Sizewell C Project

Radioactive Substances Regulation (RSR) Permit Application

Head Document

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1 INTRODUCTION

1.1 General Introduction

1. NNB Generation Company (SZC) Ltd (SZC Co.) plans to construct and operate a new nuclear power station at Sizewell in Suffolk on the east coast of England, known as Sizewell C (SZC). SZC will be similar to the new nuclear power station under construction in Somerset in the South West of England, known as Hinkley Point C (HPC).

2. SZC Co. was incorporated on 28th October 2014 as a private limited company. SZC Co.'s company number is 09284825 and its registered office is at 90, Whitfield Street, London W1T 4EZ.

3. SZC Co. will be applying for a Nuclear Site Licence (NSL), planning permission and relevant environmental regulatory permissions for the purpose of construction and operation of a new build nuclear power plant consisting of two UK EPR™ Pressurised Water Reactor (PWR) type nuclear reactors and associated facilities, including interim storage of radioactive waste and spent fuel generated on the SZC site, The SZC site is adjacent to the existing power stations at Sizewell A (SZA) and Sizewell B (SZB), which are currently in decommissioning and operational, respectively. The expected net electrical output of each UK EPR™ reactor unit will be approximately 1,670MW giving a total site capacity of approximately 3,340MW. This is enough to power approximately 5 million homes or 6% of the UK national requirement, making a significant contribution to the generation of low-carbon electricity.

4. SZC Co. is applying, as the future operator, for an environmental permit for the disposal of radioactive waste arising from the production of low-carbon electricity from two UK EPR™ PWR type nuclear reactors and associated facilities.

5. This document is the SZC Co. application for an environmental permit under Schedule 23 of the Environmental Permitting (England and Wales) Regulations 2016 (as amended), known as the Radioactive Substances Regulation (RSR), regulated by the Environment Agency [Ref 1].

6. The UK EPR™ units design has already achieved Generic Design Assessment (GDA) approval in the UK [Ref 2]. The UK EPR™ reactor design has been justified, under the Justification of Practices involving Ionising Radiation Regulations 2004 [Ref 3]. The design for SZC has been based on the design for HPC, currently under construction in Somerset, England. The design at HPC already holds the necessary permits and licences (and including the RSR permit as is being applied for through this document). A key strategy for SZC Co. is to replicate as much of from HPC as possible. The starting design for SZC has been adopted directly from that at HPC, the following introductory sections provide further detail of the adoption and replication approach for SZC. Whilst a separate company, SZC Co. has strong links with NNB Generation Company (Hinkley Point C) Limited (NNB GenCo (HPC)), the developer and operator for HPC. This means lessons learned from HPC are easily available and transferred to the SZC project, the management arrangements previously tested at HPC are available for adoption on the SZC project.

1.2 Purpose

7. The purpose of this document is to provide sufficient information to enable the Environment Agency to determine an RSR permit for SZC Co. for the operation of the proposed SZC power station as well as enabling the Environment Agency to undertake a public consultation on SZC Co.'s application. This is achieved by the following:

- To demonstrate the application of Best Available Techniques (BAT) for the management of radioactive waste throughout the lifetime of SZC (using the Claims, Arguments and Evidence (CAE) approach);
- To demonstrate the radiological impacts to people and the environment from the discharge of very low levels of radioactivity in gaseous and aqueous effluents are As Low As Reasonably Achievable (ALARA) and well below all regulatory limits and constraints;
- To propose appropriate radioactive discharge limits required for the operation of the SZC power station;
- To present and justify new information developed since the UK EPR^{TM} GDA; and
- To demonstrate that SZC Co. has suitable organisation, arrangements and resources to be capable of complying with the conditions and limitations RSR permit if granted.

1.3 Scope

8. The scope of this application is defined under Schedule 23 of the Environmental Permitting (England and Wales) Regulations 2016 (as amended) [Ref 1]. Appendix G cross-references the requirements of the Environmental Permit RSR application and where they are addressed in the application.

9. The application, comprising this document (known as the head document) and a suite of supporting documents and information set out in the appendices), describes SZC Co.'s proposal for the management of disposal of radioactive waste associated with the operation of the proposed SZC power station. This includes:

    - A description of the technology and systems related to the disposal of associated radioactive waste;
    - The demonstration of BAT to minimise the amount of radioactive waste unavoidably produced and the impact of disposal of radioactive waste on people and the environment;
    - SZC Co.'s proposed radioactive discharge limits for associated activities;
    - The impacts of associated disposal of radioactive waste on human and non-human;
    - Plans for future plant and environmental monitoring programmes;
    - Setting out relevant monitoring arrangements for compliance against the RSR permit conditions; and
    - A forward work plan (FWP) defining the future steps SZC Co. is committed to undertaking.

10. The radioactive substances activities which are being applied for within this submission cover the disposal of radioactive waste from the operation of the two UK EPR^{TM} reactor units and associated facilities, including the interim storage facilities for spent fuel and intermediate level waste (ILW) at SZC.

11. SZC Co. is in the process of developing its application to obtain a NSL, regulated by the Office for Nuclear Regulation (ONR) for activities related to the operation of the nuclear power station at SZC. It is expected that while the application for a NSL will take place after the RSR application is made, the RSR permit were it to be granted, would only take place after the Environment Agency had consulted with ONR. This means that SZC Co. is applying for an RSR permit for a nuclear site. It is noted that certain elements of the RSR permit are also regulated under the NSL Standard Licence Conditions (LCs) and therefore these are dual

regulated. In order to avoid duplicated regulatory engagement and inspection it is expected that ONR and Environment Agency will both cover these areas (see Section 1.5).

12. Radioactively contaminated land on a nuclear licensed site is considered by the ONR as an accumulation of nuclear matter (unless it arises from authorised disposals). Therefore, as noted in the above paragraph the identification and management of radioactively contaminated land at SZC would be regulated by ONR, and therefore is out of scope of this application.

13. SZC Co. will need to obtain key consents, permits and licences before securing Financial Investment Decision (FID). Therefore, while an RSR permit might be granted in advance of NSL and FID, no work affected by the conditions of the permit will be undertaken until all the relevant permissions are in place.

14. SZC Co. is a learning organisation and as such has applied the learning from the GDA for the UK EPR™ and site-specific work at HPC, as well as of EPR™ and PWR sites in the development of this application.

15. The RSR permit application for SZC has been developed in the following way:

- Starting with information that has been taken from the successful completion of the GDA for the UK EPR™ and the further development to the detailed and site-specific design for HPC, including relevant UK context and further learning from other EPR™ projects. This is considered applicable because the proposed SZC development is a replication of the HPC nuclear power station with the exception of some site-specific structures, however, reviews of acceptability for SZC has been undertaken and is described in the relevant sections in this application. Further information on the development of the design is presented in Section 2.2.
- Lessons learnt from the permitting process and ongoing compliance of HPC have been considered in the production of this RSR submission. This also includes the development of the SZC organisation and arrangements.
- Recognising SZC project phases and the requirement to make the right decisions at the most appropriate time while demonstrating fit-for-purpose arrangements consistent with the corresponding project phase.
- Demonstrating compliance with the permit limits and conditions through activities considered to be part of normal business for SZC Co. (summarised in this document); and
- Understanding the activities that SZC Co. will commit to for the future to ensure continued compliance to the RSR permit (presented in the FWP in Section 8.2).

1.4 References

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*EDRMS is the electronic document and record management system employed by SZC Co. to store all documents and records

1.5 Overview of SZC Permits, Consents and Licences

1.5.1 RSR Permit Application Process

16. Under RSR, the Environment Agency is responsible for regulating all disposals of radioactive waste from nuclear sites in England. "Disposal" of radioactive waste includes discharge of gaseous and aqueous effluents into the atmosphere or sea and disposals of solid waste or non-aqueous liquids by transfer to another suitably permitted site for final disposal.

17. SZC Co. believe that the information presented in this document is consistent with that required by the Environment Agency to determine the application for an environmental permit, in line with the Environmental Permitting Regulations [Ref 1]. The Environment Agency will consult on the RSR permit application made by SZC Co. and on the draft permit and draft decision document during their permit determination phase. This application will be placed on the public register.

1.5.2 Key SZC Environmental Permits being applied for

18. In addition to this permit application for the purposes of disposal of radioactive waste at SZC, SZC Co. is also applying for the following operational environmental permits:

- Water Discharge Activity (WDA) Permit – The WDA Permit is for permission to discharge cooling water and trade effluents via designated authorised routes; and
- Combustion Activity (CA) permit – The CA permit is for permission to operate the emergency diesel generators.

1.5.3 Other key applications and submissions being applied for

19. SZC Co. is applying to other bodies for various permissions, licences and consents required to construct and operate the proposed nuclear power station at SZC. The design, construction, operation and decommissioning of nuclear power plants are subject to a wide range of legislation and regulation from a safety, security and environmental perspective by nuclear regulators, the ONR and the Environment Agency respectively for SZC.

20. SZC Co. has developed this application for a RSR permit, well in advance of when it would be required for operational activities at SZC, so that it could be considered in parallel with other key applications and submissions, which include but are not limited to the following:

- Development Consent Order (DCO) – submitted to the Planning Inspectorate required for designated nationally significant infrastructure projects, such as SZC, pursuant to the Planning Act 2008 [Ref 5]. An Environment Impact Assessment has been undertaken as required under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 [Ref 6] to inform the DCO process. The information related to radioactive substance activities is considered consistent with that included in this document and that required by the Environment Agency for determining the application for an environmental permit.
- Nuclear Site Licence – Regulated by the ONR. This is required for SZC Co. to construct and operate SZC under the Nuclear Installations Act 1965 [Ref 7]. There are significant areas of alignment and opportunities for integration between the NSL and RSR permit in terms of organisation and arrangements to ensure a common, holistic approach. In particular, ONR and Environment Agency

intend to provide 'dual regulation' of a Nuclear Licensed Site (NLS) in the following arrangements:

- Accumulation of Radioactive Waste (LC32) and
- Leakage and Escape of Radioactive Material and Radioactive Waste (LC34)

- These areas are expected to be fully demonstrated at a later time in the project, where appropriate based on the relevant activities and project milestones. In addition, disposals of radioactive waste arising from contaminated land should be in accordance with LC33 ("disposal of radioactive waste"), and with the arrangements under the RSR permit. Further details are provided in Section 6.
- Article 37 – As SZC Co. plans to construct and operate a power generation facility involving the generation of and disposal of radioactive waste, under the Euratom Treaty the European Commission (EC) requires the UK Government Department for Business, Energy & Industrial Strategy (BEIS) to provide general information of the impact to member states under Article 37 [Ref 8] of the Euratom Treaty.
- Article 41 – In preparation for an investment in the SZC project, Article 41 of the Euratom Treaty requires SZC Co. to prepare a communication of the SZC project to the EC [Ref 9].
- Funded Decommissioning Programme (FDP) – Under the Energy Act 2008 (as amended) [Ref 10], operators of new nuclear power stations are required to have secure financing arrangements in place to meet the full costs of decommissioning and their full share of waste management and disposal costs. These arrangements are set out in a FDP. SZC Co. is preparing its FDP arrangements and will submit these to the Secretary of State for approval before construction of the power station begins.

21. In addition to the above, additional environmental permits, licences and consents will be required to support the construction activities of the nuclear power station at SZC, these permits will be applied for as necessary in accordance to the project schedule.

1.6 Structure and Content of this Application

22. This head document provides a standalone overview of the RSR permit application. It describes the principles, requirements and high-level demonstration of meeting the principles and requirements. Further detailed evidence is to be found in the RSR supporting documents which this head document references. This head document also includes a non-technical summary, FWP, site plan and permit application forms. Figure 1-1 shows the structure of the application and supporting documentation.

23. This application sets out how SZC Co. intend to comply with an RSR permit, where full compliance is not currently achievable (or appropriate), steps to achieve compliance is written into this permit application by way of a FWP, and appropriate commitments have been made by SZC Co.

24. The following section provides a brief description of the content of the head and supporting documents. The SZC Company Manual, incorporating the necessary elements of a management prospectus, is included in the supporting documents.

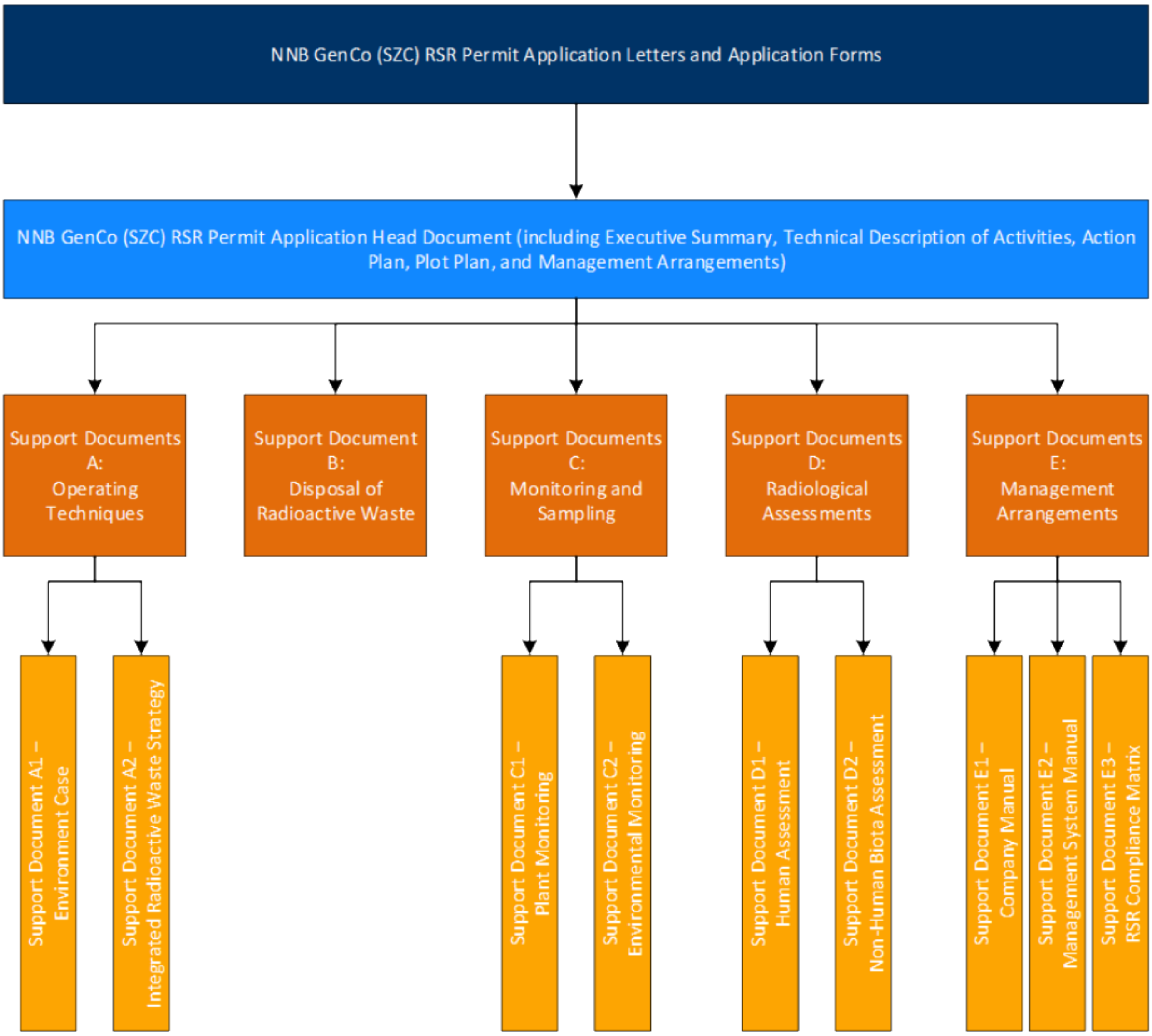


Figure 1-1 SZC RSR Permit Application Document Structure

Table 1-1 Structure and Content of the Head Document and Supporting Documents

Section / Document No.	Title	Content
Non-Technical Summary		
Head Document		
1	Introduction	Background information in relation to SZC Co., the SZC project, the GDA and HPC. In addition, this section provides a high-level description of the SZC site and its surrounding environment.
2	Technical Description of Activities	A description of UK EPR™ reactor design, the plant facilities its main systems and processes which are believed to have an impact to the generation, treatment and management of radioactive waste (solid, aqueous and gaseous) during the operational phase.
3	Operating Techniques	Information on the generation, treatment and details of disposal of radioactive waste generated by those relevant activities within the boundary of SZC. The section also contains information which relates to the Integrated Radioactive Waste Strategy (IWS). The IWS has been written taking into account the expected waste generation during the operational part of the premises life cycle and the associated waste management. This section also demonstrates that the facilities planned at SZC have been optimised and are considered to demonstrate Best Available Techniques (BAT) in their capacity to minimise the production, discharge and disposal of any relating radioactive wastes. This is done through presentation of the Environment Case developed for SZC.
4	Disposal of Radioactive Waste	An estimation of gaseous and aqueous radioactive discharges with proposed limits and Quarterly Notification Levels (QNLs). In addition, this section provides details in relation to proposed disposal routes for various types of solid radioactive wastes including an estimation of their volumes and associated activity values. This section also confirms that all radioactive wastes are disposable against current Waste Acceptance Criteria (WAC) and that there are no plans to incinerate or dispose of radioactive waste on the SZC site.
5	Monitoring and Sampling	Proposed methods which will be adopted for both the sampling and assessments of gaseous and aqueous discharges and in-process monitoring. This section also describes the proposed environmental monitoring arrangements.
6	Radiological Assessments	Findings from comprehensive prospective dose assessments for both humans and non-human species resulting from expected and planned discharges from SZC. These dose assessments have taken into account the unique environmental characteristics of SZC and the combined impacts with the neighbouring SZB power station (in-combinations impacts from SZA have not been included in the assessment output as explained in Section 6).
7	Management Arrangements	The key proposed management arrangements and organisation structure/capability for SZC Co. are summarised and the intention to develop arrangements throughout the lifetime of the project described.
8	Conclusions	This section presents key conclusions of this RSR submission. Presents a future programme of work set out by SZC Co. in order to comply with the RSR permit as required at various phases of the lifetime of SZC.
Appendices		

Section / Document No.	Title	Content
A	Operating Techniques	The following sub documents form a part of this support document: • A.1 - Environment Case; The Environment Case presents the CAE that demonstrate the application of BAT in the production, storage, treatment, monitoring, discharge and disposal or radioactive waste from SZC. • A.2 - Integrated Radioactive Waste Strategy. The Integrated Radioactive Waste Strategy describes the strategy for the management of radioactive waste produced on the SZC site.
B	Disposal of Radioactive Waste	This document (Discharge Limits of Radioactive Waste) provides details of the quantitative estimates of the discharges of gaseous and aqueous radioactive wastes, the arising's of combustible waste and other radioactive wastes based on expected discharge data for normal operations and planned events. Significant radionuclides have been identified as considered relevant to SZC Co. operations and Environment Agency permitting limit categories.
C	Monitoring and Sampling	The following sub documents form a part of this support document: • C.1 - Plant Monitoring This document provides a description of the sampling arrangements, techniques and systems for both the measurement and assessment of discharges and disposals of radioactive wastes and the associated in-process monitoring. • C.2 - Environmental monitoring This document presents the steps involved in setting out the process for development of an environmental monitoring programme.
D	Radiological Assessments	The following sub-documents form a part of this support document: • D.1 - Human Radiological Impact Assessment This document provides detailed Radiological Impact Assessment (RIA) for the gaseous and aqueous discharges, which include a prospective dose assessment at the proposed limits for discharges to the public. • D.2 - Non-Human Biota (NHB) Radiological Impact Assessment This document provides detailed RIAs of the impact of the radioactive discharges on non-human species.

Section / Document No.	Title	Content
E	Management Arrangements	The following documents are included here: • E.1 - Company Manual This includes the requirements of a safety and environmental management prospectus and describes the company structure, governance arrangements and key roles and responsibilities • E.2 - Management System Manual This document describes the structure and layout of the company integrated management system (IMS). • E.3 - RSR Compliance Matrix This document groups the standard permit conditions in themes and outlines the compliance arrangements needed now and in the future to comply with the conditions of the permit.
F	SZC Site Plan	The figures included in this Appendix are as follows: • Interim RSR permitted boundary drawing • Final RSR permitted boundary drawing
G	Abbreviations and Glossary	• Definitions - Building Codes - Systems Codes • Abbreviations • Glossary • Common Units • Unit Prefixes
H	Cross-reference to relevant Environment Agency Guidance and GDA UK EPR™ Documentation	Table used to cross reference the application form requirements to specific sections of the RSR permit application documentation and links to GDA documentation – initially prepared for internal use, however, shared to facilitate Environment Agency determination and public consultation.
I	Application Forms	The application forms completed are as follows: • Part RSR A - About you and your premises • Part RSR B3 - New bespoke radioactive substances activity permit (nuclear site – open sources and radioactive waste) • Part RSR F - Charges and declarations Note: The version of the application forms included for public consultation have had personal data removed for confidentially.

1.7 Summary of the Environment around the SZC Site

25. The following section provides a brief description of the environment around the proposed developed at SZC.

1.7.1 Geographical Location

26. The proposed SZC site would be located on the Suffolk coast, approximately halfway between Felixstowe and Lowestoft within the administrative boundary of East Suffolk Council. The site is north-east of the town of Leiston and north of the village of Sizewell. It lies in the civil parish of Leiston within East Suffolk district (population 248,249 [Office for National Statistics] cited in [Ref 11]).

27. Between 10km and 20km from the site are the towns of Saxmundham, Southwold, Framlingham and Wickham Market, and there are a number of smaller settlements closer to the site. Beyond this, Ipswich, Felixstowe, Lowestoft and Norwich are the closest major population centres.

28. The land to the south of SZC is occupied by two existing nuclear power stations, SZA and SZB (Figure 1-2). SZB is owned and operated by EDF Energy Nuclear Generation Limited, and is expected to operate until at least 2035. SZA is owned by the Nuclear Decommissioning Authority (NDA), an executive non-departmental public body sponsored by BEIS. The SZA site is operated by Magnox Limited, one of the NDA's Site Licence Companies. SZA has permanently ceased generation, all its nuclear fuel has been unloaded and removed from the site and the current NDA strategy expects SZA to enter Care and Maintenance in 2027 [Ref 74].

NOT PROTECTIVELY MARKED

29. The site is bounded to the east by the North Sea, and to the north and west by a mixture of woodland, arable land and marshland. The general setting is rural and the site lies within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB), a UK national statutory designation. Part of the site lies within the Suffolk Heritage Coast and it also includes part of the Sizewell Marshes Site of Special Scientific Interest (SSSI).

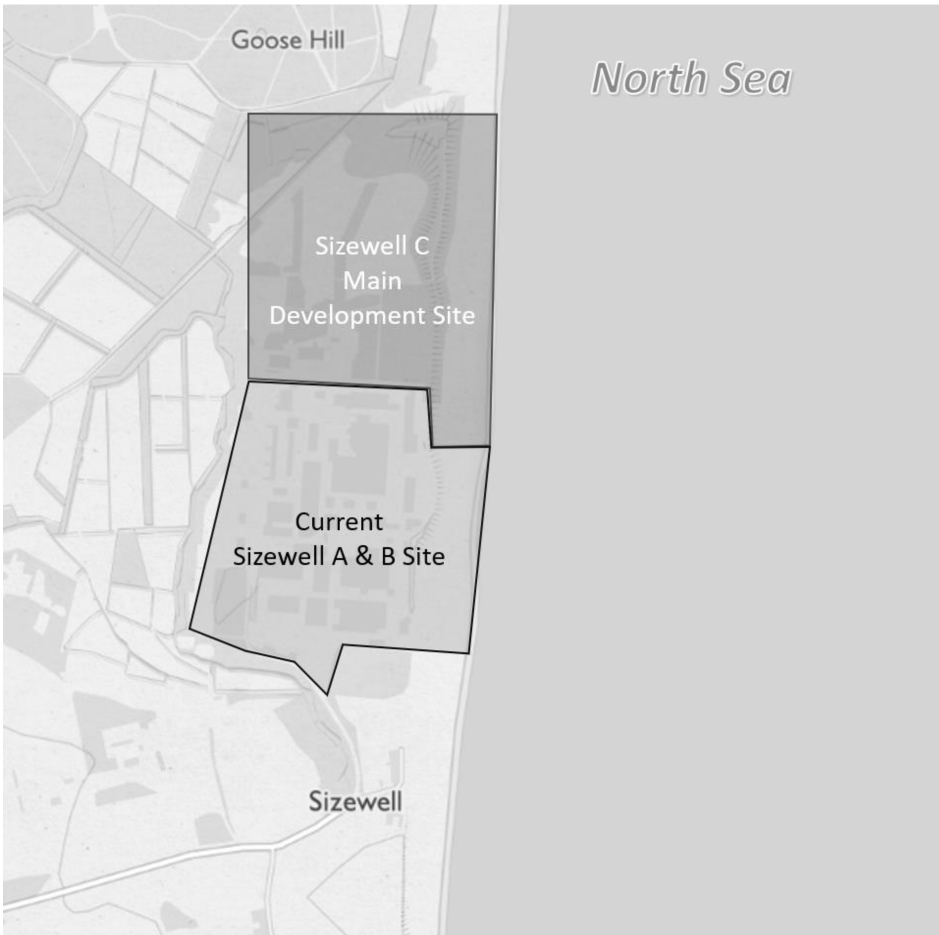


Figure 1-2 Location of SZC in relation to the current Sizewell nuclear sites

30. To the immediate north is the Royal Society for the Protection of Birds (RSPB) Minsmere Reserve which is subject to several habitat designations, including the Minsmere-Walberswick Heaths and Marshes SSSI, Special Protection Area (SPA), Special Area of Conservation and Ramsar Site. To the west is the Sizewell Marshes SSSI, and to the east is the Outer Thames Estuary SPA.

31. These habitats have been considered in the SZC Non-Human Biota Radiological Impact Assessment [Ref 63]. As noted above, this assessment only considered the impact from the operational station, any construction impacts are addressed through the DCO application for SZC.

Land Ownership

32. The land on which SZC will be built is currently owned by EDF Energy Nuclear Generation Limited. SZC Co. is securing legally binding arrangements with EDF Energy Nuclear Generation Limited for the ultimate purchase of the land. These arrangements ensure SZC Co. has control of the land prior to permit issue and in advance of finally purchasing the land which will take place after FID. Notwithstanding this, no activities

will actually be undertaken on the site that relate to the RSR permit in advance of FID and until after land ownership is secured.

33. Part of the proposed SZC site is currently part of the SZB RSR permitted area. This application covers the main portion of the SZC site but excludes the SZB permitted area as presented in Appendix F Figure F-1, the land covered in this RSR permit application is referred to as being within the interim permitted boundary, indicated by the green line. At a future date, SZC Co. and EDF Energy Nuclear Generation Limited will apply for a partial transfer of the SZB permit to SZC to extend the SZC permitted site to include this area of land as presented in Appendix F Figure F-2, this land is referred to as being within the final permitted boundary, indicated by the green line.

Topographical Features

34. The topography of the site is characterised by generally flat countryside surrounded by gently sloping hills. Most of the site area ranges between 0-5m Above Ordnance Datum (AOD), and generally the ground levels gently rise from east to west terminating at a hill on the western boundary which peaks on a hillock at a maximum elevation of 10.0m AOD. The south side is bounded by the SZB site which sits on a plateau at around 6m AOD, and a ridge entering the south east boundary of the site at a peak elevation of 10.4m AOD.

Geological Features

35. The solid geology constituting a competent foundation for the main development site comprises Red Crag, a shelly sandstone which is part of a sequence of crag deposits present along the Norfolk and Suffolk coastline. This is separated from underlying chalk by Palaeogene deposits including London Clay.

36. Both the Red Crag and the underlying chalk are designated as primary aquifers and provide water sources to streams and wetlands. The Palaeogene deposits between are considered to act as a confining layer for the primary aquifer. Peat deposits, which currently exist at the Site, also retain water probably originating from groundwater and surface water sources.

Local demographic features

37. The local council covering the SZC site is East Suffolk Council[1], with approximate population of 248,249 [Office for National Statistics] cited in [Ref 11].

38. Suffolk Coastal is largely rural in nature and has a slightly lower population density compared to Waveney and the averages across Suffolk and the East region of the UK.

39. SZC is located in a rural area with very few industrial developments close to the site. The closest town to the site is Leiston – located approximately 3.5km to the west, and with a population of approximately 5,743 [Office for National Statistics] cited in [Ref 11].

1.7.2 Hydrology

Description of surface water bodies

40. The general hydrological overview is subdivided into the surface water courses and groundwater recharge sub-sections:

[1] On 1st April 2019, the two district councils, Suffolk Coastal and Waveney, joined to form East Suffolk Council.

Surface water courses

41. . There are two main surface water courses that may be affected by the development:

- The Leiston Beck/Drain system, which is located to the west of the SZC site. This includes Leiston Beck and Leiston Drain, Sizewell Drain and IDB Drain No. 7.
- The Minsmere River system, which is located to the north of the SZC site. This includes the Minsmere New Cut and the Minsmere Old River.

Groundwater recharge

42. The principal source of groundwater recharge is infiltration of rainfall, with the bulk of the recharge occurring to the west of the site, approximately 30km inland from the coast. This area, which is a topographic high, provides a driving head resulting in easterly groundwater flow. Low permeability deposits closer to the coast act to limit groundwater recharge. However, where these deposits are absent or have been eroded by, for example, incising of river valleys groundwater recharge from rainfall is greater. The amount of water available for groundwater recharge is also affected by land use.

43. Groundwater and surface water are typically in at least partial hydraulic continuity in the area, with strong hydraulic connection observed in the wetlands around SZC where groundwater provides an important source of baseflow. Surface water also locally provides recharge to groundwater, including in the wetlands, when surface water levels are elevated relative to groundwater.

1.7.3 Description of the littoral area, tides, currents

Intertidal area

44. The intertidal area of the coastline between Lowestoft Ness to the north of SZC and Felixstowe Landguard Point to the south is dominated by sand and shingle [Ref 12]. This theme is evident in the area immediately around Sizewell, from Dunwich Cliffs to Thorpeness, this area having a relatively sandy lower beach with coarser shingle above [Ref 13]. The lower sandy margin tends to represent the landward edge of a series of wave-driven near shore, shore-parallel, sandbars. The area behind the shingle shore is variously dominated either by shallow cliffs or heavily vegetated (i.e. not actively forming) sand dunes.

45. These shores have a high recreation and amenity value, falling within an AONB, and the shore immediately to the north of SZC is backed by the RSPB's Minsmere nature reserve.

Tidal ranges and wave climate

46. The area has a small tidal range, resulting in relatively narrow intertidal areas where waves have a proportionally greater influence. At Sizewell itself, the level of Mean Low Water Springs is 1.09m below Ordnance Datum Newlyn (ODN) and Mean High Water Springs is 1.22m above ODN. Therefore, there is a mean spring tidal range of 2.31m. The local Chart Datum to ODN correction is -1.3m.

1.7.4 Meteorology

47. Meteorological data have been obtained from the UK Met Office for the Sizewell site for the years 2003 to 2012. The wind roses shown below (Figure 1-3) show the frequency distribution of wind speed and direction from which the wind is blowing.

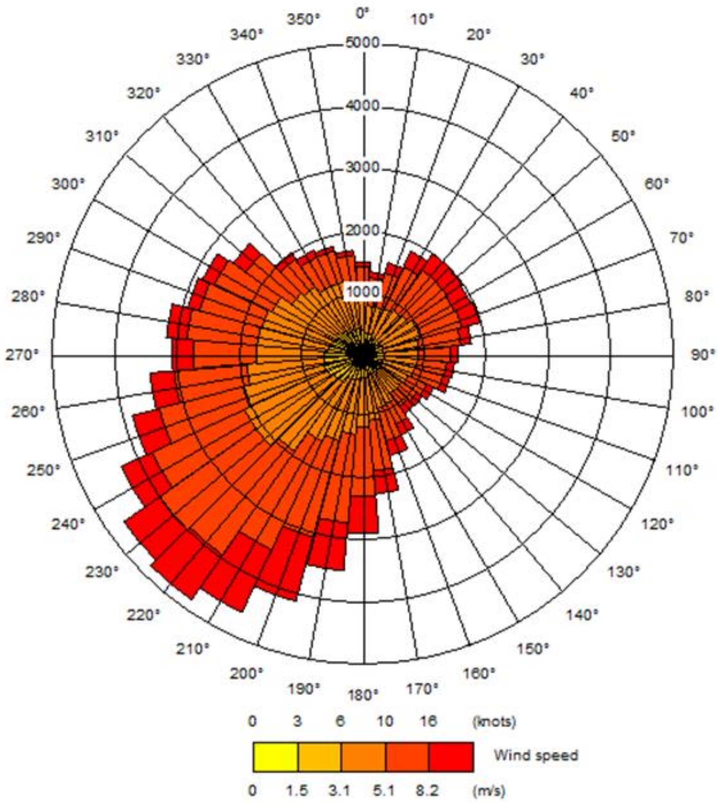


Figure 1-3 Windrose Data for SZC

2 TECHNICAL DESCRIPTION OF ACTIVITIES

2.1 Introduction

48. This section provides the reference design of the UK EPR^{TM} units proposed at SZC, general principles of an UK EPR^{TM} unit, overview structures and systems and operation of the UK EPR^{TM} units having a bearing on radioactive waste. Those site specific design features which are unique to SZC are described in this section. Design changes which have taken place in the design development since GDA have been considered with regards to their impact on the types and quantities of radioactive waste produced are discussed further in Section 2.10.

2.2 Design evolution

2.2.1 EPR™ design

49. The generic EPR™ reactor design developed by Framatome[2] in partnership with EDF is derived from the most recent generations of reactors built in France (N4 reactors) and Germany (KONVOI reactors) and combines the safety experience and knowledge from operating reactors. Such a design has brought together reliable, well-proven technology to provide enhanced safety, environmental protection, technical and economic performance. The generic EPR™ reactor units currently under construction at Flamanville 3 (FA3) in Normandy, France, was the reference design for the UK EPR™. Other EPR™ projects across the world are underway with Olkiluoto 3 (OL3), Finland under construction and Taishan 1 and 2 (recently entering operation in 2019), lessons will be learnt and fed into the learning from experience arrangements in place for the SZC project [SZC RSR CMT 1].

50. EDF operates 58 nuclear plants in France producing about 75% of the country's electrical power demand [Ref 14]. The evolution of the UK EPR™ reactor design has been derived from extensive experience of developing PWR by both EDF, a major utility operator, and Framatome, a key manufacturer. PWRs have evolved over several generations of design since the 1970s in order to meet more stringent safety demands from the regulators, improve performance and increase power output.

51. EDF's approach to evolving the UK EPR™ reactor design has been to develop a standard design through incremental improvement. This process includes enhancing safety, constructability and operational effectiveness, embodying the learning gathered from completed and operational facilities, and from projects under construction. Figure 2-1, below, illustrates a typical layout of a single generic EPR™ reactor unit.

Figure 2-1 EPR™ reference design overview

[2] Previously part of AREVA, 2001-2017, within this context.

2.2.2 GDA UK EPR^{TM} design

52. As requested by the UK Government, following issue of the White Paper on Nuclear power in 2008 [Ref 15], the nuclear regulators in England and Wales set up a new process for assessing acceptability of the generic aspects of new nuclear reactor designs that might be constructed in the UK, such as the UK EPR^{TM}, before site specific applications were made, such as SZC. This process is called the GDA. The UK EPR^{TM} was the first new reactor design to complete the GDA process.

53. The GDA for the UK EPR^{TM} was submitted by AREVA NP (now Framatome) and EDF SA (Electricité de France Société Anonyme), known as the Requesting Party and assessed by the regulators, the ONR covering safety and security, and the Environment Agency covering waste management and environmental protection.

54. The GDA involved a rigorous and structured examination of detailed environmental, safety and security aspects of the reactor design. The assessment was carried out against the regulators' defined principles – including, in the case of ONR, the Safety Assessment Principles (SAPs) [Ref 16], and in that of the EA, the RSR Environmental Principles (REPs) [Ref 17].

55. Following assessment of the UK EPR^{TM}, on the basis that all the GDA Issues identified have been resolved and closed, the ONR and the Environment Agency granted Design Acceptance Confirmation (DAC) [Ref 18] and Statement of Design Acceptability (SoDA) [Ref 2] for the UK EPR^{TM} Reactor Design in December 2012.

56. The regulators identified a number of additional points (known as "GDA Assessment Findings" (GDA AF)) that needed to be resolved, which were either site or operator specific but didn't preclude the ability to expect a licence or permit to be granted. For each GDA AF a plan ("resolution plan") was to be proposed by the operator for resolving each AF and these plans have been considered credible by the regulators in each case. Each GDA AF was mapped against key milestones in the project (i.e. closure needed before commissioning). A number of GDA AFs have already been closed through design development primarily for the HPC site specific design development, which have been incorporated into the reference configuration accepted for SZC. A review has taken place of GDA AF raised by the Environment Agency and the applicability of the resolution plans and closure forms developed for HPC to SZC; this has been summarised in Section 2.10 of this document.

57. The GDA design was for a single unit site with site conditions bounded by those UK sites previously nominated by developers assessed by the UK Government process of Strategic Siting Assessment for new nuclear power stations [Ref 19]. Since the GDA, the design and associated safety and environmental documentation for HPC has developed and a number of further UK and site specific design changes have been made, including incorporation of lessons learnt. The initial design configuration for SZC, known as reference configuration zero (RC0), has adopted the current reference design for HPC, known as reference configuration two (RC2) which is considered fit for commissioning for HPC. A further reference configuration (RC1) will be put in place for SZC prior to the start of detailed engineering delivery and construction, in order to capture all necessary SZC site-specific modifications to the HPC RC2 design.

2.2.3 Justification of Practices Involving Radiation Regulations 2004

58. The Secretary of State made the decision that that the UK EPR^{TM} reactor design is justified, under the Justification of Practices Involving Ionising Radiation Regulations 2004 [Ref 3]. The final justification decision of the UK EPR^{TM} reactor was issued in the form of the Justification Decision (Generation of Electricity by the EPR^{TM} Nuclear Reactors) Regulations 2010 [Ref 20]. SZC Co. will operate SZC within the constraints of the justification decision.

2.2.4 Hinkley Point C design

59. HPC was the first nuclear new build site to be granted the NSL and environmental permits for the operation of a nuclear power station in nearly 20 years. Prior to HPC the last nuclear power station to be granted these licences and permits in the UK was SZB in 1995.

60. The HPC reference design was based on the UK EPR™ reactor unit design at the end of the GDA process, with the addition of site-specific features which were outside GDA scope. It is considered appropriate that the starting design baseline for SZC can be transferred from the current design under construction for HPC for the following reasons:

- The GDA only covered a single unit generic site whereas the HPC site, under construction, is for a twin unit site. SZC is also planned to be a twin unit site. The GDA did not include additional facilities such as the ILW Interim Storage Facility (HHI) or the Interim Spent Fuel Store (HHK).
- Design changes and developments have been implemented in the latest HPC design which have arisen from HPC specific design studies, ongoing learning from experience from FA3 construction and installation phases as well as learning from other external events, such as post-Fukushima resilience enhancements.
- Design changes that have further adapted the design as presented in GDA to take account of detailed UK requirements, including closure of the GDA AFs.
- Detailed design of systems has been undertaken at HPC which is equally applicable at SZC, including integration of supply chain interfaces. This means the design has a greater stage of maturity and design stability.
- Incorporation of site specific hazard studies into the HPC design. GDA only included limited external hazard studies due to its generic nature and this has been extensively developed. In most areas, SZC will demonstrate that the external hazards envelope at HPC continues to apply for SZC. There will be a number of site specific aspects, such as seismic and coastal flooding, where new studies will need to be performed for but the methodologies will remain the same and the approach to protecting against the hazard for SZC is clear.

61. NNB GenCo (HPC) already hold an operational RSR permit, key learning has been incorporated in this RSR application since the NNB GenCo (HPC) RSR permit and NSL granting (in 2012 for NSL and 2013 for RSR). The design changes from GDA to the HPC design have been subject to regulatory scrutiny, from an RSR perspective, as part of the HPC RSR permit application and compliance arrangements.

2.2.5 SZC Design

62. The SZC design has been replicated from HPC. Since the UK EPR™ GDA, design development has continued resulting in an improved design maturity with regards to the site specific UK EPR™ at HPC, therefore the starting point for the SZC design is adopting the mature and stable twin unit UK EPR™ design used as the basis for HPC construction and erection activities. As far as is practical the design of SZC will replicate that of HPC in order to benefit from the design maturity and work already completed to date.

63. A consistent state of the UK EPR™ design process is delivered using the concept of RCs. The most recent reference configuration for HPC is RC2, which includes a list of all design changes to support implementation and related studies, including hazard and fault studies, to deliver consistent state 2 (CS2) for HPC. CS2 will be the frozen HPC design, to be used up to commissioning, following on from the implementation of the design changes associated with RC2, integration of supply chain feedback and

closure of necessary GDA AFs. CS2 will be adopted by SZC Co. as it is formed as the consistent state replication baseline for SZC.

64. In order to maintain consistency between the HPC and SZC designs, the initial reference configuration for the SZC project is based on RC2 for HPC, known for SZC as RC0. As a result, all system, structure and component codes are retained between HPC and SZC. A review of the applicability of the design into SZC has been undertaken, where appropriate BAT justification of the SZC design will rely on available evidence from the HPC project, where there are no site-specific impacts, and there have been no significant changes to the design. A second reference configuration is planned for SZC (RC1) to capture all changes to the SZC RC0 design as a result of SZC site-specificities and to allow incorporation, as appropriate, of ongoing HPC design changes and development. These will be subject to a formal design change process by SZC Co. and will be suitably screened for environmental impact/impact on permit compliance, it is expected that only mandatory site-specific changes or those resulting in a significant benefit will be incorporated in order to ensure transferable learning and practice between HPC and SZC as a series of UK EPR™ stations.

65. It is recognised that over time, further learning and improved practices will be identified, as more operational UK EPR™ Operational Experience Feedback (OEF) becomes available, SZC Co. will review and incorporate any information as considered applicable [SZC RSR CMT 1].

66. Further details of the replication strategy for SZC are summarised below.

2.2.6 Replication Strategy

67. A systematic approach of replication has been developed, this is in line with "The ETI Nuclear Cost Drivers Project: Summary Report" dated 20 April 2018:

- Maximise the series approach to build a series of UK EPR™ Units;
- Maintain a common approach to the safety case on several Units providing a high level of control of requirements and predictability;
- Maximise the maturity of design by using execution design of the construction of the First of a Kind (FOAK);
- Maximise the efficiency of the supply chain already experienced with the plant design; and
- Maximise the efficiency during the construction and commissioning by implementing lessons learned from the previous units.

68. The SZC work to date has been initiated based on the most mature documentation available from HPC; RC2 but will ultimately inherit CS2 studies from HPC as they become available (the result of the implementation of HPC RC2, i.e. CS2)

- Considering the gap between HPC and SZC, the most advanced and relevant detailed design considered for SZC is the design delivered for the execution of the construction and erection phases at HPC (RC2). With the exception of site-specific design changes, this can be directly transferred to SZC, as described in Section 2.
- This replicated HPC design will benefit from the suppliers' feedback, interfaces will be stabilised and complete, the safety case very mature and fully compliant with the regulator's requirements.
- The approach limits the risk of snowball effects linked with the complexity of the Nuclear Power Plant. It is highly predictable and allows teams to focus on the lessons learned.

69. Key project assumptions:

- The safety case will be owned and produced by SZC Co., as the Nuclear Site Licensee. The safety case requirements and demonstration that risk is managed to As Low As Reasonably Practicable (ALARP) for HPC, are assumed to be applicable by default to SZC for replicated buildings. All the design inherited from HPC will be compliant with this safety case. There is a common approach to the nuclear safety design assessment principles which also include the environmental considerations affecting the radioactive substance activities [Ref 16]. There is not expected to be new challenges from the regulator for the replicated buildings, as the strategy is to maintain the FOAK design and substantiate that the design is still compliant with the SZC site conditions. The SZC PCSR will use the HPC PCmSR (or if the schedule demands, an earlier evolution) as its reference.
- The UK EPR™ series effect considers that the timing gap between the HPC and SZC projects will be short enough to maintain the applicability of all the codes and standards applied during the design, manufacturing and construction of HPC. Justification will be provided, where appropriate, to demonstrate that any evolutions in codes and standards is insignificant with respect nuclear safety.
- SZC thermal power level and the associated operating principles of the Units are the same as the HPC technical specification of the Nuclear Steam Supply System (NSSS).
- The electrical power output, along with the requirements, interfaces, scope and the associated operating principles of the Turbine Group defined in the HPC technical specification of the Turbine Group are fully maintained.
- The baseline will be maintained for the sequence of construction: considering the same plot plan for replicated buildings and maintained locations, 2-unit site with a 12 months' gap for construction between the units.
- Review and Acceptance (R&A) of design documentation, qualification of equipment, manufacturing processes and supplier qualification does not have to be repeated for replicated scope.
- SZC Site conditions are assumed to have limited impact on the HPC design (specifically the radioactive substance activities related design aspects). SZC site data are assumed to be bounded by HPC site data, where there are site changes, it is planned to modify the construction / enabling works phase to maintain the design for permanent construction where reasonable, as discussed above except for key site specific areas where re design is required, this is discussed further in Section 2.6.
- The supply chain can be fully replicated from HPC, including procurement of equipment.

70. Where elements of these assumptions are proven not to be valid, SZC-specific Design Changes may be included in RC1 to adapt the HPC design.

- To maximize the Next of a Kind (NOAK) effect in terms of engineering rework, R&A of the documentation, qualification of equipment, manufacturing process and qualification of supplier, the Tier 1 supply chain, but also the Tier 2 supply chain is intended to be maintained.

71. Key principles:

- The content of the HPC CS2 (detailed engineering design resulting in the implementation of HPC RC2) is considered as mature, compliant with relevant regulations, and constructible. It is not expected that further specific changes will be made for SZC unless required by site specific constraints, this seeks to ensure consistency and that the benefits of a consistent UK EPR™ series design are established.

- Manage and control the design configuration in order to minimise the differences in scope of documentation and data which will be applicable on both sites.

72. Where these principles may be challenged, they will be treated with a high level of scrutiny to protect the replication benefits and minimise the risk of rework and impact to schedule. This is conducted through strict governance over any deviation from the replication baseline (SZC RC0) to justify changes. The areas where challenge may be expected are:

- Adaptation of the design to accommodate SZC site-specific characteristics which are not bounded by the HPC values;
- Unavoidable change in the equipment provided by the supply chain;
- Adaptation of the design due to unavoidable change in the construction methods resulting from the different sit constraints; and
- Difference in regulatory expectations for implementing changes due to the difference in phases between the HPC and SZC projects.

73. The replication strategy applies not only to the design but also supply chain management, by building on the experience and learning developed from contractors working on HPC, organisational development and management arrangements (this is further explained in Section 6).

74. The justification for the replication of the HPC design as far as reasonably practicable is based on the benefit gained by a stable and mature design, which has been demonstrated as constructible at HPC. Nuclear power stations are very complex with multiple barriers to prevent and minimise radioactive waste generation, abate and treat waste to reduce discharges to the environment and mitigate the probability and consequences of unplanned events. The complex and intricate interrelationship between structures, systems and components (SSC) means that even small changes need to be carefully scrutinised and analysed to ensure that perceived benefits do not have unintended consequences that can outweigh any improvement. This process must also consider the impact of any change if it is inadequately conceived or implemented.

75. In Section 5 and supporting documents D1 and D2, it is demonstrated that the impacts from routine radiological discharges are very low and well below all regulatory dose limits and constraints. They are close to the point where internationally recognised organisations such as the United Nations International Atomic Energy Agency (IAEA) would consider the dose to be "*below regulatory concern*" [Ref 21].

76. The legal requirement defined in the Environmental Permitting Regulations is to ensure doses are kept ALARA. This is implemented through the application of BAT. BAT has to balance benefits and detriments to achieve the optimum solution to keep radiological impacts ALARA. In doing this BAT has to take due cognisance of cost in its considerations. Therefore, given the huge amount of work already completed as part of the detailed design for HPC to meet the exacting requirements specified in the UK and the very low radiological impacts associated with the operation it is considered BAT to replicate the HPC design at SZC So Far As Is Reasonably practicable (SFAIRP). This offers significant savings in the construction cost of SZC which is crucial in enabling low-carbon electricity that can help tackle climate change at a competitive price for consumers.

77. This same argument equally applies to replication of the supply chain, which enables the transfer of skills, learning and detailed design to the construction, manufacturing and installation of equipment. Moreover,

the replication of tested management arrangements from HPC to SZC enables learning to be transferred to SZC resulting in safer and more effective and efficient processes.

