included.

21.5 Scope of the assessment

Potential receptors

21.5.1 Emissions of radionuclides to the air and into the marine environment are anticipated to occur during the commissioning, operational and decommissioning phases of the Moorside Power Station. However, stringent limits and controls will be imposed through the environmental permitting regime, the nuclear site licence and transport regulations to ensure that these discharges and doses do not adversely affect human and non-human species within the terrestrial and marine environments.

21.5.2 Human receptors include members of the public who spend time close to the site and consume foodstuffs produced locally. Non-human receptors include biota present in terrestrial and marine habitats surrounding the Moorside Site. Detailed initial assessments have been carried out to determine the radiological effects on both human and non-human receptors. These assessments are also being used to support NuGen's application for a Radioactive Substances Activity environmental permit which will need to be granted by the EA before commissioning and operations can commence. This permit application is due for submission in early 2017.

Spatial and temporal scope

21.5.3 Any radionuclide which may be discharged from the Moorside Power Station could be carried some distance through dispersion of emissions by atmospheric circulation or by marine currents. However, in the light of the stringent limits that will be imposed through the environmental permitting regime, it is considered highly unlikely that there will be any significant effects beyond the local area around the discharge points to the atmosphere or to the marine environment. This will be confirmed once detailed predictive computer based modelling has been finalised and the outcome will be reported in the Environmental Statement (ES) that will be submitted with the application for a DCO for the Moorside Project and will also be assessed by the EA in considering the application for the RSA EPR10 permit, by the European Commission as part of the submission of general data under Article 37 (Euratom) and in the context of the Habitats Regulations Assessment.

21.5.4 The potential for effects applies from the start of commissioning, for the duration of the operation of the Moorside Power Station and decommissioning and subsequently in the case of long-lived radionuclides. Build-up of radionuclides in the environment has been assessed, assuming conservatively that discharges at operational levels continue over a timescale of 100 years (60 years of operations and 40 years post operations, including decommissioning). Storage of some radioactive wastes on site will continue until at least 2150, however there will be no significant radioactive discharges associated with this.

Potentially significant effects

21.5.5 Initial assessments have been undertaken to determine the predicted dose to representative individuals of the human population occupying areas in close proximity to the Moorside Power Station and non-human species in the local terrestrial and marine environments. The dose assessment take into account the impact of the operation of the Moorside Power Station as well as naturally occurring background radiation, existing levels of radionuclide contamination, currently consented and projected permitted discharges from other facilities (including discharges from the Sellafield Site) and build-up over radioactivity in the environment over the lifetime of the Moorside Power Station.

21.5.6 The granting of a RSA EPR10 environmental permit for the Moorside Power Station will require that legal dose thresholds (which conform to internationally agreed standards) are met. The radiological assessments will consider radiological dose to the wider human population in the local, UK, EU and worldwide context.

21.6 Environmental measures incorporated into the proposed development

21.6.1 A BAT Case for the Moorside Power Station has been developed and is described in full in the RSA EPR10 environmental permit application. It contains the claims, arguments and evidence which have been developed to demonstrate that the design of the AP1000 Nuclear Power Plant has been environmentally optimised. The ultimate purpose of this BAT case is to demonstrate that the engineered and management controls of the Moorside Power Station have been assessed and fully optimised to ensure that the impact to both the environment and members of the public from potentially harmful ionising radiation is As Low As Reasonably Achievable (ALARA).

21.6.2 The following six claims have been developed in order to demonstrate that the design of the Moorside Power Station has been optimised through the application of BAT:

- Claim 1: NuGen shall eliminate or reduce the generation of radioactive waste;
- Claim 2: NuGen shall minimise the radioactivity in radioactive waste disposed of to the environment;
- Claim 3: NuGen shall minimise the volume of radioactive waste disposed of to other premises;
- Claim 4: NuGen shall select the optimal disposal routes for wastes transferred to other premises;
- Claim 5: NuGen shall minimise the impacts on the environment and members of the public from radioactive waste that is disposed of to the environment; and

- Claim 6: NuGen shall use BAT to provide a true and accurate record of gaseous and aqueous radwaste discharges

21.6.3 Specific environmental measures that have been incorporated into the overall design of the Moorside Project relating to this environmental topic. How these have been targeted to receptors which are relevant to radiological issues are set out in **Table 21.2** below.