78. The replication approach will also enable savings to be made at decommissioning, lessons will be able to be learnt from HPC and applied to SZC.

79. Furthermore, the SZC design can take benefit from the previous safety and environmental assessments and regulatory oversight taken place to date to develop the maturity of the HPC design, beyond the GDA. SZC Co. will also benefit from OEF gained by NNB GenCo (HPC) through commissioning and the applicability of these lessons is maximised by the replicated design. This is considered to enhance safety and environmental protection applicable learning. A full characterisation of the SZC site data is being undertaken, as part of nuclear site licensing, to assess any potential impact of the SZC site conditions on the design. It is understood that the SZC site conditions, will require some design modifications for some of the conventional cooling aspects of design, the main nuclear design can be replicated without change. As such from a radioactive substance activity point of view the designs are identical, subject to the operating regime. As explained in Section 2.6 below, the site plot plan has been adapted from that of the HPC plan, although the relative positions of the main Nuclear Island (NI) and Conventional Island (CI) buildings has been retained, in order to maximise the degree of replication expected.

80. As with any major engineering construction project, changes will inevitably occur throughout the development programme for SZC. It will be essential to assess any changes to determine the implications on environmental performance and to identify opportunities to further enhance positive impacts and mitigate any negative impacts whilst maintaining the replication strategy principles. Robust change management process will further contribute to the demonstration of BAT. The management arrangements section of this document describes the systems and processes in place to ensure control of the design.

2.3 Sizewell C Lifecycle Phases

The proposed SZC Project will be undertaken in a number of key phases as listed in Table 2-1 and described further below. As described within Section 7, Management Arrangements, each phase undertakes different activities and therefore will require different arrangements to ensure compliance to the RSR permit. To this effect, different permit conditions and arrangements are expected to be required in different phases. SZC Co. will ensure the organisation is ready to undertake each phase of activity in advance, as described in Section 7 and also set out per phase within the RSR Compliance Matrix [Ref 70].

Table 2-1 SZC Project Phases

Project Phase	Key Milestone
Pre-construction	Commence significant preliminary works on-site (Earthworks)
Construction	First Nuclear Safety Concrete
Non-active Commissioning	Start of non-active commissioning
Active Commissioning	Start of radioactive commissioning First nuclear fuel delivery on-site

Project Phase	Key Milestone
	First Criticality
Operation	Start of commercial operations
Decommissioning and Site Restoration	Permanent shutdown of reactors

2.3.1 Pre-construction Phase

81. This project phase involves undertaking an assessment of the HPC design for suitability and acceptability for SZC, the design considered here was HPC RC2 and included the full SSC, as well as the site layout plan. The purpose of the pre-construction phase to produce a detailed design of SSC making up the SZC UK EPR^{TM} to ensure that they will perform their required functions, for SZC this has followed the replication strategy. Detailed design typically concludes with a design freeze followed by the generation of specifications for manufacture (with further design if necessary) and subsequent agreement by key stakeholders to move forward to the construction phase of the project. It is expected that following receipt of necessary operational permits and licences for SZC, the engineering consistent state will be updated for SZC for the construction phases.

82. It is not anticipated that radioactive waste will be produced during this phase, although the decisions taken with regard to design and operational strategies will have an impact on radioactive waste generated during all subsequent phases. As described above the starting SZC design has been adopted from HPC which has already undertaken significant detailed design, it is expected that further detailed design will take place for both HPC and SZC, including site specific details, and the management arrangements in place for SZC to manage and control the design will ensure these are appropriately incorporated to the final SZC reference configuration (RC1).

83. This phase also includes the development of the project for future phases with regards to the application of necessary consents, permits and licences as required for the construction and operation of the site. This development phase enables the organisation to put arrangements in place, such as procurement, organisational capability and learning, to facilitate future phases. Further details of the management arrangements needed during the Pre-Construction phase relevant to the RSR permit are described in Section 7.

84. The activities taking place during pre-construction include significant preliminary works on-site (Earthworks), such as start of levelling of the site and preparation of the construction platforms. This will be the first significant works on-site, SZC Co. must ensure the correct arrangements and permits are in place before starting work.

2.3.2 Construction Phase

85. This phase will commence after the site preparation works and includes the construction of structures and the manufacture and installation of components. Many of the structures and components will be manufactured and/or constructed at locations remote from SZC. SZC Co. will undertake surveillance to ensure the quality of the equipment meets the specified requirements. Arrangements will be in place to preserve and maintain equipment brought to site and installed prior to commissioning (see FWP in Section 8.2).

86. It is not anticipated that radioactive waste will be produced during this phase. However, should any radioactive contaminated land be discovered, this is dealt with by the HPC Management Contaminated Land procedure, this will be reviewed, adopted and accepted for implementation into SZC before work starts on site (see FWP in Section 8.2). Non-radioactive wastes generated during the construction phase will be disposed of in accordance with relevant regulatory requirements.

87. Radioactive sealed sources will be bought on to site by contractors to undertake non-destructive testing. These sealed sources require a mobile source permit which the contractor will hold. The transport, use and ultimate disposal of the sealed sources will be managed under the contractors' arrangements, including responding to any unplanned events (noting the risk of a contamination event is very small due to the robust nature of the sources and the methods of use). SZC Co. will have arrangements in place to ensure only suitably permitted sources and reputable organisations work on the SZC site.

88. It is anticipated that construction, and following phases, for Unit 1 will start first followed by Unit 2 with an expected lag of 12 months.

2.3.3 Commissioning Phase

89. This phase of the project involves a thorough programme of testing to demonstrate as far as it is practicable to do so that the reactor plant, as built and including all components and systems, is capable of both safe and reliable operation in accordance with its design specification, performance objectives and safety environmental requirements. The relevant management arrangements will be reviewed, adopted and implemented within the identified relevant phases (or part 1), see FWP in Section 8.2. The commissioning of the reactor comprises two phases:

- Non-active Commissioning: This includes both systems and components and their functional testing. Functional testing by pressure testing and examinations of those components of nuclear safety significance ensures that the reactor is safely operable under full temperature and pressure conditions, albeit without fuel. These tests are completed before fuel is loaded into the reactor.
- Radioactive (Active) Commissioning: This phase of commissioning commences with fuel delivery and involves the active commissioning of the reactor components, e.g. testing the fuel storage systems before fuel loading, loading of the fuel into the reactor vessel, initial criticality and power ascension testing. During power ascension testing the reactor is progressively increased in power and the operational and safety performance is verified. This phase will generate waste and effluent of the same nature as those generated during the operational phase.

2.3.4 Operational Phase

90. During this phase the reactor is at operating power and on load. Each UK EPR^{TM} reactor unit has an operational design lifetime of approximately 60 years. Spent fuel will be initially stored in the ponds inside the Fuel Building (HK) before transfer to the HHK. The UK EPR^{TM} reactor design is such that once the fuel is loaded in the reactor core, the reactor can operate at full power continuously in a "fuel cycle" of approximately 18-22 months.

2.3.5 Decommissioning & Site Restoration Phase

91. This phase commences after permanent shutdown of the reactors at the site. The Decommissioning Strategy to be employed at SZC would be "early site clearance", which essentially mean that decommissioning would commence as soon as practicable after End of Generation (EoG) at the site and

would proceed without delay to complete the decommissioning process of the site. High level decommissioning plans for SZC estimate that the decommissioning of the site could be achieved approximately 25 years after the permanent shutdown of the reactors, with the exception of the HHI and HHK, which could be kept in operation after SZC is decommissioned until such a time the Geological Disposal Facility (GDF) is available.

92. The current assumption for completion of the decommissioning process is the complete radiological clearance and de-licensing of the site. De-licensing will run in parallel with the environmental permit surrender process. NNB GenCo (HPC) has produced a strategy for implementation of the Guidance on the Requirements for Release from Radioactive Substances (GRR) into the HPC RSR permit [Ref 22]. SZC Co. will review the plan and arrangements developed by NNB GenCo (HPC) and seek to learn from their experience in developing its own site specific requirements (see FWP in Section 8.2).

2.4 Pressurised Water Reactor

2.4.1 Nature and purpose

93. At the centre of the UK EPR™ is the reactor core capable of producing a thermal output of 4,500MW_{th} from a controlled fission reaction contained within a thick-walled steel pressure vessel. The thermal power is transferred into steam which operates turbo generator with a net electrical output of about 1,670MW_e. The operation of the UK EPR™, as a PWR is based on a primary system, a secondary system and cooling system.

94. The UK EPR™, a PWR, incorporates technology from French N4 and German KONVOI reactors. Two EPR™ units are proposed to be constructed on the SZC site of approximately 1670MW_e each, cooled through an open system which works broadly in the same way as other PWR's already in operation. As the chosen model, the third generation EPR™ offers improvements to the first and second generation reactors currently in operation in Europe. Examples of these improvements are presented in the following sections.

95. The principle on which a nuclear power plant operates is very similar to that of a conventional power station: the boiler that burns fossil fuel is replaced by the nuclear reactor, where the heat produced comes from the fission of fuel nuclei.

96. The heat produced converts water into steam which is used to rotate a turbine, driving the Alternating Current generator and producing electricity. Between the heat source (the nuclear fuel) and the heat sink (the sea), a PWR has three separate systems which are physically separated to provide additional barriers of protection, as shown in :

- The primary system extracts the heat produced by the fuel in the reactor;
- The secondary system uses this heat to convert water into steam for the turbine; and
- The cooling system condenses the steam released into the turbine.

2.4.2 Primary System

97. This is a closed system water-filled pressurised system installed in a leak tight concrete enclosure, the reactor building (HR). It comprises a reactor, namely a steel vessel contacting the nuclear fuel (reactor core) and four cooling loops, each containing a reactor coolant pump and a steam generator. The heat produced by the nuclear reaction inside the reactor vessel is extracted with pressurised water which circulates in the

primary system. The heated water then passes through the steam generator. Here the heat is transferred to the water of the secondary system which flows between the steam generators tube.

2.4.3 Secondary system

98. This is also described as a closed loop system which is independent of the primary system. It supplies steam to the turbo generator set located in the turbine hall (HM). Water in the system evaporates in the steam generators heated by the primary system water. The steam drives a turbine coupled to the generator which produces electrical energy. After leaving the turbine, steam is cooled and returned to its liquid state in the condenser and then returned to the steam generator. The efficiency of the UK EPR^{TM} turbine generator set is planned to exceed that of current PWR plants within the EDF PWR fleet.

2.4.4 Cooling System

99. The condenser is itself continuously cooled by water circulating in a third system, it is independent and isolated from the primary and secondary systems. It cools the condenser by circulating sea water; the plant cooling system. This comprises:

- The seawater intake tunnel;
- The pumping station (HPX) that filters and pumps the sea water and sends it to the condenser; and
- An outfall pond which releases cooling water back into the sea by means of an overflow and an underwater tunnel, ending in a diffuser which is anchored to the seabed.

100. SZC will operate an open cooling system. An open cooling system refers to circulating water which is directly drawn from and discharged into the sea. The SZC condensers will be directly cooled by sea water from the North Sea. At no point does this open cooling system have the potential to come into contact with the radioactivity which exists within the Primary System.

2.4.5 Power generation and operation

101. The electricity from the generator is stepped-up to high voltage (400kV) via transformers before being exported on EDF Energy overhead lines to the National Grid substation which connects the generation output to the National Grid transmission system as shown in below for the electricity generating process of a PWR.

102. The proposed new nuclear power station at SZC has been designed for 60 years of operation. It makes more efficient use of its fuel than current PWR designs. This has the benefit of reducing the quantities of radioactive spent fuel for a given energy produced. During the operational phase of SZC radioactive waste from the UK EPR^{TM} reactor will arise in solid, aqueous and gaseous form. A full description of those UK EPR^{TM} systems which result in the production of radioactive wastes is summarised in Section 2.9. It is noted that systems and plants have been designed and are planned to be operated using BAT to ensure a minimisation in the production of aqueous and gaseous discharges and to ensure the environmental impact resulting from release of activity into the environment is reduced to levels which are ALARA.

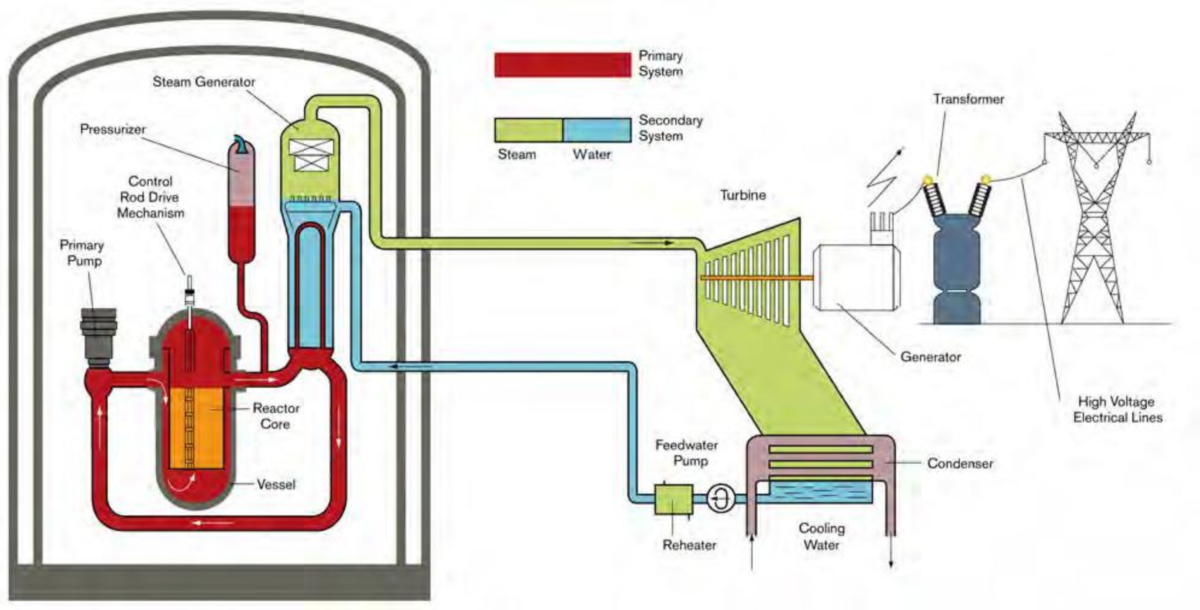


Figure 2-2 Schematic layout of the EPR™ power generation process

2.5 Sizewell C Site

103. As described above, the SZC site is in Suffolk on the east coast of England, and it sits alongside an operating EDF Energy PWR nuclear power station, SZB, as well as an older nuclear power station which is currently undergoing decommissioning, SZA.

2.6 SZC Site layout

2.6.1 Layout of facilities at SZC

104. The layout and design of SZC has taken into consideration a number of options and constraints including:

- Nuclear and conventional safety and security measures;
- Environmental risk and radiological protection;
- Adequate spacing between the reactor buildings and turbine hall to facilitate construction and operation;
- Provision of an open circuit main cooling system;
- On-site spent fuel storage and ILW storage for two UK EPR™ reactor units;
- Energy transmission infrastructure from the Energy Platform to the National Grid 400 kV substation; and
- An Operational Service Centre (HBX) to be located between the two units.

105. A Justification of Site Suitability Report is being produced to support the NSL application, supporting the site conditions at SZC such as with regards to sizing and layout of the plot plan. The layout of the key building

groupings at SZC, including the NI and CI, is largely the same as HPC, taking advantage of the design development and refinement already undertaken for that project but recognising SZC is a different site than HPC The SZC layout optimisation is described below.

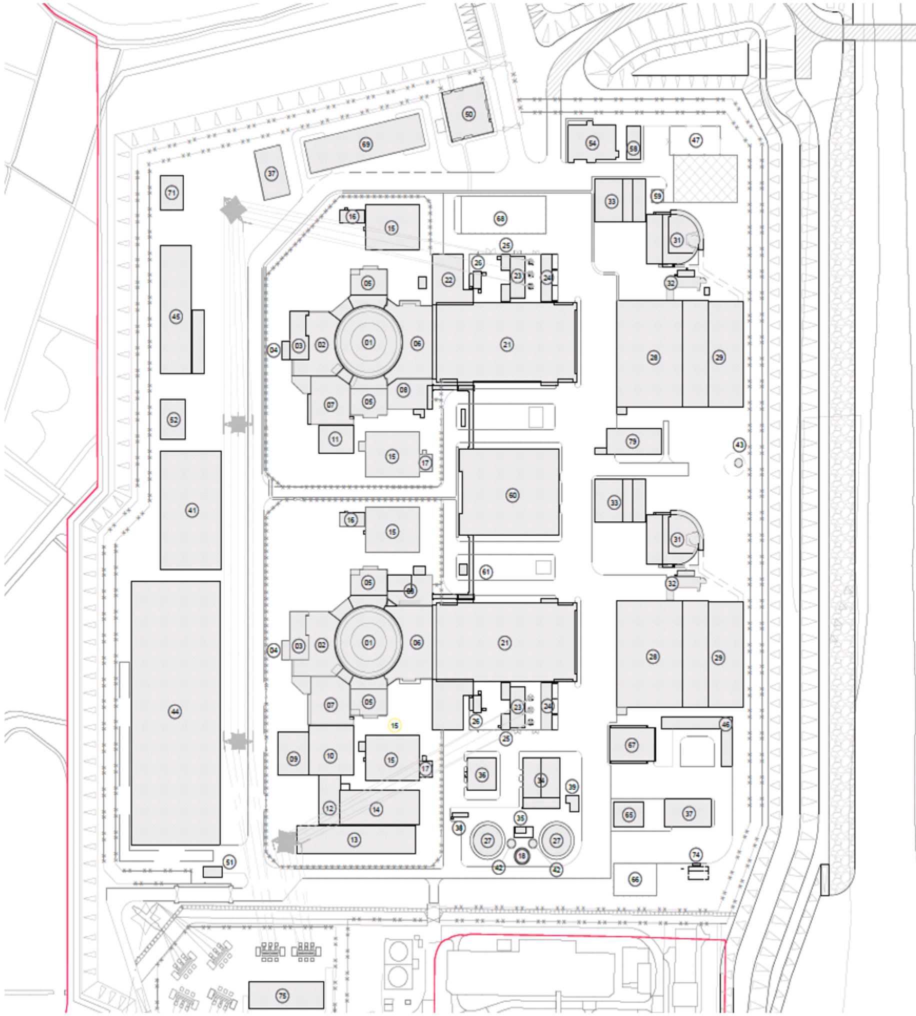
2.6.2 Unit positioning

106. The first UK EPR™ reactor unit to be built at SZC is referred to as Unit 1 and the second as Unit 2. The respective positioning of Units 1 and 2, with Unit 1 to the South, has been developed based upon rationale of simplification of the construction sequence, allowing construction of common facilities required to support both units being built with Unit 1 first. The layouts have been adjusted to correspond with construction sequence drawings. In the second phase of the works, the construction traffic from Unit 2 across Unit 1 operational area will be minimised.

107. All common facilities required for plant operation are linked with the construction of Unit 1, e.g. Effluent Treatment Buildings (HQA/HQB), Hot Workshops, etc. This will allow Unit 1 to operate and meet all safety and licensing criteria independently of Unit 2 completion. Figure 1-2 illustrates how the units are positioned at SZC alongside the neighbouring SZB site.

108. The proposed SZC site layout plan is shown in Figure 2-3. The HPC and SZC site layout plans are different, the SZC permanent site is smaller and of a different shape to HPC and therefore, facilities have been organised to fit the site, however the NI is unchanged in size and configuration. The arrangement of facilities for SZC have been assessed and are considered to be the best configuration given the constraints imposed by the site.

109. As with the HPC design the HHI and HHK will continue operation beyond the life of the rest of the site and therefore are located in a position where the rest of the site can be decommissioned, and the site boundary (and associated permits and licences) can be reduced. This is planned to enable the release of land for re-use and ensure only the land necessary for longer term storage is subject to the necessary regulation. The size and shape of these stores has been modified from the HPC site layout due to the available space, however, this does not change the function of the Structures, Systems or Components.



Ref:	Building	Ref:	Building
	Nuclear Island		**Ancillary Buildings - Plant/Office/Access/ Storage/Fuel & Waste Management**
01	Reactor Building	34	Demineralisation Station
02	Fuel Building	35	Valve Room for Demineralisation Station
03	Fuel Building Hall	36	Auxiliary Boilers
04	Boron Storage Building	37	Hydrogen Storage
05	Safeguard Elec Building	38	Oxygen Storage
06	Safeguard Mech Building	39	Hydrazine Storage
07	Nuclear Auxiliary Building	41	Raw & Potable Water Storage/Supply
08	Access Tower	42	Degassed Water Storage Tank
09	Radioactive Waste Storage Building	43	Marine Works Outfall Structure
10	Radioactive Waste Process Building	79	Chloronation Plant Tank
11	Radioactive Waste Treatment Building (Unit 2)	44	Interim Spent Fuel Store
12	Hot Laundry Building	45	Intermediate Level Waste Interim Storage Facility
13	Hot Workshop, Hot Warehouse, Facilities For Decontamination	46	Conventional Waste Store
14	Effluent Tanks & Refuelling Water Storage Tanks	47	Transit Area for Very Low & Low Level Waste
15	Emergency Diesel Generator Buildings	50	Main Access Control Building
16	Cooling Water Discharge Weir Buildings - Div 1	51	Secondary Access Control Building
17	Cooling Water Discharge Weir Buildings - Div 2	52	Auxiliary Administration Building
18	Nuclear Island Demineralised Water Tank	54	Emergency Response Centre
		58	Emergency Response Energy Centre
	Conventional Island	59	Meteorological Station
21	Turbine Hall	65	Chemical Products Storage
22	Conventional Island Electrical Building	66	Garage for Handling Facilities
23	Gas Insulated Switch Gear Building	67	Oil & Grease Storage
24	Main Transformer Platform	68	Contaminated Tools Store
25	Unit Transformer Platform	69	Warehouse
26	Auxiliary Transformer Platform	71	Equipment Store for Interim Spent Fuel Store
27	Conventional Island Demineralised Water Tank	74	Sewage Treatment Plant
	Operational	75	National Grid Substation Building
60	Operational Service Centre	53	Off-Site Delivery Checkpoint
61	Sky Bridge	70	Emergency Equipment Store
	Cooling Water Pumphouse & Associated Buildings	76	Back-Up Generator
28	Cooling Water Pump House	77	Ancillary Substation Compound
29	Forebay		
31	Outfall Pond Building		
32	Filtering Debris Recovery Pit		
33	Fire-Fighting Water Building		

Figure 2-3 SZC proposed site layout

110. Figure 2-4 shows the buildings subject to replication from HPC - building on SZC with design replicated from HPC shown in green while site specific buildings are identified in orange. This shows that the SZC NI, the facilities where the generation of radioactive waste, its treatment, storage and monitoring takes place, are identical to HPC. The key SZC specific aspects of the design relate to:

- The heat sink part of the cooling water pumping stations and marine work infrastructure, which due to site specific nature (i.e. tidal patterns) requires some redesign from HPC, there is no impact to the NI; and
- The size and shape of HHI and HHK has been modified from the HPC site layout due to the available space, however, this does not change the function of the structures, systems or components; and
- The NI stack height, this is site specific and calculated based on the local dispersion of airborne material. For SZC the assessment resulted in the same stack height as used at HPC, therefore, this did not actually impact the design.

111. The site specific changes to the plot plan do not impact the radioactive substance activities being applied for in this permit application.

112. It is noted that the site layout for SZC is not final and there may be further minor alterations as the detailed design for SZC develops.

Figure 2-4 Building on the SZC with design replicated from HPC

2.7 Overview of SZC buildings and associated facilities

113. This chapter provides a description of the proposed SZC permanent development including the general site layout, and key buildings. It provides an overview of the permanent development physical characteristics and functions within the SZC main development site, including the area the offshore marine infrastructure will sit in, see Figure 2-5.

114. It is noted that additional facilities will be required during the construction of SZC, however, these facilities are not relevant to this permit application and will be covered by construction specific environmental permit applications and consents at the appropriate time.

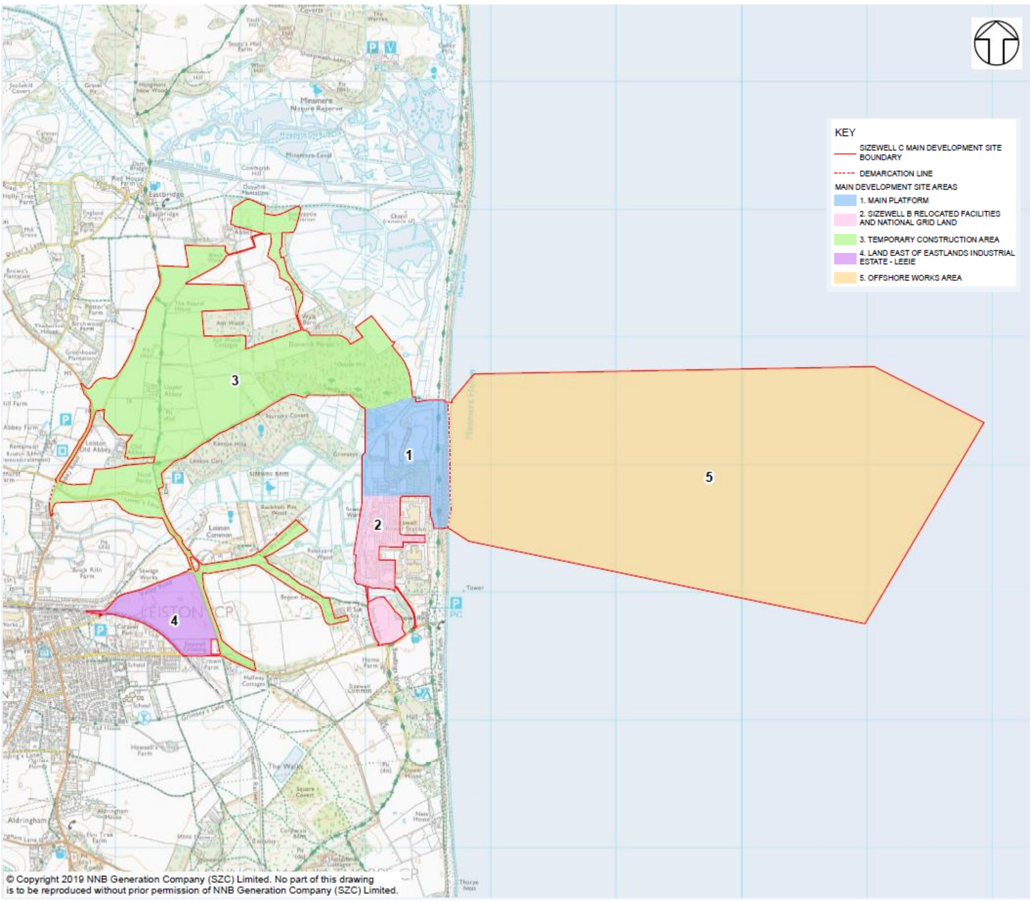


Figure 2-5 Main Development Site

2.7.1 List of main structures

115. SZC will consist of two UK EPR™ reactor units, each with ancillary systems and common buildings and facilities.

116. As explained above, the GDA presented a single EPR™ unit, whereas SZC is planned to be a twin unit site with some facilities being shared between the units.

117. Table 2-2 lists the main structures for SZC from an RSR permit perspective and provides a high-level description as to where the design has come from:

- UK EPR™ Standard Structures – a standard structure within a generic UK EPR™ as was assessed through GDA;
- SZC Structures – a HPC site specific design development, following GDA, which has been reviewed for SZC acceptability and has been adopted directly into SZC; or
- Shared Structures – Only one shared facility for the twin unit site.

Table 2-2 SZC List of Main Structures

Main Structures	Code	HPC Standard Structures	SZC Site Specific Structures	Shared Facilities
Nuclear Island and Extensions				
Reactor Building	HR	✓		
Four Safeguard Buildings	HL	✓		
Fuel Building	HK	✓		
Nuclear Auxiliary Building	HN	✓		
Radioactive Active Waste Storage/Process Building (for radioactive waste treatment of Units 1 and 2)	HQA*/HQB*	✓		✓
Radioactive Waste Treatment Building of Unit 2 (transfer of radioactive waste from Unit 2 to Effluent Treatment Building)	HQC*		✓	
Access Tower	HW	✓		
Emergency Diesel Generator Buildings	HDX	✓		
Cooling Water Discharge Weir Building (Division 1/Division 2)	HCW/HCZ		✓	
Discharge Tanks Building (Discharge Tanks of the KER, TER and SEK)	HXA		✓	✓
Hot Workshop, Hot Warehouse and Facilities for Decontamination	HVD		✓	✓
Hot Laundry	HVL			✓
Conventional Island				
Turbine Hall	HM	✓		
Conventional Island Electrical Building	HF	✓		
Auxiliary Transformer Platform	HJA	✓		
Balance of Plant				
Galleries	Various		✓	
Pumping Station	HPX	✓		
Forebay	HPF		✓	
Intake Tunnel Heads	HPT		✓	
Fish Recovery and Return Outfall	HCF		✓	
Outfall Pond Buildings	HCA	✓		
Outfall Tunnel Heads	HCT	✓		✓
Filtering Debris Recovery Pit	HCB		✓	
Demineralisation Station	HY		✓	✓

Main Structures	Code	HPC Standard Structures	SZC Site Specific Structures	Shared Facilities
Fire-Fighting Water Distribution Building	HOJ	✓		
Hydrogen, Nitrogen and Oxygen Storage	HZH/ HZO		✓	✓
Chemical Products Storage	HZC	✓		
Buildings related to spent fuel and ILW storage				
Interim Spent Fuel Store	HHK		✓	✓
Intermediate Level Waste Store	HHI		✓	✓
Ancillary Buildings/Areas				
Operational Service Centre	HBX	✓		✓
Auxiliary Administration Building	HUD		✓	✓

*For the purposes of the structure descriptions the HQA/B/C buildings are referred to as the Effluent Treatment Buildings

2.7.2 Description of structures of each unit

118. As for many other PWRs, the design of SZC physically separates nuclear facilities from non-nuclear facilities, as far as practicable, in order to minimise radiation doses to workers and minimise radioactive waste associated with routine operations. The design is thus based on two main components, namely the NI and the CI. The SZC layout locates the HR at the centre of the NI, which houses the main equipment of the NSSS.

119. The structures described below are considered relevant to RSR activities.

2.7.2.1 Nuclear Island Structures

Reactor Building (HR)

120. The Reactor Building (HR) contains the primary system along with other SSC such as accumulator, safety injection system, support pipework, valves, and refuelling water storage reservoir. Irradiated fuel, outside of the reactor, may also be present during fuel movement operations. The elements that make up the primary system are the reactor vessel, the pressuriser, four heat transfer loops, each with a steam generator and a primary coolant pump and the connecting pipework.

121. The building is the third barrier protecting the public against the effects of an accident (the first is the cladding around the fuel and the second is the primary circuit structures). The concrete shield wall surrounding the primary system protects the containment from accidentally generated projectiles and reduces radiation levels in the areas surrounding the primary loops.

122. In normal operation, this building protects the reactor cooling system against external events and attenuates radiation from the reactor core. In abnormal or accident conditions7, the HR provides containment and limits the radiological consequences at the site boundary. At power there are high neutron and radiation fields adjacent to unshielded parts of reactor and pipework.

123. The HR, the Safeguard Buildings (HL) and the HK share the same foundation raft. This minimises the relative movement of the buildings in the event of an earthquake. They are also designed to withstand the effects of shock waves (from an external explosion).

124. The HR consists of an external framework, known as the containment, and internal structures. The containment is designed to withstand internal accidents involving the steam supply system, as well as external damage from natural and manmade causes.

125. The containment consists of:

- An inner chamber of pre-stressed concrete, which is pressure-resistant in the case of an accident, has a metal liner and is leak proof when under pressure;
- An outer reinforced concrete shell and;
- An annulus space within the containment shell, maintained below atmospheric pressure, so that leakage from the inner chamber can be contained. After treatment using high efficiency particulate air (HEPA) filtration, air from the annulus space is discharged into the atmosphere via the NI stacks.

126. The HR houses the primary system, which serves to contain the reactor coolant at its operating pressure and temperature, and reduce leaks and radioactive discharge into the enclosures atmosphere. This system fulfils three main functions:

- Transfers heat from the reactor core to the steam generators;
- Controls reactivity by adjusting the boron concentration in line with the control rods and;
- Controls the pressure via the pressuriser.

127. The primary coolant is borated, demineralised water, which serves as a moderator, heat transfer, and chemistry control.

128. The primary coolant produced during normal operation of the primary circuit, is directed to the coolant storage and treatment system (TEP), and the gaseous effluents are sent to the gaseous waste processing system (TEG), through either the chemical and volume control system (RCV) or the nuclear vent and drain system (RPE).

129. Leaks during operation and discharge from venting and draining during maintenance or repair, are collected by the RPE.

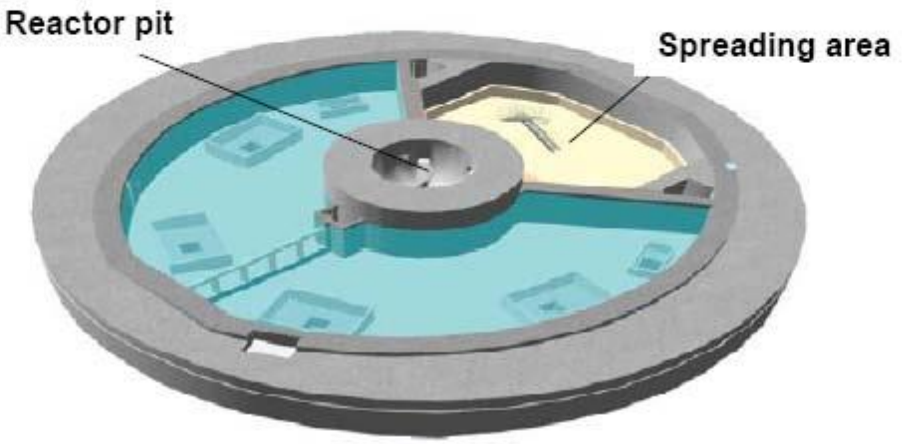


Figure 2-6 View of the lower section of the reactor building

130. The HR also includes the In-Containment Refuelling Water Storage Tank (IRWST), which is shown in blue in Figure 2-6. This is installed in the HR to ensure a water reserve is available to:

- Ensure water is available for recycling following injection after draining a tank, when primary coolant has been lost, or after a breach; and
- Cool the corium (a lava like molten mixture of portions of nuclear reactor core, formed during an uncontrolled core overheating incident), among other Severe Accident safety systems, in the unlikely case of this type of incident.

131. The installation's structural arrangements to mitigate a core meltdown accident, consist of the area provided for the molten core material to spread and the channel leading from the reactor pit to this area. The spreading area extends over approximately 170m^2 and is situated to the side of the reactor pit. It is surrounded on two sides by the IRWST, see Figure 2-6.

Safeguard Buildings (HL)

132. These buildings house the safety equipment including the pumps and valves for the Safety Injection System (RIS), the pumps and heat exchangers for the cooling system and the corresponding ventilation system.

133. All systems classed as safeguards are designed with quadruple redundancy and are sited in physically separate divisions.

134. Each division has:

- A low-pressure safety injection system;
- A medium pressure safety injection system, which is also used for cooling the reactor on shutdown;
- A component cooling water system; and
- An emergency feedwater system.

135. In addition, divisions one and four, house a residual heat removal system.

136. The buildings also contain the electrical safety systems, the instrumentation & control (I&C), the control room and ventilation systems.

Fuel Building (HK)

137. Each HK houses:

- Equipment relating to fuel, including the HK fuel pool, the fuel transfer area, the fresh fuel area and the loading area for the irradiated fuel containers;
- Equipment associated with the reactor cavity and Fuel Pool Cooling (and Purification) System (PTR);
- Equipment for the reactor's TEP and storage facilities for the Reactor Boron Water Make-Up System (REA) and the extra boration system; and
- Some ventilation equipment for the HK and for the space between the containments.

138. The HK is designed to enable new or irradiated fuel elements to be handled and stored in a controlled atmosphere. It houses the equipment necessary for these operations and enables their use.

Fuel Building Extension (HKH)

139. An extension to HK, to facilitate loading and manoeuvring of the spent fuel handling equipment, as part of the ISFS process.

Boron Storage Building (HKB)

140. Controlled environment storage facility for boron.

Nuclear Auxiliary Building (HN)

141. The HN is built on an independent foundation raft next to the HK. The HN for each reactor, houses some of the operational systems and dedicated maintenance areas.

142. The main systems installed in the HN are:

- PTR;
- TEG;
- Part of the steam generator blowdown system (APG);
- The Nuclear Auxiliary Building ventilation system (DWN);
- The operational chilled water system (DER);
- The reactor boron water make-up system (REA); and
- The sampling equipment and laboratories.

143. All air extracted from the ventilation systems of radiologically controlled areas in the NI, is collected and treated and monitored before it is discharged via the stack.

Effluent Treatment Building (HQA/HQB)

144. The Effluent Treatment Building (HQA/HQB) treats and processes liquid and solid wastes prior to monitoring and disposal. It is designed and sized to treat waste arising from two EPR^{TM} units.

145. The building is divided into two parts, one section is used for storing solid waste and the other treats liquid and solid waste.

146. The waste storage section comprises:

- A room for storing drums and containers of solid waste for loading into waste container for onward transport to a suitably permitted off-site disposal facility;
- Areas for checking drums before disposal;
- An area for storing the resins from the APG;
- A reception room for the mobile resin treatment stations; and
- A handling equipment to package the LLW.

147. The part of the building used for the treatment of liquid and solid waste, consists of a heavy-duty area that mainly houses the Liquid Waste Processing System (TEU) (storage and processing) and the Solid Waste Processing System (TES) (storage of resins and concentrates, filter encapsulation cell). It also houses a plant for producing concrete and storing aggregates. In addition, it contains the HQA/HQB control room and the electrical rooms.

148. The HQA/HQB at SZC is shared between the two units and is adjoined to Unit 1. Therefore, the solid radioactive wastes (LLW and ILW) generated in Unit 2 will be pre-conditioned in the HQC before transfer by road to the shared HQA/HQB. Resins are pumped from Unit 2 to the HQA/HQB via an underground gallery.

Radioactive Waste Treatment Building of Unit 2 (HQC)

149. The HQC is a dedicated building for pre-conditioning and preparing solid radioactive wastes (LLW and ILW) generated in Unit 2, for transport to the shared HQA/HQB for treatment and conditioning.

150. The two main functions of the radioactive waste building of Unit 2 are:

- Pre-conditioning of filters (used on RCV, PTR, TEP of Unit 2) in concrete drums (type C1 or C4), closed with a temporary biological plug; and
- Preparation and transfer to the shared HQA/HQB adjoined to Unit 1, of the waste packaged in concrete drums (filters) or metallic boxes (low activity ion exchange resins).

Access Tower (HW)

151. The HW main function for each unit is to control access to the NI. The building contains a room for maintaining and decontaminating small pieces of equipment leaving the controlled area plus operations rooms and technical rooms.

Emergency Diesel Generator Buildings (HDX)

152. Each of the two HDs per unit (four across the two units) houses two main diesel generator sets and one station black out diesel generator. The HDXs are constructed from reinforced concrete and are built on an independent foundation raft.

153. The two HDs are geographically separated, in order to avoid a common hazard such as internal fire.

154. Each HD houses two main diesel generator sets, each of which supplies a safety train within a division of the safeguard building, as well as a station black out unit. The two generators and the station blackout generator with their auxiliaries are protected against internal hazards by a separating wall.

155. Both HDs are designed to withstand external hazards and contain internal hazards.

Cooling Water Discharge Plant

156. The cooling water discharge plant for each unit consists of a HCB (pre-discharge section) for collecting marine debris from the pumping station and an outfall pond (discharge pond), which is connected to the outfall galleries. The outfall galleries of both outfall ponds (Unit 1 and Unit 2) meet at a connecting structure that connects to the common outfall tunnel shared by both units.

Discharge Tanks Building (HXA)

157. The different types of effluent are sent to three specific types of tank (KER, TER, SEK systems) for temporary storage and checking before discharge. The Refuelling Water Storage Tanks (PTR system) store boronated water that is used to increase the inventory of the in-containment refuelling water storage tank during shutdown states.

Hot Workshop, Hot Warehouse and Decontamination Facility (HVD)

158. The HVD is encompassed in a single structure.

159. The hot workshop is designed to enable maintenance on radioactive contaminated components or tools. The hot workshop may generate liquid effluents, which are temporarily stored before being sent to the TEU for treatment prior to monitoring and discharge off-site.

160. The hot warehouse is designed to store radioactive contaminated tools.

161. The decontamination facility is designed to reduce or suppress radioactive contamination of tools, components or wastes. Decontamination of equipment enables reuse of tools and minimisation of the volume of material requiring disposal.

Hot Laundry (HVL)

162. Laundry facility to wash potentially contaminated PPE.

2.7.2.2 Conventional Island Structures

Turbine Hall (HM)

163. The HM contains:

- The turbine generator set and associated auxiliary systems;
- The condenser and heating station that supplies water to the steam generators; and
- Steam bypass system from the turbine to the condenser, to enable house load operation in the case of an electrical system fault.

Conventional Island Electrical Building (HF)

164. The HF adjoins the HM near the transformer platforms. The building houses the permanent and secured electrical distribution panels, which supply the Conventional Island's auxiliary equipment and the automated controllers that manage and monitor it.

165. HF also supplies electricity continuously at 10kV to each of the four electrical buildings in the NI (HLX).

Auxiliary Transformer Platform (HJA)

166. The platforms for each unit adjoin the HM and are located close to HF. Each platform houses the main transformer, the two unit transformers and the line and coupling breakers. A dedicated platform houses the auxiliary transformer, which is always live.

2.7.2.3 Balance of Plant structures

Galleries

167. The buildings on the site are linked by various engineered galleries. These galleries have controlled access and carry pipework and services. The galleries provide another barrier to the environment should there be a leak from pipework within the gallery. The galleries are accessible which means pipework can be easily inspected. Specific galleries also provide safe and secure access between the operation centre and the access tower for personnel.

Pumping Station (HPX)

168. The HPX supplies raw water to the power plant primarily for cooling the condensers via the HPF which is a deep basin located adjacent to the pumping station. Seawater is transferred to the HPF via the intake tunnel.

169. The HPX has four separate drainage channels:

    - Two central channels which mainly supply the essential service water system and the circulating water condenser cooling system; and
    - Two side channels, each fitted with a chain filter which mainly supply the essential service water systems, the auxiliary (raw water) cooling system and the ultimate cooling water system.

170. The supply of seawater to the essential service water systems and ultimate cooling water system pumps (used respectively for the component cooling water system and the residual heat removal system) is designed so that if a drum screen or chain filter stops working, the seawater is still supplied.

Outfall Pond Buildings

171. Provides outfall route to the sea for main cooling water, SEC, EVU and all other sea water based systems, plus discharge route to the sea for liquid effluent discharges.

Outfall Tunnel Heads

172. A common outfall tunnel is shared between the two UK EPR[TM] units at SZC and is the main discharge outlet for radioactive liquid waste. The location of the two outfall heads are approximately 3.5 km off-shore.

Demineralisation Station (HY)

173. Demineralised water storage building (limited quantities of sulphuric acid and caustic soda).

Fire-fighting Water Distribution Building (HOJ)

174. The main function of the fire-fighting water distribution building is to store and supply large volumes of water to be used in the event of a fire or other safety issues and in case of loss of the heat sink for the emergency feedwater system pumps.

Hydrogen, Nitrogen and Oxygen Storage (HZH/HZO)

175. Storage of hydrogen, for cooling the generator and reducing amount of oxygen present in the primary circuit water. Storage of nitrogen, supplying the grid synchronisation system.

Chemical Products Storage (HZC)

176. Stores for various station operations chemical (no COMAH risk).

2.7.2.4 Spent fuel and ILW storage facilities

Interim Spent Fuel Store (HHK)

177. After removal from the reactor, spent fuel will be initially stored in the spent fuel pool in the HK for an initial cooling period. The spent fuel will then undergo treatment (including drying) and is loaded into a Multi-Purpose Canister (MPC) which will be sealed and is capable of passively cooling the contained spent fuel with no external support. The loaded and sealed MPCs are transported from the HK along the haul route to the HHK, where they are loaded into a HI-STORM and stored. The HHK provides safe and secure passive storage of spent fuel once it leaves the spent fuel pool of the HK from both UK EPR[TM] units. The spent fuel will remain here until disposal at the national GDF is available, the intended design life for the HHK is for storage of spent fuel up to 120 years after EoG. When operational the HHK will contain stored MPCs in HI-STORM containers and equipment for unloading MPCs from the transporter and moving MPCs within the building, fuel inspection and testing is undertaken back in the HK, as required. Whilst in storage, cooling is completely passive and there is no need for any active cooling systems to be used. Throughout the operational life of this facility, an inspection and monitoring regime will be implemented to ensure that fuel is safely stored and can be safely disposed at the end of life of the facility [SZC RSR CMT 8].

ILW Interim Storage Facility (HHI)

178. ILW generated during the operational phase will be placed in the HHI. ILW generated during the 60 years of UK EPR[TM] operation, primarily from the solid waste treatment, resins and spent liquid effluents in the HQA, will be conditioned, as appropriate, and packaged in the HQB before transfer to the HHI. The ILW packages provide containment, and the HHI itself provides a second containment. The HHI will provide interim storage for all ILW pending removal to a final national GDF, when available. The early decommissioning and site clearance strategy relates to the intention that following EoG the operational ILW will be repackaged and disposed of, off-site, and the HHI can be decommissioned as soon as

practicable. Some ILW is planned to be repackaged as some ILW is expected to have decayed to LLW during interim storage and therefore can be disposed as LLW (reducing the volume of ILW). Further details of decay storage of ILW is presented in RSR Permit Application Support Document A2. Any ILW generated during decommissioning will be managed appropriately as part of the decommissioning activities.

2.7.2.5 Ancillary Buildings / Areas

Operational Service Centre (HBX)

179. Access control points, nuclear sampling, radiochemistry laboratory.

Auxiliary Administration Building (HUD)

180. Provides additional ancillary, administration and supporting welfare facilities for operational staff

2.8 Environmental Protection Functions

2.8.1 Introduction

181. The EPR16 (as amended) regulations place an inherent requirement on operators to prevent uncontrolled, increased, or potentially harmful discharges to the environment, by ensuring equipment that protects the environment is correctly operated and maintained [Ref 1][3]. Additional conditions relating to equipment providing an Environmental Protection Function (EPF) are found in the generic RSR Environmental Permit conditions [Ref 23].

182. NNB GenCo (HPC) developed the EPF register [Ref 24] to address the following Environment Agency assessment finding, arising from the GDA process:

> *"Future operators shall provide evidence during the detailed design phase that the methodology (developed in response to GDA Issue GI-UKEPR-CC-01) used for categorising safety function and classifying structures, systems and components (SSCs) has been applied to relevant SSCs that deliver an environmental protection function."*

183. The EPF Register is a record of environmentally significant equipment and information relating to its function(s), requirements and other relevant information applicable to all UK EPR™ units. The EPF Register is currently held by NNB GenCo (HPC) to ensure consistency, however, SZC Co. has visibility of and ability to use the register and there will be provision for SZC Co. to take ownership and create a SZC EPF register if required, this is linked to Commitment 2 as the organisation changes will signal the change of ownership [SZC RSR CMT 2].

184. The register includes radiological and conventional (non-radiological) Environmental Protection Equipment (EPE) but it does not duplicate the nuclear safety classification system. Therefore, in the context of the RSR permit, the EPF register does not cover faults.

185. An EPF is defined as a function provided by a system, structure or component that provides protection to the environment. The recognised functions are defined below in:

[3] NSL Licence Condition 28 also covers this area – Examination, Inspection and Maintenance and Testing of equipment important to safety.

Table 2-3 Environment Protection Function definitions

Minimisation	Minimisation of waste generation at source e.g. by de-oxygenating water, corrosion is limited which minimises build-up of corrosion products.
Containment	Including storage, transfer and leaktightness of radioactive or hazardous materials or effluent e.g. containing liquid radioactive/hazardous waste in a tank.
Abatement	Abatement of effluents from routine operations to minimise discharges e.g. use of demineraliser to remove soluble radioactivity from aqueous effluent prior to discharge; or use of HEPA filters to remove particulate radioactivity from a gaseous effluent waste stream prior to discharge.
Treatment	Treatment of solid waste from routine operations to minimise the volume of waste disposed of off-site e.g. compaction or shredding of solid waste to reduce volume.
Mitigation	Mitigation of waste arising from unplanned and accidental events and controls to prevent unauthorised discharged or non-compliant waste disposal e.g. bunds around chemical storage tanks.
Monitoring	Monitoring and control including in-process and discharge monitoring and relevant I&C to ensure compliance with the relevant conditions of the permits/consents etc. e.g. flow measurement to ensure that discharges are within the permitted volumes.
Optimisation	Optimisation of equipment, primarily associated with solid radioactive waste management, where it assists in the sorting and segregation of waste streams so as to make best use of the available disposal routes. In this respect it may minimise secondary waste arisings by avoiding the unnecessary creation of radioactive waste; however, it differs from the "minimisation" function because it does not minimise the source term of radioactivity or generation of waste at source. Optimisation may also include the preferential partitioning of radionuclides between media. e.g. a valve to transfer resin to waste treatment systems for further treatment; once sentenced resins cannot be recovered.

2.8.2 Equipment designation

186. Equipment assessed was assigned one of the following designations:

- Environmental Protection Equipment (EPE) – Equipment identified that provides an EPF (i.e. one or more of those identified in the table above).
- Key Environmental Protection Equipment (KEPE) - KEPE is the most important EPE identified and prioritised as part of the risk assessment process. A risk assessment is undertaken for equipment for which an EPF function is identified; this is used to determine KEPE status. This risk assessment assesses consequences and environmental impact of failure of the equipment to assess overall severity of failure. Engineering judgement is then applied for the final determination of KEPE status.
- No Environmental Protection Requirement - Equipment that does not contribute to delivering an EPF.

2.9 Key SZC Radwaste Systems and Components

187. This section presents an overview of the main systems of the SZC design which are relevant to the Radioactive Substances activities and therefore give context to the following sections in this permit application.

2.9.1 Radioactive waste systems

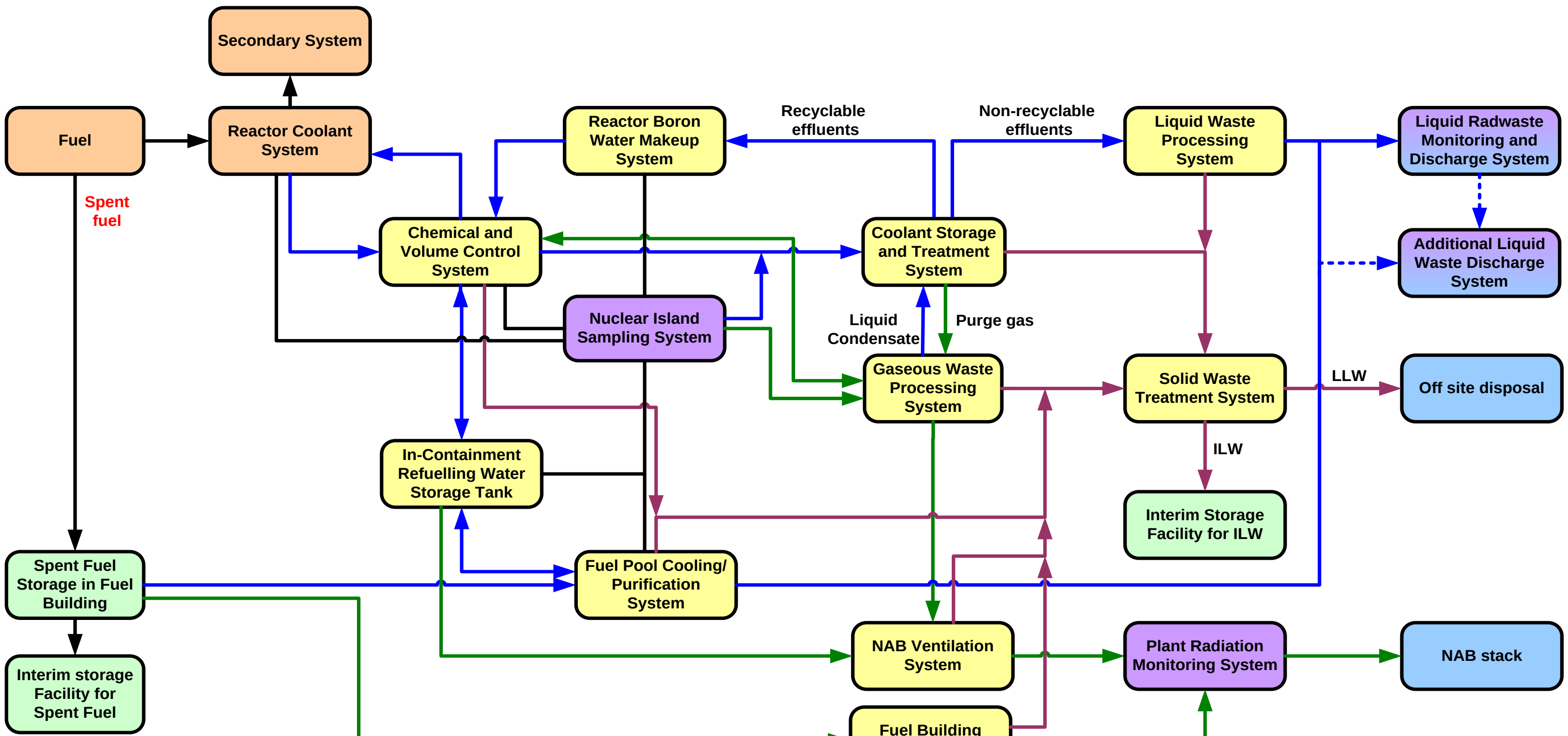
Table 2-4 Main systems which have an impact on Radioactive Waste

Main Systems	Code	Description of Main Equipment	Key Environmental Protection Equipment	Main Equipment Protection Function	Location of System	Shared by both units
Reactor Coolant System	RCP	The RCP includes: • Reactor vessel • Steam generators • Pressuriser, control rod assemblies • Ancillary equipment, i.e. pumps and instrumentation that form the primary circuit	No KEPE	Containment, providing second barrier to radioactive material (EPF is aligned with nuclear safety function)	HR	No
Chemical and Volume Control System	RCV	The RCV is used to maintain the chemistry of the primary coolant. The RCV also provides volume control for the primary coolant and contains any leaks from reactor coolant pump seals.	Water Filters Demineralisers Online boron meters	Containment and abatement (dependent on specific equipment)	Across the: HR HK HN.	No
Nuclear Island Sampling System (primary and secondary side)	REN (primary side) RES (secondary side)	The REN/RES collect samples from the primary and secondary circuit, respectively, and enables centralisation for analysis and determination of the chemical and radio-chemical characteristics of aqueous samples taken from various systems.	Gas Chromatograph	Monitoring and containment	Across the: HR HK HN.	No
Steam Generator Blowdown System	APG	The APG serves to maintain the necessary quality of the water/steam cycle by cleaning the blowdown water (by filtration and demineralisation) so as to keep the activity concentration and the chemical characteristics of secondary side water within operational specifications during all plant operating conditions.	Water Filters Demineralisers	Containment and abatement	Across the: HR HLX HN HM.	No
Nuclear Vent and Drain System	RPE	This RPE collects aqueous and gaseous effluents from across the facility and transfers them to various systems according to the ability to recycle the effluent or according to its radiological characteristics.	No KEPE	Containment	Across the: HR HK HLX HN HQA/HQB HBX HQC.	No

Main Systems	Code	Description of Main Equipment	Key Environmental Protection Equipment	Main Equipment Protection Function	Location of System	Shared by both units
Coolant and Storage System	TEP	The TEP manages the primary coolant, it is divided into four sub-systems.	Water Filters Demineralisers Degasser	Containment and Abatement	Across the: HK HN.	No
Reactor Boron Water Make-up System	REA	The REA contributes to the reactivity control of the primary coolant.	No KEPE	Containment	Across the: HK HN	No
Fuel Pool Cooling (and Purification) System	PTR	The PTR is divided into two sub-systems which cool and purifies the water in the spent fuel pool.	Water Filters Demineralisers Heat Exchanger Temperature Sensor	Containment and abatement	Across the: HR HLX HK.	No
Gaseous Waste Processing System	TEG	The TEG treats the gaseous effluents from the various tanks and systems serving the primary circuit.	Waste gas compressor Reducing station valves Delay Bed and Isolation Valves Gel Drier Pressure Sensors Gas and particulate filter	Containment and abatement	Mainly located in the HN	No
Solid Waste Processing System	TES	The TES treats solid wastes from the site, including the conditioning of LLW and ILW.	Grout production station Waste Package Inspection equipment Filter Change Machine Shredder Compactor LLW Sorting Glove Box Sampling equipment Flow rate sensors	Containment, optimisation and treatment	Mainly located in the HQA/HQB.	Yes
Liquid Waste Processing System	TEU	The TEU is the main system for treating non-recyclable aqueous effluents prior to discharge.	Water Cartridge Filters Demineralisers Evaporator	Containment and abatement	HQA/HQB	Yes

Main Systems	Code	Description of Main Equipment	Key Environmental Protection Equipment	Main Equipment Protection Function	Location of System	Shared by both units
Effluent Treatment Building Sampling System	TEN	The TEN takes samples from the TEU and TES to determine the most appropriate treatment technique.	No KEPE in this system	Monitoring	HQA/HQB	Yes
Condenser Vacuum	CVI	The CVI collects effluents from the secondary circuit including off-gas and recycles them accordingly.	No KEPE in this system	Containment	HM	No
Liquid Radwaste Monitoring and Discharge System	KER	The KER monitors and stores aqueous effluents in the tanks prior to discharge. There are 3 tanks in the KER that service both UK EPRs.	Discharge tanks Tank inlet valves Tank outlet valves Final isolation valve Flow rate sensors FPS Flow rate control valves	Containment and monitoring	HXA	Yes
Additional Liquid Waste Discharge System	TER	The TER is not normally used and is kept in reserve to provide additional storage capacity. There are 3 tanks in the TER that service both UK EPRs.	Discharge tanks Tank inlet valves Tank outlet valves Flow rate control valves	Containment and monitoring	HXA	Yes
Conventional Island Liquid Waste Discharge System/ Site Liquid waste Discharge System	SEK	The SEK comprises of two systems: • Conventional Island Liquid Waste Discharge System • Site Liquid Waste Discharge System There are 2 tanks in the SEK located in the HXA that service both UK EPRs.	Discharge tanks Tank inlet valves Tank outlet valves Final isolation valve Flow rate sensors FPS Flow rate control valves	Containment and monitoring	SEK located in the HM is not shared SEK located in the HXA is shared by both UK EPRs	Parts are shared as indicated to the left

Main Systems	Code	Description of Main Equipment	Key Environmental Protection Equipment	Main Equipment Protection Function	Location of System	Shared by both units
Plant Radiation Monitoring System	KRT	The KRT contributes to the safety of the station, both under normal operating conditions and in accident situations.	TEG and Heating, Ventilation and Air-Conditioning (HVAC) in-process equipment Stack discharge equipment Fuel Pool monitoring equipment RPE in-process monitoring equipment TEU in-process monitoring equipment	Monitoring	Across the: HR HK HLX HN HQA/HQB HXA	No



Notes:
1. The main systems and connections relevant to the RSR submission are indicated above. This diagram is a simplification and does not attempt to identify all of the connections between systems and nor does it replace the more detailed engineering diagrams.
2. The Nuclear Vent and Drain System is not explicitly indicated above but is responsible for the transfer of liquid and gaseous effluents between the systems.

Figure 2-7 Relationship between RSR systems connected to the primary circuit

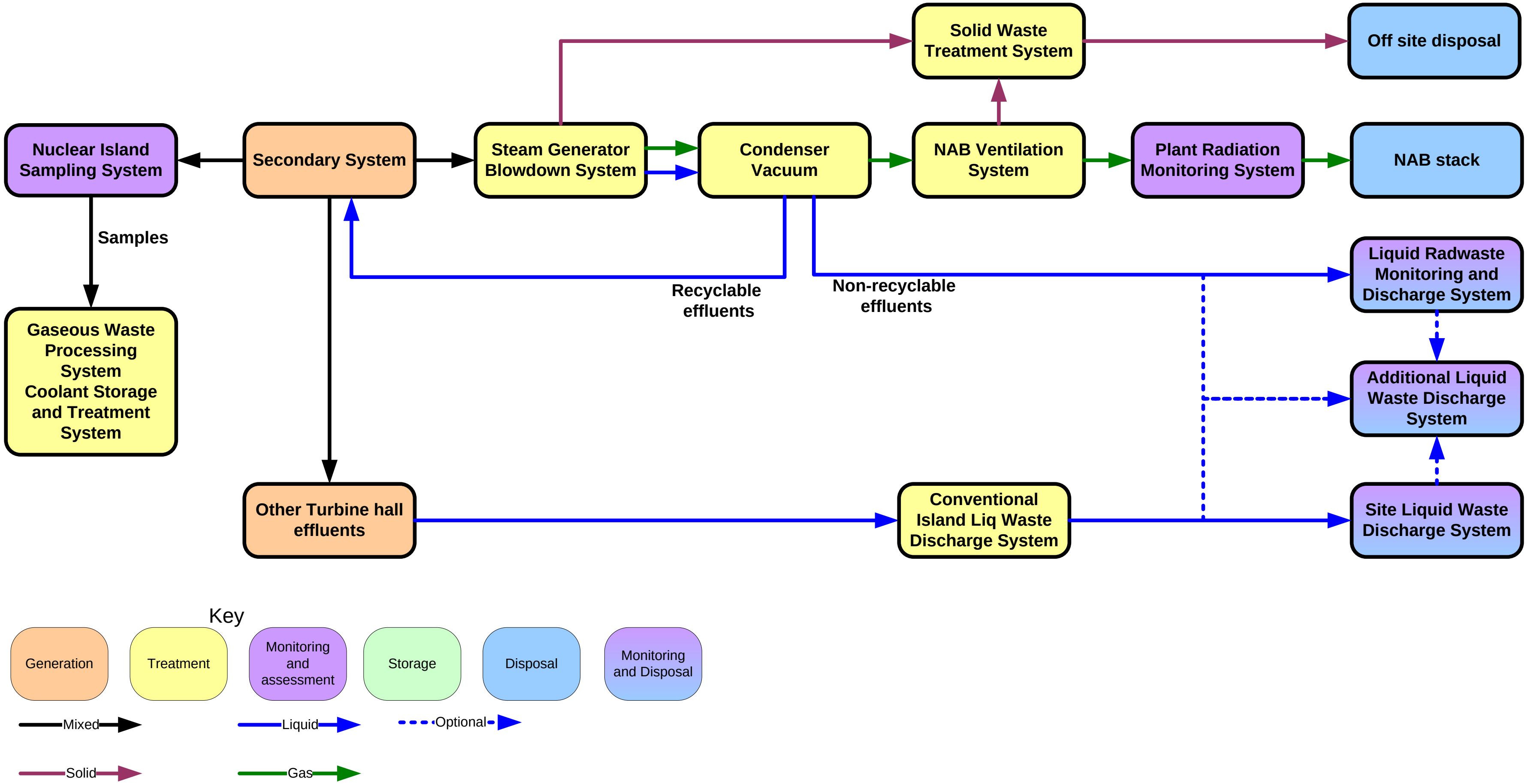


Figure 2-8 Relationship between RSR systems connected to the secondary circuit

2.9.2 Ventilation systems

188. Ventilation systems provide important EPFs, these are common across all HVAC systems servicing radioactive controlled areas, such as containment, monitoring and abatement of radioactive material prior to discharge. KEPE for ventilation systems includes isolation dampers, HEPA filters, iodine traps and flow measurement equipment.

Table 2-5 Main Building Ventilation Systems

Building Ventilation System	Code	Description of Main Equipment	Location of System	Shared by both UK EPRs
Containment Sweep Ventilation System	EBA	The EBA manages the supply, extraction and filtration of ventilation air from the HR.	Mainly located in the HR	No
Controlled Safeguards Buildings Ventilation System	DWL	The DWL manages the supply, extraction, filtration and discharge of ventilation air from the HLX.	Mainly located in the HLX	No
Fuel Building Ventilation System	DWK	The DWK manages the supply, extraction, filtration and discharge of ventilation air from the HK.	Mainly located in the HK	No
Nuclear Auxiliary Building Ventilation System	DWN	The DWN extracts ventilation effluent from controlled areas in the HN, HLX and HK (apart from accidents), and from purging the HR when the unit is shut-down and the reactor head removed for refuelling outage.	Across the: • HN • HLX • HK • HR	No
Effluent Treatment Building Ventilation System	DWQ	The DWQ conditions, extracts and filters ventilation air in the HQA/HQB.	Mainly located in the HQA/HQB	Yes, discharge point through Unit 1
HVL, HXA, HVD Building Ventilation System	DWV	The DWV provides ventilation of the HVL, HXA and HVD buildings and filtration of contaminated exhaust air from the HVD building and rooms of the HVL building where an aerosol risk is present.	Across the: • HVL • HXA • HVD	Yes
Access Building Ventilation System	DWW	The DWW controls the supply, extraction and filtration of ventilation air from the controlled areas of the HW.	Mainly located in the HW	No
Containment Inter-space Ventilation System	EDE	The EDE located in the Annulus of the HR is primarily of importance in accident situations as it maintains the negative pressure in the inter-space between the containment walls.	Mainly located in the HR	No

2.10 Design development since GDA for SZC

2.10.1 Developments since GDA

189. The GDA for the UK EPR^{TM} concluded with the Environment Agency granting a SoDA. As part of this process the Environment Agency identified a number of points that would need to be resolved at a later stage, known as GDA AFs. The Environment Agency considered the extant AFs as part of the determination of the HPC permit and a number of these were agreed to become permit information conditions. Some of these information conditions have subsequently been addressed at HPC and changes incorporated in the design that forms the reference configuration for SZC. Below (Table 2-6) summarises a review of the AFs and their applicability to SZC noting that some are considered to be closed based on the work undertaken in the HPC project resulting in incorporation into the HPC RC2 and hence SZC RC0 design or information included within this permit application.

Table 2-6 Analysis of GDA Assessment Findings on SZC

AF ID	Description	HPC Status and applicability to SZC
AF-UKEPR-AF-01	The future operator shall, at the detailed design stage, identify any changes to the 'reference case' for solid radioactive waste and spent fuel strategy, and provide evidence that the site-specific IWS achieves the same objectives.	The Environment Agency noted that NNB GenCo (HPC) has closed this assessment finding following the update of the HPC IWS. The SZC RSR permit application has included a site specific radioactive waste strategy. SZC Co. has committed to updating the IWS [SZC RSR CMT 9] as part of this application. The IWS will be managed and updated as part of normal document review and revision process.
AF-UKEPR-AF-02	The future operator shall, at the detailed design stage, provide an updated decommissioning strategy and decommissioning plan.	The Environment Agency noted that NNB GenCo (HPC) has closed this assessment finding on the basis of decommissioning strategy provided as part of the HPC FDP. The decommissioning strategy is applicable to the UK EPR^{TM} and equally applicable at SZC as it is HPC. SZC Co. is preparing a SZC Decommissioning and Waste Management Plan (DWMP) to support the FDP. SZC Co. has committed to submitting a FDP [SZC RSR CMT 10] as part of this application. The SZC DWMP will be based on the HPC DWMP. Updates to the plan will be made as part of normal business.
AF-UKEPR-AF-03	Future operators shall keep the removal of secondary neutron sources (to further minimise creation of tritium) under review. EDF and AREVA should provide future operators with relevant EPR^{TM} operational information when available to facilitate their reviews of BAT.	This AF has been superseded by IC3 in the HPC RSR permit. This Information condition cannot be closed until the power station has been operational for at least 3 fuel cycles. SZC Co. has committed to undertake its own assessment at a similar time [SZC RSR CMT 11].
AF-UKEPR-AF-04	Future operators shall, during the detailed design phase for each new build project, review BAT on minimising the production of activated corrosion products for the following matters, where possible improvements were identified in the Pre-Construction Environmental Report (PCER): i) corrosion resistance of steam generator tubes; ii) electro-polishing of steam generator channel heads; iii) specification of lower cobalt content reactor system construction materials;	This AF has been superseded by IC8 in the HPC RSR permit. This Information Condition was closed by the Environment Agency upon provision of a report addressing these aspects. Final submission of the report took place in Q2 2018, with Environment Agency acceptance of the closure of IC8 confirmed via RASCAR (REV/180510/ZP3690SY) in May 2018. The conclusions of this report are included in the design of the SZC NSSS which forms part of the SZC RC0 design. As such it is considered that this finding has been addressed. Information relating to the topics raised in the AF are

AF ID	Description	HPC Status and applicability to SZC
	iv) further reducing use of Stellites™ in reactor components, in particular the coolant pump. Where appropriate, any improvements considered BAT should be incorporated into the new build.	incorporated into the Environment Case presented in Supporting Document A1 of this this application.
AF-UKEPR-AF-05	Future operators shall, before the commissioning phase, provide their proposals for how they intend to implement zinc injection. The proposals shall be supported by an assessment of the impact of zinc injection on waste and crud composition.	SZC Co. has committed to provide documentation to the Environment Agency covering chemistry control [SZC RSR CMT 12] which will address the elements covered by the IC 13 in the HPC RSR permit.
AF-UKEPR-AF-06	Prior to construction of the conventional and NI liquid effluent discharge tank systems, future operators shall demonstrate that site-specific aspects such as size and leak-tight construction techniques are BAT.	The sizing element of this AF was closed during HPC RSR permit determination. This was confirmed in the Environment Agency decision document for the HPC RSR Permit. The same size tanks are used at SZC therefore it is considered that this aspect has been addressed. A change from the original design presented in GDA has been adopted at HPC which significantly simplifies the construction techniques. This means that standard non-destructive testing methods can be applied to demonstrate leaktight construction. HPC is preparing a closure form for AF-06 based on information from the equipment supplier. The same design is adopted at SZC and the same techniques are expected to be applied to demonstrate leaktight construction. SZC Co. will provide comparable information on leaktight construction of the discharge tanks at SZC.
AF-UKEPR-AF-07	Future operators shall, before the commissioning phase, provide an assessment to demonstrate that proposed operational controls on the fuel pool are BAT to minimise the discharge of tritium to air.	This AF has been superseded by IC13 in the HPC RSR permit. SZC Co. has committed to provide documentation to the Environment Agency covering chemistry control [SZC RSR CMT 12] which will address the elements covered by the HPC IC13.
AF-UKEPR-AF-08	Future operators shall, during the detailed design phase, provide their proposals for the operational management of the TEU to minimise the discharge of radioactivity from the site so that exposures of any member of the public and the population as a whole are kept ALARA and to protect the environment.	This AF has been superseded by IC9, 10 and 11 in the HPC RSR permit. NNB GenCo (HPC) has provided information to the Environment Agency which has addressed IC9 and 10. Final report to close out IC9 was submitted in December 2018, with acceptance by the Environment Agency confirmed via RASCAR (REV/190110/ZP3690SY) received 07/03/2019. Final report to close out IC10 was submitted in December 2018, with acceptance by the Environment Agency confirmed via RASCAR (REV/190111/ZP3690SY) received 07/03/2019. Information relating to IC9 and IC10 are incorporated into the Environment Case presented in Supporting Document A1 of this this application. There are not any site specific factors that would affect the application of IC9 and IC10 to SZC. SZC Co. has committed to provide documentation to the Environment Agency covering chemistry control [SZC RSR CMT 12] which will address the elements covered by the IC 11 in the HPC RSR permit.
AF-UKEPR-AF-09	Future operators shall, during the detailed design stage, provide a predicted mass balance showing how their proposed aqueous radioactive waste management regime will affect the disposal of carbon-14 to the gaseous, solid or aqueous routes. For each route the form of Carbon-14 expected shall be provided. For solid wastes the quantities	This AF has been superseded by IC15 in the HPC RSR permit. SZC Co. has committed to provide documentation to the Environment Agency covering chemistry control [SZC RSR CMT 12] which will address the elements covered by the HPC IC13.

AF ID	Description	HPC Status and applicability to SZC
	of each type of waste shall be provided with expected carbon-14 content.	
AF-UKEPR-AF-10	The future operator shall provide confidence that adequate radioactive waste management cases (RWMCs), supported by appropriate stage Letters of Compliance (LoCs), can be developed for all ILW on the timescales identified in EDF and AREVA's plan for disposability of ILW	NNB GenCo (HPC) has prepared a RWMC. SZC Co. has committed to preparing an RWMC [SZC RSR CMT 8]. NNB GenCo obtained a conceptual LoC for operational ILW applicable to both HPC and SZC. The Environment Agency noted that NNB GenCo (HPC) has closed this assessment finding on the basis of the prepared RWMC and schedule of future LoC submissions. SZC Co. has committed to producing subsequent LoC submissions as part this application [SZC RSR CMT 8].
AF-UKEPR-AF-11	The future operator shall provide evidence during the detailed design phase that the proposed specific techniques for preventing and, where that is not possible, minimising the creation of LLW and ILW are the BAT.	NNB GenCo (HPC) provided information on this topic in its RSR permit application. The Environment Agency confirmed the information provided was sufficient to address the AF in the Environment Agency decision document for the HPC RSR Permit. The design of SZC is the same as HPC and the same information is included in this application for SZC therefore the same logic is expected to apply.
AF-UKEPR-AF-12	The future operator shall provide evidence during the detailed design phase that the proposed specific techniques for treating and conditioning of LLW and ILW before disposal are the BAT.	This AF has been superseded by IC17 in the HPC RSR permit. SZC Co. has committed to develop detailed radioactive waste management arrangements to ensure it can safely dispose of all radioactive wastes that are inevitably produced having applied BAT to minimise the waste arisings in the first place, segregated waste to enable optimal management and used BAT to characterise and sentence waste [SZC RSR CMT 7] which will address the elements covered by the IC 17 in the HPC RSR permit.
AF-UKEPR-AF-13	If smelting of any LLW is pursued, the future operator shall demonstrate that the conditions of acceptance of the selected smelting facility can be met.	As part of the Environment Agency determination of the HPC RSR application this AF was closed on the basis it was superseded by RSR permit conditions 3.1.5 & 3.1.6, it is expected the same logic will apply to SZC Co..
AF-UKEPR-AF-14	If incineration of any LLW is pursued, the future operator shall demonstrate that the conditions of acceptance of the selected incineration facility can be met.	As part of the Environment Agency determination of the HPC RSR application this AF was closed on the basis it was superseded by RSR permit conditions 3.1.5 & 3.1.6, it is expected the same logic will apply to SZC Co..
AF-UKEPR-AF-15	If incineration of any ILW is pursued, the future operator shall demonstrate that the conditions of acceptance of the selected incineration facility can be met.	SZC Co. will not incinerate ILW. NNB GenCo (HPC) confirmed the same position and the Environment Agency permit grant decision document confirmed this AF was therefore not applicable. The Environment Agency confirmed this position in the HPC RSR Decision document, it is expected the same logic will apply to SZC Co..
AF-UKEPR-AF-16	The future operator shall, before the commissioning phase, propose techniques for the interim storage of spent fuel following a period of initial cooling in the pool. The future operator shall provide an assessment to show that the techniques proposed are BAT.	AF 16 has been superseded by IC14 in the HPC RSR permit. Further details of the HHK are presented in the SZC RSR permit application.

AF ID	Description	HPC Status and applicability to SZC
AF-UKEPR-AF-17	The future operator shall, before the commissioning phase, provide confidence that adequate RWMCs, supported by appropriate stage LoCs and taking due account of necessary storage periods, can be developed for spent fuel on the timescales identified in EDF and AREVA's plan for disposability of spent fuel.	NNB GenCo (HPC) has prepared a RWMC. NNB GenCo (HPC) has prepared a RWMC. SZC Co. has committed to preparing an RWMC [SZC RSR CMT 8]. NNB GenCo (HPC) has not yet sought a conceptual LoC for spent fuel. However, the Environment Agency noted that NNB GenCo (HPC) has closed this assessment finding on the basis of the prepared RWMC and schedule of future LoC submissions which has included LoC process into normal business processes. SZC Co. has committed to producing LoC submissions as part this application [SZC RSR CMT 8].
AF-UKEPR-AF-18	Future operators shall provide: a) during the detailed design phase, the location and arrangement of sampling and continuous monitoring facilities for gaseous and aqueous wastes supported by an assessment that these will provide representative sampling and monitoring; b) during the detailed design phase and before final equipment selection, the details of equipment and techniques to be used for analysis of gaseous, aqueous and solid wastes supported by an assessment that these represent BAT for monitoring.	At HPC the AF was superseded by RSR permit information conditions 4, 5, 6 and 7. The design at SZC is the same as HPC and this application contains information that was presented to close out IC4 at HPC. Final report to close out IC4 was submitted in December 2018, with acceptance by the Environment Agency confirmed via RASCAR REV/190108/ZP3690SY received 05/03/2019. There are not any site specific factors that would affect the application of IC4 to SZC SZC Co. has committed to preparing relevant monitoring documentation [SZC RSR CMT 4] which covers the elements covered by the IC 5, 6 and 7 in the HPC RSR permit.
AF-UKEPR-AF-19	Future operators shall provide evidence during the detailed design phase that the methodology (developed in response to GDA Issue GI-UKEPR-CI-04) used to qualify SMART devices for nuclear safety functions, has been applied to relevant SMART devices that provide an EPF.	This AF was closed at HPC through the development of plan that brought the qualification of SMART devices into the existing qualification programme. The same arrangements will apply at SZC.
AF-UKEPR-AF-20	When undertaking detailed design of SSCs that deliver an EPF, future operators shall provide evidence that demonstrates the allocation of actions between humans and technology has been substantiated and dependence on human action to maintain a benign state has been optimised.	This AF was closed at HPC through the development of plan that brought the consideration of human factors into the existing human factors programme. The same arrangements will apply at SZC.
AF-UKEPR-AF-21	Future operators shall provide evidence during the detailed design phase that the methodology (developed in response to GDA Issue GI-UKEPR-CC-01) used for categorising safety function and classifying SSCs has been applied to relevant SSCs that deliver an EPF.	This AF was closed on the basis of the development of the EPF Register (as described in Section 2.9). The same arrangements will be applied at SZC.

2.10.2 Link to HPC RSR permit compliance

190. Following the RSR permitting process for HPC, the Environment Agency raised a number of Information Conditions (referred to hereafter as HPC IC's) associated with the RSR permit for NNB GenCo (HPC) to address in order to ensure compliance. NNB GenCo (HPC) have developed plans to resolve and close these information conditions at the appropriate time, based on the replication strategy for SZC it is recognised that there will be applicability to SZC. Where possible ICs that have already been closed for HPC have been

reviewed for applicability to SZC and incorporated in the documentation for the permit application. Table 2-7 describes each HPC IC and the current HPC status and applicability to SZC.

Table 2-7 Summary of HPC Permit Information Conditions and Applicability to SZC

HPC RSR IC Reference	Description	HPC Status and applicability to SZC
IC 1	For each calendar year the operator shall provide the Environment Agency with a progress report on the organisational development relevant to permit compliance.	Annual reports continue to be submitted by NNB GenCo (HPC) and have been accepted by the Environment Agency. SZC Co. will review these annual reports in alignment with the FWP and [SZC RSR CMT 2].
IC 2	For each calendar year the operator shall provide the Environment Agency with a full report of design, build, commissioning and operations activities relevant to permit compliance. The report shall address: the fuel specification, the primary coolant chemistry specification including zinc injection, the secondary coolant chemistry specification, the choice of ion exchange resins, in process monitoring, leak-tight construction techniques and SMART devices. The first report shall cover the changes from the design assessed for the GDA Statement of Design Acceptability.	Annual reports continue to be submitted by NNB GenCo (HPC) and have been accepted by the Environment Agency. SZC Co. will review these annual reports in alignment with the FWP and [SZC RSR CMT 1], and other relevant commitments as appropriate.
IC 3	The operator shall assess the performance of secondary neutron sources during operations and whether they can be removed. The operator shall provide a full report on the findings of its assessment to the Environment Agency.	Commitment Plan 3, which covers the close out of IC3 for HPC was reviewed and updated in 2017. This was expected to be reviewed in 2019 however is now planned for 2020 given the long timescales for activities required under the plan. HPC IC3 is linked to RC10/11 covered by a resolution plan which has shorter deliverables including OPEX from other EPRs which will support IC3. SZC Co. will review Commitment Plan 3 in alignment with the FWP and [SZC RSR CMT 11].
IC 4	The operator shall provide the Environment Agency with a report that demonstrates that requirements for the sampling of discharges have been adequately considered in the design of the plant. Matters to be considered include sufficient space for equipment, suitable sampling arrangements, suitable and safe access, suitable environmental conditions.	The final report to close out IC4 was submitted to the Environment Agency in December 2018. The report is concerned with the design of monitoring/sampling arrangements for discharges (but not the discharge outlets themselves) so therefore the contents of the report are considered applicable to SZC, and have been incorporated into the Environment Case [Ref 25], providing evidence to demonstrate that the design of monitoring/sampling arrangements for liquid/gaseous discharges is BAT.
IC 5	The operator shall provide the Environment Agency with a report that demonstrates that monitoring and sampling equipment for gaseous, aqueous and solid wastes is BAT.	The final report to close out HPC IC5 will be produced in 2020 by NNB GenCo (HPC) to summarise the findings of the EOS2 reports for liquid, gaseous and solid. SZC Co. plan to learn from the findings at HPC when available, the FWP includes the expectation to review and incorporate this learning as appropriate [SZC RSR CMT 4].
IC 6	The operator shall provide the Environment Agency with a report that demonstrates that analysis equipment for gaseous, aqueous and solid wastes is BAT.	The final report to close out HPC IC6 will be produced in 2020 by NNB GenCo (HPC) to summarise the findings. SZC Co. plan to learn from the findings at HPC when available, the FWP includes the expectation to review and incorporate this learning as appropriate [SZC RSR CMT 4].
IC 7	The operator shall provide the Environment Agency with a report that defines and documents the techniques proposed to be employed to determine the activity of radioactive waste disposals. The report shall	SZC Co. plan to learn from the findings at HPC when available, the intention of the commitments made in the FWP are to allow SZC Co. to review and incorporate this learning as appropriate [SZC RSR CMT 2].

HPC RSR IC Reference	Description	HPC Status and applicability to SZC
	include information on the management of relevant laboratories and staff.	
IC 8	The operator shall provide the Environment Agency with a report on the use of BAT to minimise the production of activated corrosion products. The report shall consider the possible improvements identified in the Pre-Construction Environmental Report: the corrosion resistance of steam generator tubes, the electro-polishing of steam generator channel heads, the specification of lower cobalt content reactor system construction materials and the use of Stellites in reactor components, in particular the coolant pumps.	The final report to close out HPC IC8 took place in Q2 2018. The report demonstrates that the specification of low cobalt content materials, and reduction of stellite usage in the primary circuit. The specification of materials in the primary circuit is not a site-specific concern so the report is considered applicable to SZC and has been incorporated into the Environment Case [Ref 25].
IC 9	The operator shall provide the Environment Agency with a report on the detailed design proposals for the Liquid Waste Processing System including a BAT assessment.	The final report to close out HPC IC9 was submitted in December 2018. The report, along with the associated HPC IC10 report, and planned work to close out HPC IC11, resulted in new arguments and evidence being created to support the BAT demonstration of TEU. The discharge routes or other site specific elements are not contained within the TEU system so the work is considered applicable for SZC and has been incorporated into the Environment Case [Ref 25].
IC 10	The operator shall provide the Environment Agency with a BAT assessment to show that the use of the evaporator, the choice of filter porosity and the demineralisation media have been optimised. The operator shall also provide evidence that the Liquid Waste Processing system has sufficient capacity and resilience (for example, in case of outage due to maintenance or breakdown) to cope with all the aqueous radioactive waste arisings.	
IC 11	The operator shall provide the Environment Agency with its specification for the operational management of the Liquid Waste Processing System, together with a demonstration of how this contributes to the use of BAT to minimise the activity in liquid discharges.	
IC 12	The operator shall provide the Environment Agency with a report demonstrating how its proposals for reactor commissioning, shutdown and start-up contribute to the minimisation of corrosion product generation. The report shall include consideration of circuit cleaning, passivation and other measures.	SZC Co. plan to learn from the findings at HPC when available, the FWP includes the expectation to review and incorporate this learning as appropriate [SZC RSR CMT 12].
IC 13	The operator shall provide the Environment Agency with its specification for the operational management of the fuel pool (including temperature, ventilation and chemistry control), together with a demonstration of how this contributes to the use of BAT to minimise the activity in discharges (addressing, in particular, the maintenance of fuel integrity and the minimisation of the discharge of tritium to air).	See AF-07. SZC Co. has committed to provide documentation to the Environment Agency covering chemistry control [SZC RSR CMT 12] which will address the elements covered by the HPC IC13.

HPC RSR IC Reference	Description	HPC Status and applicability to SZC
IC 14	The operator shall provide the Environment Agency with its specification for the operational management of the Interim Spent Fuel Store (including temperature, ventilation and chemistry control), together with a demonstration of how this contributes to the use of BAT to minimise the activity in discharges (addressing, in particular, the maintenance of fuel integrity and the minimisation of the discharge of tritium to air).	This was written with wet storage in mind, given the change to dry storage for both HPC (and adopted for SZC) this is expected to be covered by a future permit variation by NNB GenCo (HPC) and therefore not directly applicable to SZC Co.
IC 15	The operator shall provide the Environment Agency with its predicted mass balance showing how its proposed aqueous radioactive waste management regime will affect the disposal of carbon-14 to the gaseous, solid or aqueous routes. For each route the form of carbon-14 expected shall be provided. For solid wastes the quantities of each type of waste shall be provided with expected carbon-14 content.	See AF-09. SZC Co. has committed to provide documentation to the Environment Agency covering chemistry control [SZC RSR CMT 12] which will address the elements covered by the HPC IC15.
IC 16	The operator shall provide the Environment Agency with a report setting out and justifying its proposed environmental monitoring programme.	SZC Co. plan to learn from the findings at HPC when available, the FWP includes the expectation to review and incorporate this learning as appropriate [SZC RSR CMT 5].
IC 17	The operator shall provide the Environment Agency with its specification for the design and operational management of the solid waste processing system.	SZC Co. plan to learn from the findings at HPC when available, the FWP includes the expectation to review and incorporate this learning as appropriate [SZC RSR CMT 7].
IC 18	The Operator shall provide the Environment Agency with an action plan to identify requirements for in-process monitoring to demonstrate compliance with the conditions of this permit.	Final report to close out HPC IC18 was submitted in September 2013 and has been incorporated into the Environment Case [Ref 25].
IC 19	The operator shall provide the Environment Agency with a report that demonstrates that in-process monitoring is BAT.	SZC Co. plan to learn from the findings at HPC when available, the FWP includes the expectation to review and incorporate this learning as appropriate [SZC RSR CMT 5].

2.10.3 Significant Design Changes following GDA

191. Significant changes to the design from GDA and since the HPC RSR permit application, with regards to the development of the HPC RC2 design are described in Section 6 of Supporting Document A1 [Ref 25]. A list of the key design changes relevant to the RSR permit are outlined below:

- Improvements to the prevention of leaks from the RCP;
- Addition of a new laboratory sample drain line for the use of chemicals to minimise the potential of contamination of gloveboxes and to ensure routing of effluents to the most appropriate abatement systems;
- Design changes to the liquid effluent discharge tanks to minimise particulate/sedimentation;
- Improvements to prevent unmitigated gaseous releases from the TEG;

- Design change to the RPE primary coolant gaseous effluent system to minimise the risk of dose uptake by operators resulting from a potential transient gaseous release;
- A change to use 500 litre steel drums for storage and disposal of non-resin ILW in place of the original C1/C4 casks;
- Inclusion of information regarding the selection of optimal disposal routes for solid waste management;
- Further details regarding the design of the TEU to ensure capacity and resilience to treat all liquid wastes generated; and
- The long-term storage of spent fuel (prior to the development of a national disposal strategy and facility) will be undertaken on site in a dry storage facility, rather than long-term storage in spent fuel ponds, as originally intended in the GDA.

2.10.4 SZC specific Design Changes

192. As described in Section 2.2.5 the key SZC site-specific changes are as follows:

- Outfall tunnel (heat sink) design;
- Nuclear Island Stack Height; and
- Size and shape of HHI and HHK.

3 OPERATING TECHNIQUES

3.1 Introduction

193. This section demonstrates the use of BAT regarding the generation and disposal of radioactive waste from SZC.

194. The structure of this section is as follows:

- Description and explanation of definitions and key principles
- The Environment Case sets out the BAT demonstration of the optimisation of radioactive waste, where the CAE are defined.
- The Integrated Radioactive Waste Strategy defines how the radioactive waste once generated will be managed and disposed of.

3.2 Definitions and key principles

3.2.1 As Low As Reasonably Achievable

195. During application of environmental optimisation, where disposal is unavoidable further techniques are deployed to ensure that the risk of such disposals are optimised.

196. Optimisation of protection is conducted on the basis that radiological doses and risks to workers and members of the public from a source of exposure should be kept As Low As Reasonably Achievable (the ALARA principle). The Environment Agency provide the following definition [Ref 17]:

"…..the means by which an operator optimises the operation of a practice in order to reduce and keep exposures from the disposal of radioactive waste into the environment as low as reasonably achievable, economic and social factors being taken into consideration (ALARA)."

3.2.2 Best Available Techniques

197. These techniques, described above in the application of ALARA, typically cover a range of engineering and management processes and practices and, when taken together, they are referred to as BAT. The Environment Agency define BAT as follows [Ref 28]:

The use of the best available techniques shall emphasise the use of non-waste technology, if available.

The term "best available techniques" means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration shall be given to:

a) comparable processes, facilities or methods of operation which have recently been successfully tried out;

b) technological advances and changes in scientific knowledge and understanding;

c) the economic feasibility of such techniques;

d) time limits for installation in both new and existing plants;

e) the nature and volume of the discharges and emissions concerned.

It therefore follows that what is "best available techniques" for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

If the reduction of discharges and emissions resulting from the use of best available techniques does not lead to environmentally acceptable results, additional measures have to be applied.

"Techniques" include both the technology used and the way in which the installation is designed, built, maintained, operated and dismantled.

3.2.3 Environmental Optimisation

198. SZC Co. has adopted the environmental standard developed and applied at HPC. This standard presents a policy statement and accompanying principles to satisfy company requirements and regulatory expectations relating to the demonstration of the application of BAT. This standard sits beneath the EDF

Energy corporate policy on Environment and articulates the expectations of SZC Co. at a high level in its approach to demonstration of the application of BAT and is consistent with SZC Co.'s other policies such as Health and Safety policy. This standard has close relationship with the Integrated Waste Management Standard [Ref 26] and Land Quality Management Standard [Ref 27].

199. This Standard is applicable to SZC Co. and its contractors in the design, manufacture, construction, installation, commissioning, operation and, ultimately, decommissioning of new nuclear power stations. Environmental optimisation, through the demonstration and application of BAT, is (and will continue to be) incorporated into the IMS arrangements, including modification and change control.

200. The construction, commissioning and operation of a UK EPR™ nuclear power station will have an impact on the environment because of the use of natural resources and generation of wastes and discharges. It has been policy during the design of the UK EPR™ to minimise these impacts as far as is reasonably achievable through the application of the waste hierarchy and BAT, consistent with safety and sustainability principles. All of the organisations involved in the design and construction of the UK EPR™, including contractors and subcontractors shall demonstrate, strong commitment to developing and maintaining a focus on best environmental practices and ensuring that the design minimises the impact on people and the environment. SZC Co. is committed to commissioning, operation and the ultimate decommissioning of its UK EPR™'s in a manner which minimises its impacts on workers, the public and the environment as far as reasonably achievable.

201. The Environmental Permitting (England and Wales) Regulations 2016 (as amended) translate the EC Basic Safety Standards Directive (BSSD), 2013 into UK law and require the Environment Agency to ensure that: "all exposures to ionising radiation of any member of the public and of the population as a whole resulting from the disposal of radioactive waste are kept ALARA, taking into account economic and social factors."

202. The RSR permit includes specific conditions to address this legal requirement. BAT is required to optimise performance, taking into account the broad range of factors indicated above to prevent, or where this is not possible, minimise the:

- Activity in the radioactive waste produced
- Activity discharged in gaseous and aqueous effluents
- Volume of solid waste produced
- Risks and environmental impacts of discharges and disposals

203. In addition, BAT must be applied to:

- Exclude all entrained solids, gases and non-aqueous liquids from radioactive aqueous waste prior to discharge to the environment
- Characterise, sort and segregate solid and non-aqueous liquid radioactive wastes, to facilitate their disposal by optimised disposal routes
- Monitoring and assessment of discharges and disposals.

204. Within the context of RSR, BAT is the means by which an operator optimises the operation of a practice in order to reduce and keep exposures from the disposal of radioactive waste into the environment ALARA, economic and social factors being taken into consideration. Those techniques which represent BAT are also taken to have met the requirements of optimisation and ALARA.

205. Importantly, this judgement includes comparing benefits in terms of safety, environmental protection etc., and costs in terms of time, effort or money. The Environment Agency considers that BAT is the point when the detriments from implementing further techniques become grossly disproportionate to the benefits gained [Ref 28]. The assessment should consider the performance and impacts over the lifecycle of the facility to ensure a holistic view is taken.

206. BAT may be determined by a comparison against international best practice, codes and standards, and operational experience or, where relevant good practice cannot be demonstrated, through an optioneering process where meaningful alternatives are available. BAT need not be complicated and should be an implicit part of the processes by which SZC Co. and its contractors plan to design, build and operate the plant. However, SZC Co. are required to be able to substantiate BAT explicitly, ensuring appropriate records are kept and maintained in the form of an “environment case” [Ref 25].

207. SZC Co. has adopted the following statement relating to the demonstration of BAT:

- SZC Co. shall ensure environmental optimisation, through the application of BAT, will be applied at all stages of the project lifecycle from design and procurement through operation to decommissioning and site restoration.
- SZC Co. recognises the importance of BAT in complying with its environmental permits and consents under the relevant environmental regulations necessary for the safe management, storage, treatment, monitoring, discharge and disposal of gaseous, liquid and solid radioactive and non-radioactive effluents and wastes arising from its sites.
- SZC Co. shall apply BAT to minimise discharges and the environmental impacts of activities.
- SZC Co. shall apply a proportionate, rigorous, transparent and timely process using an evidence-based approach to support, explicitly demonstrate and record its decisions and their basis.
- SZC Co. shall use appropriate tools and techniques when undertaking assessment to determine BAT consistent with NNB GenCo (HPC)’s principles for environmental optimisation.
- SZC Co. shall use a holistic and integrated approach to BAT taking into account relevant factors, including relevant social and economic considerations, in determining environmental optimisation.

208. This statement is accompanied by 7 principles which have informed the development of SZC Co.’s approach to the demonstration of BAT.

- Reduce risks and impacts to people and the environment so far as is reasonably achievable taking into account relevant factors, including technical, social and economic considerations, and determine the contribution that the techniques make to reduce these risks. This includes radiological and non-radiological risks and impacts.
- Apply the waste hierarchy to minimise waste arisings from all activities that will, or have the potential to, give rise to waste, with priority given to those techniques that eliminate or reduce the generation of waste.
- Determine and implement BAT at the most appropriate stage (i.e. design, procurement, construction, commissioning, operation, decommissioning and site restoration) of the project lifecycle and promote opportunities for continued optimisation during future phases of the project

where reasonably achievable.

- Demonstrate the application of best practice, guidance and standards to select techniques, and demonstrate where the application of best practice, guidance and standards is not possible that a meaningful range of alternatives have been considered.
- Demonstrate that the selection of BAT to deliver optimised performance is recorded through a series of arguments that, when taken together and underpinned by demonstrable and defensible evidence, supports the selection of the BAT.
- Adopt a proportionate, open and transparent approach ensuring the effort expended, both in terms of undertaking the assessment and implementing any findings, are in proportion to the benefits expected using an inclusive process which is recorded and maintained.
- Ensure adequate and appropriate training is provided to anyone involved in activities that may impact environmental optimisation and that they have access to competent resource for advice as appropriate.

3.2.4 BAT in relation to replication for Sizewell C

209. As described above, the SZC Co. strategy to develop SZC is to replicate the HPC design and approach as far as reasonable. The HPC design being sufficiently mature, GDA approved and with the necessary permits and licences is considered a suitable basis on which to develop SZC.

210. From a radioactive substances activity perspective, as described in Section 2 the related SSC are replicated from the HPC design, there is minimal change from the NI design between HPC and SZC with regards to the building design and use. In developing the HPC design, since GDA, BAT has continued to be applied by NNB GenCo (HPC).

211. Three potential elements which have been considered in the context of the design and site-specific factors which could affect radiological impact of SZC and subsequently influence the BAT case. These are: the height of the main unit discharge stack; the location of the marine outfall; and the location of the interim ILW and spent fuel stores. These issues are described in more detail in Supporting Document A1.