Table 21.2 Rationale for incorporation of environmental measures

Potential receptor	Predicted changes and potential effects	Incorporated measure
Moorside Site		
Humans and biota	Radiological discharges to air and the marine environment above the current baseline during commissioning/operation and decommissioning of the Moorside Power Station.	Generic design needs as dictated by the requirements of the Generic Design Assessment process (which is subject to evaluation and approval by the ONR and the EA) and site specific design measures to minimise radionuclide releases will be implemented to ensure that any emissions are in accordance with regulatory requirements and that the discharge limits set by the EA through the RSA EPR10 environmental permit are not exceeded. These measures will include:- ▪ The heights of the stacks through which gaseous radioactive discharges are released has been optimised to achieve a high degree of dispersion and dilution of the effluent plume before it reaches the receptor points; ▪ The position of the outfall tunnels has been optimised to achieve a high level of dilution of the aqueous radioactive discharges in the marine environment; ▪ Abatement systems for the gaseous discharges include filters and delay beds to reduce the amounts discharged of those radionuclides that could result in the highest impact on receptors; ▪ Abatement systems for the aqueous discharges include ion exchange resins to reduce the amounts discharged of those radionuclides that could result in the highest impact on receptors; and ▪ Shielding incorporated into the design of the reactor buildings and waste handling and storage facilities largely eliminate any direct radiation dose to members of the public.

21.7 Assessment methodology

Methodology for prediction of effects

21.7.1 The radiological impacts on members of the public and the environment are assessed to demonstrate that they are within the constraints prescribed by the regulations. This assessment also allows the contribution that environmental optimisation techniques make towards reducing the impacts to be determined and demonstrates that BAT has been applied.

21.7.2 This section contains an overview of the methodologies applied and preliminary results of the following assessments:

- dose to human receptors during the commissioning/operation of the Moorside Power Station; and
- dose to biota during the commissioning/operation of the Moorside Power Station.

21.7.3 Assessment work for the impact of the transport of radioactive materials and wastes is on-going and will be reported in the ES.

21.7.4 Assessment work for any impact during the construction phase is on-going and will be reported in the ES.

21.7.5 Impacts to members of the public and biota are determined by assessment of radiation dose. Key steps in the dose assessment are:

- definition of source term (representative gaseous and aqueous radioactive discharges)
- selection of air and marine dispersion models to be used;
- definition of dose assessment methodologies to be used; and
- development of input parameters for dispersion and dose assessments.

Source term

21.7.6 Doses were derived following the approach set out in government and EA guidance and are based on discharges at the discharge limits that are proposed as part of the ERP10 RSA permit application. The discharges at the proposed limits are based on site wide maximum rolling annual discharges. Some of the proposed discharge limits, within the proposed permit application, are set against individual radionuclides, others against radionuclide groups. Each of these groups contain a number of radionuclides, each with different dose factors. A scoping assessment was carried out to determine which of the radionuclides in each group leads to the highest doses. This radionuclide was taken forward as a surrogate radionuclide to apply in the dose assessment. The discharges at the proposed limit and the surrogate radionuclide used for the human dose assessment are shown in **Table 21.3** for gaseous discharges and **Table 21.4** for aqueous discharges.

Table 21.3 Gaseous discharges at proposed discharge limits

Radionuclide	Radionuclide used for the human dose assessment	Proposed annual discharge limit (GBq/y)
H-3	H-3	9,000
C-14	C-14	3,000
I-131	I-131	1
Noble gases	Ar-41	40,000
Beta/gamma particulates	Cs-137	0.09

Table 21.4 Aqueous discharges at proposed discharge limits

Radionuclide	Radionuclide used for the human dose assessment	Proposed annual discharge limit (GBq/y)
H-3	H-3	200,000
C-14	C-14	20
Co-60	Co-60	1
Other beta and gamma emitting radionuclides	Co-58	9

Dispersion model and dose models

Gaseous discharges

21.7.7 For routine releases the Atmospheric Dispersion Modelling Software (ADMS) v5.1 was used (Reference 23: CERC). ADMS is a proprietary atmospheric dispersion model developed and maintained by Cambridge Environmental Research Consultants. It is an industry standard dispersion model in the UK, used to model the air quality impact of existing and proposed industrial installations. The use of ADMS enables a number of effects to be taken into account including:

- wet and dry deposition;
- radioactive decay;
- plume rise characteristics;
- building effects; and
- complex terrain.