212. In summary, the height of the stack is balance between increasing the height to achieve potentially better dispersion of material discharged from the stack and reducing the stack height to minimise the visual impact of the installation. A reduction in stack height will also have a corresponding reduction in materials usage (both in the stack itself and the corresponding foundations), a potential reduction in health and safety risk and a reduction in cost. Any change in stack height from that designed at HPC would require redesign of stack sampling systems and ventilation systems. An analysis was undertaken [Ref 29] which is reported in the Environment Case [Ref 25]. This concluded that there were no significant advantages to increasing or decreasing the stack height. There was not a significant reduction of air concentrations at nearby site-specific receptors that would warrant a change. This is supported by the low doses calculated for discharges to atmosphere.

213. The location of the outfall has been carefully considered to meet a variety of different factors including nuclear safety requirements, marine geomorphology, thermal capacity. The siting of the outfall heads need to ensure there is good dissipation of the thermal plume. In achieving this, within the constraints set by other factors then good dispersion of radionuclides from the aqueous discharges will also be achieved. Further information is provided in RSR Permit Application Support Document A1.

214. The HHK and HHI are located in a different part of the site compared to HPC and are slightly different dimensions. They will have the same capacity to store wastes and spent fuel generated from operations on the SZC site. The dimensions and location for these facilities is driven by the space available and the confines of the site boundary. The RIA includes consideration of external doses from external irradiation directly from the buildings and indirectly via a pathway called skyshine. The dose assessment shows the dose from both of these pathways is negligible and further study to optimise the location is not warranted.

215. Section 4 (and RSR Permit Application Support Document B) describes in detail how the proposed limits have been developed for SZC. The discharge limits proposed for SZC have been produced by taking the HPC granted limits, following review for SZC applicability. As described in Section 5 (and RSR Permit Application Support Document D1 and D2) the proposed limits have been used to determine the potential impact on the local environment and members of the public. There are legal levels that exposure is required to be within in order to demonstrate reduction of risk as far as reasonably achievable. The impact on the local environment and members of the public due to the proposed operation of SZC has been confirmed to be lower than the current legal limits. It is therefore, noted that the RSR specific aspects of the design are suitable for SZC.

216. It is recognised that overtime, further learning and improved practices will be identified, as more operational UK EPR™ OEF becomes available, SZC Co. will review and incorporate any information as considered applicable [SZC RSR CMT 1].

3.2.5 Proportionality principle

217. The EA's guidance [Ref 28] also states:

"We [the EA] take a BAT proportionate approach in relation to

- *the degree of assessment and demonstration we require of operators and undertake ourselves; and*
- *the techniques we require operators to use."*

218. Consequently, the demonstration of optimisation may vary from a detailed study involving an options assessment, selection and minimisation for the operation of a nuclear site to a short description of operation in accordance with recognised standards and guidance. But in all cases the overall assessment process can be described very simply as:

- Asking if there is anything further that can be done to reduce doses to people and the environment; and
- Then implementing it unless the associated detriments are grossly disproportionate to the benefits gained.

219. In other words, BAT is the point when the detriments from implementing further techniques become grossly disproportionate to the benefits gained. The Environment Agency recognise that such an assessment does not necessarily need complicated cost-benefit analysis. The use of experienced people, ownership, sound judgement and a clear, logical argument will often be sufficient to make a successful case.

220. The application of proportionality in the assessment of BAT is an important part of the methodology for demonstration of environmental optimisation for SZC and is described in Section 1. It enables focus to be placed on those areas which have most impacts, in terms of environmental performance, at the current stage of development of the installation. SZC Co. benefits from the professional experience and judgement

of its design team to apply proportionality using a blend of reasoned logical argument and good practice to design modifications for SZC that are often not of the scale requiring a full options assessment/MADA approach.

3.2.6 Precautionary principle

221. The precautionary principle was formally adopted in the Maastricht Treaty in 1992, and is one of the main principles on which EU environmental policy is based. It imposes an obligation on EU institutions to ensure that environmental policy is based on the precautionary principle. In associated EC guidance [Ref 30] it goes onto recognise that any measures adopted on the basis of the precautionary principle should also be:

- Proportionate (i.e. should not go beyond what is appropriate);
- Non-discriminatory and consistent (meaning that comparable situations should not be treated differently);
- Based on cost-benefit analysis; and
- Subject to review when new scientific information becomes available.

222. The Sustainable Development White Paper, set out the UK Government's commitment to use the precautionary principle by reference to the 1992 Rio Declaration on Environment and Development which stated:

"Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".

223. Although the precautionary principle was originally framed in the context of preventing environmental harm, it is now widely accepted as applying broadly where there is threat of harm to human, animal or plant health, as well as in situations where there is a threat of environmental damage.

224. Policy guidelines indicate when, for example, the precautionary principle should be invoked, how a risk-based approach can continue to be followed when the scientific uncertainty is such that conventional risk assessment cannot in itself determine the level of risk, and how decisions should be made on appropriate precautionary measures.

225. The Precautionary Principle is one of the key elements for policy decisions concerning environmental protection and management that underpins Environment Agency decision making. It is applied in the circumstances where there are reasonable grounds for concern that an activity is, or could, cause harm but where there is uncertainty about the probability of the risk and the degree of harm. It was originally intended to avoid situations where inaction would result from a lack of scientific evidence to act now. Von Schomberg [Ref 31] highlights the precautionary principle is not intended to apply to hypothetical effects and imaginary risks and will not apply where the desired level of protection is defined and the risk of harm can be quantified. This situation can be dealt with using ‘normal’ risk- management tools.

3.2.7 Polluter pays principle

226. The polluter pays principle is also part of a set of broader principles to guide sustainable development worldwide by reference to the 1992 Rio Declaration on Environment and Development.

227. The 'polluter pays' principle is the commonly accepted practice that those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment.

228. This principle underpins most of the regulation of pollution affecting land, water and air. Where pollution is defined as contamination of the land, water or air by harmful or potentially harmful substances.

3.2.8 Concentrate and contain

229. The preferred way to manage and control hazardous and radiological wastes is to concentrate and contain the waste and to isolate it from the environment.

230. In the case of radioactive waste 'concentrate and contain' means reduction of volume and confinement of the radionuclide contents by means of a conditioning process to prevent dispersion in the environment [Ref 28].

3.2.9 Intergenerational equity

231. The objective is to control and account for radioactive waste to protect human health and the environment now, but also to make sure we do not leave unnecessary burdens for future generations. This allows any releases to the environment to be restricted and subject to regulatory control.

3.2.10 Waste management hierarchy

232. The waste hierarchy is a stepwise approach to achieving waste minimisation that considers the lifecycles of both the processes that create waste and the waste that is produced from them.

233. The hierarchy, is set out in the Waste Framework Directive [Ref 32] in the following order of priority:

- Prevention - Creation of waste should be prevented, or reduced at source (i.e. minimised);
- Preparing for reuse: Where waste cannot be prevented, waste materials or products should, where appropriate, be reused directly or refurbished then reused;
- Recycling: Waste materials should be recycled or processed into a form that allows them to be reclaimed as a secondary raw material, where appropriate; and
- Disposal: Only if waste cannot be prevented, reused, recycled or recovered should it be disposed of into the environment and this should only be undertaken in a controlled and authorised manner.

234. These principles have been adopted in the UK government policy on radioactive waste management [Ref 33]. The regulators consider that they should be applied during the planning, design, construction, manufacture, commissioning, operational and decommissioning stages of a facility SFAIRP.

3.2.11 Relevant good practice

235. Good practice may take many forms. The scope and detail of good practice will reflect the nature of the hazards and risks, the complexity of the activity or process and the nature of the relevant legal requirements.

236. ONR and Environment Agency expect licensees and / or permit holders to apply relevant good practice as a minimum.

237. What is accepted as relevant good practice may change over time because of technological innovation which improves the degree of control, cost impact of improvements or knowledge about the hazard.

238. In terms of specific sources of relevant good practice for the nuclear industry there are several legal requirements which must be met and in some cases Approved Codes of Practice and Guidance have been issued to assist the licensee in achieving compliance.

239. There are also several national and international bodies which produce standards or guidance documents. Where the UK is tied by international agreements, e.g. EU, the standards have the same status as UK ones; where such agreements do not exist, the guidance may be considered as authoritative, but subsidiary to UK requirements.

3.3 Environment Case

3.3.1 Introduction

240. RSR Permit Application Support Document A1 [Ref 25] presents the Environment Case for SZC. The supporting document outlines the key consideration for demonstrating BAT. It describes the approach to SZC Co. has adopted to demonstrate the application of BAT recognising the substantial work undertaken at HPC on which the SZC design is based. It presents a summary of the BAT case by radionuclides and key system before detailing each of the claims with its supporting argument and evidence.

241. The Environment Case covers 4 interlinked topics, as shown in Figure 3-1.

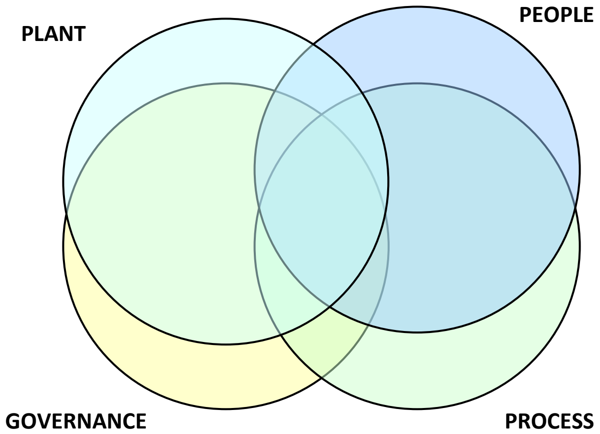


Figure 3-1 Environment Case Topics

242. SZC Co. will manage:

- People – The human resource elements of SZC Co. including training, development and competency. The management of this is covered in Section 6.
- Governance – The decision-making process, financial resources and their arrangements within SZC Co.. This includes ensuring that the company has processes in place to manage the implementation of UK and international Environmental Policy and subsequent environmental legislation. Changes to the governance arrangements may indirectly impact the Environment Case, however it is unlikely to alter the CAE approach that is fundamental to the Environment Case, and so governance

arrangements are not discussed further in this document.

- Process – This covers the management and compliance arrangements of SZC Co., including: company policies, procedures and guidelines; implemented by an overarching Manage Procedures document. Changes to the Manage Procedures document may result in a change or update to a Claim, Argument or piece of Evidence, however, it is unlikely to alter the CAE approach that is fundamental to the Environment Case, and so the Manage Procedures document is not discussed further in this document. This is captured within the SZC RSR Permit Application Head Document (Section 7).
- Plant – This is presented as the Environment Case, the HPC Environment Case has been reviewed and adopted into SZC, as appropriate, as well as being updated against latest information and SZC design, as is consistent with the replication strategy described in Section 2.2.6.

243. The Environment Case builds on foundations demonstrated during the GDA, and the current HPC design development. The demonstration of BAT will be continued through the implementation of the FWP presented in Section 8.2 and maintained in the Environment Open Points Register [Ref 34]. Demonstration of BAT is a pre-requisite for applying for limits for discharges of radioactive waste to the environment. The proposed discharge limits being applied for in this application, described in Section 4, takes full account of the benefits that are derived through the application of BAT that is outlined here and is described in more detail in RSR Permit Application Support Document A1 [Ref 25].

3.3.2 Development of the Environment Case

244. The Environment Case, presented in Section 3.3 in this application, provides a documented record of the application of BAT using the terminology of 'Claims', 'Arguments' and 'Evidence', defined as:

- Claim – A high-level statement of what is being sought in terms of environmental optimisation. The Claim may be based on a specific permit condition or regulatory requirement.
- Argument – An element that contributes to achieving a claim (or claims). It links the evidence to the claim. The argument can be deterministic, qualitative and/or quantitative, and contributes to the demonstration that a claim is valid. The Environment Case includes "sub-arguments" that allows complex arguments to be further subdivided, where needed.
- Evidence – This is used as the basis of the argument i.e. how the argument is validated. Evidence can be facts, (e.g. based on established scientific principles and prior research or practices elsewhere), or assumptions.

245. The high-level Claims for SZC are given in Table 3-1. Each Claim is supported by Arguments (and Sub-Arguments in some cases) and substantiated by Evidence and Identified References, an illustration of which is shown in Figure 3-2.

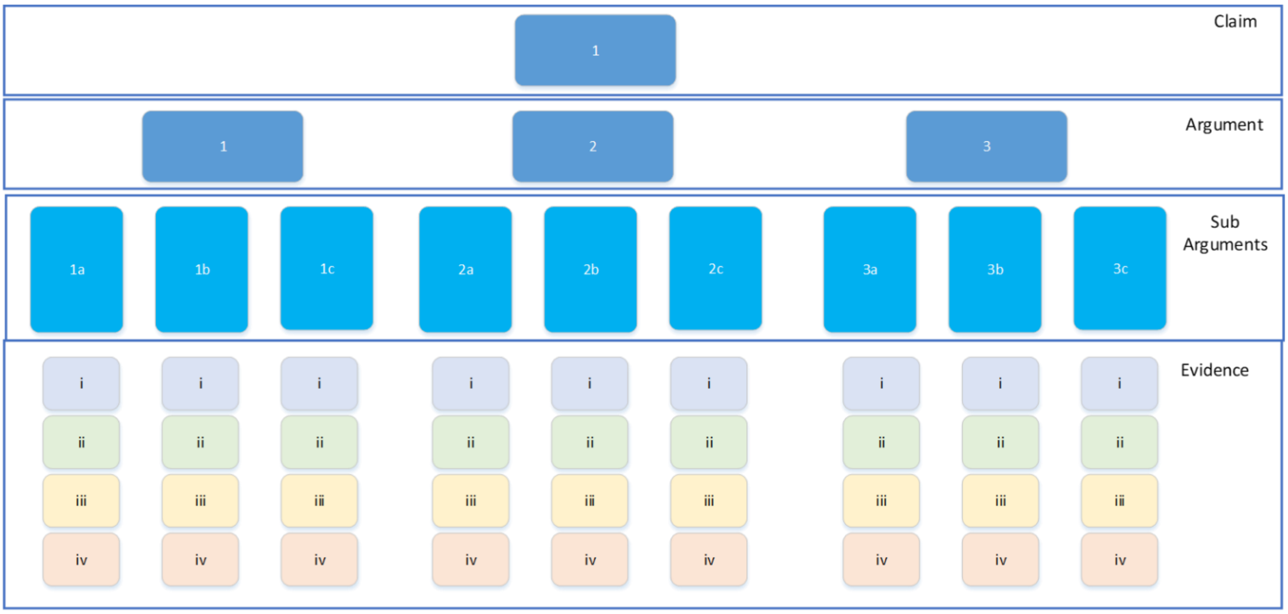


Figure 3-2 Illustration of Claims-Arguments-Evidence method for demonstrating BAT

Table 3-1 SZC Environment Case Claims

Environment Case Claims	
Claim 1	SZC Co. Shall Eliminate or Reduce the Generation of Radioactive Waste.
Claim 2	SZC Co. Shall Minimise the Amount of Radioactivity Discharged or Disposed of to the Environment
Claim 3	SZC Co. Shall Minimise the Volume of Radioactive Waste Disposed to Other Premises
Claim 4	SZC Co. Shall Minimise the Impacts on the Environment and Members of the Public from Radioactive Waste that is Discharged or Disposed of to the Environment
Claim 5	SZC Co. Shall Undertake Appropriate Monitoring to Check Compliance with the Conditions of the RSR Permit.

246. This section presents the CAE that have been generated to summarise the Environment Case for optimisation through the application of BAT. Full details of the methodology adopted in the production of the case are provided in RSR Permit Application Support Document A1 [Ref 25].

247. The arguments (and where applicable sub arguments) that have been prepared to demonstrate that the claim is valid have been grouped under each claim. Each argument is directly followed by the relevant evidence that has been gathered during the preparation of the case.

248. The claims and arguments presented are based on the evidence that was available during the preparation of this application and relate primarily to the design of systems and components. The arguments, together with their evidence, are presented for each claim. In each case the argument is presented first, followed where applicable by sub arguments and then by sub-sections which provide the evidence for each of the main elements of each argument.

249. It is recognised that any significant design changes in the future will be subject to demonstration of BAT following established guidance and change control arrangements.

3.3.3 The SZC Environment Case

250. The following section describes the high level and key parts that make up the SZC Environment Case. Further details of the CAE are presented in Supporting Document A1 [Ref 25].

3.3.3.1 Key Arguments

251. Significant arguments related to radwaste systems KEPE are provided below, the full CAE are set out within the RSR Permit Application Support Document A1 – Environment Case.

Table 3-2 Claims and arguments grouped by system

System	Relevant claims and arguments[4]
Reactor Coolant System (RCP)	C1A4 - Specification of Materials C1A5 - Primary Coolant Chemistry C1A6 - Commissioning, Start-up and Shutdown procedures C2A9 - Design, Construction and Operation of Containment Systems C2A10SA2 - Design to prevent / minimise discharges during decommissioning C2A12SA15 - Ion Exchange of Liquid Effluents (for demineralisers in the NSSS) C2A12SA16 - Selection of Ion Exchange Resins (for demineralisers in the NSSS) C3A15 - Design to minimise the volume of operational and decommissioning waste arisings
Chemical and Volume Control System (RCV)	C1A5 - Management of Primary Coolant Chemistry to Minimise the Activity and Generation of Radioactive Waste C2A9 - Design, Construction and Operation of Containment Systems C2A10SA7 - Reactor Start-up and shutdown procedures C2A12SA15 - Ion Exchange of Liquid Effluents C2A12SA16 - Selection of Ion Exchange Resins C2A12SA18 - Filtration of Liquid Discharges C2A13SA22 - Decay Storage of Gases prior to Discharge C4A19 - Preferential Partitioning of Radionuclides
Nuclear Island Sampling system (REN/RES)	C1A5 - Management of Primary Coolant Chemistry to Minimise the Activity and Generation of Radioactive Waste C2A10SA6 - Control of Coolant Chemistry to Ensure Integrity of the Secondary Circuit C2A10SA7 - Reactor Start-Up and Shutdown Philosophies C212SA15 - Ion Exchange of Liquid Effluents C2A12SA19 - Segregation and Management of Liquid Effluents
Steam Generator Blowdown System (APG)	C2A10SA6 - Control of Coolant Chemistry to Ensure Integrity of the Secondary Circuit C212SA15 - Ion Exchange of Liquid Effluents C2A12SA18 - Filtration of Liquid Discharges C2A12SA19A9 - Segregation and Management of Liquid Effluents
Nuclear Vent and Drain System (RPE)	C1A4 - Specification of Materials C2A9 - Design, Construction and Operation of Containment Systems

[4] Nomenclature for claims and arguments is as follows: CxAxSAx where x denotes the number of the C (Claim), A (Argument) or SA (Sub Argument). For example, C2A13SA24 relates to Sub Argument 24 of Argument 13 in Claim 2 of the SZC Environment Case (as detailed in Section 2.3).

	C2A12SA19A9 - Segregation and Management of Liquid Effluents C2A12SA20 - Decay Storage of Liquid Effluent prior to Discharge
Coolant Storage and Treatment System (TEP)	C2A9- The Design, Construction and Operation of Containment Systems C1A5 - Management of Primary Coolant Chemistry to Minimise the Activity and Generation of Radioactive Waste C212SA15 - Ion Exchange of Liquid Effluents C2A12SA17 - Evaporation of liquid discharges C2A12SA18 - Filtration of liquid discharges C2A12SA19A9 - Segregation and Management of Liquid Effluents C2A12SA20 - Decay Storage of Effluent prior to discharge C3A6 - Selection of Methods to Minimise Solid Waste Generation C4A19 - Preferential Partitioning of Radionuclides
Reactor Boron Water Make-up System (REA)	C1A5 - Management of Primary Coolant Chemistry to Minimise the Activity and Generation of Radioactive Waste C212SA15 - Ion Exchange of Liquid Effluents
Spent fuel pool water cooling system and fuel pool water processing system (PTR)	C2A9 - The Design, Construction and Operation of Containment Systems C2A10SA2 - Design to prevent/minimise discharges during decommissioning C212SA15 - Ion Exchange of Liquid Effluents C212SA16 - Selection of Ion Exchange Resins C2A12SA17 - Evaporation of liquid discharges C2A12SA18 - Filtration of liquid discharges
In-Containment Refuelling Water Storage Tank (IRWST)	C2A9 - The Design, Construction and Operation of Containment Systems C2A10SA2 - Design to prevent/minimise discharges during decommissioning
Gaseous Waste Processing System (TEG)	C2A9 - The Design, Construction and Operation of Containment Systems C2A10SA2 - Design to prevent/minimise discharges during decommissioning C2A10SA7 - Reactor Start-up and Shutdown procedures C2A13SA22 - Decay Storage of Gases prior to discharge C2A13SA23 - Process Gas Recirculation System C2A13SA24 - Filtration of gaseous discharges C2A13SA2 - Gaseous Waste Discharge System C4A19 - Preferential partitioning of radionuclides
Solid Waste Processing System (TES)	C2A10SA2 - Design to prevent/minimise discharges during decommissioning C2A12SA17 - Evaporation of Liquid Discharges C2A14 - Decay Storage of Solid Radioactive Waste C3A16 - Selection of Methods to minimise solid waste generation C3A17 - Application of Volume Reduction Processes to Solid Wastes

Liquid Waste Processing System (TEU)	C1A6 - Commissioning, Start-Up and Shutdown Procedures C2A9 - The Design, Construction and Operation of Containment Systems C212SA15 - Ion Exchange of Liquid Effluents C212SA16 - Selection of Ion Exchange Resins C2A12SA17 - Evaporation of liquid discharges C2A12SA18 - Filtration of liquid discharges C2A12SA19A9 - Segregation and Management of Liquid Effluents C2A12SA20 - Decay Storage of Effluent prior to discharge C4A19 - Preferential partitioning of radionuclides C4A20 An appropriately designed Liquid Effluent Discharge System will minimise impacts of discharges to the environment
Condenser Vacuum (CVI)	C2A13SA23 - Process Gas Recirculation System C2A13SA24 - Filtration of Gaseous Discharges
Liquid Radwaste Monitoring and Discharge System (KER)	C2A9 - The Design, Construction and Operation of Containment Systems C2A12SA17 - Evaporation of liquid discharges C4A20 - An appropriately designed Liquid Effluent Discharge System will minimise impacts of discharges to the environment
Additional Liquid Waste Discharge System (TER)	C2A12SA18 - Filtration of liquid discharges C4A20 - An appropriately designed Liquid Effluent Discharge System will minimise impacts of discharges to the environment C4A19- Preferential partitioning of radionuclides
Site Liquid Waste Discharge System (SEK)	C2A12SA18 - Filtration of liquid discharges C2A12SA19A9 - Segregation and Management of Liquid Effluents C4A20 - An appropriately designed Liquid Effluent Discharge System will minimise impacts of discharges to the environment
Plant Radiation Monitoring System (KRT)	C3A16 - Selection of Methods to minimise solid waste generation C4A21 – Appropriately designed Gaseous Discharge Points will minimise impacts of discharges to the environment
Building Ventilation Systems	
Containment Sweep Ventilation System (EBA)	C2A9 - Design, construction and operation of containment systems C2A13SA24 - Filtration of Gaseous Discharges C4A19 - Preferential partitioning of radionuclides
Controlled Safeguards Building Ventilation System	C2A9 - Design, construction and operation of containment systems C2A13SA24 - Filtration of Gaseous Discharges
Fuel Building Ventilation System (DWK)	C2A9 - Design, construction and operation of containment systems C2A13SA24 - Filtration of Gaseous Discharges
Nuclear Auxiliary Building Ventilation Systems (DWN)	C2A9 - Design and construction and operation of containment systems C2A13SA24 - Filtration of Gaseous Discharges C2ASA24 - Gaseous waste discharge system C4A21 – Appropriately designed Gaseous Discharge Points will minimise impacts of discharges to the environment
Effluent Treatment Building Ventilation System (9DWQ)	C2A9 - Design, construction and operation of containment systems C2A13SA24 - Filtration of Gaseous Discharges
Operating Building Ventilation Systems	C2A9 - Design, construction and operation of containment systems C2A13SA24 - Filtration of Gaseous Discharges

Access Building Ventilation System	C2A9 - Design, construction and operation of containment systems C2A13SA24 - Filtration of Gaseous Discharges
Annulus Ventilation System (EDE)	C2A9 - Design, construction and operation of containment systems

3.3.3.2 Claims, Arguments and Evidence

252. The following section graphically summarises the Environment Case for SZC showing the hierarchy of arguments and evidence that site under each of the main claims, see Figure 3-3 – Figure 3-19. Further details of the CAE are presented in Supporting Document A1 [Ref 25].

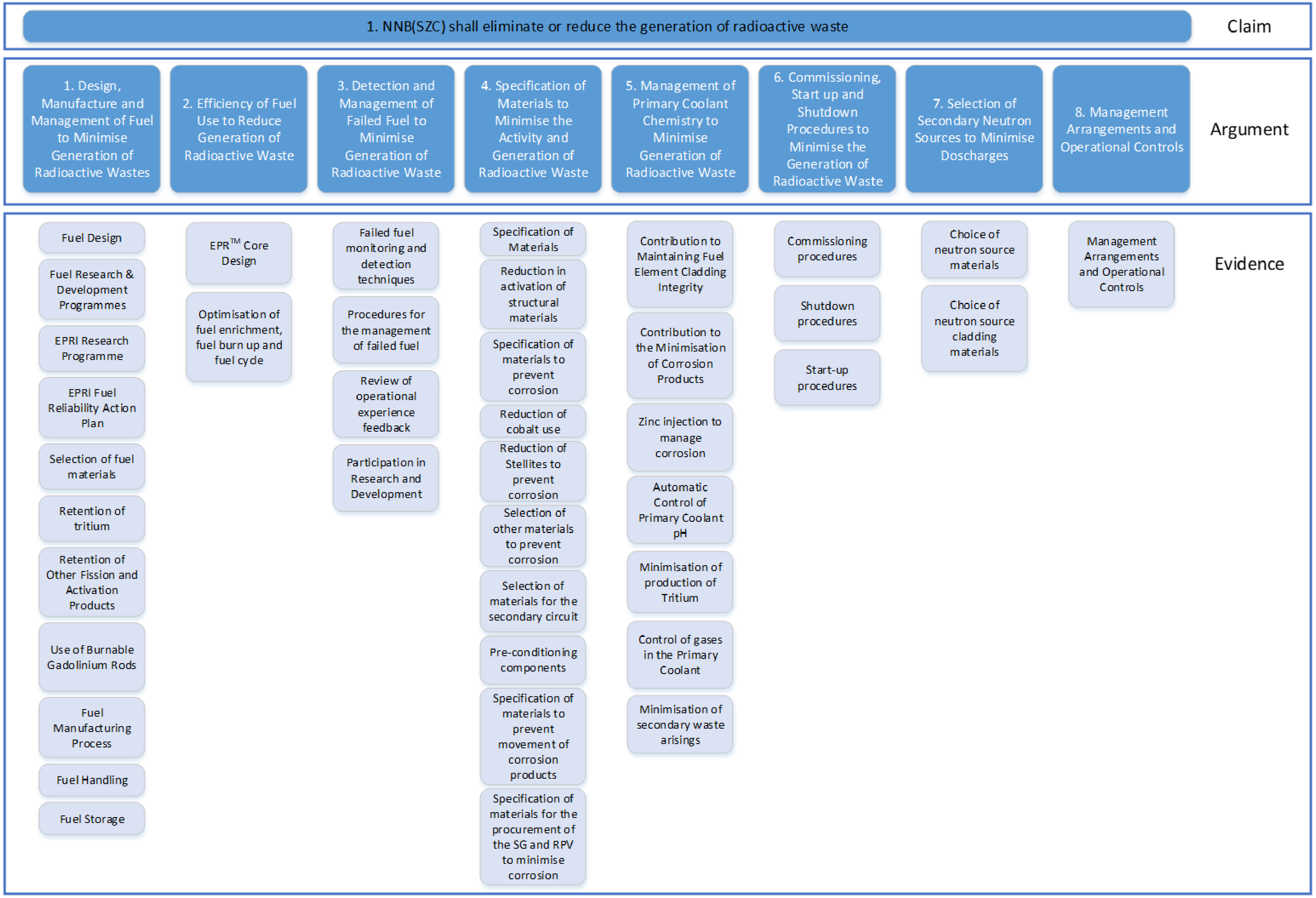


Figure 3-3 Claim 1 Overarching Structure

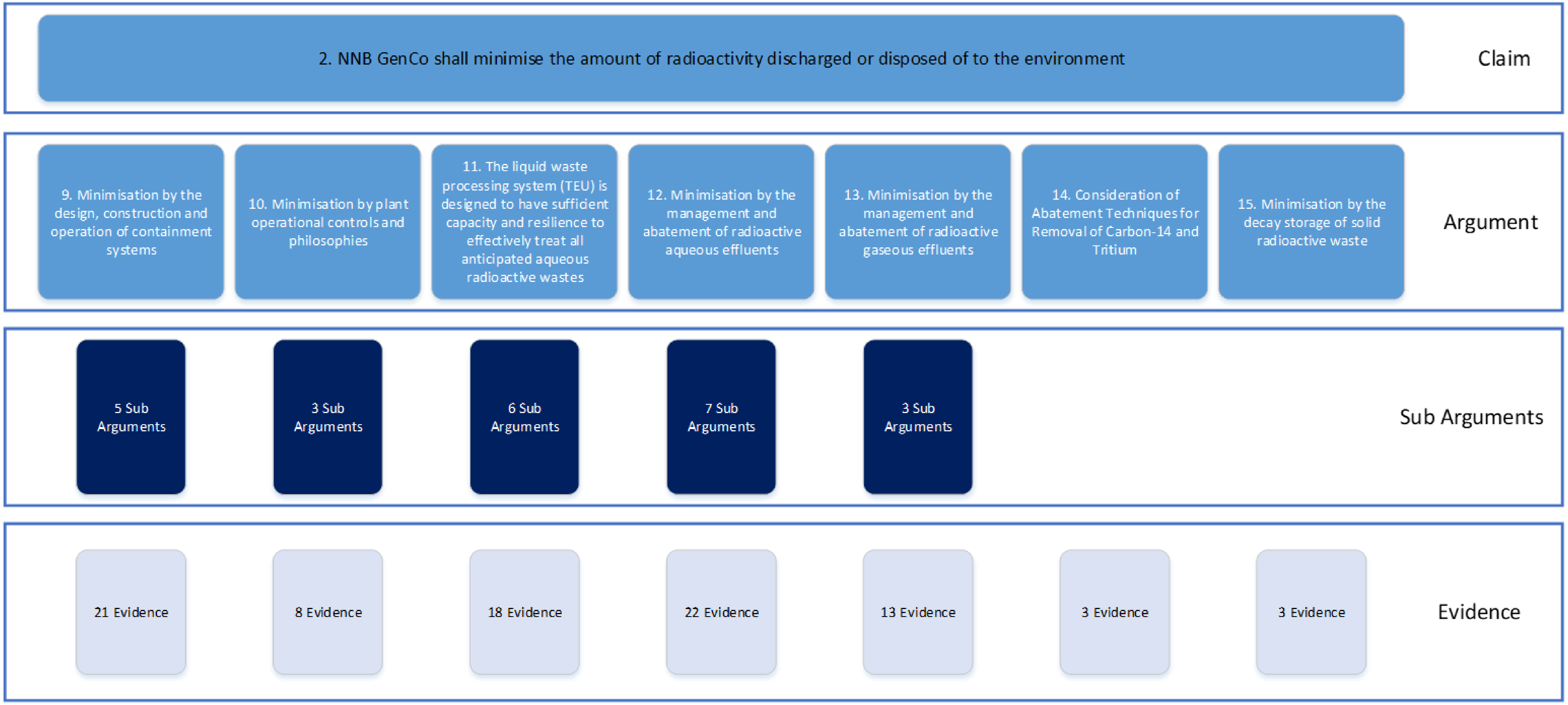


Figure 3-4 Claim 2 Overarching Structure

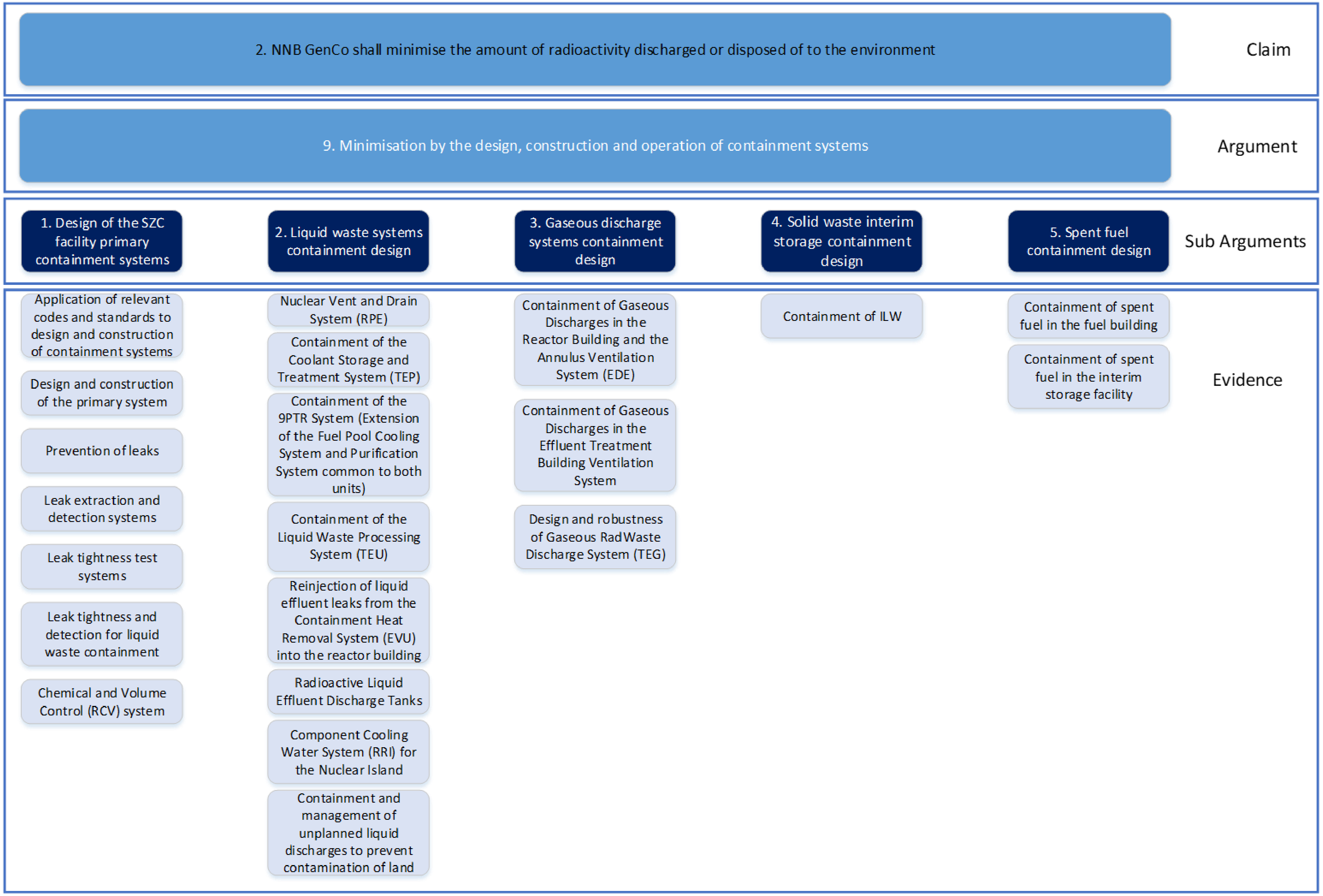


Figure 3-5 Claim 2 Argument 9

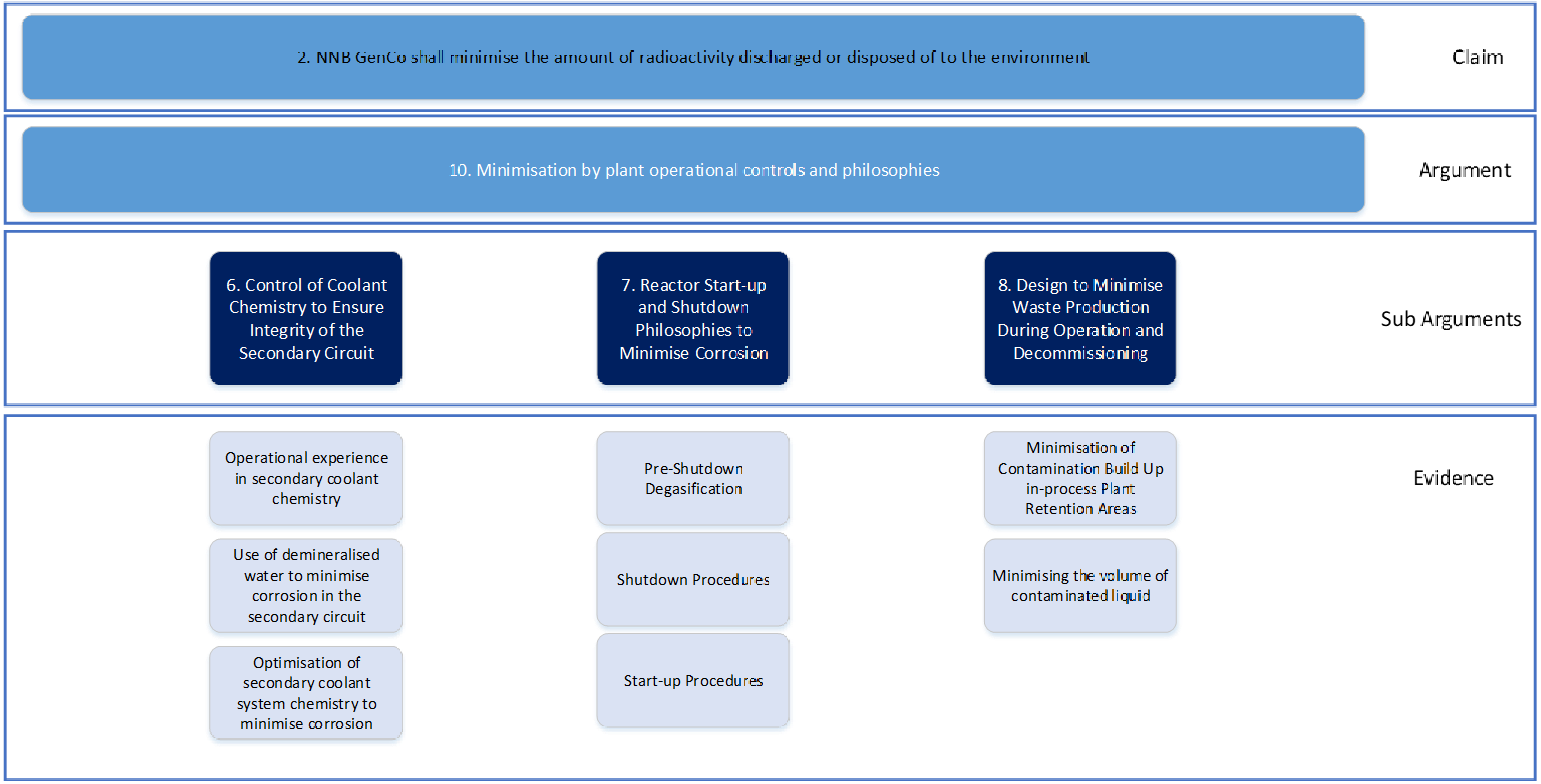


Figure 3-6 Claim 2 Argument 10

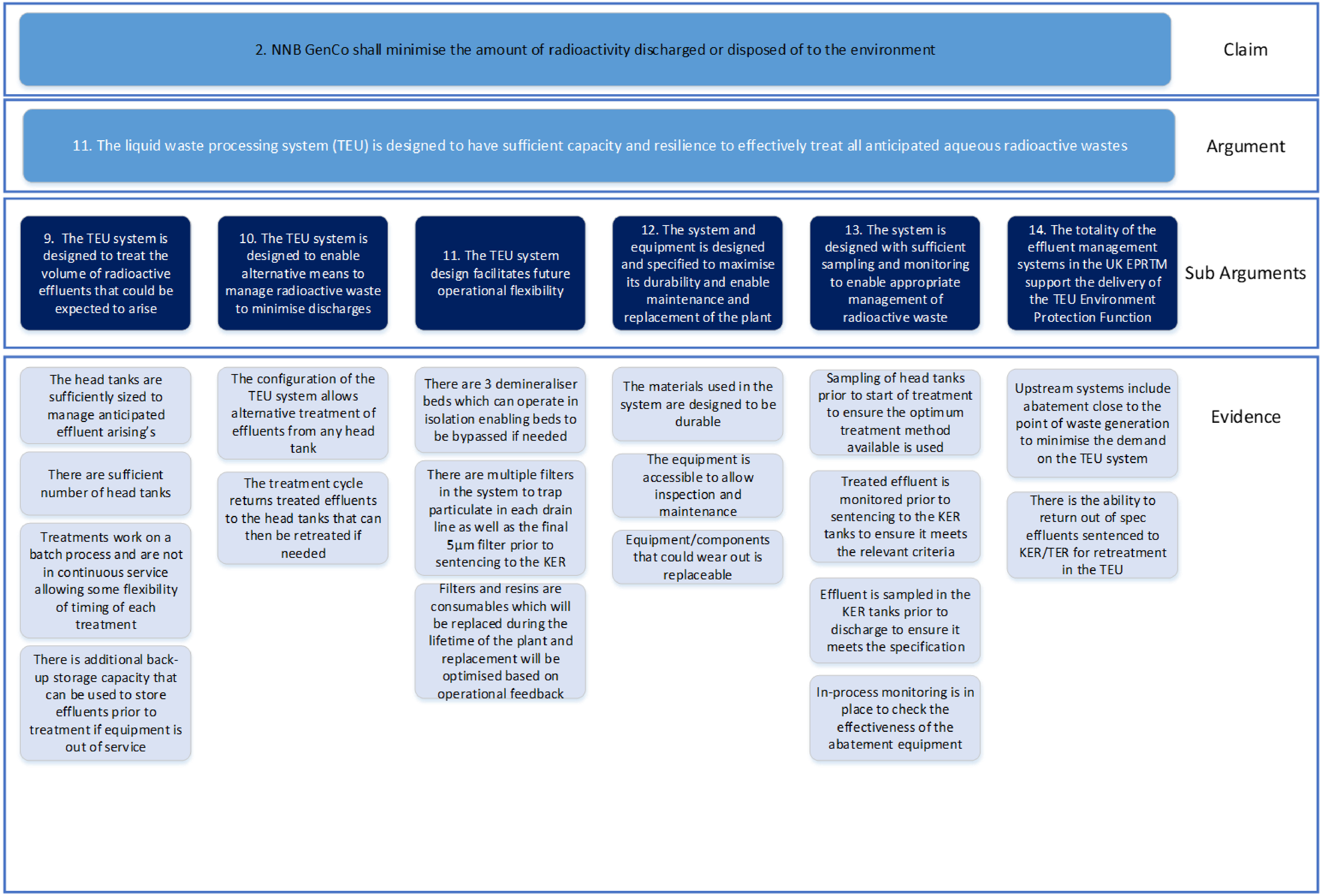


Figure 3-7 Claim 2 Argument 11

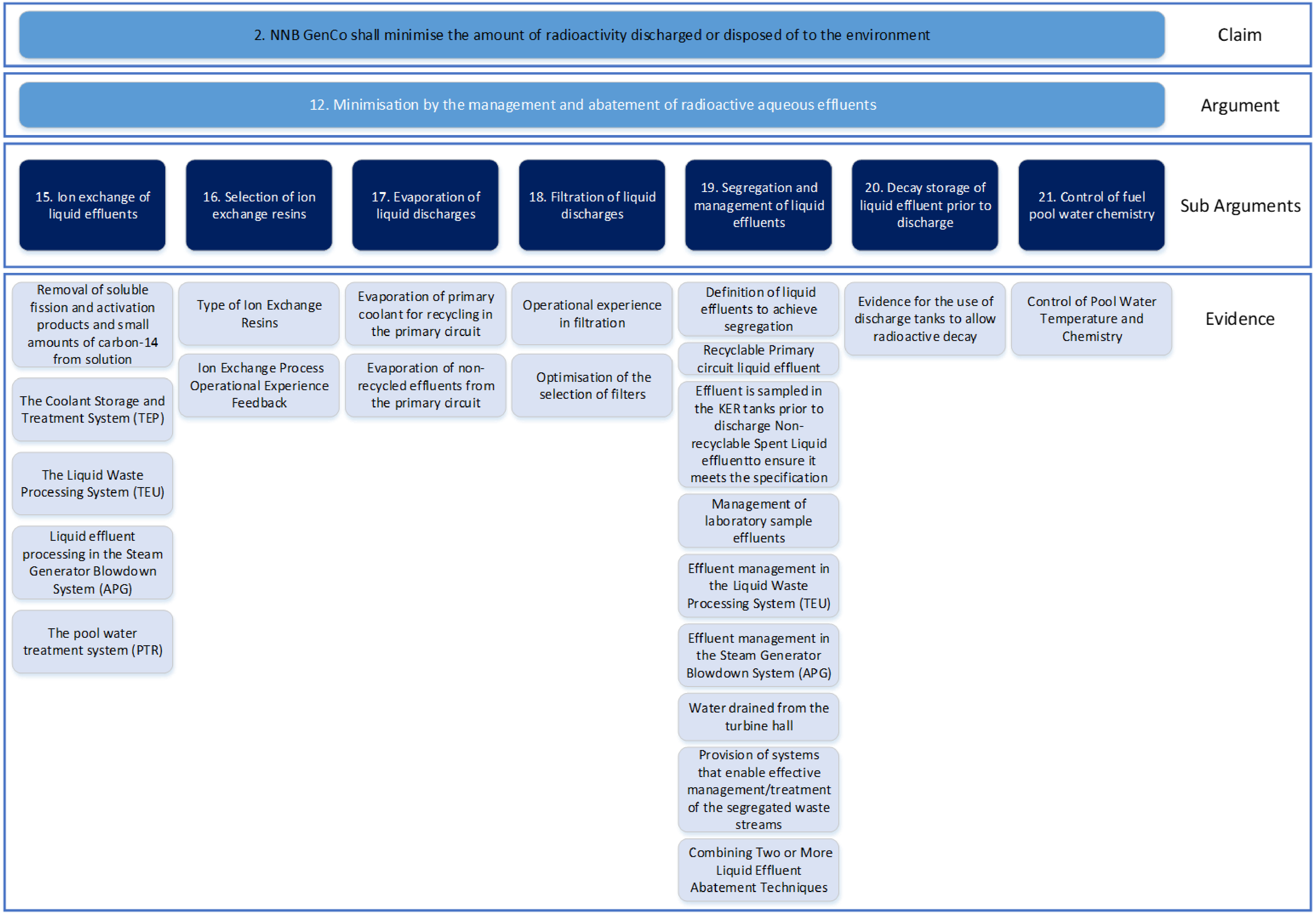


Figure 3-8 Claim 2 Argument 12

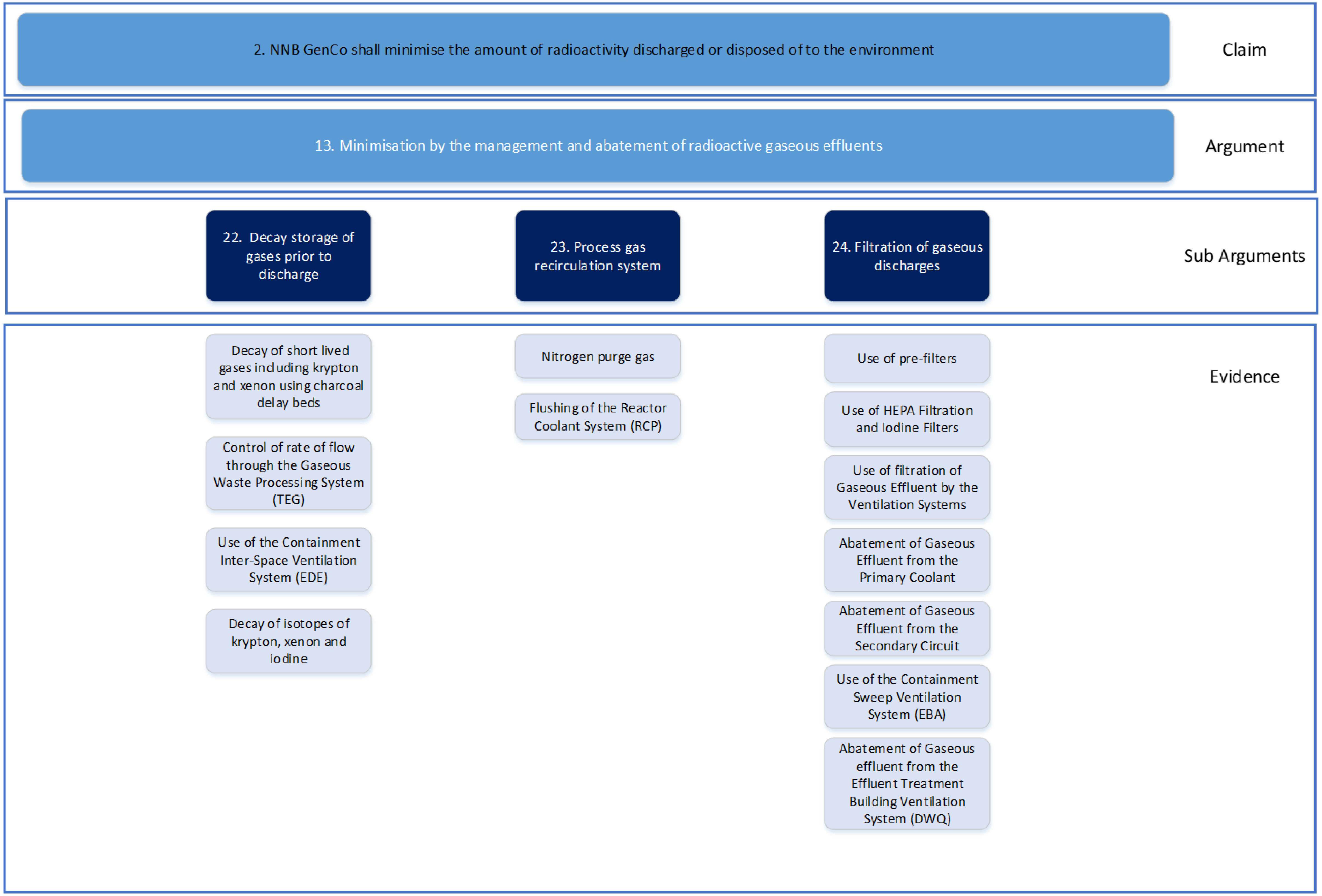


Figure 3-9 Claim 2 Argument 13

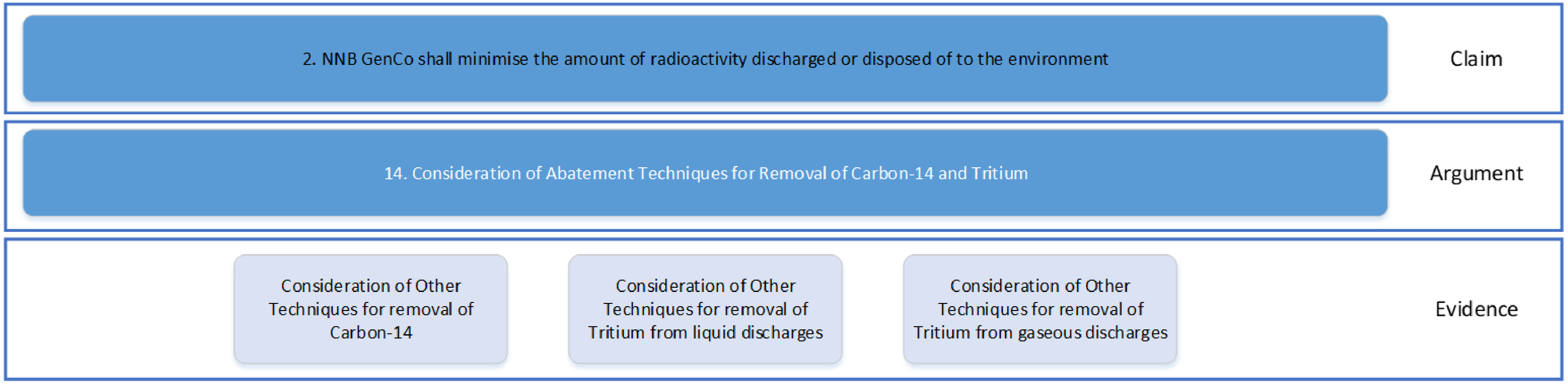


Figure 3-10 Claim 2 Argument 14

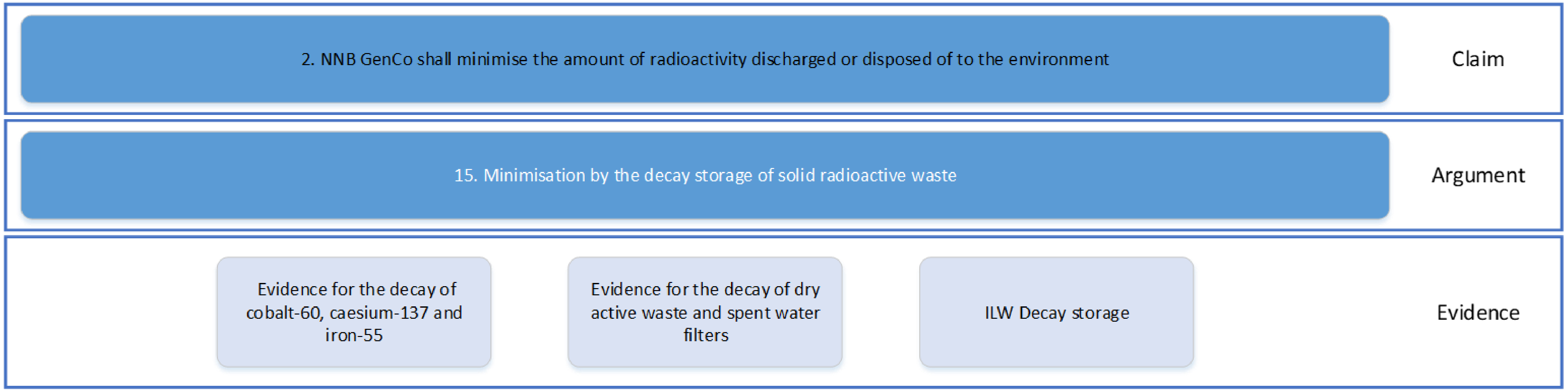


Figure 3-11 Claim 2 Argument 15

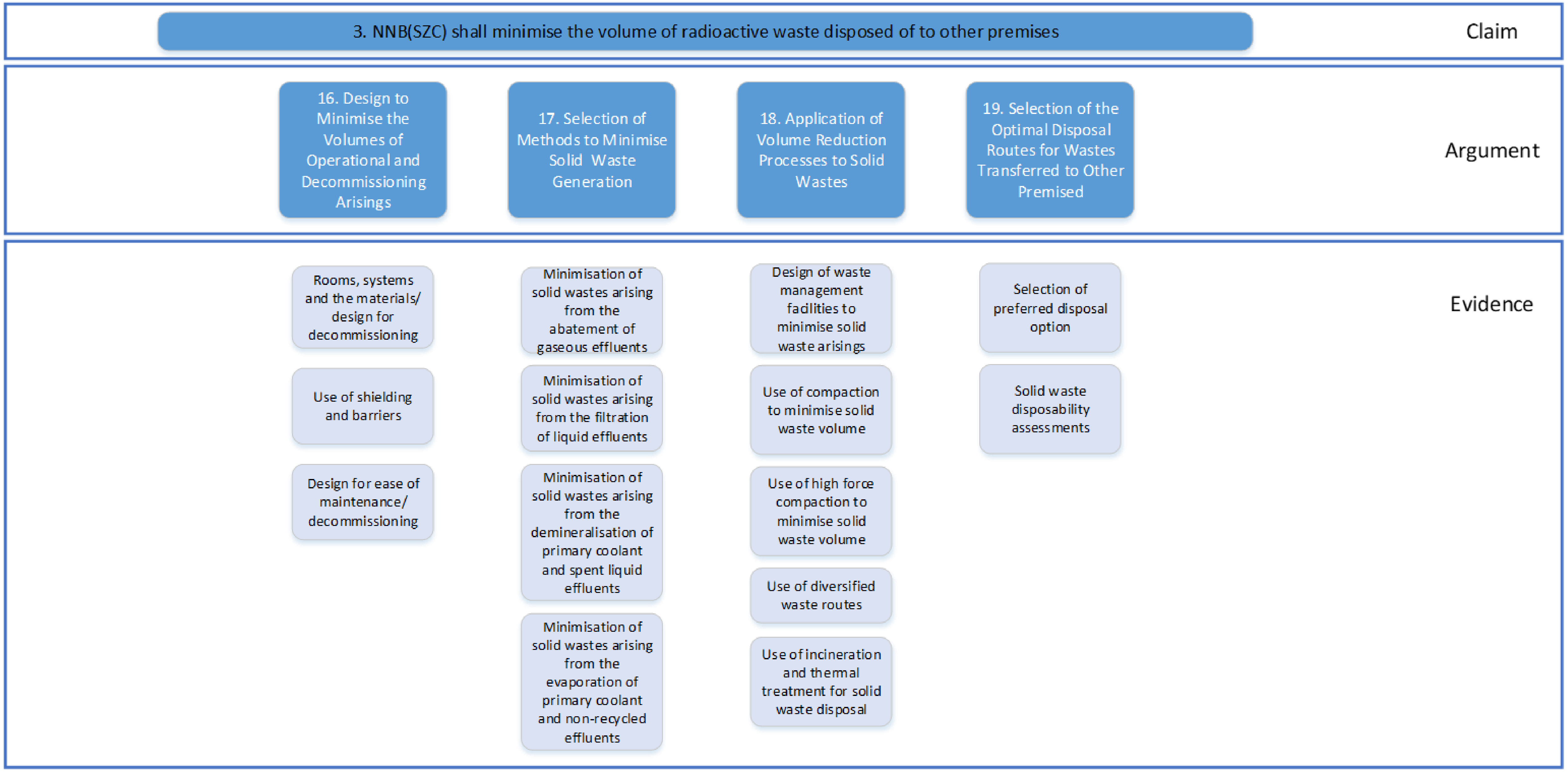


Figure 3-12 Claim 3 Overarching Structure

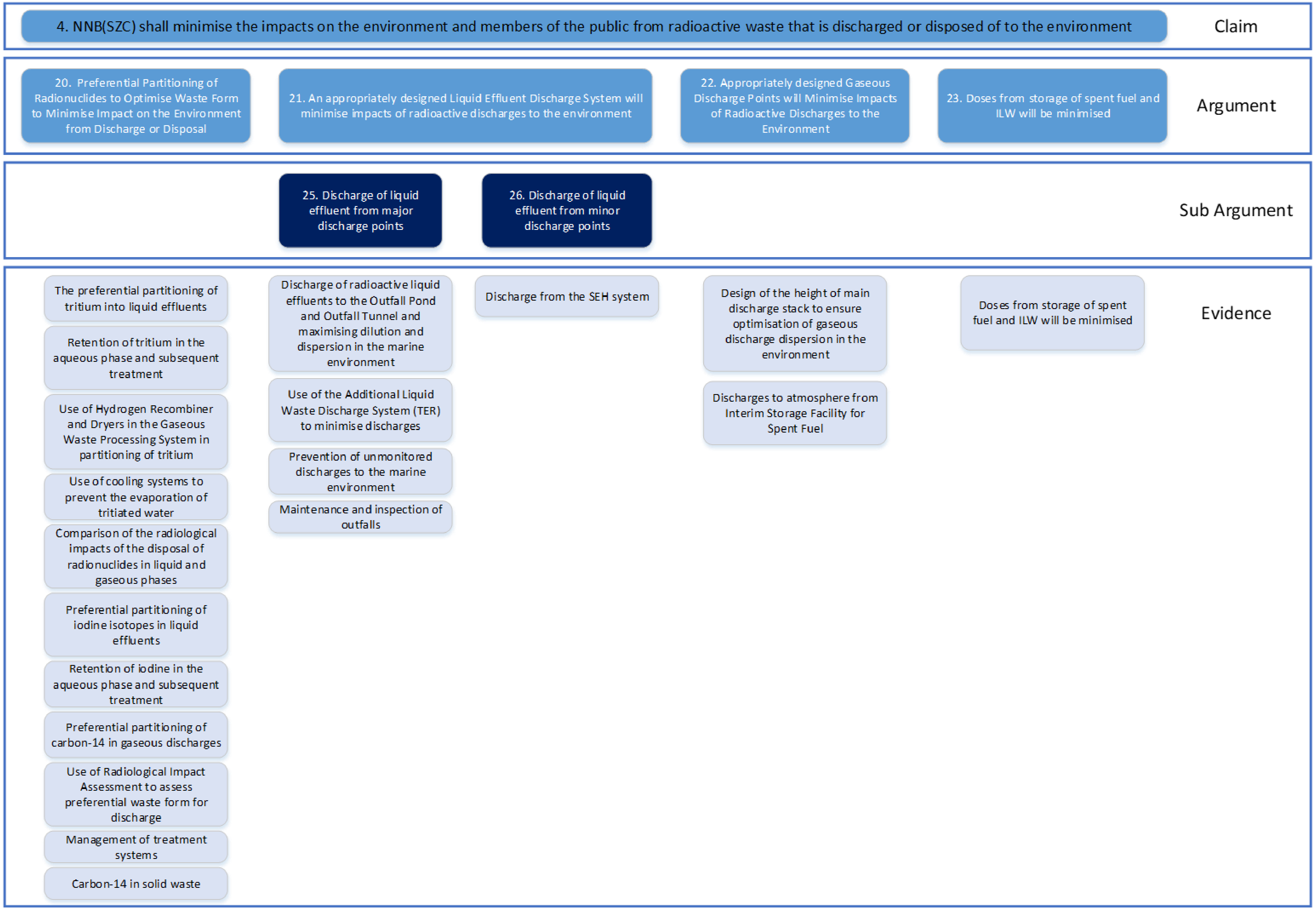


Figure 3-13 Claim 4 Overarching Structure

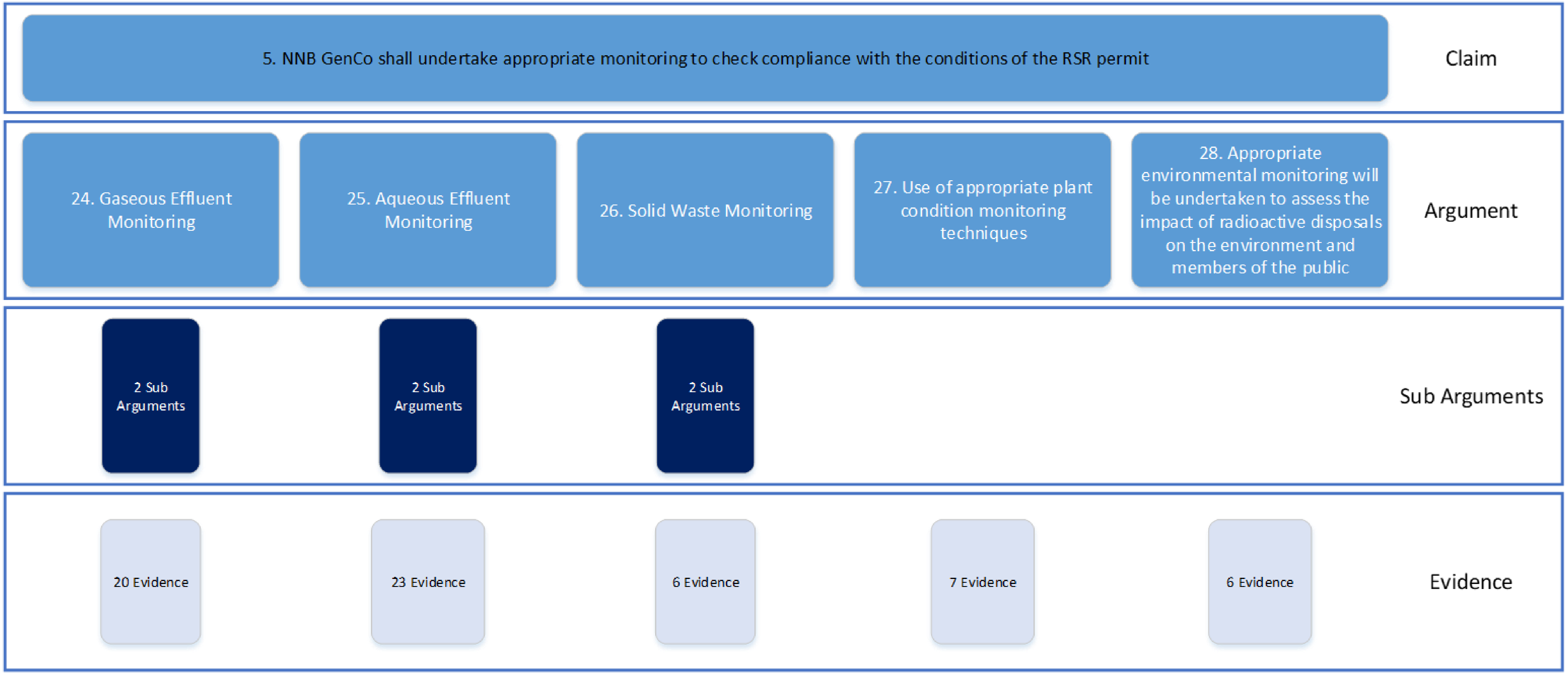


Figure 3-14 Claim 5 Overarching Structure

Claim: 5. NNB GenCo shall undertake appropriate monitoring to check compliance with the conditions of the RSR permit

Argument: 24. Gaseous Effluent Monitoring

Sub Arguments:

- 27. Sampling and Monitoring of radioactive gaseous discharges
- 28. Appropriate in-process monitoring is undertaken and optimised for gaseous effluents

Evidence:

Under 27. Sampling and Monitoring of radioactive gaseous discharges:

- Arrangements for monitoring and sampling of radioactive gaseous discharges
- Provision for independent sampling of gaseous discharges
- Sampling techniques for gaseous discharge monitoring
- Optimisation of the location of gaseous effluent discharge sampling points
- Isokinetic conditions for gaseous discharge sampling and monitoring
- Representative sampling techniques for gaseous discharges
- Operation and maintenance of the gaseous effluent sampling system
- Design of the gaseous effluent sampling line
- Optimisation of temperature, pressure and flow-rate conditioning for the gaseous effluent sampling and monitoring system
- Optimisation of alarms, automated actions and back-ups for gaseous effluents
- Radiological protection for operators for gaseous effluent sampling and monitoring
- Protection of the gaseous effluent sampling system

Under 28. Appropriate in-process monitoring is undertaken and optimised for gaseous effluents:

- Arrangements for in-process monitoring of gaseous effluents
- Monitoring techniques used for in-process gaseous effluents
- Optimisation of the location of gaseous effluent in-process sampling points
- Isokinetic conditions for gaseous in-process sampling
- Representative sampling techniques for gaseous in-process effluent
- Operation & Maintenance of gaseous in-process monitoring
- Other requirements for gaseous in-process monitoring

Third column:

- Analysis and assessment of radioactive gaseous effluents

Figure 3-15 Claim 5 Argument 24

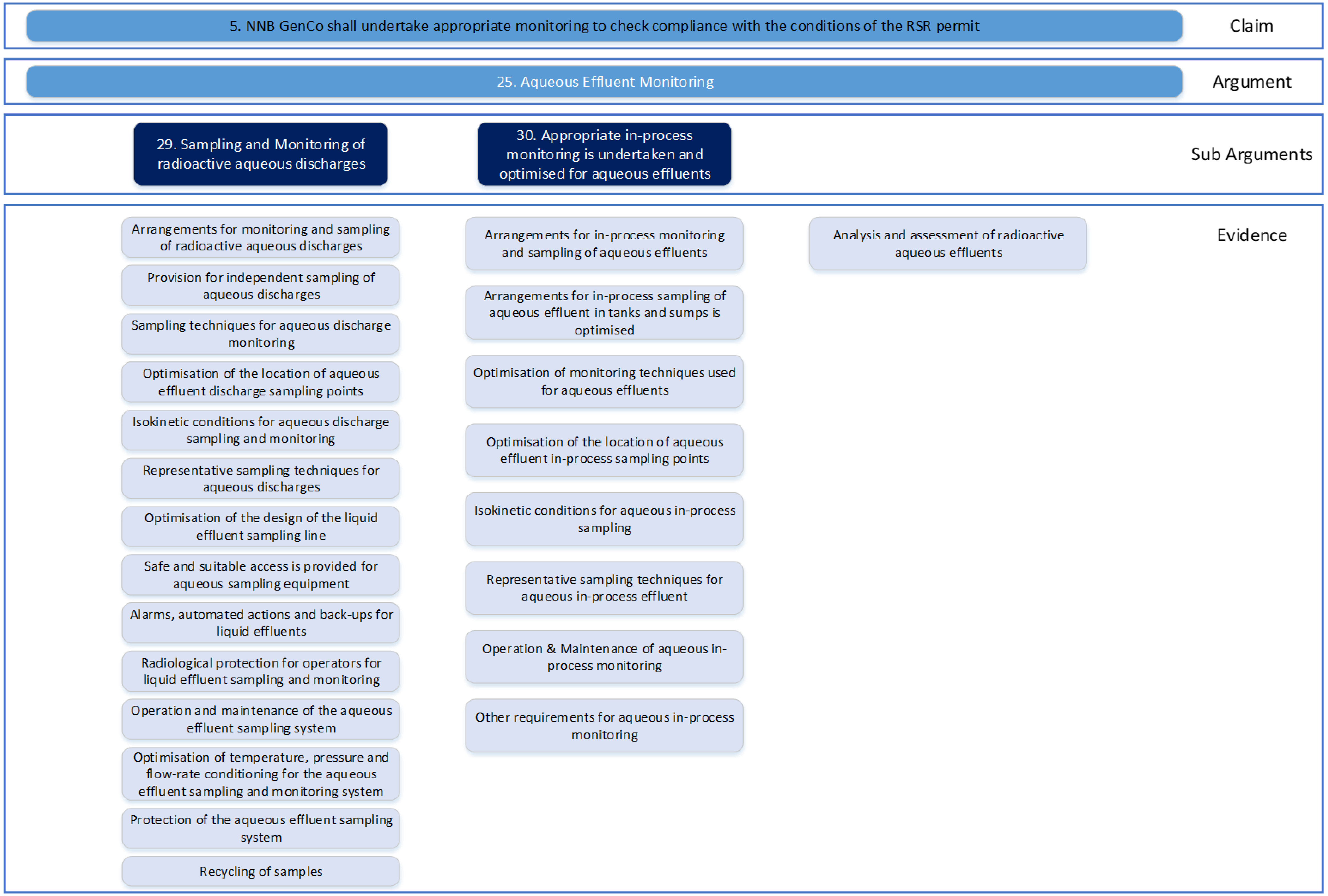


Figure 3-16 Claim 5 Argument 25

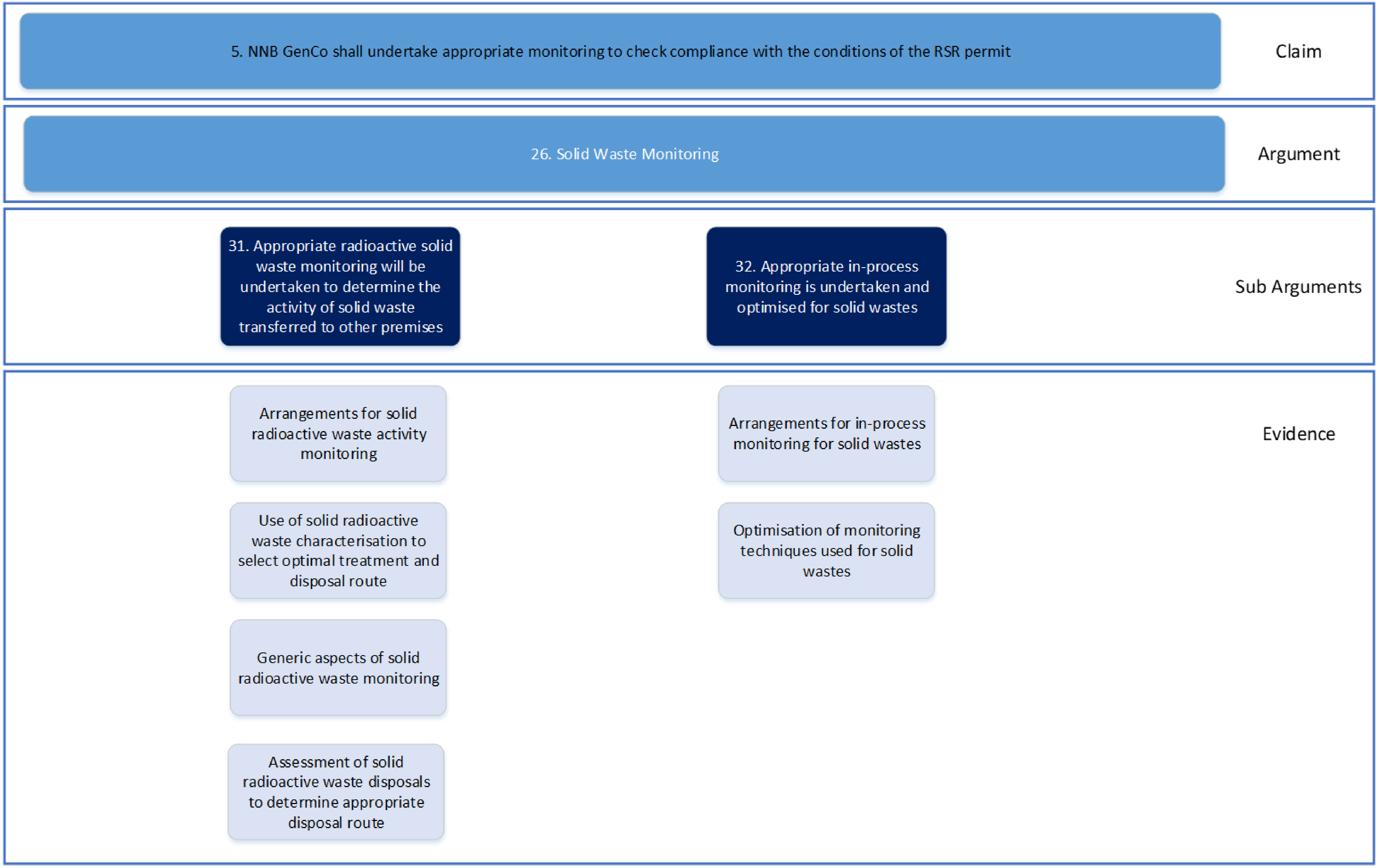


Figure 3-17 Claim 5 Argument 26

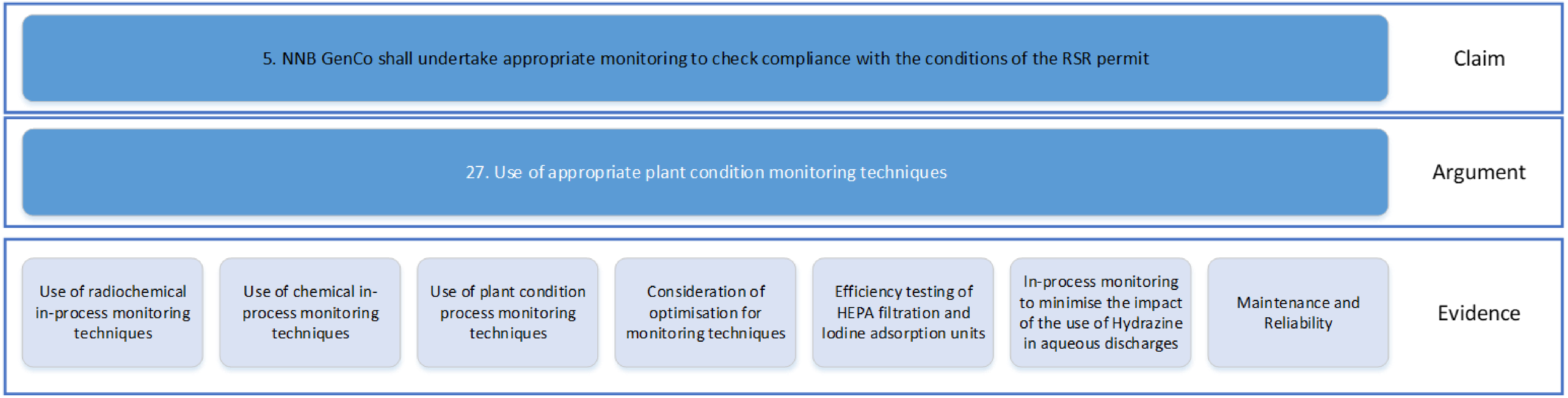


Figure 3-18 Claim 5 Argument 27

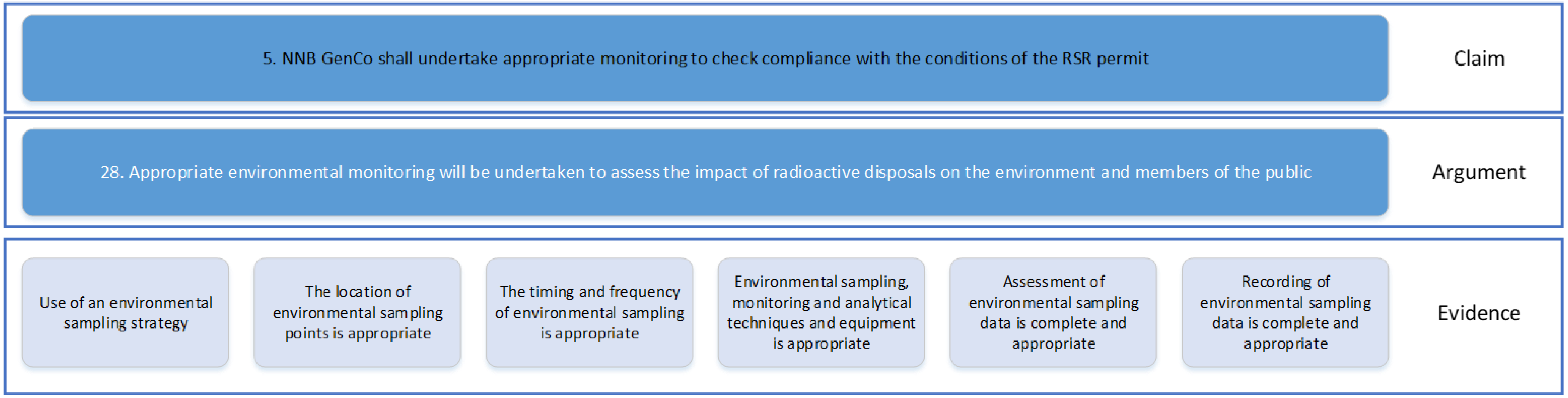


Figure 3-19 Claim 5 Argument 28

3.3.4 Ongoing demonstration of BAT

253. SZC Co. recognises that BAT needs to be implemented from the design, through procurement specifications, manufacturing, installation, commissioning, operations and, ultimately, decommissioning. It is not just the technology or equipment but how it is operated, maintained, calibrated and how people are trained to use it. Therefore, it is important that the lifecycle to demonstrate BAT is incorporated into the arrangements.

254. In addition, SZC Co. recognises that what constitutes BAT will change over time. These potential improvements need to be balanced against the time, trouble and effort to implement such changes and the potential risks associated with changes being implemented without full and thorough consideration of the risk of inadequate conception or execution. Even though SZC has not been built yet, significant effort has been invested in developing a consistent and coherent design that meets all of its safety and environmental protection requirements. Any deviation from this design will require detailed analysis of all of the potential impact of making such a change (positive and negative). At all times BAT is about striking the right balance between benefits and disadvantages and ensuring that any proposed improvement delivers benefits that outweigh the costs. BAT must be proportionate to the risks against which it is being considered in order to effectively deliver optimisation and the ensure demonstration of ALARA.

255. SZC Co. will continue to review its demonstration of BAT through the lifecycle of the project. Forward actions and future BAT assessments that are identified in this document will be formally captured and managed via the BAT open points register [Ref 16]. The open point register is currently owned and sits within NNB GenCo (HPC) IMS, however, SZC will adopt the arrangements to follow the open points process at the appropriate time, as defined in Section 7, and has taken on the open points within the register captured within RC2. Open points may either require SZC Co. to perform a specific action, or to confirm that an action has been performed by another stakeholder, however the onus of responsibility is on SZC Co. for the closure of the open point. For HPC owned open points, SZC Co. will review and adopt the closure as applicable. The register also includes a list of all completed and planned BAT assessments or related deliverables, applicable to both HPC and SZC. This demonstrates the long term nature of SZC Co.'s commitment to the application of BAT, and ensures that open points identified at any of the steps outlined above, are tracked through the project lifecycle until the appropriate stage for them to be addressed. This will include system level BAT reviews at key stages of the project and assessment of KEPE through the manufacturing, installation and commissioning process to substantiate the claims made.

256. SZC Co. will adopt the arrangements successfully applied at HPC to manage the environment case, including tracking open points arising from detailed design and manufacturing processes. Further information on the management arrangements related to BAT are presented in Section 6.

3.4 Integrated Radioactive Waste strategy

3.4.1 Introduction

257. Under the Environmental Permitting Regulations, 2016 (as amended) [Ref 1], SZC Co. requires a RSR permit, granted by the EA, to dispose of radioactive waste resulting from SZC operations and subsequent decommissioning.

258. This section provides a summary of RSR Permit Application Support Document A2, presenting how the production, handling, discharge and disposal of radioactive wastes (gaseous, liquid and solid) and spent fuel will be managed throughout the lifecycle of the SZC installation.

259. Integrated waste management will continue to be incorporated into the IMS arrangements, including modification and change control. The construction, commissioning, operation and decommissioning of a UK EPR™ nuclear power station will have an impact on the environment because of the use of natural resources and generation of wastes and discharges. It has been policy during the design of the UK EPR™ to minimise these impacts as far as is reasonably achievable through the application of the waste hierarchy and BAT, consistent with safety and sustainability principles.

260. All of the organisations involved in the design and construction of the UK EPR™, including contractors and subcontractors shall demonstrate, strong commitment to developing and maintaining a focus on best environmental practices and ensuring that the design minimises the impact on people and the environment. NNB is committed to commissioning, operation and the ultimate decommissioning of its UK EPR™'s in a manner which minimises its impacts on workers, the public and the environment as far as reasonably achievable.

261. The SZC Co. statement, adopted from HPC, states:

- SZC Co. will ensure that wastes generated at all stages of the project lifecycle from design and procurement through to commissioning and operation to decommissioning and site restoration will be minimised through application of the waste hierarchy and in accordance of the principles of integrated waste management.
- SZC Co. will develop and maintain a documented IWS which will include the management of all wastes and discharges, radioactive and non-radioactive, arising from the full range of activities planned over the whole lifecycle of the site.
- SZC Co. will base the development of its IWS on the following four key elements:
    1. Implementation of the waste hierarchy. Application of the waste hierarchy has been fundamental in the design of the EPRTM and its use will be continued in the construction, operation and ultimate decommissioning of the installation;
    2. Application of environmental optimisation, through the application of BAT;
    3. Application of operational experience and feedback in design, construction, operation and decommissioning.
    4. Co-operation with other UK waste producers on waste policy and strategy issues, and effective engagement with major stakeholders.

262. SZC Co. will utilise a set of core principles adopted from NNB GenCo (HPC) to underpin its approach to waste management and applies to all wastes. In addition to the core principles for waste management, a number of specific principles have been established relating to the management of radioactive waste. These principles shall be applied by SZC Co. and it contractors throughout the supply chain. The management of waste is a complicated and intricate process. The principles described below need to be applied intelligently recognising there are some competing and conflicting demands that will result in various trade-offs to balance advantages and disadvantages to achieve an optimum solution. The first are applicable to all waste, regardless of its radioactive properties. The second set are specific to radioactive waste.

263. Broadly the principles of waste management cover the following, known as the waste hierarchy:

- Prevention
- Minimisation

- Reuse
- Recycling
- Energy recovery
- Disposal

Core Principles

- To prevent the generation and accumulation of wastes or, where this is not reasonably practicable, minimise it through application of the waste hierarchy and best engineering practice.
- To ensure that all wastes have a safe and viable disposal route identified before they are produced and make best use of waste disposal routes/assets applying the proximity principle where reasonably practicable.
- To avoid the use of hazardous materials or, where this is not practicable, substitute for a lower hazard alternative, or minimise the use or holding of such hazardous materials or materials that could give rise to hazardous waste (including radioactive waste).
- To characterise, sort and segregate waste to optimise its subsequent safe and effective management and disposal.
- To safely store wastes in a robust and adequate containment to prevent escape and leakage of wastes, minimise the risks to people and the environment and mitigate the impact of any leakage or escape.
- To protect the environment and people by minimising the impact of discharges and disposals to people and the environment through the application of BAT and ALARP.
- To document and retain appropriate records relating to the management, disposal and discharge of wastes, including data of source management.
- To ensure that anyone involved in activities that impact on the generation and/or disposal of wastes will be provided with adequate and appropriate training and have access to competent resource for advice

Radioactive Waste Management Principles

- To ensure radiation doses to the workforce and the general public from radioactive waste management operations, including disposal, are ALARP/ ALARA and within legal limits.
- To develop and maintain adequate safety and environment cases for all radioactive waste management activities including segregation, characterisation, handling, accumulation and storage of wastes on site and ultimately disposal off-site.
- To concentrate and contain radioactivity in a solid form and minimise the volume of solid radioactive waste disposed of by transfer to other facilities SFAIRP.
- To optimise the use of decay storage to reduce the activity of radioactive wastes prior to disposal.
- To store, in a passively safe condition, all radioactive wastes for which WAC are yet to be defined.
- To dispose of radioactive wastes as soon as reasonably practicable where a safe and viable route has been established.

NOT PROTECTIVELY MARKED

3.4.2 Constraints and Dependencies

264. Waste management for the SZC project has a number of constraints and dependencies associated with it, which can be divided into six groups:

Design Maturity and Dependencies

265. Due to the level of maturity of SZC RC0 - the initial SZC reference configuration - which is based on HPC RC2, there is a low risk that future design enhancements will significantly impact the management and disposal of radioactive waste and spent fuel. This is because the NI: the areas of the plant which will result in the generation, treatment, storage, monitoring and disposal of radioactive waste; are not affected by site-specific factors and therefore will be unchanged during the replication strategy.

Regulatory Constraints and Dependencies

266. The UK regulatory framework for radioactive waste management is complex, and the EPR™ was originally designed to comply with French regulatory requirements. However, they are consistent with corresponding UK regulation and legislation and derive from the same international principles. The design satisfied the GDA requirements and EDF and AREVA were awarded the DAC from the ONR and a SoDA from the EA, which remain valid for 10 years and therefore applicable to SZC permitting and licensing.

Financial Constraints and Dependencies

267. The Energy Act 2008 requires that a new nuclear power station owner must develop a FDP, to set funds aside during operation to cover the full cost of decommissioning and waste management. Each owner must gain approval from the Secretary of State before the site can be developed by virtue of the site licence. This application covers RSR specific aspects of decommissioning and references out to other key documents such as the FWP and DWMP.

Timing Constraints and Dependencies

268. It is recognised that the LLWR has a current estimated lifetime that is shorter than that for the operation of SZC. It is assumed – as part of EPR 2016 (as amended) - that a new disposal facility will be provided by the NDA to cover the period following the closing of the Low Level Waste Repository (LLWR). If this is not the case, SZC will need to store LLW on site until a facility becomes available. This eventuality has been incorporated into the design using buffer zones, and an ongoing application of the waste hierarchy and waste segregation practices to reduce reliance on the LLWR.

269. The GDF will not be available until many years after EoG of SZC. Therefore, the strategy for ILW management is to store waste on-site in safe form pending future disposal. Provision will be made to safely store all of the expected ILW that could arise during all phases of the SZC lifecycle.

270. The strategy for spent fuel at SZC is to store all spent fuel on-site pending disposal, in such a manner that does not foreclose the option for re-processing should this become a viable alternative in the future. Provision will be made to store the spent fuel until it is sufficiently cooled for disposal; approximately 55 years following EoG.

Sustainability Constraints and Dependencies

271. SZC is designed to minimise waste arisings and their impact on the environment so that there is no undue burden on future generations. The use of resources, including waste disposal facilities and applying the waste hierarchy has been optimised to take account of the implications of strategies on future generations. The financial arrangements made under the FDP and the waste transfer contract, ensure that all waste and

decommissioning liabilities are covered by a programme, which can be implemented and has secure financing.

272. As a low carbon electricity source, the design of the plant and protection systems takes into account climate change considerations to ensure its safe electricity generation for the future.

Other Constraints and Dependencies

273. It is assumed that a route for waste under exemption provisions (formerly Very Low Level Waste (VLLW)) will be available throughout the lifetime of SZC and that this will provide a viable management option for a range of UK EPR^{TM} waste streams, particularly those arising from decommissioning.

274. Appropriate wastes will be transferred off-site for high force compaction or incineration in support of the LLW minimisation strategy. Incineration and metal recycling will also be considered to maximise the capacity of the LLWR as set out in the National LLW strategy.

3.4.3 Scope

275. The Integrated Radioactive Waste Strategy has been developed for this RSR permit application and therefore is specifically focussed on the scope of the RSR permit. A full IWS will be developed for SZC, see exclusions section below [SZC RSR CMT 9].

276. The SZC RSR Integrated Radioactive Waste Strategy presents how radioactive wastes (gaseous, liquid and solid) and spent fuel will be managed throughout the lifecycle of the SZC installation. Learning from experience from the HPC development is included herein where appropriate.

277. The strategies described in this IWS are to a level of detail that is proportionate to the potential impact and effort necessary to manage the routine radioactive waste and fuel arisings. Radioactive waste generated as a result of an accident or emergency are not explicitly covered but the same principles would apply.

278. The principal objective of the IWS is to ensure that waste and fuel management throughout the lifecycle of the SZC installation is consistent with the EDF Energy Corporate policies on Environment and Sustainability and the underpinning principles defined by the Integrated Waste Management Standard [Ref 26], Environmental Optimisation Standard [Ref 35] and Land Quality Standard [Ref 27]. It is therefore intended to be the first point of reference for any internal or external stakeholder who has an interest in how the SZC project is currently intending to manage its radioactive waste and spent fuels.

279. The IWS takes the outcome of the Environment Case to described how radioactive waste will be managed.

Exclusions

280. The strategies described in this IWS are considered to be at a level of detail proportionate to the potential impact and effort necessary to manage the routine radioactive waste and spent fuel arisings.

281. This IWS has been produced for the point of RSR permit application and therefore a full IWS is not considered required at this time, see further detail in Table 3-3.

282. The content and structure of the document is based on NDA guidance [Ref 36]. Table 3-3 describes the aspects of the NDA guidance were not believed to be appropriate for inclusion into the SZC IWS because they are covered elsewhere in the RSR permit application or excluded from the scope of this RSR permit application.

Table 3-3 NDA IWS guidance mapping

NDA guidance for an IWS not specifically provided within RSR Permit Application Support Document A2	Location of SZC's provision of this information
Summarising UK regulatory framework for waste management	This is provided within the IWS (RSR Permit Application Support Document A2 of the RSR application [Ref 37])
Defining the high level principles of waste management, environmental optimisation and land quality management	[Refs 26, 27, 35] also specifically covered in the Management Arrangements section of this application
Justification of waste management strategies	See RSR Permit Application Support Document A1.
Risks and uncertainties associated with waste and fuel management	Managed via the 'Manage Risks and Opportunities' procedure and captured in the SZC Co. risk management tool [Ref 68], which is covered in the Management Arrangements section of this application.
Strategy for management of non-radioactive wastes	Not included in the permit application version of the IWS, will be included in a full IWS at the appropriate time for the project. However, to ensure there is no gap in the types of wastes to be included, this IWS includes consideration of the non-radioactive properties of the radioactive wastes which would otherwise be out of scope for the categories of radioactive waste, these properties are used to gain Disposability in Principle (DiP) statements from Radioactive Waste Management Ltd (RWM) The non-radioactive waste properties of radioactive waste are considered as part of the management and disposal in the RSR application, however non-radioactive and hazardous waste without any radioactive waste properties are not included at this time [SZC RSR CMT 9].
Radioactive waste generated from accident or emergency scenarios	The RSR application only covers normal and expected operation. Accident and emergency preparedness is accounted for in emergency planning works [Ref 39].

283. The IWS is a live document to be periodically updated as the SZC project progresses, and future revisions will expand the scope to incorporate non-radioactive wastes and otherwise omitted requirements of the NDA guidance, when the SZC has reached sufficient maturity to require their inclusion [SZC RSR CMT 9].

Generation of wastes

284. It is expected that wastes will be generated throughout the lifetime of SZC, however different wastes will be generated during different phases as indicated below. The description of what activities take place during each of the below phases are described in Section 2.3 above.

Table 3-4 Description of each lifecycle phases expected generation of radioactive waste

Lifecycle phase of SZC	Expected generation of radioactive waste
Pre-Construction	No radioactive waste will be generated, or spent fuel managed. However, during this phase the decisions taken with regard to design and operational strategies will have an impact on these aspects during subsequent phases. The process of eliminating or reducing waste at the design stage is the highest priority option under the waste hierarchy.
Construction	Although, non-radioactive wastes and effluents will be generated during the construction phase, there are not anticipated to be any radioactive wastes arising during this phase. Ensuring the systems, structures and components are built, manufactured and installed as designed and specified is important to the future operational performance of the power station.
Commissioning	Non-active (before fuel delivery) – there are not anticipated to be any radioactive wastes arising. Active (fuel on site) – first potential for radioactive waste to be generated, mainly following flushing of systems etc.
Operation and Maintenance	Radioactive wastes are expected to be generated as planned – liquid and gaseous discharges at/below permitted levels with LLW disposed of by transfer to another premises and ILW and spent fuel to be interim stored on site until transfer to GDF.
Decommissioning	Radioactive waste is expected to be generated following cleaning and decontaminating facilities prior to demolition, etc. The ILW and spent fuel will also still be on site in interim storage facilities. Re-packing, if required, may result in additional radioactive waste generation.

Key systems and facilities

285. SZC has a number of key facilities for the processing and interim storage of radioactive waste and spent fuel, which are explained above in Section 2.9. For context here see below:

- The RCV which collects primary coolant let-down from the primary circuit and conditions recyclable effluents through filtration and demineralisation being making up primary coolant according to the chemistry regime.
- The TEP which recovers enriched boric acid for reuse in the primary chemistry control and stores recyclable effluents before reuse.
- The PTR which helps maintain the integrity of fuel in the at-reactor fuel pool by ensuring the temperature of the pool is maintained and by treating the fuel pool water to remove any

contaminants through filtration and demineralisation.

- The RPE system, which collects and channels liquid and gaseous waste from the primary circuit and related facilities to the appropriate treatment system e.g. the system for treatment of primary liquid effluent, the TEU for non-recycled effluents and the TEG;
- The TES for the processing and treatment of solid radioactive waste;
- The TEG which sweeps tanks to remove gaseous radioactive effluents before treatment in a carbon delay bed system to abate short-lived radionuclides.
- The TEU which treats non-recyclable effluents using filtration, demineralisation and evaporation, depending on the radiological and chemical properties of the effluent, to concentrate and contain the radioactive waste in a solid waste form prior to monitoring and disposal of the effluent SFAIRP.
- The HHI, which stores solid radioactive waste pending ultimate disposal in the GDF; the storage facility will also be utilised for the decay storage of solid short-lived ILW to enable subsequent disposal as LLW;
- The HHK to store all the spent fuel generated by SZC;
- The Conventional Island Drainage System (SEK), which collects and channels potentially chemically contaminated effluents (such as those from the HM and the Demineralised Water Production Building), and channels them to the SEK or the KER tanks where they are monitored and, if required, treated, prior to discharge; and
- The discharge tunnel, which is common to both reactor units, for the final disposal of monitored and treated liquid effluent into the North Sea.

Assumptions and opportunities

286. Some specific assumptions and opportunities related to the SZC IWS have been identified during the production of this IWS as are presented in the table below.

Table 3-5 SZC IWS Assumptions and Opportunities

Assumptions	Reasoning and Impact on IWS/Design of SZC
The full lifetime arisings of spent fuel will be stored on-site until a GDF is available for its disposal	A national GDF for spent fuel is not expected to be available to accept new build spent fuel during SZC operation and therefore the HHK capacity is designed for all SF generated at SZC [Ref 40]. Spent fuel will be stored in the HHK until the GDF is available and the spent fuel has cooled sufficiently in align with Transport for Dangerous Goods Regulations [Ref 41].
ILW will be stored safely and securely on site until the GDF is available for its disposal	In the UK ILW is normally stored on the site at which it arises as there are no alternative storage locations. The SZC design incorporates sufficient storage capacity for ILW arisings over the design lifetime.
Spent Fuel will be processed and packaged for storage at an on-site facility	The SZC nuclear power station will include facilities for the encapsulation of spent fuel prior to despatch to the GDF. SZC Co. may seek to utilise shared facilities with the proposed series of UK EPR™ stations but this concept is not included in the design at this stage.