21.7.8 Meteorological data based on the UK Meteorological Office output from their weather modelling system, known as Numerical Weather Prediction (NWP), was used. The meteorological records consisted of hour-by-hour values for wind direction, wind speed, temperature, relative humidity and cloud cover for a ten-year period (2005-2014), specifically developed for Moorside.

21.7.9 An ADMS modelling domain was set up for Moorside, taking into account the site-specific terrain, preliminary site layout and site-specific meteorological data. The model outputs include the activity concentration in air and deposition rate for each of the radionuclides at each of the human and non-human receptor locations considered as well as at locations of maximum activity concentrations and deposition rates beyond the RSA EPR10 permit site boundary.

21.7.10 From the deposition rate, activity concentrations in soil and terrestrial foodstuffs were determined by applying the terrestrial transfer model FARMLAND, as implemented in the PC CREAM08 computer model (Reference 24: NRPB). FARMLAND is a dynamic model with a modular substructure, which simulates radionuclide transfer through different parts of the food chain, including major crop types and animals. The movement of radionuclides within each module is represented by transfers between interconnected compartments in the model.

21.7.11 The outputs from the dispersion models were then combined with habit data and dose factors to derive doses to humans and terrestrial biota.

Aqueous discharges

21.7.12 The dispersion of aqueous radioactive discharges into the marine environment was assessed using the Dispersion of Radionuclides into the Sea (DORIS) module, which is a sub-module component of the PC CREAM08 software (Reference 24: NRPB). PC CREAM08 provides a robust and well-established assessment tool that allows for the assessment of marine dispersion of routine radionuclide releases to local receptors and to the far-field.

21.7.13 The discharge is assumed to occur into a relatively small 'local marine compartment' with a coast length of 20 km, a width of 5 km and an average water depth of 20 m. Given that the aqueous discharge outfalls are currently anticipated to be no more than 4 km offshore, the 'local compartment' is considered to be appropriate for assessment purposes. It is assumed to be a single well-mixed water compartment which is surrounded by a larger regional compartment, i.e. the local compartment acts as an interface between the point of discharge and the regional marine model. The dispersion of activity into the surrounding regional compartment and beyond is modelled through water exchange rates.

21.7.14 For the Moorside Power Station the DORIS modelling set up for the Sellafield Site was used. This is appropriate as both sites are adjacent to the same regional compartment and discharge into the same local compartment. As the Moorside Power Station will be discharging directly into the Sellafield local

compartment this modelling compartment represents the area where the highest activity concentrations would occur.

21.7.15 The output from the marine dispersion modelling includes activity concentrations in marine water, sediments and marine organisms. These activity concentrations were then combined with habit data and dose factors to derive doses to humans and marine biota.

Direct radiation dose

21.7.16 The scope of this assessment was to derive an estimate of the direct radiation dose that could be received by a member of the public. It should be noted that in due course a detailed direct radiation modelling assessment will be carried out by the ONR as part of their safety assessment of the Moorside Power Station. In addition, after the start of operations at the Moorside Power Station, assessments of direct radiation will be carried out by monitoring radiation levels beyond the future nuclear site licence boundary and at the nearest habitation. The assessment described here is not meant to replace those future assessments; rather it has been designed to give an estimate based on calculations, screening tools and very conservative assumptions which will result in worst case doses. The results should only be used for the purposes of the prospective public dose assessment until more detailed assessment results are available.

21.7.17 The assessment takes account of the following sources of ionising radiation on the Moorside Power Station Site:

- the three AP1000® nuclear reactors;
- spent ion-exchange resins situated in the three auxiliary buildings (one for each reactor);
- radioactive waste in the three radiological waste buildings (one for each reactor);
- the centralised Intermediate Level Waste (ILW) store; and
- the centralised Spent Nuclear Fuel (SNF) store.

21.7.18 Direct radiation dose is predominantly due to gamma radiation emitted by some radionuclides when they undergo radioactive decay. It decreases rapidly with distance from the source. To derive a bounding estimate, direct radiation doses were derived for the closest distance between each source and the Moorside Power Station RSA EPR10 permit boundary. Dose rates were estimated by undertaking a Microshield assessment. Microshield is a comprehensive photon/gamma ray shielding and dose assessment computer program that is widely used for scoping assessments of direct radiation doses.