Assumptions	Reasoning and Impact on IWS/Design of SZC
ILW and spent fuel can be conditioned and packaged into passive forms to meet the standards required by NDA- RWM for disposal at the proposed GDF.	As part of the GDA process, the views of RWM on the acceptability for disposal of ILW and spent fuel from UK EPR™ units were sought. RWM concluded that, in principle, conditioned ILW and spent fuel will be acceptable for disposal. NNB GenCo (HPC) has since received a conceptual Letter of Compliance (LoC) from RWM for the disposal of operational ILW that covers HPC and SZC. NNB GenCo (HPC) has also developed a schedule for HPC for making future disposability submissions for ILW and spent fuel [Ref 42]. A LoC schedule for SZC will be produced and follow the same logic (See FWP in Section 8.2).
SZC can utilise the work undertaken by HPC on ILW and spent fuel packaging and disposal to develop and obtain its own LoC.	It is expected that the SZC Co. ILW and spent fuel will also be acceptable for disposal and that their justification can be based on that work undertaken for HPC.
LLW and ILW will be segregated and managed to ensure that volumes are minimised SFAIRP	This will be achieved through the application of BAT to minimise arisings, in both the engineered systems, and in management systems.
Authorised disposal routes for LLW will be available throughout the design life of SZC.	This assumption is based on the current UK LLW policy and strategy and infers that capacity for long term storage of large volumes of LLW on site is not required in the SZC design. Sufficient short term storage capacity has been allowed in the design.
Appropriate radioactive wastes can be disposed of via commercially operated incineration companies. There will be no on-site incineration of wastes.	A number of radioactive wastes arising from nuclear power operations are treated through incineration. SZC Co. recognises the need to ensure that appropriate wastes meet the Conditions for Acceptance (CfA) for incineration routes. It is noted that combustible radioactive wastes from SZB are already managed by off-site incineration in the UK. There is no plan to build and operate an incinerator at SZC.
Radioactive metallic wastes that are suitable for treatment (e.g. by melting) will be sent off-site where practicable.	Facilities for the treatment of metallic wastes are available in the UK and in Europe. Their use is consistent with the UK's LLW strategy.
A disposal route will be available for waste (formally VLLW) via an exemption provision, throughout the operational and decommissioning phases of SZC.	This is based on the UK LLW strategy. Availability of such disposal routes waste will reduce waste disposal costs and enable more effective segregation of radioactive wastes, thereby minimising future LLW disposals. This is of particular importance for decommissioning waste.
LLW generated by SZC is disposable at LLWR	As part of the RSR permitting process waste characteristics have been submitted to LLWR for a disposability assessment to ensure that all of the identified LLW generated at SZC will meet the current WAC at LLWR. A DiP has been obtained for all SZC LLW utilising LLWR segregated waste service to minimise volume of waste disposed, this aims to protect the longevity of the strategic national asset. Granting of the DiPs will include consideration of non-radioactive characteristics of radioactive waste, so that there are no orphaned waste streams.

Assumptions	Reasoning and Impact on IWS/Design of SZC
Waste volume estimates are based on the RC2 design, taking account that there are two UK EPR^{TM} units at SZC.	These estimates determine the capacity for waste storage and processing facilities for SZC. They are based on extensive review of PWR operating experience for EDF stations in France and more widely across Europe and take account of best practice in PWR operation. The waste arisings are therefore based on practical experience rather than theoretical estimates, consequently there is expected to be a lower margin of uncertainty associated with them. They are also consistent with waste volumes identified for HPC. SZC Co. will continue to seek operational experience from other stations to ensure relevant good practice for waste minimisation and treatment are applied at SZC.
Decay storage of wastes containing short-lived isotopes will be used where practicable to reduce the volume of waste disposed of as ILW.	Decay storage of suitable wastes to enable disposal as LLW is already used in the UK and will be employed at SZC where practicable.
Disposal facilities for ILW and spent fuel will be available to SZC on the timescales indicated in this IWS.	GDF is the UK Government's policy for ILW and spent fuel disposal and a timeframe for GDF operations [Refs 40, 42, 43] is consistent with the timescale identified in this IWS for the anticipated disposal for SZC ILW and spent fuel.

3.4.4 The Integrated Radioactive Waste Strategy

287. The following sections summarise the strategies for specific groups of radioactive waste and also provide an overview inventory of the expected arisings from the operation and decommissioning of SZC. The strategies are based on the application of BAT, incorporating the need to minimise arisings and to minimise the impacts of the waste disposals and discharges to the environment.

Overview

288. The SZC UK EPR^{TM}'s is like other PWR's operating worldwide in that the basic production "unit" is based on a primary system, a secondary system and a cooling system. Considerable detail concerning the make-up and operation of these systems is presented in the EC. Whilst waste will arise from operation of all three sub-systems, the generation of radioactive wastes is principally associated with operation of the primary (reactor) circuit during start up, normal operation, and shutdown (fuelling and maintenance) conditions. Various radioisotopes arise from fuel fission and the activation of reactor circuit components, various constituents of the liquid coolant and corrosion products. Once present in coolant, radioactive materials are readily transported to all parts of the coolant circuit and thereby into other reactor support systems. A number of effluent processing systems are therefore employed to capture and treat such arisings from the primary circuit, leading to the production of the following three general radioactive waste streams for recycling, interim storage or disposal:

- Solid waste (which includes mobile wastes such as resins and sludges that are treated and consigned off-site for disposal and non-aqueous phase liquids such as oils);
- Liquid waste (discharged via the liquid effluent discharge pipeline); and
- Gaseous waste (discharged via stacks).

289. Radioactive wastes generated during active commissioning will fall under the same three headings and will wherever practicable be managed in the same manner as those arising during operations.

Interface with the Environment Case

290. The Environment Case [Ref 25] describes how avoidance and minimisation of waste (including discharges) is achieved.

291. Wastes that are unavoidably produced have their activity concentrated and contained as much as possible. This results in gaseous and liquid waste streams being abated with a transfer of activity into a solid form. It is recognised that for Tritium and Carbon-14 it is not viable to abate the discharges and there is no net benefit from the transfer of these radionuclides into a solid waste form. However, preferential partitioning in liquid or gaseous waste occurs as a result of other processes which reduces the radiological impact of discharges of tritium and Carbon-14. Where radioactive wastes are generated with radionuclides of short half-lives then the principle of "delay and decay" is pursued, where practicable. This includes some noble gases in gaseous effluents and some shorter-lived fission and activation products in liquid and solid wastes.

292. Where a practicable means of abatement exists the principle of concentrate and contain of radioactivity into solid waste arisings, in accord with Government policy, is applied at SZC.

293. The strategy for solid radioactive wastes is that they are to be disposed of as soon as reasonably practicable where a viable disposal route is available. ILW and spent fuel for which there are no available disposal routes will be accumulated and safely stored on-site in compliance with the expected requirements of the NSL and RSR Environmental Permit until a suitable disposal route or an alternative management route becomes available.

294. Detailed arrangements for radioactive waste management will be covered in SZC Co. operating procedures required to demonstrate compliance with NSL and RSR requirements. For LLW, these instructions are anticipated to cover minimisation, segregation, characterisation/assessment, packaging, labelling, record keeping and consignment for transfer/disposal.

295. The SZC design incorporates a number of measures aimed at minimising the amount of solid waste by facilitating their segregation and volume reduction, taking account of the review of the performance and operating experience from similar predecessor reactors.

296. The disposal of the waste from SZC will depend on the radioactivity level and physical characteristics of the waste produced.

3.4.5 Management of Low Level Waste

Description of low level waste generated during the operation of SZC

297. The LLW that will be generated from SZC operations can be grouped in two broad categories:

- LLW generated through routine operations; and
- LLW generated during maintenance and refuelling operations

298. The precise volume of solid LLW produced is dependent on the future management of the various systems associated with the operation of SZC.

High level strategy

299. The strategy for LLW is that waste generated throughout the lifetime of SZC will be disposed of as soon as reasonably practicable, following treatment to minimise volume and appropriate conditioning or packaging. The ultimate disposal of the wastes is expected to be via one of the following main routes depending on the radioactivity level of the waste produced, its physical characteristics and its chemical properties:

- Recycling of metals via commercially available routes;
- Incineration of combustible wastes using commercially available routes;
- Disposal to facilities authorised to accept exempt waste (notably for soil, rubble and aggregates) where no reuse or recycling options are viable;
- Disposal of LLW at LLWR where the above alternatives are not viable.

300. It is noted that there will be no on-site disposal of solid radioactive waste. The preferred LLW processing and disposal strategy is described in more detail in the RSR Permit Application Support Document A2.

301. As part of the RSR permit application process a DiP has been sought from appropriate providers of waste treatment and disposal services to ensure SZC does not generate any orphan wastes evaluated against the current WAC. SZC Co. will in due course develop appropriate commercial arrangements with waste service provider(s) [SZC RSR CMT 7].

302. In determination of the preferred disposal route for LLW, direct disposal to the LLWR is seen as the least desirable option and where a reasonably practicable alternative disposal route exists, e.g. incineration or metal melting, this has been chosen as the preferred option. This approach is consistent with the national strategy for LLW and SZC Co. will aim to utilise alternative disposal routes to the LLWR when available and demonstrated as being BAT. This will contribute to the minimisation of volume of waste sent to the LLWR and maximise its remaining operational lifetime.

LLW management facilities

303. Having applied BAT to minimise the amount of radioactive waste generated and then used techniques to concentrate and contain radioactive waste in a solid form on-site facilities include a shredder and a low force compactor to help size reduce waste before packaging on site for subsequent transfer off site for further treatment or disposal. Further details are provided in Claim 3 of the Environment Case [Ref 25].

304. There are additional waste management equipment used to package the waste for onward disposal at an off-site facility. This includes the ability to encapsulate waste in order to meet the WAC of the permitted, receiving site. All radioactive waste despatched from the site will need to comply with applicable UK and international legislation at the time of despatch, including the relevant requirements of the Carriage of Dangerous Goods (Amendment) Regulations 2019 [Ref 41], and also meet the requirements of the receiving site.

305. In addition, waste assay and monitoring equipment is used to ensure the WAC of the receiving site are met.

3.4.6 Management of Intermediate Level Waste

Description of intermediate level waste generated during the operation of SZC

306. The majority of ILW will arise from the treatment of liquids and gases in order to minimise discharges of radioactivity to the environment (in order to achieve concentrate and contain principle) whilst balancing this against potential increased doses to workers.

307. In addition to the process wastes, a variety of ILW streams may be generated as a result of maintenance work carried out during reactor operation and work performed during reactor outages. A waste stream will also be generated from performing reactor flux measurements and routine replacement of certain components, which may have become activated or contaminated.

308. The categories of ILW arising from SZC are as follows:

- ILW ion-exchange resins;
- ILW cartridge filters;
- ILW sludges; and
- Operational wastes > 2mSv/hr.

309. Non-Fuel Core Components (NFCCs) are ILW, however, as captured in the assumptions table above, the current strategy for NFCC is for co-storage. Co-storage with Spent Fuel Assemblies (SFA) in order to maximise space and minimise the volume of storage. This does not foreclose disposal options and is intended to avoid double handling and maximise waste packing efficiency.

High level strategy

310. The strategy for management of ILW is interim decay storage over the life of the plant, the ILW will be stored in the HHI. Decay storage is considered an appropriate strategy because it minimises the accumulation of waste on-site and diverts waste away from the proposed GDF.

311. The ILW once generated is treated and conditioned for packaging in the HQA and Radioactive Waste Processing Building (HQB) and transferred in casks across site to the HHI.

312. At the end of the interim storage period the casks have either decayed sufficiently to no longer be classified as ILW and so can be further managed as LLW or are planned to be transported off-site to the proposed GDF.

313. All radioactive waste despatched from the site will need to comply with applicable UK and international legislation at the time of despatch, including the relevant requirements of the Carriage of Dangerous Goods (Amendment) Regulations 2019 [Ref 41], and also meet the requirements of the receiving site, known as the LoC regarding disposability acceptance from the RWM.

314. The UK Government has assessed that a GDF could be operational for the disposal of legacy ILW in the 2040s [Ref 43].

ILW management facilities

315. There are two types of ILW packages proposed for storing SZC ILW – cylindrical pre-cast concrete casks; designated C1 containers for resins and 500L steel drums for cartridge filters, dry active waste and sludge.

316. Following a period of interim storage the radioactivity of some ILW packages will have decayed to such levels that become below levels classified as ILW. Therefore, this waste will be removed from the HHI and managed further as LLW.

317. ILW generated during operations will be managed in the HQA and HQB. This building provides the safe handling, treatment, conditioning, buffer storage, packaging and monitoring of wastes prior to transfer of packages to the HHI. The HHI is a shielded store where the drums and C1 containers will be stacked for storage, there will be an area to deliver and manoeuvre the packages as well as carry out inspection and quarantine as required. Further information regarding the processes involved in management the ILW is provided is provided in the RSR Permit Application Support Document A2.

318. It is not planned to undertake any waste treatment processes within the HHI.

Off-site disposal

319. It is required that all wastes generated can be managed, the LoC must be obtained to demonstrate the disposability of waste acceptability, that a waste package can be accepted at a future GDF. Outside of the RSR permit application, SZC are following the LoC process with RWM, including obtaining interim and full LoCs [SZC RSR CMT 8]. The UK EPR™ (for HPC and SZC) has previously received a conceptual LoC, demonstrating acceptability of the disposability of the wastes generated from the UK EPR™.

3.4.7 Liquid Radioactive Wastes

Description of liquid radioactive waste generated during the operation of SZC

320. The SZC design comprises a number of processing systems to minimise discharges of radioactive liquid effluent, which have taken account of operational feedback and experience of EDF and other PWR plants. These systems receive and process effluent before discharge, in accordance with waste minimisation, with a focus on reduction at source, collection and segregation, treatment, reuse/recycling and finally, residual substances are monitored and discharged to sea.

High level strategy

321. The overall SZC strategy for the management of liquid radioactive wastes is:

- Minimising the production of activity in effluents at source;
- Preferential partitioning of radionuclides, where appropriate, to minimise environmental risks and impacts;
- Optimum use of segregation and effluent treatment systems to afford the greatest flexibility in their management;
- Abatement to concentrate and contain radionuclides, where appropriate, through the use of demineralisation, evaporation and filtration, ensuring minimisation of all entrained solids, gases and non-aqueous liquids from aqueous waste;
- Optimum use of suitable storage systems, taking advantage of any delay and decay that may arise;
- Assessment and sentencing of liquid wastes prior to discharge;
- Optimise the manner and timing of any discharge to sea to minimise the impacts on the environment and members of the public.

Liquid radioactive waste management techniques

322. Having minimised at source through material and chemistry control the radioactive effluent that is unavoidable created is treated. The treatment of the effluent results in the concentration of activity in the form of solid waste and a controlled amount of residual radioactivity in liquid form – the concentrate and contain principle – resulting in radioactive wastes which can be discharged to the environment in compliance with the requirements of the RSR Environmental Permit.

323. The SZC liquid waste treatment systems use degassing, filtration, demineralisation and evaporation to treat radioactive liquid effluents.

- Degassing removes dissolved gases from the liquid waste stream (such as noble gases).
- Filtration removes insoluble materials from the primary coolant or other effluent streams.
- Demineralisation (also known as ion exchange) removes soluble materials from aqueous streams.
- Evaporation involves evaporating the liquid effluent and then condensing the purified distillate for subsequent disposal with the evaporator concentrate being further treated prior to disposal as solid radioactive waste.

324. Segregation of effluents at source is used to minimise the activity and volumes of radioactive effluents discharged (the treatment of less dilute effluents improves the decontamination that can be achieved) while optimising the production of solid radioactive waste from the effluent treatment systems (filters, concentrates and ion-exchange resins). These techniques are described further in RSR Permit Application Support Document A1, with regards to the demonstration of BAT.

325. The description of the liquid waste treatment systems (such as KER, TEU and RPE) are described in Section 2 – technical description of activities, as well as specifically regarding the IWS in RSR Permit Application Support Document A2.

Liquid radioactive waste discharge routes

326. As referred to above, the main liquid radioactive waste discharge routes are:

- KER tanks,
- TER tanks
- SER tanks
- Minor routes

327. SZC will have a number of other liquid effluent systems. In all cases it is expected that these effluent streams will not normally contain radioactive material, but in certain situations, the presence and detection of trace quantities of radioactivity cannot be ruled out from these effluent systems, such as water run-off collections systems from groundwater (e.g. on-site car parks), return line of the circulating seawater cooling system, and others as described in RSR Permit Application Support Document A2. The contribution from these minor discharge outlets to the limits of the total discharge as described in Section 4.3 is expected to be very small.

3.4.8 Gaseous Radioactive Wastes

Description of gaseous radioactive waste generated during the operation of SZC

328. Gaseous effluent is segregated at source and treated in different systems depending on its nature. Gaseous radioactive discharges fall into one of four categories:

- Primary circuit
- Ventilation
- Secondary circuit
- Other minor sources

High level strategy

329. The management strategy to minimise radioactive gaseous discharges from the operating activities of SZC is based on the design of the plant and their operational practices. The design features use BAT to minimise gaseous discharges at source and to minimise the impacts of discharges by means of abatement and discharge plant, and also balance worker doses and costs incurred during treatment in the plant with public doses from discharges. Systems and plant are managed and operated in a manner so as to minimise the environmental impacts of discharges, and it is ensured that all discharges are monitored and recorded to demonstrate that they will comply with expected limits and levels that will be specified in the RSR permit.

330. The overall SZC strategy for the management of gaseous radioactive wastes is:

- Minimising the production of gaseous effluents at source;
- Taking advantage of preferential partitioning where it occurs as a by-product of other processes, where appropriate, to minimise the environmental risks and impacts;
- Abatement of gaseous waste streams;
- Monitoring of gaseous wastes prior to discharge;
- Optimising the design of the stacks such that emissions minimise the impacts on the environment and members of the public.

Gaseous radioactive waste management techniques

331. The activated charcoal delay beds are the primary abatement mechanism for iodine as well as noble gases. Iodine (activated charcoal) traps are only put in service on detection of high activity.

332. In addition, treatment of potentially radioactive gases is implemented to ensure that the most hazardous isotopes are removed from effluent streams and contained within solid filters. Such as gaseous abatement techniques using HEPA filters and activated charcoal adsorption. The CAE presented in RSR Permit Application Support Document A1 provide further information on the demonstration of BAT for specified radionuclides, such as carbon-14 and tritium.

Gaseous radioactive waste discharge routes

333. As referred to above, the main gaseous radioactive waste discharge routes are:

- NI stack
- Atmospheric Steam Dump (VDA)

NOT PROTECTIVELY MARKED

- Atmosphere (minor)
- Other minor routes such as louvres, vents, doors, windows from Radioactive Controlled Areas

334. As described in Section 5 suitable monitoring is carried out throughout the plant as well as at the point of discharge to record the discharge. It is noted that the stack designs (including height of the stacks) have been done so to maximise dispersion and dilution in the air.

3.4.9 Spent Fuel

Description of Spent fuel generated during the operation of SZC

335. The SZC UK EPR™ reactor core contains the nuclear fuel in which the fission reaction occurs, as described in Section 2. Each reactor core in the UK EPR™ will typically consist of fuel assemblies providing a controlled fission reaction and a heat source for electrical power production. Each fuel assembly is formed by an array of Zircaloy M5 tubes, made up of fuel rods and guide thimbles. The fuel rods consist of uranium dioxide pellets stacked in a Zircaloy M5 cladding tube, which is then plugged and seal welded.

336. It is currently assumed that a proportion of the SFA will be removed approximately every 18 months of operation from each reactor. The average expected fuel cycle may be lengthened or shortened for safety, operational or commercial reasons (noting safety being the overriding priority).

337. Spent fuel is highly radioactive when it is removed from the reactor. The radioactivity of spent fuel falls to about one hundredth of its original level within a year and to one thousandth of its original level within 40 years. The high level of radioactivity concentrated within spent fuel results in a significant level of heat being produced. This characteristic makes a period of interim storage, during which the level of heat production reduces, an important element of spent fuel management ahead of its eventual disposal.

High level strategy

338. As stated in the 2008 Government White Paper [Ref 15], in the absence of any proposals from industry (for reprocessing) any new nuclear power station that might be built in the UK should proceed on the basis that spent fuel will not be reprocessed and that plans for, and financing of, waste management should proceed on this basis.

339. There is currently no GDF for spent fuel and whilst there is a Government programme in place to develop a GDF, it is not expected to be available when the SZC starts generating spent fuel. The strategy for spent fuel management at SZC is, therefore, to store the spent fuel on-site pending availability of a GDF. It is noted that an alternate strategy may be selected by the UK government for the long term management of the spent fuel (disposal/storage/reprocessing). The strategy selected for the interim storage of spent fuel on-site at SZC does not foreclose any of these future options.

340. After removal from the reactor, spent fuel will be stored in the spent fuel pool in the HK for an initial cooling period. The spent fuel will then be loaded into a MPC which will be sealed, drained, dried and filled with helium. The MPC provides the confinement barrier and is designed to ensure passive cooling of the spent fuel.

341. The loaded MPC will then be transported to the HHK where it will be placed into a concrete storage shelter which provides shielding and protects the MPC. The spent fuel will be stored in this way for up to 120 years. The process is reversible should it be deemed necessary to return an MPC containing spent fuel to the HK for inspection.

342. At the EoG, defueling of the reactors and transfer of the fuel from the reactor core to the HK pool is planned to be undertaken at the earliest safely practicable opportunity. After a period of cooling in the HK pool the final SFA will be transferred from the HK Building to the HHK Building via a series of HHK operational campaigns.

343. At some point after all spent fuel has been removed from the HK Building, but well within the 120-year operation of the HHK Building, the HK building will be decommissioned. This will foreclose the ability to carry out reverse operations. To offset this risk, space on the SZC Site Plot Plan has been reserved for a Spent Fuel Inspection and Repackaging Facility (SFIRF).

344. Prior to the start of decommissioning of the HK Building, the SFIRF will be operational and able to provide capability for the HHK reverse operations including inspection and repackaging if required. Pending the availability of a GDF, the SFIRF will ultimately be converted into a Spent Fuel Encapsulation Facility wherein spent fuel will be transported from the HHK Building for repackaging prior to offsite disposal to the GDF.

345. As described above, there is currently no long term storage site operational in the UK. It is expected that a GDF will be available for the long term storage of spent fuel generated from SZC. A disposability assessment was carried out as part of the GDA for the expected spent fuel from a UK EPR^{TM} units. This assessment concluded that compared with the existing UK spent fuel inventory, no new issues challenge the fundamental disposability of the spent fuel expected to arise from operations at SZC, therefore the spent fuel from SZC is expected to be disposable, see RSR Permit Application Support Document A2 for further details regarding ongoing work with RWM.

Management of radioactive waste generated from spent fuel management

346. Dry interim storage of spent fuel will result in the generation of small quantities of liquid, gaseous and solid radioactive wastes during packaging and potential inspection activities. Waste generated from the dry fuel storage system will be minimised by application of BAT in the system design as well as operation throughout the lifetime of SZC and will be managed via the liquid and gaseous radioactive waste management systems and facilities described above. No waste will be generated whilst the spent fuel is in storage within HHK. There will be no liquid discharges or solid waste generated from the dry storage canisters during storage. A small quantity of tritiated gas could evolve in the MPC and diffuse through the MPC. This is expected to be at low rates and low activities to the point where no worker protection controls will be required within the facility. The discharges would be a very small fraction of the proposed site limit for gaseous tritium. The HHK will therefore not require any systems for the management of liquid, gaseous or solid radioactive wastes.

3.4.10 Decommissioning generated wastes

Decommissioning strategy

347. The SZC decommissioning strategy is Early Site Clearance, which fundamentally means that decommissioning will commence as soon as practicable after the EoG and will proceed without significant delay until decommissioning of the site is complete. High level decommissioning plans for SZC estimate that the decommissioning of the site, with the exception of the HHK, could be achieved approximately 20 years after the EoG. The HHK will be decommissioned once spent fuel and ILW has been transported off site for disposal (as is currently intended), this is discussed further in RSR Permit Application Support Document A2. The current assumption for completion of the decommissioning process is the complete radiological clearance and de-licensing of the site. De-licensing will run in parallel with the environmental permit surrender process.

348. A number of key documents are planned to be produced to support the overall decommissioning plans for SZC, at the appropriate time [SZC RSR CMT 10]:

- NNB Corporate Decommissioning Strategy;
- SZC DWMP, part of the FDP;
- A Funding Arrangements Plan, which sets out how the operator will make financial provision to meet its liabilities; and
- Waste Transfer Contract - these contracts set out the terms on which the Government will take title to and liability for the spent fuel and ILW from SZC once it has been decommissioned.

Management of radioactive waste generated from decommissioning

349. SZC has been designed with decommissioning in mind, enabling radiation doses to workers and radioactive waste quantities to be minimised when decommissioning takes place.

350. During decommissioning, waste will be generated as a result of removing plant, equipment and structures, buildings and facilities at the site.

351. ILW and LLW generated during decommissioning will consist of primary and secondary wastes. Primary waste varies widely in terms of type, activity, size and volume, and consists of both activated and contaminated components. Secondary waste is generated during activities that support the decommissioning process. These wastes will be processed and conditioned using the same procedures and facilities as for primary waste. ILW arising during decommissioning from decontamination and dismantling activities will have similar characteristics to those wastes generated during SZC operations. Therefore, SZC Co. is confident that all secondary wastes will be acceptable for disposal. LLW generated during the decommissioning process will be disposed of to a suitably authorised site, this may include disposal of exempt waste to an authorised landfill or on-site burial where this can be justified. Appropriate segregation and decontamination procedures will be implemented to reduce, as far as is reasonably practicable, the volume of radioactive materials requiring treatment or disposal.

352. The use of methods for decommissioning will have to be justified by BAT assessment, balanced against the possible liquid and gaseous discharges arising from their use. SZC Co. is developing its decommissioning plans with due consideration of the potential disposability of any waste produced.

Land quality management

353. There is a possibility, although unlikely, that radioactive wastes might be generated from construction activities due to the presence of pre-existing land contamination. In addition, there is the potential that during operation and decommissioning, land contamination could occur. The management arrangements regarding land quality and contamination are addressed in Section 7.

354. Ground investigations undertaken to date at the SZC site do not show any legacy radiological contamination that SZC Co. will need to address.

355. The design of the UK EPR^{TM} at SZC is such to minimise the risk of environmental contamination from leaks during operation through to decommissioning.

356. Under LC32, 33 and 34 of the NSL, ONR are expected to regulate at the SZC site regarding radioactively contaminated land.

RSR Permit Surrender

357. Following industry consultation, in July 2018 the Environment Agency published 'Management of radioactive waste from the decommissioning of nuclear sites: GRR [Ref 44].

358. The GRR guidance sets out the standards that a nuclear site must meet in order to be released from its RSR permit, when all activities involving the management of radioactive waste have ceased.

359. Requirements set out within GRR are expected to be included within an RSR permit granted to SZC Co. Specifically, a new permit condition will be introduced requiring the following deliverables:

- A Waste Management Plan (WMP) – This will set out the operator's intent for managing all radioactive substances on or adjacent to the site, and demonstrate that this has been optimised; and
- A Site-wide Environmental Safety Case (SWESC) – Demonstrates that members of the public, and the environment are adequately protected from the radiological hazard associated with the site, in its present state, and in all future states of the site.

Waste Management Plan

360. The operator is required to produce a WMP that will manage the programme of radioactive waste disposal from the site until work involving radioactive substances has been completed. As per the guidance, the WMP will have 3 principal aims:

- Show that radioactive waste management is optimised
- Describe how the site will be brought to a condition that meets Environment Agency requirements for release from RSR.
- Supports the arguments and claims presented in the SWESC. Specifically, where radioactive waste is to be managed or disposed of on-site, either in a disposal facility, in situ or for a specific purpose, the risk to the public and the environment posed by the disposal will be an input to the SWESC. The same is true of liquid/gaseous discharges to the local environment.

Site-Wide Environmental Safety Case

361. The SWESC should describe and substantiate the level of protection provided both during the period of RSR and after release from the RSR permit. It should describe the site reference state and specify the time by which that state will be achieved. It should reflect progress in the implementation of the WMP, and provide to the Environment Agency adequate confidence in the environmental safety of the site.

362. The SWESC should take account of all radioactive substances (whether disposed waste or contaminated ground or groundwater) remaining on and adjacent to the site. It should describe all aspects of the site setting and conditions, otherwise referred to as the Conceptual Site Model.

363. The operator is required to maintain a SWESC that is proportionate to the hazards involved, and a simple SWESC may be adequate for a site where the operator can easily demonstrate that only very low concentrations or quantities of radioactive waste need to be managed. The complexity should also be proportionate to the available data and level of technical understanding.

Site Reference State

364. The current plan for SZC identifies the site reference state as 'Greenfield', indicating the site is restored to an equivalent state to prior to construction. Preliminary ground investigations undertaken to date show a radiologically clean site. SZC Co. intends to keep the site clean and no disposals are planned to take place on the SZC site.

365. Release of a site from an RSR permit will not take place until it has been demonstrated that the site reference state has been achieved, and in most cases it is anticipated that this will require a period of validation monitoring.

Next Steps

366. The inclusion of WMP and SWESC are new to all RSR permits. Existing sites have been given time to establish an implementation plan. NNB GenCo (HPC) has produced a strategy for implementation of the GRR into the HPC RSR permit [Ref 22]. SZC Co. will review the plan and arrangements developed by NNB GenCo (HPC) and seek to learn from their experience in developing its own site-specific requirements [SZC RSR CMT 9].

3.4.11 Receipt of Radioactive Waste

367. SZC Co. is applying for a permit that includes the receipt of radioactive waste. The waste will be restricted to that which is associated with the operation of the two UK EPR™ units proposed for SZC. This includes the ability to receive returned samples and waste returned to the site in accordance with template permit standard condition 3.1.7. This standard condition in the template permit requires the operator to provide information to potential consignors about waste that can be accepted under this permit to ensure that consignors only send waste that the operator can receive. SZC Co. will not receive radioactive waste from other operators and will not dispose of any radioactive waste on its premises.

368. SZC Co. has yet to confirm whether it will participate in the National Arrangements for Incidents involving Radioactivity (NAIR). However, in order to provide flexibility should the organisation decide to do so in the future, SZC Co. is additionally applying for the ability to receive Radioactive Waste in support of the NAIR or in a RADSAFE Incident Response.

3.4.12 Conclusions

369. This IWS provides a baseline summary document of the waste management strategy proposed for the SZC. It shows that there is an appropriately planned management strategy for all the waste streams to be produced by the two UK EPR™ units proposed for SZC.

370. SZC Co. has engaged with LLWR to confirm that all LLW wastes, requiring disposal by transfer to another (suitably permitted) facility, are disposable (both radiological and chemically) against the current WAC. SZC Co. has access to a conceptual LoC from RWM that confirms the acceptability of operational ILW at any future GDF. SZC Co. will continue to engage with RWM to complete the LoC process for operational ILW, spent fuel and decommissioning ILW at an appropriate time.

371. This IWS has been produced for the application of the EP-RSR for SZC. As SZC develops the IWS will be updated as SZC continue to optimise its waste management strategies, taking note of UK and international operating experience as well as developments in waste management technology, policy and legislation.

4 DISPOSAL OF RADIOACTIVE WASTE

4.1 Introduction

372. This section and associated RSR Permit Application Support Document (B – Disposal of Radioactive Waste) [Ref 45] describes the selection of radionuclides for the setting of limits and levels for radioactive discharges from normal operations from the proposed main gaseous and liquid discharge outlets at SZC, and proposes associated twelve-rolling-month limits and QNLs. The approach used to determine these limits and levels is presented and discussed on a case by case in the subsequent sub-sections.

373. Normal operations, in this context, are defined as planned situations such as routine start-up, shutdowns and maintenance of systems and those events which, while unplanned, are not unexpected during the lifetime of the plant. It also considers operating variables which give the operator the flexibility to choose the most suitable operating regime without disproportionate restrictions on discharges. Contingency has been applied to account for any fuel defects[5]. Whilst high standards are applied and fuel defects are rare events and cannot be predicted, they are not unexpected through the course of operations at a power station. The fuel rod failure rate in Light Water Reactors was $1x10^{-5}$ during the period 2003-2006 [Ref 75].

374. The limits proposed are based on information from the PCER presented in the GDA [Ref 46] but also considers the lessons learnt from the HPC permit application process and SZC design. The detailed information provided in the GDA has not been repeated here, instead, the information presented here is intended to demonstrate that the discharge limits and levels proposed for the selected radionuclides will comply with UK regulatory requirements.

375. The principal objective of the final arrangements for setting limits and levels on radioactive gaseous discharges for SZC is to ensure minimisation of the radiological impact through application of BAT and compliance with conditions of the RSR environmental permit.

376. The supporting document demonstrates that although the receiving environment and local receptors are different at SZC compared to HPC, the limits proposed still ensure that the resulting dose at SZC is well below the dose constraint values whilst also enabling a consistent operating approach across the two sites supporting the claim that the HPC limits are also appropriate for SZC.

377. The purpose of this section is to demonstrate that all waste from SZC will be disposable, and there is flexibility in terms of where we can dispose of it. This section provides quantitative estimates and proposed limits of the discharges of gaseous and aqueous radioactive wastes, arising's of combustible waste and disposal by off-site incineration and arising's of other radioactive wastes (by category and disposal route (if any)).

4.1 Production of Radionuclides

4.1.1 Tritium (Liquid and Gaseous)

378. Tritium production in the reactor occurs from primary coolant, fuel and secondary neutron sources.

[5] Fuel defects are terms referred to as failed fuel, where the barrier (fuel cladding) has been degraded in some way and may impact the performance as they may be removed from the core earlier than planned. It is the goal of modern nuclear utilities to operate with a core free of defect.

379. In primary coolant the three main sources of tritium production are from boron, lithium and deuterium. Boron used to control reactivity, lithium hydroxide (LiOH) is used to control pH and deuterium is present in all sources of water make-up. It is recognised however that the use of enriched boric acid and depleted LiOH minimises tritium production.

380. The fuel is a source of tritium due to ternary fission however the release of tritium is minimised through the use of Zircaloy fuel cladding. Zircaloy is a material known for being virtually impermeable to tritium migration, therefore tritium will only be transferred to the primary coolant through cladding failures.

381. Secondary neutron sources produce a continuous flux of neutrons to ensure optimal operation. The use of beryllium as a secondary neuron source also produces tritium and use of beryllium sources is demonstrated as BAT.

382. There is no viable method for abatement of tritium applicable to PWR operations available. It is expected that tritium generated will be discharged as tritiated water. The majority of tritium (~90%) is retained in the liquid phase as tritiated water, and the proportion that is discharged via the gaseous phase is degassed as tritiated water vapour. Further detail is provided in Support Document A1 [Ref 25].

4.1.2 Carbon-14 (Liquid and Gaseous)

383. Carbon-14 is mainly produced from the activation of Oxygen-17, Nitrogen-14 and to a lesser extent Carbon-13.

- Oxygen-17 is present in the RCP, primarily in water but also in the chemicals used for reactivity and chemical control. 80% of Carbon-14 production is expected to be from activation of Oxygen-17.
- Nitrogen-14 is dissolved in primary coolant. 20% of Carbon-14 production is expected to be from activation of Nitrogen-14.
- Carbon-13 is also expected to be dissolved in primary coolant however the % of Carbon-14 production from activation of Carbon-13 is considered low.
- Approximately 80% of the discharges of Carbon-14 are in the form of methane ($^{14}CH_4$) and 20% as carbon dioxide ($^{14}CO_2$). Degassing of liquid effluents prior to treatment results in the majority of Carbon-14 being discharged as gaseous effluent, which results in a lower dose impact. The use of nitrogen as a cover gas for tanks in the primary circuit provides a significant safety benefit compared to the use of hydrogen and is consistent with developments in PWR evolutionary designs worldwide. Use of nitrogen as a cover gas results in neutron activation of Nitrogen-14, and as such results in an increase in discharges of Carbon-14 via the gaseous route (of approximately 10%), though the increase has minimal effect on the dose impacts, and the change is considered a positive given the significant benefits to nuclear safety.

384. There is no viable method for the abatement of Carbon-14 resulting from PWR operations. A number of technologies for the abatement of Carbon-14 have been assessed for their viability (and whether they are BAT) for use at nuclear power plants (See Claim 2, Argument 14, Support Document A1 [Ref 25]).

4.1.3 Iodine 131 (Gaseous)

385. Isotopes of iodine (predominantly Iodine-131, but also Iodine-133 and others) are fission products that may pass in very small concentrations out of the fuel cladding and into the primary coolant. The majority of isotopes of iodine are retained in the liquid phase, however a small amount may be discharged via TEG. Iodine isotopes are abated by the carbon delay beds in TEG, and typically only discharged in very small

quantities. Iodine traps are installed in the DWN and brought into service if required by high activity in one of the HVAC cells. The permit limit granted to HPC for the discharge of Iodine-131 was done so on the basis that Iodine-131 is the most radiologically significant of the halogen group and is broadly representative of the whole group given that the means of production and abatement are the same for Iodine-131, as for the other isotopes of iodine. Restricting the limit to Iodine-131 only is considered BAT given it is easier to detect and has a longer half-life than many of the others.

4.1.4 Noble Gases

386. The majority of noble gases are fission products (primarily Xenon-133, Xenon-135 and Krypton-85 (see Table 4-1) for approximate proportions). During normal operations a small proportion of these fission products pass into the primary coolant from the fuel and are degassed from the tanks in the primary circuit. The gaseous effluent passes through TEG prior to discharge, where the majority of the short-lived radionuclides are decayed away in the carbon delay beds. Argon-41 can also be formed via neutron activation of naturally occurring Argon-40 in the air of the HR by neutron flux around the reactor pressure vessel. It is routed through the HR ventilation system and discharged via the NI stack. Careful chemistry control ensures that Argon-40 dissolved in primary coolant is minimised, and as a result Argon-41 only appears in very small quantities and appears only transiently given its two-hour half-life.

4.1.5 Beta emitting radionuclides associated with particulate matter

387. Other fission and activation products are discharged as fine aerosols formed mainly as a result of activation (Cobalt-58, Cobalt-60) or are fission products (Caesium-134, Caesium-137). All discharges via the NI stack go via HEPA filtration prior to discharge, and radioactivity discharged to the environment as aerosols represents less than one microgram per year.

388. The breakdown of the total activity of noble gases and other fission and activation products is based on an analysis of data for the actual discharge from the French nuclear power plants most similar to the UK EPR™. The anticipated distribution of the radionuclides for each of these groups, expressed in percentage terms by activity, is presented in Table 4-1 and Table 4-2. This takes account of the fact that the first barrier (the fuel rod cladding) cannot ensure complete leak resistance and explains the presence of fission products such as isotopes of iodine and isotopes of caesium in the gaseous waste.

Table 4-1 Distribution by activity of noble gases discharges in gaseous form

Radionuclide	Ratio (%)
Krypton-85	13.9
Xenon-133	63.1
Xenon-135	19.8
Argon-41	2.9
Xenon-131m	0.3

Table 4-2 Distribution by activity of fission and activation products discharged in gaseous form

Radionuclide	Ratio (%)
Cobalt-60	30.1
Cobalt-58	25.5
Caesium-134	23.4
Caesium-137	21.0
Total fission/activation products	100.0

4.1.6 Other radionuclides liquid discharges including Caesium-137 and Cobalt-60

The total activity relating to other fission and activation products is divided between the various isotopes of other fission and activation products emitting beta or gamma radiation, based on an analysis of information on actual discharges from EDF's existing reactor fleet, as shown in Table 4-3. This analysis included Cobalt-60 and Caesium-137, for which specific site limits are proposed. The presence of fission products such as isotopes of caesium is due to the occasional failure of fuel cladding however the fuel pool will have a closed loop cooling and purification system which includes abatement methods such as evaporation, demineralisation and filtration to remove radioactivity from the pool water. This will result in very limited discharges of pool water into the site liquid effluent system.

Table 4-3 Distribution by activity of Cobalt-60, Caesium-137 and other fission and activation products discharged in liquid form

Radionuclide	Ratio (%)
Cobalt-60	30
Cobalt-58	20.7
Nickel-63	9.6
Caesium-137	9.45
Antimony-125	8.15
Silver-110m	5.7
Caesium-134	5.6
Antimony-124	4.9
Manganese-54	2.7
Tellurium-123m	2.6
Other	0.6
Total	100

4.2 Identification of Significant Radionuclides

389. The ‘key radionuclides’ in gaseous and liquid radioactive discharges from nuclear power stations are defined in the EU Commission recommendation [Ref 47] as:

“The radionuclides to which requirements for detection limits should apply. These key nuclides should represent categories of radionuclides or a specific type of radiation, be significant in terms of radiological impact and be suitable measurement sensitivity indicators.”

390. Environment Agency guidance [Refs 48, 49] defines ‘significant’ radionuclides as those which:

- Are significant in terms of radiological impact on people (that is, the dose to the most exposed group at the proposed limit exceeds 1 µSv per year);
- Are significant in terms of radiological impact on non-human species (this only needs to be considered where the impact on reference organisms from the discharges of all radionuclides at the proposed limits exceeds 40 µGy/hour);
- Are significant in terms of the quantity of radioactivity discharged (that is, the discharge of a radionuclide exceeds 1 TBq per year);
- May contribute significantly to collective dose (this only needs to be considered where the collective dose truncated at 500 years from the discharges of all radionuclides at the proposed limits exceeds 1 man-sievert per year to any of the UK, European or World populations);
- Are constrained under national or international agreements, or is of concern internationally[6];
- Are indicators of plant performance, if not otherwise limited on the above criteria; and
- For the appropriate generic categories from the RSR Pollution Inventory (e.g. “alpha particulate” and “beta/gamma particulate” for discharges to air) to limit any radionuclides not otherwise covered by the limits set on the above criteria[7].

391. The above definitions have been adopted to identify significant radionuclides for radioactive discharges from SZC.

392. Identification of significant radionuclides considers the following three sources of information (in terms of half-life, radiation dose, magnitude of source term or being indicators of plant performance):

- EU Commission Recommendation 2004/2/Euratom [Ref 47];
- Information presented for GDA [Ref 46] – the radionuclides of interest presented for the GDA correspond to those currently limited in France;
- Limits granted for HPC [Ref 48].

[6] The Environment Agency do not set limits to give effect to the targets in the UK Strategy for Radioactive Discharges (UKSDR) and do not set limits for the substances reported under the UKSDR.

[7] Where no limit is specified in the permit for any given radionuclide, discharges are in effect numerically unlimited although still controlled by the BAT conditions. The generic categories can be used to limit all radionuclides not otherwise limited in the permit.

393. A wide range of radionuclides will be generated during the operation of SZC. Support Document B [Ref 45] identifies the significant radionuclides for gaseous and liquid discharges and describes how they are managed. These significant radionuclides and key groups of radionuclides are presented in Table 4-4.

Table 4-4 Summary of Radionuclides Proposed for Discharge Limits

Gaseous Radionuclides	Liquid Radionuclides
Tritium	Tritium
Carbon-14	Caesium-137
Iodine-131	Carbon-14
Noble Gases*	Cobalt-60
Beta-emitting radionuclides associated with particulate matter**	Other radionuclides***

* Noble Gases comprise: Argon-41, Krypton-85, Krypton-85m, Krypton-87, Krypton-88, Krypton-89, Xenon-131m, Xenon-133, Xenon-133m, Xenon-135, Xenon-135m, Xenon-137, Xenon-138;

**Beta-emitting radionuclides associated with particulate matter; comprising of isotopes Chromium-41, Manganese-54, Iron-59, Cobalt-58, Cobalt-60, Caesium-134, Caesium-137. This is a combination of the list of 'other fission and activation products' presented for GDA [Ref 50] and 'Any Other Activity (AOA)', which is RSR limited for SZB and SZC; and

***Other fission and activation products comprising isotopes: Chromium-51, Manganese-54, Iron-55, Iron-59, Cobalt-58, Nickel-63, Zinc-65, Niobium-95, Zirconium-95, Silver-110m, Tellurium-123m, Antimony-124, Antimony-125, Caesium-134 and Cerium-144.

394. It should be noted that there are some differences between the significant radionuclides considered for liquid discharge limits in the GDA submission for the UK EPR^{TM}, those subject to discharge limits at SZB and the recommendations of the EU Commission. The various radionuclides will be monitored and expressed under a single grouping ('other radionuclides'). These are further identified and explained in Support Document B (Disposal of Radioactive Waste) [Ref 45].

395. Similarly, the grouping of radionuclides selected for the setting of gaseous discharge limits for SZC differs slightly from the grouping presented for the GDA [Ref 46]. Although discharges will be assessed differently from those presented for the GDA, this does not change the design of the treatment systems and the way that radioactive gaseous discharges will be undertaken, which remains consistent with the information presented in the GDA.

396. It should be noted that not all of these radionuclides would be expected to be directly measured at source. However, measurements of specific indicator radionuclides will ensure that the total values obtained adequately cover the nuclides in each group that are included in the RSR environmental permit (Link to Support Document C1 – Plant Monitoring).

397. The radionuclides presented in Table 4-4 have been considered in the following sections and proposed limits for discharge throughout operation are presented in Section 4.4 and 4.5. It is noted that not every

radionuclide discharged may be subject to a specific discharge limit. Some of the radionuclides discharged are proposed to be grouped according to similarities in how they are generated, managed and abated.

4.3 Approach for proposing limits and notification levels

4.3.1 Development of SZC Approach

398. The setting of annual limits should consider the baseline of past plant discharges, future plant operations and improvement schemes that will be implemented during the period of authorisation. This includes:

- Identification of Expected Best Performance (EBP) and contingencies to identify the maximum expected discharge;
- Establishment of radionuclides that require discharge limits; and,
- Assessment of representative person annual effective dose against dose constraints and biota dose rates against relevant benchmarks.

399. The discharge limits determined for SZC are based on:

- EU Commission Recommendation 2004/2/Euratom definition of 'key radionuclides' [Ref 47] and joint environmental agency's guidance [Ref 49];
- Radioactive source terms demonstrated as part of the GDA process;
- Data from the French fleet of 1300MWe PWRs, and German KONVOI reactors, which are the parent designs from which the UK EPR™ evolved. data on effluent discharges and the associated limit values was reviewed, with consideration for operating margins covering standard contingencies relating to plant operations (unscheduled system drainage for maintenance, temporary faults with abatement plant, etc.);
- Discharges produced by the UK EPR™ in relation to the 1300MWe units;
- The types of fuel envisaged for the UK EPR™;
- The system design improvements optimising discharges as described in Section 2 and supporting Document A1; and
- The limits granted for HPC given the identical nature of the NI.

400. The SZC Co. approach is consistent with the approach identified above. It includes estimates of the best performance for radioactive waste discharge from SZC and proposed rolling annual limits that take into account matters, including trends and events, expected to occur during routine operations. These include reactor shutdowns, maintenance activities, fuel defects and the performance of the waste management systems. Summary results for the annual effective dose to the representative person and dose rates to NHB are given in Section 6 and in further detail in RSR Permit Application Support Document D1 [Ref 53].

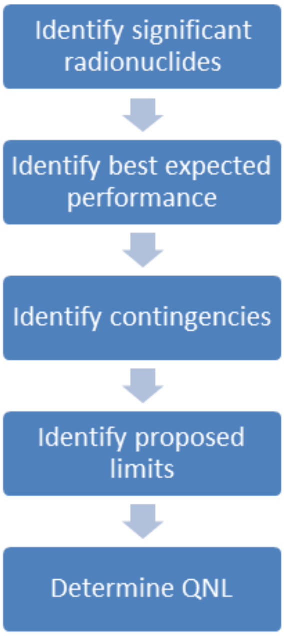


Figure 4-1 SZC Co. Approach for identifying limits

401. It is noted that although based on HPC, there is currently limited operational data available from Taishan 1, therefore SZC Co. continues to rely on GDA [Ref 46] and SoDA as well as the review of design changes to demonstrate there should be no impact on the limits granted for SZC. Further operational data, where available, will be reviewed and incorporated as appropriate.