Collective dose

21.7.19 Radionuclides discharged into the environment have the potential to disperse, allowing exposure of wider populations, albeit at much lower levels of individual exposure than to the individuals within the general population who

would be expected to receive the highest doses (the representative person). This collective effective dose is defined as the sum of all the exposures from a given source to a defined group of people and has units of man-sieverts (manSv).

21.7.20 Some radionuclides, owing to their long radioactive half-lives and their behaviour in the environment, may become globally dispersed and act as a long-term source of irradiation of both the regional and world populations. Such exposures would be in addition to the irradiation of the populations exposed during the initial dispersion of these radionuclides from their points of discharge. Of the radionuclides which would be discharged from the Moorside Power Station, tritium, carbon-14, and krypton-85 have to potential to travel further afield.

21.7.21 Collective doses for radionuclides discharged to atmosphere and the marine environment were calculated using the PC CREAM08 model (Reference 24: NRPB). The collective dose assessment is based on country by country population and food production data for the atmospheric assessment and seafood catch data for the marine assessment. PC CREAM also contains a model to estimate doses from the global circulation of radionuclides released into the atmosphere and marine environment.

21.7.22 Collective doses were calculated for the UK, European, and world populations.

Human dose assessment

Overview

21.7.23 The assessment outcomes are as follows:

- prospective dose assessment for human receptors to cover the following:
  - annual dose to the most exposed members of the public from gaseous radioactive waste discharges from the Moorside Power Station;
  - annual dose to the most exposed members of the public from aqueous radioactive waste discharges from the Moorside Power Station;
  - annual dose to the most exposed members of the public from direct radiation from the Moorside Power Station;
- contribution of other man-made sources to the dose assessment for members of the public (excluding medical sources); and
- collective dose assessments for radioactive waste discharges from the facility truncated at 500 years to UK, European and world populations.

Receptor and exposure pathways

21.7.24 The radiological effect on the local community from the commissioning, operation and decommissioning of the proposed Moorside Power Station (i.e. the reactors plus other facilities where radioactive material is treated or stored) is evaluated by assessing the radiation dose to a ‘representative

person'. Because it is not practicable to assess doses to each individual member of the public that could be exposed, the 'representative person' approach has been applied. The representative person is an individual receiving a dose that is representative of the more highly exposed individuals in the population (Reference 10: EA). Thus the doses received by all other members of the public should not be higher than the representative person dose.

21.7.25 The main sources of potential effects are:

- aqueous discharges to sea resulting in:
  - contamination of fish, crustaceans and molluscs which are then caught and consumed;
  - contamination of the local coastline and beaches;
- gaseous discharges to the atmosphere resulting in:
  - airborne contamination leading to internal doses from inhalation and external doses as a result of plume submersion;
  - deposition on land and transfer into the food-chain leading to external doses from ground contamination and internal doses from the ingestion of contaminated foods; and
- direct radiation from reactor buildings, waste facilities and associated buildings resulting in external dose.

21.7.26 A number of candidates for the representative person are determined from habit surveys (types and quantities of food consumed and locations frequented etc.) of the local population. The representative person with the highest annual dose is defined as the representative person in terms of potential radiological effects from the Moorside Power Station.

21.7.27 Different age groups have been taken into account to represent different physiologies and habits. Doses to 1 year old infants, 10 year old children and adults have been assessed. These age groups are considered to sufficiently represent all ages (Reference 10: EA). Doses to the foetus (including embryo and breast fed infants in the first 3 months after birth) were not assessed, as the radionuclides that can lead to the foetus receiving a higher dose than the mother are not present in the discharges from the Moorside Power Station (Reference 10: EA).

Location of receptor

21.7.28 For the majority of the prospective near-field radiological assessment requirements for members of the public, the zone of influence is limited to local representative persons who live or work adjacent to the proposed Moorside Power Station and obtain most of their food from local sources. For assessment of the radiological effect from gaseous discharges and direct radiation, experience gained from similar assessments is that the locations of the representative persons are likely to be within 1-2 kilometres of the source of emissions.

21.7.29 For aqueous discharges, the zone of influence for representative persons will be within the boundary of the local marine compartment, i.e. a water volume where the initial mixing of the discharge from the proposed Moorside Power Station into the marine environment is assumed to occur. For the Moorside Project the relevant local marine compartment has a coastal length of 20 km, a water depth of 20 m and extends 5 km into the Irish Sea.

21.7.30 The location of local farms, residential dwellings, nearby places of work for workers who are not working with radiation themselves and places for leisure activities have been assessed. The locations were compared to the predicted activity concentrations and deposition rates from the gaseous discharge plumes and a number of representative receptor locations were identified as follows:

- the local farm location where the highest activity concentrations were observed representing a farming family assumed to produce and consume their own terrestrial foodstuffs, including animal products;
- the closest residential dwelling, representing a family consuming vegetables and fruit grown in their garden;
- the location at the RSA EPR10 permitting boundary where the highest activity concentrations were observed which was conservatively assumed to be the location of a future potential public footpath representing leisure activities in the area surrounding the Moorside Power Station during the operational phase; and
- the location of a nearby church to represent members of the public from the wider region who may visit the area regularly.

21.7.31 Habit data from local surveys as well as generalised UK habit data have been assessed and a number of habit profiles were identified. The habit profiles were then matched to the representative receptor locations and the doses were calculated for each of the resulting combinations.

Non-human dose assessment

Overview

21.7.32 The ERICA software tool provides an integrated approach to dose assessment prediction for a number of reference organisms which represent the most commonly found organisms in a range of typical habitats (Reference 25: Beresford *et al.*). The databases supporting the ERICA tool are built up around these reference organisms. Each reference organism has its own geometry and is representative of either terrestrial, freshwater or marine ecosystems. The selection of reference organisms makes it possible to address all protected species within Europe.

21.7.33 The default reference organisms within the ERICA tool version 1.2 were compared to the species found during on-site ecological survey carried out for the EIA in order to ensure that suitable analogue species were identified. Ecologists working on the EIA surveys also supplied occupancy estimates based

on the average time each species spends in each media specified in the ERICA tool (e.g. in water, in air, in sediment, etc.). These species were then mapped against reference organism categories and appropriate species were chosen for each reference organism category, as shown in **Table 21.5**.

Table 21.5 ERICA reference organisms and their corresponding Moorside representative species

ERICA reference organisms	Moorside representative species
Terrestrial environment	
Amphibian	Great crested newt
Annelid	Earthworm
Arthropod - detritivores	Woodlouse
Bird	Barn owl
Flying insects	Dingy skipper butterfly
Grasses and herbs	Crested dog's-tail
Lichen and bryophytes	*Rhytidiadelphus squarrosus*
Mammal - badger	Badger
Mammal - large	Roe deer
Mammal - flying	Various bat species
Mammal - small-burrowing	Mole
Mollusc - gastropod	Garden snail
Reptile	Adder
Shrub	Hawthorn
Tree	Willow
Marine environment	
Benthic fish	Plaice
Bird (wading)	Duck
Crustacean	*Nephrops norvegicus*
Macroalgae	*Pelvetia canaliculata*
Mammal	Grey seal
Mollusc - bivalve	Razor clam

ERICA reference organisms	Moorside representative species
Pelagic fish	Whiting
Phytoplankton	Various species
Polychaete worm	*Magelona johnstoni*
Sea anemones	Cerianthus Lloydii
Zooplankton	Various species

21.7.34 Non-human species were assumed to be present at the location of maximum air concentration for the terrestrial environment or at the maximum concentration which will occur in the local marine compartment. This approach ensured that the maximum possible radiological effects to all animal and plant population groups were assessed.

Gaseous discharges

21.7.35 A predictive dose assessment for non-human species has been undertaken for the terrestrial environment based on gaseous discharges at the proposed annual limits shown in **Table 21.3**. Using output from the modelling of the atmospheric dispersion of the discharges, three locations were assessed in detail as follows:

- the area of highest activity concentration outside of the Moorside Power Station RSA EPR10 permit boundary;
- the northern end of Low Church Moss Site of Special Scientific Interest (SSSI); and
- the River Ehen (which supports a Special Area of Conservation (SAC)).

21.7.36 Sites with national statutory designations within a 5 km distance of the Moorside Site were considered. Doses at the SSSI Low Church Moss were assessed explicitly. As the other sites with National Statutory designations are situated further away, it was assumed that the doses found at the Low Church Moss location provides a bounding estimate for all terrestrial sites that are subject to National Statutory designations.