4.3.2 Determining Significant Radionuclides

402. Not every radionuclide discharged may be subject to a specific discharge limit. The radionuclides identified as significant and the proposal for setting limits for SZC is consistent with published regulations and guidance. The Environment Agency guidance [Ref 49] uses the criteria stated in Section 4.2 of this document to define limits:

403. Based on the EU Commission Recommendation 2004/2/Euratom [Ref 47] and the Environment Agency criteria, the following radionuclides are considered significant and are included in Table 4-4 with proposed limits:

- Tritium is considered significant for liquid discharges given that the quantity of radioactivity discharged exceeds 1 TBq per year;
- Carbon-14 is considered significant given that the dose to the most exposed group at the proposed limit exceeds 1 µSv per year for liquid discharges;
- Caesium-137 in liquid discharges is regarded as a good indicator of fuel and plant performance. Moreover, Caesium-137 is persistent in the environment. As such it is considered a significant radionuclide that should be limited;
- Cobalt-60 although not considered significant by the Environment Agency criteria, is considered significant given that releases are a good indicator of any issues relating to corrosion and can be identified by measurement in liquid discharges and therefore considered significant; and

- Other radionuclides excluding those above which also indicate plant performance are also included together as a group.

404. Information on the origin of the radionuclides presented in Table 4-4 is given is subsequent sections of this chapter.

4.3.3 Description of External Pathway Receptors

405. For gaseous discharges, the most relevant exposure pathways are ingestion of terrestrial foods, inhalation of airborne activity and external exposure from material in the air and deposited on land. Inhalation of airborne material and external exposure are difficult to assess directly and may be monitored using environmental models.

406. For liquid discharges, the most relevant exposure pathways are the ingestion of marine fish and seafood, and external exposure from contaminated silts and sediments. The monitoring programme is therefore to be directed at a wide range of foodstuffs and external dose rate measurements.

407. For both gaseous and liquid discharges the particular pathways and reference groups considered, regarding impact from SZC proposed permitted activities are described in SZC RSR Permit Application Support Document D1 (Human Radiological Impact Assessment) [Ref 53].

4.3.4 Determining Expected Best Performance

408. As part of GDA, a number of representative plants were selected to assess EBPs for the UK EPR™ as described in Section 3.1. OEF data from the eight 1,300MWe PWR sites (20 units in total) have been analysed over the period 2001 – 2003, equivalent to 60 reactor-year's data. This provided statistical distributions for a number of radionuclides representing values averaged for each site to one unit per site, over the three years considered. These reflected the impact of site management on the discharges of a number of radionuclides and the control of environmental performances over time. It would not have been appropriate to set EBP values at the average level of each statistical distribution, considering the scattering of some data and the environmental improvements that are expected for the UK EPR™.

409. Annual discharges do not provide full visibility on the effect of monthly fluctuations on discharge profiles. To allow further analysis of the fluctuations of discharges related to normal transients and expected contingencies, additional monthly OEF data have been presented in the GDA [Ref 46]. OEF data from Flamanville (2 units) and Paluel (4 units) have been analysed over the period 2002 – 2007, equivalent to 36 reactor-years data. This period has been studied to take account of more recent data that were available at the time of assessment. These two sites have been selected as they provided data that was considered to be representative of the fleet over the period studied.

410. Since no operational data is available for the UK EPR™, the future radioactive discharges from SZC have been assessed based on OEF data from indicative PWR predecessors, as was done for the HPC RSR permit application. Following the determination of the EBP without contingency, the impact of a number of contingencies on the releases was estimated. It is essential to assess the impact of the contingencies and transients on the predicted future discharges in order to determine an adequate maximum discharge value to accommodate plant operations in the long term. Reasonable headroom needs to be added to the expected performance without contingency.

411. In addition to the OEF data used, and in order to fully understand the role of site management choices regarding discharges and the contingencies and transients associated with some of the discharges, extensive discussions with the operational staff at Penly site and with the EDF Division de Production

Nucléaire (which gathers information for all the French fleet) have taken place. This helped identify the site-specific management factors influencing the gaseous discharges. The representative values for the discharges of 1,300MWe units were then adapted to the UK EPR™, taking into account design changes and other criteria to assess the predicted future annual and monthly discharge. Finally, OEF from a number of other sites, known for having encountered contingencies such as fuel leaks, was used in order to determine the impact of such events on the overall gaseous discharges. A notable difference between liquid and gaseous discharges is that most gaseous discharges are continuous, and therefore the impact of site management on these tends to be smaller than on the periodic liquid discharges.

412. The EBP is determined through consideration of indicative EPR™ precursors and the evolutionary EPR™ design. The EBP for a single unit was presented for GDA [Ref 46] and given that there are two UK EPR™ units on the SZC site the total EBP is estimated by doubling the values presented at GDA.

413. It is recognised that overtime, further learning and improved practices will be identified, as more operational UK EPR™ OEF becomes available, SZC Co. will review and incorporate information such as operational data as it becomes available from UK EPR™ units and other EPR reactors, as considered applicable [SZC RSR CMT 1].

414. Importantly, the EBP data assumes a long-term plant availability of 91%. This availability corresponds to an average over 60 years, which is the expected operational life span of the UK EPR™.

4.3.5 Contingencies

415. Relevant contingency is about consideration of operating variables which give the operator the flexibility to choose the most suitable operating regime without disproportionate impacts on discharges.

416. The EBP discharges require justified contingency to allow there to be some headroom between these discharge levels and the proposed limits.

417. Some of the main contingencies associated with gaseous and liquid discharges come from unplanned shutdown, coolant chemistry changes, fuel failure as well as leaks from the primary coolant containment and changes in the way coolant is recycled or discharged.

418. However, the robust application of the waste management and minimisation techniques presented in the earlier chapters on the Environment Case and IWS (Section 3) seek to ensure routine annual discharges are kept below the annual limits proposed in Table 4-6 and Table 4-9. This is consistent with the condition expected in the Environmental Permit that requires the operator to use BAT to minimise the quantity and impact of radioactive effluent discharges.

4.3.6 Limits

419. The GDA presented proposed limits for a single UK EPR™ based on the French practice of calendar based annual limits. The UK's discharge limits are taken on a twelve-rolling-month basis. Overall, the main difference between these two types of limits is that where discharges are assessed on a twelve-rolling-month basis, they account for operational contingencies and start-up or shutdown phases that may have occurred over the preceding full 12 months of operations. Assessing discharges on a calendar yearly basis does not provide visibility over a rolling period of time. Therefore, twelve-rolling-month limits need to be higher than calendar year limits as they account for a 'build-up' effect of any higher monthly discharges encountered over a twelve-rolling-month period.

420. This application proposes annual discharge limits on a twelve-rolling-month basis for the radionuclides identified as significant against the published regulator guidance. Given the replication strategy adopted for SZC where the NI is identical to HPC. Therefore, given the means of generating radioactive waste, how BAT is applied to minimise this at source and how BAT is then used to minimise the radioactivity in the effluent discharged, are also the same between SZC and HPC, the discharge limits proposed for SZC are also the same as those granted at HPC.

4.3.7 Quarterly Notification Levels

421. The purpose of QNLs is to signal circumstances where discharges in any consecutive 3-month period are above expected levels and may indicate operational issues. They therefore give to the plant operator an ongoing indication of plant performance and any gradual deterioration in this. Exceeding QNLs is not a breach of the RSR environmental permit although the exceedance must be reported to the EA. QNLs are normally set above the level for normal transients but below those for unplanned (although foreseeable) plant faults such as fuel leaks. If the QNL is exceeded the operator is required to inform the Environment Agency giving the reasons for the exceedance, procedures that will be in place to address this and a demonstration of continuing use of BAT to control discharges. Only in some circumstances, exceedance of the QNL may indicate failure of BAT.

422. The purpose of the QNLs presented above is consistent with the standard conditions of the RSR environmental permit and the Environmental Principles detailed by the Environment Agency in its REPs document [Ref 17], notably Principle RSMDP12 which states that that advisory levels should be set to:

- Prompt review of whether BAT is being used; and
- Ensure early assessment of the potential impact of increased discharges.

423. The general methodology developed for assessing QNLs, requires to be tailored to each radionuclide to produce a QNL that is fit to consider specific factors that may make their discharges fluctuate over time such as production, abatements, and discharge profile.

424. QNLs were proposed in the Environment Agency GDA Public Consultation Document [Ref 50] based on a single UK EPR^{TM} unit derived from the EBP data supplied by the Requesting Party and the EA's regulatory experience and insight. Importantly, as previously identified the EBP data assumes a long term availability of 91%. This availability corresponds to an average over 60 years, which is the expected operational life span of the UK EPR^{TM}. It is possible that no shutdown will occur over rolling quarters hence the availability in this case will be equal to 100%. Where the discharges of certain radionuclides are directly linked to their production, the QNLs should be set based on 100 % availability. Therefore, in some cases the QNLs proposed by the Environment Agency in the context of GDA will underestimate the levels proposed in this Submission.

425. QNLs are based on historical performance and OEF of predecessor plant, given that a UK EPR^{TM} has not yet been operated. In the Environment Agency guidance on the setting of discharge limits [Refs 48, 49] it indicates that in the absence of previous experience QNLs could be set on 25% of the annual limits. This simple approach does not consider the discharge practice that may prevail for UK EPR^{TM}. The QNLs proposed in this Submission are based on an assessment of indicative predecessor plants as presented in the HPC RSR permit application recognising the QNLs granted by the Environment Agency to NNB GenCo (HPC). The QNLs proposed also account for two units and additional site specific facilities on the HPC site which are not included in the GDA.

426. In the absence of any additional information, SZC Co. is applying for proposed QNLs which are the same as those granted to HPC. The Environment Agency recognises that the QNLs in the GDA Public Consultation Document [Ref 50] may need to be reviewed and revised during site specific permitting process, especially in light of OEF as it becomes available. Once the UK EPR™ units are commissioned and operational the monitoring of performance will inform the setting of QNLs. This may result in QNLs being updated in the future and varied from those proposed in this Submission.

4.4 Gaseous Discharges

4.4.1 Introduction

427. This sub-section presents the proposed twelve-rolling-month limit and associated QNL for the discharges of significant radionuclides associated with gaseous effluents from SZC. Further details on the production and treatment processes for the radionuclides in liquid effluent and analysis of OEF data from indicative EPR™ predecessors are provided in Support Documents A1 and A2 [Ref 25] [Ref 37], the GDA [Ref 50] and the Environment Agency GDA Public Consultation Document [Ref 46].

428. The SZC design, developed from the GDA [Ref 50] and HPC design, will allow for adequate and appropriate sampling, measurement and assessment of gaseous radioactive discharges. Discharge assessment will be applied at each main SZC gaseous discharge outlet to demonstrate compliance with discharge limits and to meet other objectives, as defined in Support Documents A1 and C1 [Refs 25, 51]. As indicated in Support Documents C1 and C2 [Refs 51] [Ref 52], these significant radionuclides will be included in the gaseous discharge monitoring programme at SZC.

429. The proposed limits result in doses that are well below the public dose limits and regulatory constraints. The limits are also consistent with the limits permitted for HPC [Ref 48] and the Environment Agency GDA UK EPR™ Public Consultation Document [Ref 46]. Further detail regarding how these are derived is presented in Support Document B.

4.4.2 Expected Best Performance

430. As described above, the EBP is determined through consideration of indicative EPR™ precursors and the evolutionary EPR™ design, including following the approach also used to determine the EBP for HPC.

431. On this basis the annual EBP for gaseous discharges for significant radionuclides are presented in Table 4-5.

Table 4-5 Annual expected best performance for gaseous discharges

Radionuclides	Expected Best Performance (GBq/y)
Tritium	1000
Carbon-14	700
Noble Gases	1600
Iodine-131	0.005
Beta-emitting radionuclides associated with particulate matter	0.008

4.4.3 Limits

Table 4-6 Proposed Gaseous Limits (12-month Rolling Basis)

Radionuclides	Proposed Annual Limits (GBq/y)
Tritium	6,000
Carbon-14	1,400
Noble gases	45,000
Iodine-131	0.4
Beta emitting radionuclides associated with particulate matter	0.12

4.4.4 QNL

Table 4-7 Proposed Gaseous Quarterly Notification Levels

Radionuclides	Proposed QNL (GBq)
Tritium	400
Carbon-14	300
Noble Gases	1,500
Iodine-131	0.064
Beta-emitting radionuclides associated with particulate matter	0.008

4.5 Liquid discharges

4.5.1 Introduction

432. This sub-section presents the proposed twelve-rolling-month limit and associated QNL for the significant radionuclide liquid discharges from SZC. Further details on the production and treatment processes for the radionuclides in liquid effluent and analysis of OEF data from indicative EPR^{TM} predecessors are provided in Support Documents A1 and A2 [Ref 25, 37], the GDA [Ref 50] and the Environment Agency GDA Public Consultation Document [Ref 46].

433. The SZC design, developed from the GDA and HPC design, will allow for adequate and appropriate sampling, measurement and assessment of liquid radioactive discharges. Discharge assessment will be applied at each main SZC liquid discharge outlet to demonstrate compliance with discharge limits and to meet other

objectives, as defined in Support Documents A1 and C1 [Refs 25] [Ref 51]. As indicated in Support Documents C1 and C2 [Refs 51] [Ref 52], these significant radionuclides will be included in the liquid discharge monitoring programme at SZC.

434. The limits proposed are well below recommended figures. The limits are also consistent with the limits proposed for HPC [Ref 48] and the Environment Agency GDA Public Consultation Document [Ref 46]. Further detail regarding how these are derived is presented in Support Document B [Ref 45].

4.5.2 Expected Best Performance

435. As described above, the EBP is determined through consideration of indicative EPR™ precursors and the evolutionary EPR™ design, including following the approach also used to determine the EBP for HPC.

436. On this basis the annual EBP for gaseous discharges for significant radionuclides are presented in Table 4-8.

Table 4-8 Annual expected best performance for liquid discharges

Radionuclides	Expected Best Performance (GBq/y)
Tritium	104,000
Carbon-14	46
Cobalt-60	0.36
Caesium-137	0.114
Other Radionuclides	804

4.5.3 Proposed Limit

Table 4-9 Proposed Liquid Limits (12-month Rolling Basis)

Radionuclides	Proposed Annual Limits (GBq/y)
Tritium	200,000
Carbon-14	190
Cobalt-60	6
Caesium-137	1.9
Other Radionuclides	12

4.5.4 Proposed Quarterly Notification Level

Table 4-10 Proposed Liquid Quarterly Notification Levels

Radionuclides	Proposed QNL (GBq)
Tritium	60,000
Carbon-14	18
Cobalt-60	0.3
Caesium-137	0.1
Other Radionuclides	0.6

4.6 Solid waste

4.6.1 Introduction

437. There is an expectation within the EA's environmental permit RSR-B3 guidance document [Ref 54] to provide quantitative estimates of all radioactive waste arisings, therefore including solid waste. No solid radioactive waste will be disposed of on site, solid waste is not included within the SZC RSR Permit Application Support Document B (Discharges limits on radioactive waste) [Ref 45]. In order to provide a complete picture in this RSR application the following information is provided below, further information, regarding solid waste quantities, is provided in the SZC RSR Permit Application Support document A2 (IWS) [Ref 37].

438. SZC Co. is committed to the adoption of the waste hierarchy to prevent and, where this is not possible, minimise the amount of waste it produces. This includes the application of BAT to the design, construction and operation of engineering systems and the development and implementation of management controls to:

- Minimise at source the generation of wastes;
- Minimise the volumes of waste transferred to other premises; and
- Ensure wastes are disposed of in a form that minimises their impact on the environment and people.

439. Therefore, wastes that have been unavoidably generated have already been optimised prior to final transfer and disposal SFAIRP. It is the disposal of these wastes that a future application will be made by SZC Co..

440. The identification and characterisation of the radioactive wastes that are expected to be generated by the two UK EPR^{TM} units at SZC is based on extension operational experience of operating PWRs in France, and learning already implemented from other EPR^{TM}s under construction, in commissioning and in operation (HPC, FA3, OL3 and Taishan). This means that there is a higher degree of confidence associated with the nature, form and characteristics associated with the wastes than that associated with a FOAK facility.

441. It is recognised that solid radioactive wastes, including process wastes, are not expected to be generated until fuel has been brought onto site in the latter stages of commissioning. Consequently, there is a long period of time before waste will be generated and actually require disposal by transfer under this RSR environmental permit.

442. SZC Co.'s strategy for waste management means that no options are foreclosed around potential waste routes which may in the future offer meaningful alternatives. This approach enables the optimal use of waste routes that are available at the time, even though they may not necessarily be available now.

443. SZC Co. may seek alternate disposal routes via other waste service providers near the time of waste treatment, as considered appropriate and BAT. SZC Co. will establish the contractual arrangements with relevant waste disposal providers before radioactive waste is generated [SZC RSR CMT 7].

4.6.2 Combustible Waste

444. Following regulatory guidance and for the avoidance of doubt, SZC Co. is not applying for and do not plan to include disposal of solid radioactive waste by incineration on the SZC site. Any incineration will take place off site and under the regulations and permits of the relevant site.

4.6.3 Disposal of Waste on-site

445. SZC Co. will store ILW and Spent Fuel on site for an interim period prior to final off-site disposal. There will be no disposal of waste directly on-site. For further information, see Section 3.3.4.

4.6.4 Disposal of Waste off-site

446. The disposal of solid radioactive waste will be subject to regulatory scrutiny of both SZC Co.'s arrangements relating to the dispatch of radioactive waste from the site and also through the receiving site's RSR environmental permit requirements. SZC Co.'s arrangements will need to demonstrate sufficient controls are in place to control this operation. The waste transferred from SZC for disposal will need to meet the strict WAC of the site receiving the radioactive wastes. that are also regulated by the Environment Agency (in England) (or devolved regulators in Scotland and Wales). The receiving sites' WAC will reflect the relevant limitations and conditions imposed on them by the regulator through their own RSR environmental permit.

447. SZC Co. will establish the necessary contractual and procedural arrangements with the relevant waste providers which ensure waste is sent in compliance with the receiving site's WAC. SZC Co. will only transfer solid radioactive waste for disposal to sites that are suitably authorised to receive such wastes.

4.6.4.1 Hazardous wastes

448. As initially set out in the IWS assumptions (Table 4-11) the non-radioactive properties of radioactive wastes are considered as part of the radioactive waste management in order to ensure integrated and holistic waste management and ensure compliance with receiving sites WAC.

449. Once waste has been defined as radioactive, Waste Framework Directive [Ref 32] controls do not apply, even if the radioactivity represents only a small constituent of the waste. A breakdown of the wastes components that could potentially be classed as hazardous within each waste stream has been included. It is expected that the non-radioactive elements of radioactive wastes will be regulated (via the RSR

environmental permit) so that they are managed to standards consistent with that for non-radioactive waste.

450. The hazardous nature and anticipated physical and chemical composition of the waste considered suitable for treatment or disposal through alternatives to LLWR were included as part of the process for obtaining a DiP for the UK EPR^{TM} design.

451. NNB GenCo will assess the impact of the concentrations of potentially hazardous substances within each waste stream against the RSR environmental permits and WAC at the relevant disposal facilities prior to transfer and manage the waste accordingly. Deviations from the WAC may be resolved on a case-by-case basis in discussion with the appropriate service provider.

4.6.4.2 Process wastes

452. Table 4-11 summaries the properties and packaging options for low level process wastes. Further details as to the management of the waste can be found in Supporting Document A2 [Ref 37].

Table 4-11 Summary of process waste streams

Process waste	Physical description	Radioactivity	Hazardous properties	Waste packaging options
APG Ion-Exchange Resins	Ion-exchange beds are utilised in the APG to trap activation and fission products from the primary coolant circuit. In recycling the APG blowdown water from the SZC secondary circuit, the blowdown water is purified by the use of two parallel filters to remove suspended solids and two parallel demineralisation lines which use ion-exchange resins to perform the demineralisation. In the event of a fuel failure and significant primary to secondary coolant leak APG resin has the potential to become ILW. If this occurs the plant has the capability to transfer the resin into the ILW resin tanks.	Radioactive Contaminants: Activation products and fission products arising from the 1`qactivation of primary circuit corrosion products in the reactor core. These consist of predominantly beta and beta/gamma emitters. (Tritium, Cobalt-60, Cobalt-58, Manganese-54, Silver-110m, Caesium-134, Caesium-137, Beryllium-10, Carbon-14, Sodium-22, Chlorine-36, Calcium-41, Iron-55, Nickel-59, Nickel-63, Selenium-79, Strontium-90, Molybdenum-93, Zirconium-93, Niobium-94, Technetium-99, Palladium-107, Silver-108m, Tin-121m, Tin-126, Iodine-129, Caesium -135, Samarium-151). Alpha emitters are only expected to be present in trace amounts.	Spent ion exchange resins	Exemption provisions, Incineration, LLWR
Wet sludge	During operation particulates will settle as sludges in various buffer and storage tanks associated with the auxiliary water circuits (TEU and KER). These are contaminated with a range of fission and activated corrosion products. This sludge is periodically cleaned out and removed for treatment prior to disposal. The sludge consists of settled metal oxide particulate.	The main radionuclides that are present in the waste include Iron-55, Cobalt-58, Cobalt-60, Nickel-63, Tritium, Manganese-54, and Silver-110m, Other minor radionuclides comprising activation and fission products includes beta and beta/gamma emitters, Antimony-125, Caesium-134, Caesium-137, Beryllium-10, Carbon-14, Chlorine-36, Calcium-41, Nickel-59, Selenium-79, Strontium-90, Molybdenum-93, Zirconium-93, Niobium-94, Technetium-99, Palladium-107, Silver-108m, Tin-121m, Tin-126, Iodine-129, Caesium-135, Samarium-151 and a very small amount of alpha emitters.	Typical hazardous constituents that are expected to be present within this waste stream include Boron (1,000 ppm), Mercury (5 ppm), Lead (335 ppm), Nickel (165 ppm), Chromium (190 ppm), Antimony (5 ppm) and Cadmium (10 ppm).	LLWR

Process waste	Physical description	Radioactivity	Hazardous properties	Waste packaging options
Water filters from effluent treatment	Filters are used to capture particulate material in SZC water auxiliary circuits. Spent filter cartridges arise from the treatment lines of the following water auxiliary circuits: RCV, REA, TEU, and the PTR. Water filters are withdrawn from operation on the basis of clogging and/or dose rate, or after a fixed period of operational use (whichever is the soonest) and then treated as waste. The physical form of this waste stream consists of filter cartridges that are composed principally of stainless steel supports with glass fibre filter media and some organic materials. The amount of particulate radioactive material (metallic oxides) trapped on each filter can vary. The majority of waste within this category is anticipated to be ILW at the point of generation but some LLW is expected at point of generation and from the decay of ILW.	Nature of contamination: Activation products and fission products, beta and beta/gamma emitters (Cobalt-60, Cobalt-58, Manganese-54, Zinc-65, Silver-110m, Caesium-137, Beryllium-10, Carbon-14, Chlorine-36, Calcium-41, Iron-55, Nickel-59, Nickel-63, Selenium-79, Strontium-90, Molybdenum-93, Zirconium-93, Niobium-94, Technetium-99, Palladium-107, Silver-108m, Tin-121m, Tin-126, Iodine-129, Caesium -135, Samarium-151) Only trace levels of alpha emitter are expected to be present.	Chemical characteristics of raw waste: Iron, Cobalt, Nickel, Chromium, organics, cellulose (Chlorine: 489 ppm, Sulphates: 178 ppm) Toxic chemicals present in raw waste: Boron: 6,000 ppm Lead: 425 ppm Chromium tot: 240 ppm Nickel: 210 ppm Arsenic, Antimony, Mercury: 5 ppm Beryllium, Selenium: 0,2 ppm Cadmium: 11 ppm. No complexing agents or reactive metals will be present.	Condition/package as required to meet the WAC and transfer for disposal to LLWR.
Evaporator concentrates	SZC proposes to make use of evaporation for the minimisation of radioactive liquid effluents arising from the non-recyclable TEU. Evaporation is an energy intensive process and therefore only used to treat effluents which are not compatible with demineralisation (i.e. chemically contaminated effluents). Evaporation will minimise the discharge of active aqueous effluents to the environment. It results in the production of a sludge-like concentrate that will contain the bulk of the radioactivity initially present in aqueous effluent streams as activated metal oxides.	The evaporator concentrates will be contaminated with activated corrosion products and fission products comprising in the main of the following radionuclides, Iron-55, Cobalt-58, Cobalt-60, Silver-110m, Manganese-54, Caesium-137, Tritium, Nickel-63, Caesium-134, Antimony-125, and Zinc-65.	The main hazardous constituents that are expected to be present within this waste stream include Boron 42,160 ppm (or 17,000 ppm), Lead: 335 ppm, Chromium tot: 6 ppm, Nickel: 8 ppm, Arsenic: 4 ppm, Antimony: 2 ppm, Mercury, Beryllium, Cadmium, Selenium: 0.4 ppm.	Condition/package as required to meet the WAC and transfer for disposal to LLWR

Process waste	Physical description	Radioactivity	Hazardous properties	Waste packaging options
Air and water filters	All radiological controlled areas of the HN, HK, safeguards buildings, HR, operational production centre, HW and HQA/HQB are served by dedicated ventilation systems. The extract from these systems is subject to a number of airborne activity abatement techniques, including the use of HEPA filtration, before discharge to the environment. The HEPA filters remove particulate material to ensure doses to workers are ALARP and discharges to the environment are minimised. This also ensures that the doses to members of the public from airborne discharges are also minimised. The abatement systems will produce a number of spent LLW pre and HEPA filters over the course of reactor operations. In addition to the filters serving the primary systems, LLW water filters will be generated from the filtration of low activity effluent (TEU, APG). The physical form of this waste stream consists of filter cartridges that are composed principally of stainless steel supports with glass fibre filter media and some organic materials.	The main radionuclides present within the spent filters will include Iron-55, Cobalt-58, Cobalt-60, Silver-110m, Zinc-65, Caesium-137, and Manganese-54.	The main hazardous constituents that are expected to be present within this waste stream include Boron (8,150 ppm), Lead (904 ppm), Chromium (333 ppm), Nickel (291 ppm), Arsenic (7 ppm), Antimony (7 ppm), Mercury (7 ppm), Beryllium (0.3 ppm), Selenium (3 ppm) and Cadmium (15 ppm).	Water Filters: Condition/package as required to meet CfA and transfer for disposal to LLWR Air Filters: Transfer for high force compaction and onward disposal to LLWR

4.6.4.3 Operational wastes

453. Table 4-12 summaries the properties and packaging options for low level process wastes. Further details as to the management of the waste can be found in Supporting Document A2 [Ref 37].

Table 4-12 Summary of operational waste streams

Operational waste	Physical description	Radioactivity	Hazardous properties	Waste packaging options
Dry Active Wastes	Dry Active Wastes (DAW) comprise the combustible and non-combustible LLW generated through routine and maintenance operations at SZC and consist of contaminated personal protection equipment, monitoring swabs, plastic, clothing, contaminated tools, segregated pieces of metal, glassware and other process consumables. These wastes mainly arise during outages.	The DAW will be contaminated with activated corrosion products and fission products comprising in the main of the following radionuclides, Iron-55, Cobalt-58, Cobalt-60, Silver-110m, Zinc-65, Manganese-54, Antimony-125, Caesium-134, and Caesium-137.	The main hazardous constituents that are expected to be present within this waste stream include Boron (100 ppm) and Antimony (1,000 ppm).	Non combustible Transfer for High Force Compaction and onward disposal to LLWR. Combustible- Package and transfer for off-site incineration.
Oils and solvents	Oils are used in the lubrication of various components, such as circulators and process pumps, and have the potential to become radiologically contaminated during normal service. Contaminated liquids, such as chemical cleaning solutions and solvents, used as decontamination agents also arise and will be included within this waste stream.	The main radionuclides present within the waste lubricating oil will include Iron-55, Cobalt-58, Cobalt-60, Silver-110m and Manganese-54.	Waste oils and solvents are considered to be hazardous substances.	Package and transfer for off-site incineration.
Metal scraps and other metallic wastes (dose rate < 2 mSv h^{-1})	Oils are used in the lubrication of various components, such as circulators and process pumps, and have the potential to become radiologically contaminated during normal service. Contaminated liquids, such as chemical cleaning solutions and	The main radionuclides present within the metallic wastes will include Iron-55, Cobalt-58, Cobalt-60, Silver-110m and Manganese-54.	None identified.	Package and transfer for off-site metals treatment. Direct disposal to LLWR

Operational waste	Physical description	Radioactivity	Hazardous properties	Waste packaging options
	solvents, used as decontamination agents also arise and will be included within this waste stream.			

4.6.5 Timing of waste arising and transfers

454. In the 6 months preceding operations, commissioning of the active systems will take place. This will result in the generation of small volumes of solid waste being generated and the first transfers of solid radioactive waste from the SZC site would be expected. It is expected that these will fall well within the envelope of the expected arisings during full operations.

455. During the initial active operations, particularly during the first cycles of operation it is anticipated that the solid waste arisings will increase beyond those generated during commissioning but will still be below the levels anticipated when all systems and processes are operating at capacity, consequently LLW transfers and disposals would be expected to be well within the proposed limits. Waste is expected to be initially stored in the buffer storage area until the volume required for treatment and transfer is reached.

456. SZC Co. will review and apply OEF when available, such as from HPC, to determine a qualitative waste profile of expected arisings in terms of type, volume and activity during the commissioning phase and initial operation cycles [SZC RSR CMT 1].

4.7 Conclusion

457. Support Document B demonstrates that although the receiving environment and local receptors are different at SZC compared to HPC, the limits proposed still ensure that the resulting dose at SZC is well below the dose constraint values whilst also enabling a consistent operating approach across the two sites supporting the claim that the HPC limits are also appropriate for SZC. Furthermore, any changes in the design from the limits initially proposed for HPC have already been incorporated in the HPC RSR permit, the SZC specific changes from an RSR perspective have been reviewed and confirmed to not present any deviations in proposed limits for SZC compared to those permitted for HPC.

5 MONITORING AND SAMPLING

5.1 Introduction

458. This section summarises the monitoring arrangements as part of the permit application to demonstrate how SZC Co. will ensure compliance with permit conditions, including the application of BAT. For the purpose of this document, the term 'monitoring' includes the taking of samples and measurement, either on-line or in a laboratory, of radioactivity, chemical and physical properties of both in-process and discharge effluents. In the context of this document 'monitoring' includes:

- Plant Monitoring, comprising
  - Discharge monitoring enables the operator to demonstrate compliance with the permit conditions and disposal limits;
  - Solid waste characterisation and sentencing; and
  - In-process monitoring, taking place prior to discharge, of the composition of radioactive substances in primary coolant, process fluids, reactor off-gas and associated effluent, and measurement of plant conditions which enable the diagnostic of systems or components serving an EPF.
- Environmental monitoring undertaken by the operator around the site to demonstrate compliance with the expected Environment Agency RSR Permit conditions relevant to environmental monitoring.

459. Support Document A1 provides the full Environment Case for SZC and presents in full Claim 5 which demonstrates fully how SZC Co. shall undertake appropriate monitoring of the radioactive waste sources to ensure compliance with the conditions of the RSR permit.

5.2 Plant Monitoring

460. Monitoring is considered an EPF of the plant. Key systems involved in delivering the monitoring function include:

- The KRT is the plant radiation monitoring system that provides on-line measurements such as gamma activity and samples for the in-process monitoring of liquid and gaseous effluents
- The TEN system provides samples for in-process monitoring of liquid effluents
- The Nuclear Sampling System/Secondary Sampling System (REN/RES) systems enable the monitoring and optimisation of the primary and secondary coolant systems, a fundamental aspect for the minimisation at source of radioactive waste generation

461. Other systems will include in-process plant monitoring to ensure and verify the availability and effectiveness of equipment to deliver its EPF.

462. At the design stage the need is to demonstrate a full understanding of the requirements for monitoring systems and consideration for appropriate design features, i.e. requisite space for plant, have been considered. Specifications of monitoring regimes will be developed as the plant moves towards operations.

5.2.1 Discharge Monitoring

463. Discharge monitoring is required to demonstrate compliance with the limits and conditions specified within the SZC RSR permit.

Gaseous Discharge Monitoring

464. Gaseous discharge monitoring on the NI stacks on Unit 1 and 2 have the same monitoring configuration comprising of a primary and duplicate, secondary sampling lines and equipment.

465. The sampling lines located in the stack are routed to a sampling room where a combination of on-line analysers and samplers; which are part of the KRT, are located. The monitoring equipment is located in a sampling room adjacent to the stack plenum on the top floor of the HN building at the closest available point. The dedicated sampling room provides a safe and permanent means of access in a secure and controlled environment with sufficient space for equipment to be operated, inspected, calibrated and maintained.

- One sampling line supplies the beta gas monitors.
- One sampling line which supplies the online gamma spectrometer
- One large-diameter primary sampling line used to supply three secondary sampling lines, which supply a particulate and Iodine-131 sampling device, a Tritium sampling device, and Carbon-14 sampling device respectively

466. The second set of sampling lines are routed to a separate room but the equipment is identical to those described above with the exception that the online gamma spectrometer which is replaced with a 24h sampler.

467. Flow meters are located in the stack for continuous monitoring of the discharge flow rate, in accordance with recommendations of ISO2889:2010.

468. The minor gaseous outlets will not be continuously monitored. Discharges from these outlets will be assessed to check that emissions remain below 5% of the respective discharge limits specified in the RSR permit. The minor outlets will either be monitored through the use of spot samples or calculated based on process data.

Liquid Discharge Monitoring

469. The KER and SEK systems are the main routes for discharge of radioactive liquid effluent. These systems consist of large tanks housed in the HXA with components to enable isolation, recirculation, monitor/sample and discharge of effluent. The TER provides additional storage capacity and discharges via the KER network.

470. Liquid monitoring equipment will be provided for each main aqueous discharge outlet to undertake measurements for tritium, Carbon-14, Cobalt-60, Caesium-137 and ‘other fission and activation products’ discharges.

471. Monitoring is required prior to discharge to ensure suitability of effluent for discharge and when effluent is being discharged through the associated outlet to provide a representative measurement for reporting. Key equipment during discharge comprises:

- Flow meters to monitor the volume and flow rate of liquid effluent that’s is discharged via the

KER/TER/SEK tanks;

- Flow Proportional Samplers (FPS) for sampling during discharge to provide ample for analysis in the lab of the identified radionuclides for statutory reporting;

472. There are two sets of flow meters and FPS, one on the KER discharge line and one on the SEK discharge line. The TER system discharges via the KER line and associated flow meter and FPS. If the flow meter or FPS are unavailable and a discharge has to be made for operational reasons then the use of tank samples and tank level sensor measurements will be used as a back-up technique. Maintenance of the primary equipment will minimise the demand on the back-up method.

473. The standard conditions attached to an RSR environmental permit require the application of the Environment Agency Monitoring Certification Scheme standard for automatic water sampling equipment where available. At the time of writing, no equipment has yet been certified for use in pressurised systems and no other UK EDF nuclear site is currently using a certified FPS for pressurised systems. Notwithstanding this, following relevant good practice, the FPS specification will require apply the equivalent standard BS EN 16479.

Solid Waste Monitoring

474. Waste packages will be monitored via appropriate methods e.g. drum monitors, to determine the activity contained within. Proposed techniques are summarised in Table 5-1. The activity measured, waste package and conditioning process characteristics will be used to determine the volume, activity and other information needed by waste service providers (LLW and VLLW) or the on-site solid ILW store (HHI). In addition, characterisation data will be used to determine the radionuclide breakdown of the waste for compliance demonstration purposes associated with WAC or LoC requirements as applicable.

Table 5-1 Solid Waste Stream Characterisation Techniques

Waste Stream	Preferred Monitoring Technique
Active Resins	Sample taken via glove box with destructive offsite analysis to generate fingerprint and High Resolution Gamma-Ray Spectrometry (HRGS) for key radionuclides and application of scaling factors.
Charcoal Filters and Iodine Traps	Manual sample of charcoal media followed by on site laboratory based HRGS for gamma emitting radio isotopes and liquid Scintillation analysis for Tritium and Carbon-14.
Concentrates	Sample taken via glove box with destructive offsite analysis to generate fingerprint and on site laboratory based HRGS for key radionuclides and application of scaling factors.
DAW and Metallic Waste	Swabs taken from across the plant to generate fingerprint for site. Low Resolution Gamma-Ray Spectrometry (LRGS) Drum Scan for key radionuclides and application of scaling factors.
Active Air Filters	Fingerprint from relevant plant areas applied. LRGS drum scan for key radionuclides and application of scaling factors.
Sludges	Manual samples taken to generate fingerprint on campaign basis Laboratory Based HRGS for key radionuclides and application of scaling factors.

Water filters: Filters removed manually	Fingerprint established based on effluent/ swabbing LRGS drum scan for key radionuclides and application of scaling factors.
Water filters: Filters removed by filter handling machine	Fingerprint based on effluent across filter Dose rate measurement sensors in the Filter Change Machine measure key radionuclides
APG Resins	Manual resin sample to establish fingerprint and laboratory based HRGS for key radionuclides and application of scaling factors
Oils and Solvents	Manual samples on campaign basis. Laboratory based HRGS for key radionuclides and application of scaling factors. Liquid Scintillation counting for Tritium and Carbon-14

475. More details of the gaseous, liquid and solid waste monitoring systems are presented in Supporting Document C1.

5.3 Environmental Monitoring

476. SZC Co. will develop and implement arrangements to undertake environmental radioactivity monitoring around the SZC site for a number of reasons, including demonstrating compliance with the conditions of the permit, provide data to inform assessments of the radiological impact from operations. The scope of environmental monitoring includes direct radiation or contamination monitoring, and the sampling, analysis and assessment of environmental media from the vicinity of SZC.

477. These programmes involve taking samples of food, flora, fauna and environmental media to measure the amount of radioactivity that is present. These measurements are then used to determine the impacts of discharges and disposals of radioactive waste on the environment and people. The results of these environmental monitoring programmes are collated into a UK-wide Radioactivity in Food and the Environment report which is published annually

478. The environmental monitoring around the SZC site will be informed by the local environment as well as exposure pathways which vary over time. Initial monitoring has been undertaken to support the planning process. This will be revisited as the project gets closer to commissioning to confirm the pre-operational baseline. Given this is some time in the future there is no benefit in developing detailed programmes at this stage of the project. SZC Co. has described the process it will go through to develop a thorough and justifiable environmental radioactivity monitoring programme at an appropriate point in the project schedule [SZC RSR CMT 5]. This builds on and is consistent with the approach developed at HPC.

479. More details of the plan to develop the environmental monitoring arrangements are presented in Supporting Document C2 [Ref 52].

5.4 Conclusion

480. The design of SZC monitoring arrangements is considered BAT on the basis that plant monitoring has been incorporated into design process and will be used to ensure in-process optimisation to minimise waste generation and discharges at source and for compliance purposes when demonstrating permit limits and conditions are being met.

481. As the SZC project develops, SZC Co. will demonstrate that the specification of equipment to fulfil the monitoring arrangements are BAT based on the application of relevant codes and standards recognised as relevant good practice. During the procurement process SZC will continue to monitor the development of equipment supply to ensure equipment meets all specified requirements and that installation is completed successfully ensuring that the BAT criteria established is not compromised. The FWP (in Section 5 of Support Document C1 [Ref 52]) details the further work required to demonstrate that monitoring systems remain BAT during the design, procurement and construction process through the production of System Level BAT assessments as well as supporting documentation (i.e. Techniques Documents) to be completed as the process towards operations continue. The FWP details that SZC Co. fully understand the outstanding actions needed to continue applying BAT to the plant and that they are cognisant and engaged in the process so that all aspects are managed and completed in suitable timescales.

6 RADIOLOGICAL ASSESSMENT

6.1 Introduction

482. This section summarises the methodology used and the results of an assessment of radiological impact to:

- Members of the public associated with the operational phase of SZC (details presented in Supporting Document D1) and
- NHB (details presented in Supporting Document D2).

483. The assessments include:

- Annual doses to Candidates for the Representative Person, i.e. an individual receiving a prospective dose that is representative of the more highly exposed individuals in the population arising from continuous discharges of aqueous and gaseous radionuclides into the environment.
- Collective dose to UK, European and world populations.
- Dose from exposure to direct radiation and skyshine from site infrastructure.
- Annual dose to the representative person from aqueous, gaseous and external radiation (including direct radiation and skyshine). This term is equivalent to, and replaces, the term 'average member of the critical group'.
- Dose from short-term releases of gaseous radionuclides into the atmosphere.
- Build-up of radionuclides in the environment.

484. Approaches advocated by the National Dose Assessment Working Group (NDAWG), the Environment Agency and international and national advisory bodies such as the International Commission on Radiological Protection (ICRP) and Public Health England (PHE, formerly the Health Protection Agency, HPA) were adopted for assessing the impact of discharges and doses from SZC.

6.2 Human Assessment

6.2.1 Assessment scope

485. The scope of assessment considers the radiological impacts associated with the operational radioactive discharges from the proposed main site. This includes radiological impacts from discharges of gaseous and liquid and the marine environment respectively resulting from routine operations effluents to atmosphere. There will not be any disposal of radioactive effluents to groundwater during construction or operation, therefore no RIA on groundwater has been undertaken.

486. The cumulative impacts of the combined discharges from SZC and the neighbouring SZB station have been assessed as part of the permit application process.

487. SZA is defueled and is expected to have entered into the Care and Maintenance (C&M) phase before the proposed SZC facility begins power generation [Ref 74]. Discharges from SZA have therefore not been considered in the assessment of cumulative site impacts.

6.2.2 Assessment methodology

488. Having minimised and treated effluent SFAIRP some discharge of very low levels of radioactivity are unavoidable. Fission and activation products released from reactor operations are relatively constant throughout the site fuel-use cycle and hence consistent throughout any annual period. Assessment of continuous discharges is therefore appropriate for the radionuclides discharged and is discussed in this section. For the assessment of continuous discharges from SZC, the approach advocated by the NDAWG [Ref 55] has been adopted. An initial dose assessment (Stage 1 and 2) was performed using the Excel based Initial Radiological Assessment Tool developed by the EA, based on their Initial Radiological Assessment Methodology [Refs 56] [Ref57]

489. The initial assessment was then followed by a detailed, more realistic assessment using site-specific assessment parameters in accordance with the regulatory requirements for radiological assessments carried out to support environmental permit applications for nuclear facilities [Ref 54].

490. The dispersion and subsequent accumulation in food and in the environment of radionuclides discharged from SZC under a continuous discharge scenario were modelled using the supporting modules within the PC-CREAM 08 software, version 1.5.1.89, database version 2.0.0. PC-CREAM is a EU code system, which is considered by UK regulators as a suitable model for assessing the radiological consequences of routine releases. Site-specific model parameters were used to estimate environmental concentrations arising from discharges of radionuclides.

491. Discharges of aqueous radionuclides into the marine environment will be made via two outfall structures to be constructed at a location approximately 3.5 km offshore. Releases of gaseous radionuclides into the atmosphere will be made primarily via two emission stacks with physical heights of 70 m above ground level

492. Assessments have been carried out based on the proposed annual discharge limits (and using best performance values as part of a sensitivity analysis) for aqueous and gaseous radionuclides anticipated to be discharged by SZC. These assessments assume that radionuclide discharges are made in a continuous, routine and uniform manner and are consistent through a 60-year operational period.

Exposure Pathways

493. The following pathways were assessed for the candidates considered as representative person exposed to aqueous discharges:

- Internal exposure from the ingestion of seafood caught in the regional compartment (fish, crustaceans, molluscs and sea plants) incorporating radionuclides discharged into the marine environment.
- Internal exposure from inhalation of radionuclides entrained in sea spray.
- External irradiation from beta/ gamma radionuclides incorporated into beach sediment.
- External irradiation due to time spent over contaminated saltmarsh.

494. The following pathways were assessed for the candidates considered as representative person exposed to gaseous discharges:

- Internal exposure from inhalation of radionuclides in the gaseous plume and from resuspension of ground deposited radionuclides from discharges to atmosphere.

- Skin absorption of tritium[8].
- Internal exposure from the ingestion of radionuclides incorporated into locally produced terrestrial foods following deposition of radionuclides discharged to atmosphere.
- External irradiation from exposure to beta/ gamma radionuclides in the gaseous plume and from material deposited on the ground following discharge to atmosphere.

495. The following pathways were assessed for the candidates considered as representative person exposed to direct radiation from HRs, waste and spent fuel stores:

- Direct radiation exposure emanating from the surface of the building.
- Skyshine as a result of radiation emitted through the roofs of the storage facilities and being reflected by the atmosphere.

Representative Person

496. Candidates considered for the representative person for exposure to aqueous discharges were a fishing family, a houseboat dweller and a wildfowler.

497. Candidates considered for the representative person for exposure to gaseous discharges were a farming family and a worker at the neighbouring SZB facility.

498. Three candidate representative persons were considered in the external dose assessment: a dog walker, a local resident family and a SZB worker.

499. Candidates for representative persons exposed to both aqueous and gaseous discharges and external dose where also considered.

500. Site specific habits data, gathered independently by the Centre for Environment, Fisheries and Aquaculture (CEFAS), were used in the assessments. This provides information on ingestion rates and occupancy in various locations (e.g. beach, saltmarsh etc.) [Ref 58].

501. For each radionuclide, dose to three age groups is calculated: infant (1-year old), child (10-year old) and adult. Dose to a foetus and to a breast-fed infant are considered in the sensitivity analysis.

6.2.3 Assessment criteria

502. The criteria used for determining the magnitude of radiological impacts on individual members of the public are based upon the constraints summarised in Table 6-1. These criteria transpose the requirements of the BSSD [Ref 59] and are largely based on the recommendations of the ICRP [Ref 60]. The radiological exposure criteria will serve as benchmarks against which the predicted doses from permitted discharges from the proposed SZC nuclear power station will be compared.

[8] The PC-CREAM 08 dose coefficient for inhalation includes a multiplier for skin absorption pathways.

Table 6-1 UK Dose Limits, Constraints and Guidelines derived from International and European Regulations and Guidance

Dose	Source of the Dose Criterion used in the Assessment
1.0 mSv/y	An annual dose limit of 1,000 µSv/y to a member of the public from all historical, current and future sources of radioactivity subject to control.
0.5 mSv/y	A site dose constraint of 500 µSv/y to a member of the public from future planned operational discharges (excluding direct radiation) from multiple sources with contiguous boundaries at a single location. This applies to the combined discharges for SZB and C.
0.3 mSv/y	A dose constraint of 300 µSv/y to a member of the public due to future planned operational discharges and direct radiation arising from a single new source. For the purpose of legislation, SZC is considered a single new source. It is noted that in 2009 the HPA, now part of PHE, recommended that the UK Government implement a dose constraint not exceeding 150 µSv/y for members of the public in respect of new nuclear power stations and waste disposal facilities, in recognition of the fact that the design stage of such facilities presents an opportunity to reduce exposures to the public. However, this recommendation is not recognised as a statutory requirement[9].
0.02 mSv/y	The Environment Agencies, HPA and the Food Standards Agency recognise that where doses are below the former threshold of optimisation (<0.02 mSv/y) or are below regulatory concern (<0.01 mSv/y) then the effort to make assessments more realistic may not be warranted. An annual dose of 10 to 20 µSv/y (0.01 to 0.02 mSv/y) can be broadly equated to an annual risk of death of about one in a million per year. Nonetheless, the standard Environment Agency permit conditions under EPR16 (for instance that for HPC is specific in the requirement that the operator shall use the BAT in respect of the disposal of radioactive waste pursuant to the permit to: • minimise the activity of gaseous and aqueous radioactive waste disposed of by discharge to the environment; • minimise the volume of radioactive waste disposed of by transfer to other premises; • dispose of radioactive waste at times, in a form, and in a manner to minimise the radiological effects on the environment and members of the public.
0.01 mSv/y	

503. The Environment Agency recommends that a review of uncertainty and variability associated with key assumptions used in dose assessment be carried out in the event that the estimated dose to the representative person exceeds 20 µSv/y. The specific assumptions and parameters analysed were:

- Discharges - EBP discharges against proposed limits.
- Habits Data - generic food ingestion rate against site specific food ingestion rates.
- Food Source - 100% locally sourced seafood against 50% locally sourced seafood.

[9] It was not incorporated in the 2018 revision of EPR 16 which implemented the requirements of the 2013 BSS.

6.2.4 Assessment results

Direct radiation

504. The exposure of members of the public from direct radiation emanating from the SZC HRs will be negligible due to the shielding incorporated into the design of the HRs (for instance as demonstrated by SZB). Direct radiation from SZC is therefore largely attributable to the HHI and HHK facilities on site.

Continuous Discharge

505. The dose to adult, child and infant members of the fishing family arising from discharge at EBP was calculated to be 2.4 µSv/y, 1.2 µSv/y and 0.32 µSv/y respectively. The dose to adult, child and infant members of the farming family arising from discharges at EBP was calculated to be 1.9 µSv/y, 1.5 µSv/y and 3.2 µSv/y respectively.