21.7.37 The dose modelling tool ERICA has been used to model the dose to non-human (biota) reference organisms which were taken to be representative of all species present in the surrounding terrestrial environment. The Environment Agency's R&D128 tool (an alternative assessment tool that allows for the assessment of the impact of radioactive discharges to biota) was also used to model the doses to non-human reference organisms from noble gases as these are not available in the ERICA input database.

Aqueous discharges

21.7.38 A non-human dose assessment has been undertaken for the marine environment based on aqueous discharges at the proposed annual discharge

limits as set out in **Table 21.4**. The area modelled was the Sellafield local compartment of the Irish Sea within the marine dispersion module of the PC CREAM08 software package. The marine environment adjacent to the Moorside Power Station encompasses the Cumbrian coastline which includes a Marine Conservation Zone. The dose modelling tool ERICA has been used to predict the dose to non-human reference organisms which have been adopted to be representative of all species in the surrounding marine environment.

21.7.39 Within the local marine compartment used in the marine dose assessment is a MCZ (Cumbria Coast) and there is a further MCZ (West of Walney) and one recommended MCZ (Mud Hole) that fall within the regional modelling compartment. As the activity concentrations in the regional compartment are significantly lower than in the local compartment it has been assumed that the doses to non-human species in the local compartment will be bounding for the MCZs further afield.

Significance evaluation methodology

21.7.40 The results from the human and non-human dose assessments have been compared with the relevant dose limits and guideline values.

Human receptors

21.7.41 The main quantity that is calculated for comparison with the dose criteria is the dose expressed as effective dose. Dose is a combination of external effective dose from one year's exposure and committed effective dose from one year's aqueous and gaseous discharges. **Table 21.6** gives radiological protection criteria for public exposure that are considered in the assessment of the radiological effects that may arise from planned discharges to the atmosphere and to the aquatic environment.

Table 21.6 Summary of radiological protection criteria for public exposure

Criteria	Quantity	Doses to be included assessment against criteria					
		Source of radiation for site considered			Other sources of radiation (excluding medical and natural)		
		Historical discharges	Future discharges	Future direct radiation	Historical discharges	Future discharges	Future direct radiation
Dose limit	1 mSv/y	✓	✓	✓	✓	✓	✓
Site constraint	0.5 mSv/y		✓				
Source constraint	0.3 mSv/y (max)		✓	✓			
New nuclear power	0.15 mSv/y		✓	✓			

Criteria	Quantity	Doses to be included assessment against criteria					
		Source of radiation for site considered			Other sources of radiation (excluding medical and natural)		
		Historical discharges	Future discharges	Future direct radiation	Historical discharges	Future discharges	Future direct radiation
station dose constraint							
Potentially 'of no regulatory concern'*	≤0.01 mSv/y		✓	✓			

*Note: below this level the Environment Agency should not seek to reduce further the discharge limits that are in place, provided that the holder of the permit applies and continues to apply BAT

21.7.42 The preliminary assessment of the maximum dose to members of the public from future discharges and direct radiation from the Moorside Power Station is 4.6 µSv/y (0.0046 mSv). This is significantly lower than the new nuclear power station dose constraint of 0.15 mSv.

21.7.43 The preliminary assessment of the maximum annual dose to local human receptors from all sources (excluding medical exposures and natural sources) is 100 µSv/y (0.1 mSv/y). This is ten times lower than the dose limit of 1 mSv/y.

Non-human receptors

21.7.44 For non-human species doses can be compared to a guideline value of dose rate below which there appears to be no harm to the species at the population level. The Environment Agency's current guideline value is 40 µGy/h. The ERICA tool contains a lower screening rate of 10 µGy/h to provide guidance in what circumstances a more detailed assessment should be undertaken.

21.7.45 The dose rates to all of the reference organisms in both the terrestrial and marine environments are significantly lower than the ERICA screening dose rate of 10 µGy/h and the Environment Agency screening dose rate of 40 µGy/h. Overall the greatest dose impact from the current assessment to all non-human organisms in all habitats is 0.0011 µGy/h.

21.7.46 It is therefore concluded that there will be negligible impact from the future gaseous and aqueous discharges from the proposed Moorside Power Station to any terrestrial or marine species at the population level.

21.8 Preliminary assessment of residual effects

Baseline conditions

21.8.1 The radiological baseline conditions are described in the following chapters:

- **Chapter 11** for Soils, Geology and Land Quality;

- **Chapter 13** for Freshwater Environment: Groundwater;
- **Chapter 14** for Freshwater Environment: Surface Water; and
- **Chapter 16** for Marine water and sediment quality.

Predicted residual effects and their significance

21.8.2 A summary of the preliminary assessment of the predicted residual effects (i.e. the effects taking into account the incorporated measures) is provided, with respect to the types of effects that might affect each of the key receptors or receptor groups at the Moorside Site, in **Table 21.7**.

21.8.3 The approach to sensitivity/value of receptor chapter reflects the balance of the receptor (human and non-human) and the radiological impact of the identified radionuclides for predicted events scenarios upon those receptors.

Table 21.7 Moorside Site: Summary of predicted residual effects

Receptor and summary of predicted effects	Probability	Sensitivity /value of receptor	Magnitude of change	Significance of effect	Rationale
Construction					
Humans and biota					
Disturbance and redistribution of existing radioactive contamination within the Moorside Site with reference to humans and environment in the locality of the Moorside Site.	Unlikely	Medium	Very Low	Negligible (Not significant)	There is no current evidence of significant radiochemical contamination of soils within the Moorside Site. Low levels of radioactive contamination of groundwater has been identified within certain areas of the Moorside Site. However, the radiological consequences of managing soils and groundwater during the construction phase (for example during dewatering for excavations) are not currently anticipated to result in the need for enhanced control measures to limit radiological dose to the construction workforce. The radiological impact of discharges from this low level of radioactive contamination in the groundwater to the environment and its impact to humans and non-humans will be insignificant and will be controlled by regulation with oversight by the EA.
Disturbance and redistribution of existing radioactive contamination in marine sediments	Likely	Medium	Medium	Moderate (potentially significant)	Levels of pre-exiting radioactive contamination have been identified in marine sediments (sub tidal and intertidal) in the vicinity of the Moorside Site from lawful disposal from other operator's activities. It is likely that during the short marine construction period that some of the marine sediments which contain the radioactive contamination could be disturbed. This disturbance of pre-existing radioactive contamination has the potential to increase the level of radioactive exposure to humans and the environment and will require more detailed assessment. A detailed radiological dose assessment will be undertaken to support the planned off-shore construction works and related marine licence applications to better define the significance of the impact.

Receptor and summary of predicted effects	Probability	Sensitivity /value of receptor	Magnitude of change	Significance of effect	Rationale
Operation					
Humans and biota					
Release of radioactivity into the atmosphere and the marine environment with reference to humans and environment in the locality of the Moorside Site.	Likely	Medium	Low	Minor (not significant)	NuGen has undertaken an initial detailed assessment of the release of radioactivity from the proposed Moorside Power Station based upon the likely annual discharges of radioactivity and the proposed discharge limits (prospective dose assessment). In all cases the resulting annual dose from all Moorside Power Station sources and the total annual dose to the representative person for the proposed Moorside Power Station are significantly lower than the specified regulatory criteria. The operation of the Moorside Power Station will be regulated by ONR and the EA under the NSL and RSA EPR10 environmental permit respectively. NuGen will apply the waste hierarchy and BAT to all discharges and ensure they remain As Low As Reasonably Achievable (ALARA). The RSA EPR10 permit requires the application of BAT to all discharges as well as discharge sampling/monitoring to accurately record and report to the EA all discharges on a monthly, quarterly and annual basis. This data will be used by NuGen to produce an annual retrospective dose assessment to demonstrate that the discharges and the resulting doses remain ALARA.
					Detailed site specific impact assessments indicate that the dose levels to members of the public are very low at below 20 µSv (or 0.02 mSv) per year, compared to the dose limit to members of the public which is 1 mSv per year. The dose levels to non-humans are negligible (i.e. not significant). The initial results also indicate that there will be only very minimal build-up of radioactivity concentrations will result in environmental media as a result of the lifetime operations at the proposed Moorside Power Station.

21.9 Preliminary assessment of the Moorside Project as a whole

21.9.1 An assessment of the Moorside Project as a whole will be included in the ES. In the context of the radiological assessment no impact from any of the Accommodation Sites and Additional Sites is expected, as outlined above. As a result no additional, *"accumulated effects"* on the environmental receptors specified in this chapter are expected from construction activities as well as during the operation and decommissioning of the Moorside Power Station.

21.10 Preliminary assessment of cumulative effects with other developments

Scope of the assessment

21.10.1 In the context of radiological assessments it is required practice to evaluate the total dose to human receptors, for comparison against the overall dose limit of 1 mSv/y. This assessment includes the following:

- Contribution from past lawful discharges from other nuclear licensed sites that have led to an accumulation of radioactivity in the environment around the Moorside Site;
- Contribution from past events, such as accidents and nuclear weapon testing, that have led to an accumulation of radioactivity in the environment around Moorside Site;
- Contribution from future discharges of other sites releasing radioactivity into the environment that have an impact on the area around the Moorside Site.

21.10.2 For the purpose of this assessment the contribution from past discharges and events will be assessed based on measured baseline levels in the environment. For the assessment of the contribution from future discharges from other existing sites and proposed developments, the potential impact from their planned gaseous and aqueous discharges will be included.

21.10.3 As outlined in **Section 3.4**, an exercise has been undertaken to determine which other (non-Moorside) developments should be considered in the context of their ability to result in cumulative adverse environmental effects with any of the Moorside Project developments.

21.10.4 Of the other developments described in **Section 3.4**, listed in **Table 3.4** and considered in the context of **Table 3.9**, it is considered appropriate at this stage to consider the following projects as their operations will result in the release of radioactivity into the environment:

- Sellafield Site Decommissioning (Sellafield Ltd/Nuclear Decommissioning Authority);

- Low Level Waste Repository near Drigg (LLWR Ltd);
- Barrow-in-Furness Site (BAE Systems);
- Heysham New Nuclear Power Station (EDF Energy); and
- Wylfa Newydd New Nuclear Power Station (Horizon).

21.10.5 The assessment of the other developments listed above is not yet complete as information, such as their anticipated radioactive discharges to air and marine waters, is not yet available. They are briefly discussed in the context of their likely interaction with respect to their radiological impact in the sub-sections below.

Sellafield Site Decommissioning (Sellafield Ltd/Nuclear Decommissioning Authority)

21.10.6 The Sellafield Site Decommissioning project has the potential to interact with the Moorside Site itself due to its close location.

Low Level Waste Repository, Drigg (LLWR Ltd)

21.10.7 The extensions to the Low Level Waste Repository (LLWR) near Drigg could potentially lead to changing releases to air and groundwater at the same time as the Moorside Project is under construction and during its operational life.

21.10.8 It is anticipated that the radiological impact of the LLWR will remain very low and due to the distance to the Moorside Site, the cumulative effect on the Moorside human and non-human receptors is likely to be negligible.

Barrow-in-Furness Site (BAE Systems)

21.10.9 The Barrow-in-Furness Site Redevelopment Programme, which includes a new Nuclear Submarine Berth and associated facilities, could potentially lead to a change of releases to air and marine waters at the same time as the Moorside Project is under construction and during its operational years.

21.10.10 It is anticipated that the radiological impact of the Barrow-in-Furness Site will remain very low and due to the distance to the Moorside Site the cumulative effect on the Moorside human and non-human receptors is likely to be negligible.

Heysham New Nuclear Power Station (EDF Energy)

21.10.11 As described in **Section 3.4**, there do not appear to be any plans to bring forward a new nuclear power station at Heysham within the foreseeable future. This will be kept under review during the development of the ES.

Wylfa Newydd New Nuclear Power Station (Horizon)

21.10.12 The Wylfa Newydd Nuclear Power Station is anticipated to undergo construction and operate on similar timescales to the Moorside Power Station.

21.10.13 Source terms detailing discharges of radioactivity to the environment from Wylfa Newydd are not yet available. Once they become publicly available an assessment of any cumulative effects can be carried out. It is anticipated that these will be low, due to the distance to Moorside.

21.11 Consideration of additional mitigation

21.11.1 At this stage, all of the mitigation measures, which are anticipated will be required, are incorporated into the development proposals and are considered in the assessment of effects outlined in **Section 21.8**. However, if it emerges during the preparation of the Environmental Statement that additional, non-incorporated measures, need to be considered, the relevant details will be presented in the ES.

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