506. The representative person was identified as the adult member of a fishing family living close to the Sizewell site. The dose to the representative person from exposure to the combined aqueous and gaseous discharges at proposed permitted limits and from exposure to direct radiation from SZC was 13 µSv/y.

507. This dose is significantly less than the current source dose constraint of 300 µSv/y and still more than a factor of 10 less than the recommendation of PHE for new nuclear power stations. The dose to the representative person from the site (i.e. SZB and SZC) was 17 µSv/y, which is 3.4% of the site dose constraint (500 µSv/y),

Short-term discharges

508. The dose to the adult, child and infant members of the farming family from exposure to short-term discharges of gaseous radionuclides from SZC, summed across the relevant terrestrial pathways, is calculated to be 3.8 µSv/y, 3.5 µSv/y and 6.9 µSv/y, respectively.

Collective Dose

509. The collective dose is the time-integrated dose to a population from a single year of discharge. The collective dose from discharges of aqueous radionuclides to the marine environment from SZC at the proposed limits was assessed to be 0.035 manSv/y, 0.21 manSv/y and 2.3 manSv/y to UK, European and World populations respectively. The collective dose from gaseous discharges at proposed annual limits from SZC was estimated to be: 0.23, 1.0 and 25 manSv/y to UK, European and World populations respectively.

510. The per caput dose to UK, European and World population from both aqueous and gaseous discharges was calculated to be between 2.1 nSv/y and 4.5 nSv/y for discharges from SZC (and between 2.6 nSv/y and 6.0 nSv/y for discharges from SZB and SZC).

Build-up

511. The dose from the build-up of gaseous radionuclides discharged from SZC deposited on the ground, assessed as total dose to a construction worker was found to be trivial at 0.0034 µSv/y.

6.2.5 Conclusions

512. All individual doses calculated were significantly less than the corresponding source and site constraints and the public dose limit. Sensitivity analyses have shown that the predicted doses are likely to be bounding and that actual exposure will be less. Collective dose has also been shown to be trivial.

6.3 Non-Human Biota Assessment

6.3.1 Assessment scope

513. The potential impact of routine operational aqueous and gaseous discharges from the proposed SZC nuclear power plant on a range of organisms representative of those inhabiting the areas close to the facility has been assessed. The assessment was based on the proposed annual discharge limits for SZC, and the permitted discharge limits for the neighbouring SZB facility were used in the assessment of in-combination effects.

514. SZA is defueled and is expected to have entered into the Care and Maintenance (C&M) phase before the proposed SZC facility begins power generation [Ref 74]. Discharges from SZA have therefore not been considered in the assessment of cumulative site impacts.

6.3.2 Assessment methodology

515. The assessment of radiological impacts due to discharges from SZC and the neighbouring SZB facility on NHB was undertaken using the Environment Risks from Ionising Contaminants: Assessments and Management (ERICA) Integrated Approach, which comprises the ERICA tool and the associated FREDERICA database [Ref 61] [Ref 62]. Further information is provided within Support Document D2 [Ref 63].

516. The ERICA tool is a software programme with supporting databases that allows the assessment of absorbed dose rates to a set of reference organisms that are representative of those commonly found in terrestrial, freshwater and marine ecosystems, for a range of radionuclides. The ERICA reference organisms incorporate the ICRP's Reference Animals and Plants (RAPs) as well as some species protected under European legislation [Ref 64]. It is an internationally recognised tool for NHB radiological assessments.

517. The EA's R&D128 methodology [Ref 65] was used to assess the impacts of releases of noble gases, which are not currently included in the ERICA approach. The EA's R&D 128 methodology was developed for the assessment of radiological impacts on Natura 2000 sites for compliance with the EC Habitats Directive in England and Wales [Ref 66]. The assessment of impacts on NHB due to releases of noble gases from SZC, which constitute the largest component of predicted gaseous releases from the facility in terms of activity released, is not possible using the ERICA tool. Such assessments can however be carried out using the R&D 128 methodology (which incorporates representative noble gases).

518. The dispersion and subsequent environmental accumulation of radionuclides discharged from the SZC facility were modelled using the supporting modules within the PC-CREAM 08 software [Ref 67]. This is a well-established software system used by operators and regulators for human and NHB dose assessment modelling. Site-specific model parameters were used to provide realistic estimates of environmental concentrations arising from radionuclide releases.

6.3.3 Assessment criteria

519. Radiological impacts on non-human species, unlike those on humans, have no absolute regulatory or universal 'value'. This is because different non-human species or their habitats have different perceived values depending on, for example, their rarity, sensitivity or location. After estimating the level of significance from the dose there is therefore a need to consider these aspects of the species or habitats affected and draw a final conclusion on the magnitude of the radiological impacts and its significance.

520. Site-specific data from the ecological surveys carried out have been used as a basis for selecting the habitats and species of interest with respect to radiological impacts on non-human species. This was to determine whether any adverse effects on radio-sensitive species are present.

521. Five indicative habitats representative of designated areas found locally around the proposed SZC site have been identified as potentially sensitive to radiological impacts due to their ecological significance and their location relative to the site of the proposed SZC facility. These are:

- Habitat 1, a terrestrial habitat, representative of Sizewell Marshes SSSI, lies adjacent to the west and north of the Sizewell site. This terrestrial habitat was selected as it will experience the highest air concentrations and deposition due to both proximity to the site and being in the direction of maximum air concentrations (as modelled in PC CREAM). The dose rates calculated will therefore be the highest of the terrestrial habitats of interest.
- Habitat 2, a marine habitat, representative of the Outer Thames Estuary SPA area to the east of the Sizewell site.
- Habitat 3, a coastal habitat, representative of the area to the north of the Sizewell site within the Minsmere-Walberswick Heaths and Marshes SSSI, SPA and Ramsar includes both shoreline and the adjacent terrestrial area. This habitat is therefore assumed to be impacted by both aqueous and gaseous discharges.
- Habitat 4, a freshwater habitat, representative of the scrape in the centre of Minsmere Nature Reserve, within Minsmere-Walberswick Heaths and Marshes SPA.
- Habitat 5, encompasses a mixed habitat representative of the marshland within the Minsmere-Walberswick Heaths and Marshes SSSI, SPA and Ramsar.

522. The EA's current assessment screening level is 40 µGy h^{-1} for all non-human species. Therefore, assessments falling below this regulatory screening level are assumed to cause no measurable harm to non-human species, this is highlighted in the assessment results analysis.

523. For this assessment, a more stringent screening level has been selected - the ERICA default screening dose rate of 10 µGy h^{-1} (below the regulatory screening level). This screening level is considered protective of populations of NHB across all ecosystems.

6.3.4 Assessment results

Habitat 1 - Terrestrial

524. The dose rates to terrestrial organisms residing within Habitat 1 from exposure to gaseous discharges from the SZC facility that deposit to ground were assessed based on the pessimistic assumption that the organisms inhabit the location of maximum offsite air concentration and deposition rates. Large and small burrowing mammals (large and small-burrowing) received the highest dose rates of 0.005 µGy h^{-1}. The dose

rate to the worst affected terrestrial organism (caterpillar) from exposure to noble gases, calculated using the R&D 128 spreadsheet, was 0.0018 µGy h^{-1}.

525. The dose rate to the worst affected terrestrial organisms (small-burrowing mammal, large mammal, bird and reptile) from the combined discharges of gaseous effluent from the Sizewell Site (SZB and SZC) is calculated to be 0.0069 µGy h^{-1}

Habitat 2 - Marine

526. The dose rates to marine organisms residing within Habitat 2 from exposure to aqueous discharges from the SZC facility were assessed based on the assumption that the organisms inhabit the local marine compartment. The worst affected organism was the polychaete worm with a dose rate of 0.80 µGy h^{-1}.

527. The dose rate to the worst affected marine organism (polychaete worm) from the combined discharges of aqueous effluent from the Sizewell Site is calculated to be 0.91 µGy h^{-1}.

Habitat 3 - Coastal

528. Habitat 3 is a coastal environment considered to straddle Habitats 1 and 2 (terrestrial and marine) and dose rates calculated for default terrestrial and marine reference organisms in Habitats 1 and 2 are therefore considered bounding for this case, with organisms being assumed to reside permanently within their natural habitat (i.e. either the terrestrial or marine habitats).

529. Dose rates experienced by bird species inhabiting the coastal environment arising from SZC discharges, assuming a 50/50 occupancy in terrestrial and marine habitats, is calculated to be 0.0035 µGy h^{-1}, which is slightly lower than that for birds occupying only the terrestrial environment.

530. This habitat is an amalgamation of habitats 1 and 2 (see above), with the exception of dose rates to coastal birds. the dose rate to the bird from the combined discharges of aqueous effluent from the Sizewell Site is calculated to be 0.0052 µGy h^{-1}.

Habitat 4 - Freshwater

531. The dose rate to the worst affected organism arising from discharges from SZC residing within Habitat 4 (freshwater scrape) is 0.032 µGy h^{-1} to insect larvae, arising from exposure to gaseous radionuclides deposited onto the scrape and its catchment.

532. The dose rate to the worst affected scrape organism (insect larvae) from the combined discharges of gaseous effluent from the Sizewell Site, deposited onto the scrape and its watershed, is calculated to be 0.13 µGy h^{-1}.

Habitat 5 - Marshland

533. The marshland habitat was assessed as a shallow scrape adopting the same approach used for the freshwater scrape. The dose rate to the worst affected organism arising from discharges from SZC within this habitat is 0.64 µGy h^{-1} to insect larvae, arising from exposure to gaseous radionuclides deposited onto the scrape and its catchment.

534. The dose rate to the worst affected marshland organism (insect larvae) from the combined discharges of gaseous effluent from the Sizewell Site, deposited onto the marshland and its watershed, is calculated to be 2.7 µGy h^{-1}.

NOT PROTECTIVELY MARKED

6.3.5 Conclusions

535. For all of the organisms evaluated, dose rates (biological impacts of ionising radiation) remained substantially lower than the Environment Agency assessment threshold of 40 µGy h^{-1}. The dose rates were also lower than broader internationally considered thresholds. These included the:

- ERICA screening value that is considered protective of populations of NHB across all ecosystems (10 µGy h^{-1}); and
- Derived consideration reference levels, the most stringent of which is 4 µGy h^{-1} (for the duck, rat, deer and pine tree RAPs), applicable to planned exposure situations.

536. The assessment results have shown the dose rate from SZC discharges to the worst affected organism (polychaete worm occupying a marine habitat) to be 0.80 µGy h^{-1}. The worst affected organism from the combined discharges of radioactive effluent from the SZB and C facilities (insect larvae occupying a marshland habitat) was 2.7 µGy h^{-1}. This dose rate is more than one order of magnitude below the threshold dose rate of 40 µGy h^{-1}.

7 MANAGEMENT ARRANGEMENTS

537. A condition of the RSR permit requires that the permit holder must have in place an effective written management system and adequate resources to deliver compliance with the permit. This section of the head document presents the SZC Co. approach to developing appropriate management arrangements[10]. The head document is supported by the Company Manual [Ref 68], Management System Manual [Ref 68] and the RSR compliance matrix [Ref 70] (illustrated in Figure 7-1).

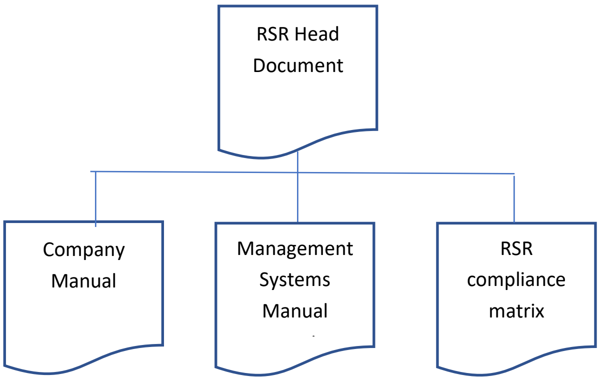


Figure 7-1 Supporting documents related to RSR Management Arrangements

538. The Company Manual [Ref 68] describes the organisation and management of the company and constitutes the “management prospectus” to support the application for a NSL and RSR environmental permit for the installation and operation of SZC. The manual shows how the organisation and appropriate governance, oversight and control arrangements in place are appropriate now and will be developed in the future as the project progresses, to ensure safety and an effective company organisation.

539. The management system manual [Ref 69] explains how the management processes for SZC Co. are to be implemented. It describes the IMS which is the tool used to ensure SZC Co. is able to act as an Intelligent Customer (IC) to design, procure, construct, commission, operate and eventually decommission SZC.

540. The management system manual does not itself set out the detail of permit compliance, this is described instead in the references to the RSR Environmental Permit Compliance Matrix [Ref 70]. The matrix identifies the management arrangements which are, or will be, put in place to deliver compliance with the RSR permit.

7.1 RSR Permit Compliance

7.1.1 Compliance Requirements

541. Compliance requirements for the RSR permit fall into two categories:

- Standard conditions which SZC Co. anticipates it will receive in the RSR permit and;
- Specific conditions which may be set by Environment Agency as part of the RSR permit grant.

[10] The RSR management arrangements are management arrangements required under the EPR 2016 (as amended). “Management arrangements” refer to specific arrangements for managing compliance with the RSR as well as business systems that act to support compliance.

542. Arrangements for compliance with the standard conditions are set out in the SZC Co. RSR Compliance Matrix [Ref 70]. The RSR compliance matrix will be updated as SZC Co. develops, following RSR permit Grant, to ensure any specific additional conditions that may be raised are captured and compliance arrangements identified.

543. Additional detail on EA's expectations for RSR compliance are provided in the following

- Permitting guidance documents:
- Radioactive Substances Regulation: Management Arrangements at Nuclear Sites [Ref 71]; and,
- REPs [Ref 17].

7.2 Approach to developing compliance

544. As discussed in [Section 2.2.5] the approach for building SZC is based on the strategy for replication of HPC. This is aligned to the overall project strategy; to maximise the opportunity to derive value from a NOAK series effect, duplicating the HPC detailed design and adopting a systematic approach to capturing, quantifying and applying lessons learned to SZC Co.. The replication strategy also extends to the adoption of management arrangements from the HPC project.

545. SZC Co. will ensure there is an appropriate IC organisation for the R&A of information and lessons learnt into the SZC project from the HPC project and other EPR™ operators [Ref 72] [11]. This IC role will extend to ensuring SZC Co. adopts NNB GenCo (HPC)'s tried and tested arrangements in a phased manner according to the RSR related activities of each project phase. The adoption process will include a period of testing and ensure users are appropriately trained. The phased approach means that the procedures will be adopted and implemented at the most appropriate time in the project's development and will be proportionate to the significance of the risks from activities that are being, or are due to be, undertaken. This is referred to as the Procedure Adoption Plan.

546. The phased approach also means that at the point of RSR permit Application, a full set of procedures to meet the standard RSR permit conditions will not be in place. However, producing and maintaining a range of arrangements for activities not due to be undertaken for some considerable time would be unnecessary, would not meaningfully contribute to environmental protection and could even distract from the focus on addressing and controlling risks present at the time. SZC Co. uses a hold point process as a mechanism by which the company demonstrates that it is in a suitable state to proceed with activities where there is a significant uplift in risk. A set of relevant criteria are identified for the review and a panel makes a recommendation to proceed based upon the organisation's demonstrable capability and maturity. It will be demonstrated that management arrangements are ready prior to a significant uplift in risk, including but not limited to RSR compliance.

7.2.1 Compliance Matrix

547. The number and detail of written arrangements required for RSR permit compliance varies over the project lifecycle (below) dependent on the RSR related activities taking place.

- Pre-Construction;

[11] "As an IC the management of the facility should know what is required, should fully understand the need for a contractor's services, should specify requirements, should supervise the work and should technically review the output before, during and after implementation. The concept of IC relates to the attributes of an organisation rather than the capabilities of individual post holders."

- Construction;
- Commissioning
- Operation; and,
- Decommissioning.

548. Development of RSR compliance for the SZC Co. project is summarised by the RSR compliance matrix [Ref 70]. This compliance matrix identifies the high level status of RSR compliance topics relevant to each of the project phases, which presents the following:

- Identification of the compliance requirements (standard conditions from guidance and permits issued to other new build organisations) and grouping into compliance areas (e.g. design change).
- Identification of the management arrangements necessary to achieve compliance (e.g. company manual) and the timing of their delivery by project phase[12].

549. The Compliance Matrix has separated the Pre-Construction phase into two parts. It identifies what arrangements and documentation is available at the point of permit application and what will be available at the time of grant of an RSR permit.

7.2.2 Procedure Adoption Plan

550. Identification of the owner within the SZC project with responsibility for timely implementation of appropriate and proportionate management arrangements in each compliance area. In alignment with the SZC project replication strategy, wherever possible management arrangements will be reviewed and adopted from the HPC project.

551. Review and adoption of management arrangements from the HPC project into the SZC project is being monitored with adequate oversight. Following the review and adopt activity, there will be training on the arrangements, a period of shadow working and final implementation of the arrangements [SZC RSR CMT 2]. Each management arrangement has been assessed to understand the extent of work required and assigned a Red-Amber-Green (RAG) status (R - progress delayed with potential threat to compliance, no plan to recover, A - Progress delayed with potential threat to compliance, plan to recover Progress as expected or delayed with no threat to compliance). This information is captured in the Procedure Adoption Plan. Progress will be reported to the EA, as appropriate, via routine regulatory meetings and is independent to the permit application process.

552. Along with stage of implementation and progress, the procedure adoption plan also identifies the owner of the procedure responsible for updating and implementing the process, the anticipated level of change from the HPC procedure which provides the starting point for adoption and the supporting documentation (guidance, forms etc.) that support the implementation of the procedure. The procedure adoption plan is aligned with the FWP presented in Section 8.2.

553. An outline of some of the key RSR aspects associated with the current Development Phase is given below. Thereafter an indication is given of those associated with subsequent Phases.

[12] At this time the compliance matrix does not include a column on decommissioning. As part of the FDP for SZC, a DWMP will be submitted and approved by the Secretary of State prior to Final Investment Decision. The planning for decommissioning from an RSR point of view is currently being done under the design and procurements headings of the table (i.e. ensuring that the design and procurement activities take account of the need to eventually decommissioning the plant). In terms of the development of arrangements specifically for the management of decommissioning activities, expected progress across the board would be 'yet to be developed', which is as expected (i.e. green RAG status) and therefore there is no benefit to including this at this time.

7.2.2.1 Pre-Construction Phase

554. As discussed above SZC Co. has developed a process for adopting management arrangements from the HPC project. This process will be followed to ensure risk-informed adoption of arrangements required to ensure compliance during each phase. During the development phase this will include adoption of the overarching corporate Environmental Policy of EDF Energy. Key environmental standards currently in use on the HPC project will also be adopted. These standards set the principles for environmental optimisation, management of land quality and waste management. They also include principles for both non-radiological and radiological environmental protection.

555. One of the key RSR related activities during the development phase is design control. The SZC project will accept the design from HPC as the starting point for SZC. In line with the replication strategy SZC Co. will have strict arrangements for ensuring the SZC design remains as close to the HPC reference as possible. The SZC power station SSCs relevant to RSR compliance which make up the NI will be a replicated from the HPC design. The ILW and spent fuel stores which are also relevant to RSR compliance will have the same design requirements however may be arranged slightly differently due to the different SZC site layout. This limits SZC Co. RSR related design activities to R&A of modifications. Few modifications are anticipated and those that do arise are anticipated to be minor due to SZC Co. inheriting the design at a mature configuration from HPC (RC2). Site specific design activities will take place (e.g. such as design of the heat sink) however they are not anticipated to affect RSR compliance. It is expected that during this phase the site specific design activities will mature to the point where the next reference configuration for SZC (RC1) will be set. At this point, SZC Co. will undertake a design review and update the BAT case and EPF Register accordingly (see FWP in Section 8.2).

556. As part of the replication strategy the HPC Project supply chain will be maintained so far as reasonably practicable to facilitate replication of the HPC design for the SZC Project. This procurement will be managed by adopting the NNB GenCo (HPC) procurement arrangements. The procurement of any site specific good and services will also be carried out in accordance with procurement arrangements adopted by SZC. A number of the SSCs will be procured as Long Lead Items, although it is not currently planned to procure LLI in advance of FID. Where appropriate, SZC Co. will adopt the same technical specifications as for NNB GenCo (HPC) and will benefit from Quality assurance activities carried out during NNB GenCo (HPC) procurement, manufacture and installation. SZC Co. will undertake independent quality assurance activities, RSR oversight for these items will therefore be limited to its IC role (the arrangements for which are included in the scope of the procedure adoption plan. Contracts are not expected to be signed in advance of FID. From an RSR perspective, the work in this phase will be focussed on procurement preparation activities in advance of any signatures of contract.

557. Another area of attention during this phase will be the development of the organisation and arrangements. This includes the review and adoption of arrangements as outline in the FWP (see Section 8.2) and the Procedure Adoption Plan. The organisation will develop in preparation of FID, noting the constraints placed on SZC Co. prior to FID. Unless otherwise agreed, during the development and construction phases notifications under Section 4 of the RSR permit will be limited to notification of changes to the SZC Co. organisation change and notification of environmental incidents. Therefore, arrangements to manage those activities will be in place in advance of RSR permit Grant. Arrangements to ensure appropriate access to and display of the RSR permit will also be in place, reviewed and updated as necessary.

558. As part of the GDA process, the regulators identified a number of issues (known as "GDA AFs") that needed to be resolved, and agreed that the plans ("resolution plans") proposed by the requesting parties for resolving the issues were credible in each case. Some of these resolution plans have now been implemented and GDA assessment finding closure forms issued. A list of the status of Environment Agency

GDA AFs raised on the UK EPR^{TM} is presented in [Section 2]. Remaining AFs will be managed by the process adopted from HPC.

559. This RSR submission draws on information assessed during GDA and the relevant subsequent submissions for made for HPC. This is valid because the proposed SZC development is to be a replica of the HPC development and is due to begin construction following only a short delay meaning there is limited scope for significant changes to the relevant codes, standards regulatory requirements.

560. In addition, as part of NNB GenCo (HPC) permit grant the Environment Agency raised a number of information conditions some of which have already been closed out in the reference configuration adopted by the SZC Project. Those that remain open will be closed out in due course by the HPC Project and therefore, via replication, for the SZC Project.

561. During the Development Phase physical work is likely to be performed to clear and secure the SZC site (including demolition and removal of existing buildings/structures and to install the perimeter fence and controlled access points). Based on current understanding of the SZC site and the intention to build a cut-off wall between the neighbouring station SZB and the construction site the risk of discovering radioactive objects or radioactive contamination (originating from the Existing Power Station) is deemed to be very low. Despite this, arrangements will, as outlined by the Procedure Adoption Plan be adopted and implemented by the SZC project.

7.2.2.2 Construction

562. During this phase the procurement of the NNB GenCo (SZC) design, manufacturing, transport, storage and installation of SSCs will take place. RSR compliance activities will relate to evaluating proposed design changes, deviations and non-conformances from the technical specifications adopted by the SZC project.

563. Technical Specifications along with Maintenance Strategies for the power plant will begin to be developed for the operation of the SSCs. These will specify requirements for Examination, Maintenance, Inspection, and Testing, and incorporate the procedures to operate the SZC.

564. During the construction phase equipment will be delivered to site and may be stored some time before being installed. The SZC Project will adopt the HPC Project’s tried and tested arrangements in accordance with the Procedure Adoption Plan applying lessons learnt for ensuring appropriate care and maintenance of this equipment including equipment with an EPF.

7.2.2.3 Commissioning

565. A period of non-active commissioning will take place ahead of active commissioning. There will be minimal direct RSR compliance involvement during the non-active commissioning phase as radioactive wastes are not expected to be generated however some tests will provide evidence that the EPF of equipment important for RSR compliance is delivered.

566. As part of active commissioning, Start-up Testing will be undertaken to demonstrate that the reactor is capable of safely commencing commercial operations. In advance of placing fuel in the reactor, SZC Co. will demonstrate that it is capable of complying fully with all of the operational requirements of the RSR permit. The Technical Specifications will be tested, reviewed, and updated by SZC Co. as part of the commissioning programme.

567. Arrangements will be adopted from the HPC Project for the management of radioactive waste, including disposal in line with the requirements of the RSR permit. These will be adopted implemented and tested in advance of the commencement of radioactive waste generation and management activities.

7.2.2.4 Operation

568. During the generation phase SZC Co. will operate the power station in accordance with its operating procedures to be adopted from the HPC Project as outlined by the RSR compliance matrix. The specifications will be subject to change control, and will be reviewed and updated on an on-going basis. Comprehensive arrangements for the management of RSR permit compliance requirements will be maintained and updated in line with operating experience throughout this Phase. Routine activities such as reporting (which will have been performed, where relevant, since receipt of the RSR permit) will continue as information is generated from the power station's operations. Performance will be monitored and further optimisation of discharges and disposals of radioactive waste would be anticipated.

7.2.2.5 Decommissioning

569. As part of the FDP for the SZC Project, a DWMP will be submitted and approved by the Secretary of State prior to the Final Investment Decision. The SZC DWMP will be based on the HPC DWMP and outlines how the plant will be decommissioned.

570. As mentioned previously the design and procurement of the SZC power station is to be replicated from the HPC project which has included the need to consider decommissioning when carrying out design and procurement activities. The RSR compliance matrix does not include the decommissioning project phase because in terms of the development of arrangements specifically for the management of decommissioning activities, the position across the board would be 'yet to be developed '. There is therefore no benefit to including it on the matrix at this time. Consideration of decommissioning in design is covered by the arrangements in place during the development and construction phases.

571. Arrangements for management and disposal of radioactive wastes will be reviewed, updated or, where appropriate, replaced to enable the management of radioactive wastes during the Decommissioning Phase. The company organisation is likely to be restructured to support these activities.

572. The activities to be undertaken during the Decommissioning Phase will differ from those carried out in the Commissioning and Generation Phases of the Power Station's lifecycle. Therefore, there will be a requirement to vary the RSR permit. SZC Co. will engage with Environment Agency / the relevant authority at the time, over the necessary variation prior to the commencement of decommissioning activities. Arrangements for performing environmental surveys in advance of releasing the site from RSR will be developed and agreed.

573. Arrangements allowing for the RSR permit to be surrendered following decommissioning of the main site and eventually the HHK will be developed and maintained over the life of the power station.

7.3 Development of Key Compliance Areas

574. This section summarises SZC Co.'s approach to the development of RSR compliance arrangements.

575. Italic text definitions at the top of each management arrangement section are based on those used by the HPC Project when reporting management arrangement updates to the EA. They describe the expected scope of each area and were originally developed by consideration of the RSR: Management Arrangements at Nuclear Sites [Ref 71].

7.3.1 Management/ Organisational structure

576. The Company Manual [Ref 68] shows how the organisation and appropriate governance, oversight and control arrangements in place are appropriate now and will be developed in the future as the project progresses, to assure all aspects of safety; Nuclear, Environmental and Industrial, and also an effective company organisation. The manual outlines that the SZC Engineering Director will be responsible for ensuring the RSR requirements for BAT are achieved and maintained. Also, the SZC Safety Director has responsibility for ensuring oversight of the RSR and other environmental permits to provide assurance that these permits are being respected, in terms of BAT and site monitoring, and the sustainability monitoring programme. The broader organisation is illustrated and further described within the Company Manual. This organisation will develop as the project progresses and changes will be controlled by the management of organisational change procedure which is to be adopted from the HPC project. This permit application makes a commitment [SZC RSR CMT 2] to develop its management arrangements in a proportionate manner as the project progresses through its subsequent phases.

7.3.2 Organisational Resources

Managing and operating the activities using sufficient competent persons and resources. Notification to the Environment Agency of proposals for significant changes to the management system or resources.

577. The Nuclear Baseline is the means by which SZC Co. demonstrates that its organisational structures, staffing and competencies are, and remain, suitable and sufficient to manage activities covered by the Nuclear Baseline Areas, throughout the full range of SZC's activities, for planned and reasonably foreseeable events including emergencies. It acts as the basis against which changes to the organisation can be managed and controlled.

578. The SZC Co. Organisation in its totality is designed to deliver the full range of its activities. These activities are not limited to the Nuclear Baseline Areas and there are additional non-Nuclear-Baseline-Area-focused organisational capabilities required to deliver the full scope of the SZC Project (referred to as the Project). As such, the Nuclear Baseline relates to those parts of the SZC Organisation that are delivering those activities covered by the Nuclear Baseline Areas. Therefore, the SZC Nuclear Baseline Organisation is a subset of the total Sizewell Organisation; as illustrated in Figure 7-2.

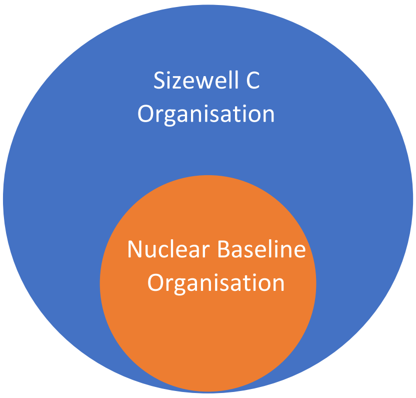


Figure 7-2 The Nuclear Baseline within the Overall SZC Organisation

579. The Nuclear Baseline:

- Provides a baseline definition of the organisation, including the management structure, required to deliver planned and reasonably foreseeable unplanned activities, against which changes can be managed and controlled;

- Supports demonstration, to both itself and the ONR, that SZC Co. would be a capable Licensee to hold a NSL;
- Supports demonstration, to both itself and Environmental Agency, that SZC Co. would be a capable Permit Holder of the RSR Environmental Permit;
- Describes the Roles and responsibilities associated with each Post within SZC Co., for which individuals are required to be demonstrated as competent to deliver SZC Co. activities; and
- Identifies organisational vulnerabilities and enable them to be addressed.

580. The Nuclear Baseline scope does not cover the whole SZC Co. organisation. However, all roles (including non-baseline roles) are maintained to the same standard, with posts assigned, training profiles and competency assessments required. The environmental baseline sets out which roles hold formal posts to support the RSR, WDA and CA permit arrangements. Only SZC Co. staff (including embedded contractors) are included in the baseline; NNB GenCo (HPC) staff supporting the SZC project do so under Inter-Project Support Agreement arrangements and therefore do not appear on both organisations baselines to prevent double counting and over-committing resource. The Nuclear Baseline requirements have been developed to be integrated with other related management arrangements. SZC Co. is committed to ensuring that the definition and management of the Nuclear Baseline is integrated into business as usual planning and delivery practices utilising existing arrangements and their outputs wherever possible.

581. SZC Co.'s Nuclear Baseline data is maintained live and the defined Nuclear Baseline will be reviewed at key points throughout the phases of the project. This ensures the organisational Nuclear Baseline requirements are fully considered, assessed and detailed and that the organisation remains competent to deliver these requirements.

582. Robust management of change arrangements are required to ensure the successful ongoing maintenance and management of the Nuclear Baseline; ensuring that any implementation of a change to the Nuclear Baseline organisation is assessed and managed as well as ongoing compliance to Licence Condition 36.

583. The Company Manual describes the responsibilities and accountabilities of developing and maintaining the Nuclear Baseline.

584. Formal issue of Nuclear Baseline publication follows a rigorous process, in line with SZC Co.'s management arrangements, which ensures that all relevant individuals and bodies within SZC Co. are involved in its review and assessment to consequently confirm that SZC is structured and resourced (in terms of both staffing and competency) sufficiently to conduct its activities safely.

7.3.3 Management of Competence and Training

Managing and operating the activities using sufficient competent persons and resources. Notification to the Environment Agency of proposals for significant changes to the management system or resources). Training of persons by assessing training needs and delivering training.

585. In order to assure itself that its activities are being carried out adequately, SZC Co. will, as outlined by the Procedure Adoption Plan, adopt the HPC Project arrangements for defining competency requirements of the Nuclear Baseline Role holders, and assessing and recording the competency of the SZC Co. Organisation. The prioritisation of training and competency assessment is driven by the need to ensure that the required

levels of organisational competency are in place in time to undertake planned activities. This ensures the required level of competency is maintained within the nuclear baseline.

7.3.4 Qualified Experts

Consultation with suitable Qualified Experts (Radioactive Waste Advisors, RWA)

586. The SZC Safety Director is responsible for ensuring RSR compliance including the RWA obligations under the permit are delivered. The intention during the development phase is to utilise the expertise of the NNB GenCo (HPC) corporate RWA body which shares the duty of advising on RSR permit compliance amongst more than one individual. The volume of RWA advice anticipated during the development phase is very low due to the limited RSR compliance related activities taking place.

587. SZC Co. is considering the options as to whether it will continue to use NNB GenCo (HPC) CRWA, appoint its own individually certified RWAs or establish its own Corporate RWA body post FID. The head of safety will be accountable for compliance and the effective operation of RWAs supporting the SZC project by ensuring the appointment of a sufficient number of individuals of the required level of competency and experience to provide the necessary advice. Appointed RWA's will have been provided with appropriate training and competency-assessed for their roles prior to appointment. This requirement could be delivered initially by the appointment of an external RWA. SZC will ensure suitable and sufficient RWA resource is available to support the SZC project to provide timely advice when it is needed to enable compliance with the conditions of the permit.

7.3.5 Learning Organisation, Reporting and Notifications

A learning and questioning attitude should be encouraged at all levels of the organisation. The Environment Agency shall be notified without delay following the detection of occurrences which has caused, is causing or may cause significant pollution or may generate significant amounts of radioactive waste; a breach of limits or permitted waste disposal; any adverse environmental effects.

588. SZC Co. is a "learning organisation" committed to continuous improvement in all aspects of its business, but particularly in the delivery of nuclear safety, security and radiological environmental protection. The SZC project will review, adopt and implement, where relevant, the enable organisational learning procedure currently used by NNB GenCo (HPC), in accordance with the Procedure Adoption Plan and in alignment with the RSR Compliance Matrix. The process includes an electronic system which is used to recording learning opportunities for NNB GenCo (HPC) and will be adapted to record learning opportunities for SZC Co. The Enable Organisational Learning procedure also defines the process for recording and reporting environmental events. Lessons from the HPC project have and will continue to be applied. The current intention for share arrangements maximises the opportunities for sharing lessons to be learned. The Company Manual sets out the key responsibilities of post holders under this enable organisational learning process.

589. During operations, SZC Co. will report information to EA, such as sampling and monitoring data. SZC Co. will formally notify Environment Agency of any significant events, these include, any breach or potential breach of a condition of the RSR permit, such as but not limited to:

- Breaching a limit or QNL specified in the RSR permit;
- Malfunctions and accidents leading, or potentially leading to significant pollution accidents; and
- Significant adverse environmental effects that could reasonably be seen to result from the operation of the facility.

590. Reporting will continue until RSR permit Surrender following completion of decommissioning and dispatch from site of all radioactive wastes to the GDF.

591. SZC Co. has adopted the regulatory interface arrangements successfully deployed on the HPC project to manage regulatory notifications and reporting.

7.3.6 Emergency Arrangements

The organisation shall have appropriate emergency response arrangements.

592. During the phases prior to fuel coming to site, SZC Co.'s emphasis is on developing emergency arrangements to deal with conventional hazards related to a large construction site and programme which are not regulated under RSR.

593. Emergency arrangements and an emergency plan will be in place prior to bringing nuclear fuel on site to ensure compliance with NSL (LC11).

594. SZC Co. will adopt the HPC projects arrangements for investigating incidents in accordance with the Procedure Adoption Plan.

7.3.7 Procurement of Goods and Services

When making decisions about the management of radioactive substances, the best available techniques should be used to ensure that the resulting environmental risk and impact are minimised. This includes consideration at the procurement stage, when materials are being specified and purchased.

595. NNB GenCo (HPC) has a full suite of procurement arrangements in place including the specification and assessment of environmental performance of good and services. The requirement to demonstrate the use of BAT as required a RSR permit is specified by the procurement procedures and contract documentation. The majority of SZC Co. goods and services procured will be a replication of the HPC project delivered to the same specifications by the same suppliers with any BAT substantiation already made and accepted by the HPC Project adopted by the SZC Project. Where the SZC project specifies and assesses site specific goods and services which are not a direct replica of those on the HPC project it will, as outlined by the Procedure Adoption Plan, adopt the tried and tested HPC project procurement arrangements.

7.3.8 Document and Record Keeping

Organisations should have the capability to secure and maintain proper protection of people and the environment, including having effective processes for managing (including identifying, updating, validating, approving, preserving and making available) records and documents that are relevant to environment protection. Records required by the permit shall be legible, be amended in such a way that the original and subsequent amendments remain legible or are capable of retrieval, be retained until notified in writing by the Environment Agency and be kept on site unless agreed otherwise in writing.

596. SZC Co. will, as outlined by the Procedure Adoption Plan adopt NNB GenCo (HPC)'s arrangements for retention of records relating to RSR permit compliance and for the designation of records, as new records are created. However, as a separate legal entity, licensee and permit holder SZC Co. will retain its own separate records to demonstrate compliance.

597. SZC Co. is currently developing a comprehensive system for the management of records that will cover the lifetime of the Power Station:

- Records will be stored electronically in SZC Co.'s document management system this will be available by secure connection at the site and relevant offices;

- Following RSR permit Grant information will be maintained in relation to compliance;
- Records will be maintained to enable SZC Co. to demonstrate that the design of the Power Station represents BAT;
- Records from the procurement, manufacturing, transport, storage, installation and testing of SSC performing environmental protection requirements will be retained to substantiate that the as-built design meets SZC Co.'s expectations and remains demonstrably BAT;
- Records will be produced throughout the Power Station's life time to demonstrate that wastes stored, pending disposal to the GDF, meet the relevant acceptance criteria, and are maintained in accordance with the Joint Regulatory Guidance for the management of high activity radioactive waste [Ref 73]; and,
- Records of waste disposals under the RSR permit will be maintained by SZC Co. until otherwise notified by EA. This responsibility will be clarified as part of the RSR permit surrender process.

7.3.9 Maintenance, Examination, Inspection and Testing

When making decisions about the management of radioactive substances, the best available techniques (including how a technique is maintained) should be used to ensure that the resulting environmental risk and impact are minimised. Structures, systems and components (SSC) that are, or comprise part of, environment protection measures should receive regular and systematic examination, inspection, maintenance and testing.

598. A process for ensuring the adequacy of maintenance of SSC will be produced, tested and reviewed ahead of the commissioning of that plant. This process is under development for NNB GenCo (HPC) to ensure compliance with NSL LC 28 and will, as outline by the Procedure Adoption Plan and RSR compliance matrix be adopted, where appropriate, by the SZC Project. The process covers the identification the EPFs of SSC to support the Environment Case. Performance indicators will be developed to demonstrate that maintenance is effective and the performance of the plant is not deteriorating. In addition, NNB GenCo (HPC) has commenced work looking at the maintenance governance documentation which will be required for the operation of the Power Station which will also be applied to SZC Co.

599. Care and maintenance arrangements for the preservation of equipment installed during the erection stage of the construction phase will be applied. This is to ensure that equipment is capable of performing its relevant function in operation.

600. Monitoring SSCs (i.e. plant and equipment to take samples and conduct measurements, tests, surveys, analyses and calculations in compliance with the RSR permit) will be installed prior to the Commissioning Phase. Following commissioning and operation of the equipment, maintenance activities will be undertaken on a routine basis. During the latter part of the Construction Phase (i.e. during Construction Testing and Pre-Operational Testing), a complete maintenance regime will be confirmed to ensure compliance with the RSR permit. This will include performance metrics and dashboards, maintenance scheduling, and competency assessments for maintenance engineering and operational functions.

601. A complete set of maintenance arrangements will be in place once SZC Co. is ready to undertake start-up testing. These arrangements will have been adopted from the HPC project, tested, reviewed and accepted into service ahead of nuclear fuel being brought to site. They will be in place throughout the power station's commercial operations and, as required, beyond. The arrangements will be updated if necessary to reflect best practice and changing requirements throughout the generation and decommissioning phases [SZC RSR CMT 6].

7.3.10 The Environment Case

The operator shall maintain an environment case, consisting of documents, which demonstrates the use of best available techniques to protect people and the environment throughout the lifecycle of the activities.

602. SZC will maintain the Environment Case and EPF register to enable it to demonstrate compliance with the conditions of the permit. The SZC Co. Environment Case is described in [Section 3.3] of this RSR permit application. SZC Co. will, as outlined by the Procedure Adoption Plan, adopt the HPC project's arrangements for managing the Environment Case and associated guidance including the environmental open point tracker to track "open points" from design, through procurement, manufacture, installation and ultimately operation. Existing guidance outlining how to review the BAT implications of design changes and if appropriate carry out BAT assessments will be adopted from the HPC project in advance of when they are required. The starting point for the SZC Co. Environment Case is the SZC RC0 design and SZC Co. will review and adopt, as appropriate, the NNB GenCo (HPC) manage environment case procedure to ensure it is updated to take account of design changes and to incorporate new evidence as it becomes available.

7.3.11 Control of Design Changes

Design changes must be controlled using a robust process which includes proportionate consideration of the impact of the proposed change on the environment case.

603. The SZC power station will, as far as possible, be a replica of NNB GenCo (HPC) design at the RC2 configuration (SZC RC0) which has been accepted as demonstrably BAT by the NNB GenCo (HPC) organisation and in turn by the Environment Agency through RSR permit issue and subsequent ongoing regulation via inspections and regulatory meetings.

604. Under the replication strategy there will be strict governance over any deviations from replication baseline. It is not expected at all, to make changes to HPC design for SZC (for instance even a non-conformance of the HPC design; if acceptable for HPC after investigation and justification; will be considered as acceptable for the SZC RC0 reference). The target of the replication strategy is to manage the design configuration very strongly in order to maximise the scope of documentation and data which will be applicable on both sites without any update. The additional works will be to prove that the design from HPC is fully compliant with the SZC site conditions without any evolution of design. To deviate from this replication strategy would undermine years of design evolution and substantiation in-line with relevant good practice and therefore will be avoided wherever possible. Areas where these principles could be challenged include site specific adaptation, procurement change, construction change and regulatory change will be treated with a very high level of scrutiny to protect in priority the replication benefits and minimise the risk of rework and schedule through a design control committee.

605. As described in the Company Manual [Ref 72], the SZC Engineering and Delivery Director is responsible for managing design changes and configuration control. The SZC Project Board and Nuclear Safety Committee will be used to consider and agree any significant design changes for adoption into SZC. The extent of SZC Co. design activity is therefore limited to acting as IC to control, review and accept design changed, including those proposed by the reference plant NNB GenCo (HPC) post RC2 (including concessions/ deviations). There are not anticipated to be any SZC Co. site specific design activities which affect RSR compliance however SZC Co. will, as outlined by the Procedure Adoption Plan, put in place appropriate arrangements for demonstration of BAT. Arrangements for how SZC Co. performs this IC role will also be based on the HPC project's arrangements, adopted as appropriate [Ref 72].

7.3.12 Monitoring and Assessment

The best available techniques, consistent with relevant guidance and standards, should be used to monitor and assess radioactive substances, disposals of radioactive wastes and the environment into which they are disposed.

606. The monitoring arrangements for the Power Station will develop as SZC Co. progresses throughout the project lifecycles phases. Requirements for each Lifecycle Phase will reflect the activities being undertaken. During the development and construction phases there is not anticipated to be any radioactive material present and therefore no need to carry out any monitoring for RSR compliance however SZC Co. will, as outlined by the Procedure Adoption Plan, adopt the HPC project's arrangements should the situation arise.

607. With respect to monitoring and the RSR permit, the two key areas are:

- Development of an environmental monitoring programme which will be used for retrospective dose assessments; and
- Specification of equipment and development of monitoring requirements for SSC which include in-process monitoring, direct monitoring of discharges, and characterisation of radioactive waste. As described in the procurement section the SZC design is a replica of the HPC design for which the approach to monitoring and specification of monitoring equipment has been demonstrated as BAT. SZC Co. will ensure, via the design change process described above, that any deviations from the specification for monitoring equipment or modification to the system design are supported by a proportionate BAT demonstration where applicable.

608. A pre-construction radiological environment baseline for the site has been established for the purposes of the DCO. For the purposes of compliance with the RSR permit, a pre-operational radiological environmental baseline for the site and surroundings of the Power Station will be established prior to the commissioning phase. A proportionate environmental radioactivity monitoring programme with a risk-informed and proportionate justification will be developed prior to first radioactive waste disposals.

609. Techniques documents outlining how monitoring will be carried out during operations will be adopted from the HPC Project sufficiently in advance of first use to enable review of applicability to SZC, training and testing of arrangements [SZC RSR CMT 4].

7.3.13 Operational Control of Disposals

Operating rules will set conditions, limitations and mandatory restrictions on operation to ensure that the plant or process is kept in a condition which optimises environmental performance. Operating instructions are used to ensure the plant or process is operated as per the design or strategy.

610. Arrangements for the control and consignment of nuclear matter will be adopted in accordance with the Procedure Adoption Plan.

611. The adoption of management arrangements for the control of disposals during operations will be take place following their development by the HPC project as outlined by the RSR compliance matrix. Adopted arrangements will be tested, implemented and where required updated as part of the Commissioning Phase. The Operations Team will operate the Power Station in strict compliance with the procedures.

612. Technical Specifications and Environmental Specifications will ensure that SSC performing functions in the management, monitoring, discharge or disposal of radioactive waste meet acceptance criteria, are kept in good repair through appropriate maintenance, and are operated in a manner that is BAT and complies with RSR permit conditions and limitations.

613. During the Commissioning Phase approved criteria will be used for the acceptance testing of equipment which delivers the requirement to avoid and reduce the generation of radioactive waste. It is noted that radioactive waste management arrangements will be in place prior to active commissioning, according to the Procedure Adoption Plan.

614. It is anticipated that new and updated procedures will be developed in support of the Decommissioning Phase, although some Technical and Environmental Specifications will be retained during the initial decommissioning works, for example to enable the removal and packaging of spent fuel and drainage of the reactor system and spent fuel pools.

615. Techniques document will outline how monitoring will be carried out during operations will be adopted from the HPC Project [SZC RSR CMT 4].

7.3.14 Manage Performance Improvement

Organisations should learn from their own and others' experience so as to continually improve their ability to protect the environment. Processes for monitoring, review and audit activities relating to strategies, plans, goals, standards, processes, procedures, plant and systems, testing and validation procedures, environmental monitoring, inspections and investigations, non-conformances, incidents and events, and self and external assessments should be established.

616. Assurance consists of internal independent review and external independent verification respectively. The latter makes use of competent external organisations, industry peer reviews and regulatory reviews and inspections. The exercise is aimed at identifying areas at risk of non-compliance with the RSR permit.

617. The SZC Safety Director is accountable for Assurance and is given a fully independent remit to assure the SZC project activities. The HPC project has established written arrangements for assuring the processes, procedures and the management system of the HPC project. These arrangements were developed with both the HPC and SZC projects in mind and will be adopted by the SZC project as outlined by the Procedure Adoption Plan.

618. The SZC Safety Director, regarding responsibility for ensuring SZC Assurance, will ensure the following activities are carried out:

- Self and independent assessment;
- Environmental management review;
- Management of notification and reporting requirements; and,
- Presentation to the SZC Board of Directors an independent view of performance.

619. The assurance management arrangements are mature, but will continue to develop as a key part of its compliance approach throughout the lifetime of the Project. The approach to assurance and associated procedures will be updated and improved, based on operational experience and feedback.

7.4 Relevant Commitments

620. The below table links the compliance areas discussed above to the relevant commitments made by the SZC project to future development its arrangements (Section 7.2).

Table 7-1 List of commitments relevant to management arrangements themes

Compliance Area	Relevant commitment
Management/ organisational structure	Commitment 2
Learning organisation reporting and notifications	Commitment 1
Maintenance examination inspection and testing	Commitment 6
Control of design	Commitment 3
Monitoring and assessment	Commitment 4 & 5
Control of disposals	Commitment 7, 8 & 9

7.5 Conclusion

621. SZC Co. will implement its replication strategy, including the adoption of NNB GenCo (HPC)'s tried and tested management arrangement to timescales that address the RSR compliance risk for each phase of the project.

622. Arrangements will be fit for purpose for the relevant stage of the project and the associated RSR risks as illustrated by the [Ref 70]. Arrangements will be tested and those set to use the trained in advance of their need date. The SZC Co. organisation will continue to grow and develop as the project progresses. The hold point process will ensure that the organisation is fit for purpose, capable of complying with all its obligations (including compliance with the conditions of the RSR permit) and is ready to progress to the next phase of the project.

8 RSR CONCLUSIONS

8.1 Introduction

623. SZC Co. is planning to build and operate the proposed new nuclear power station at SZC. We are applying for a number of consents, licences and permits, including the RSR operational environmental permit to cover all the disposal of radioactive waste under Schedule 23 of the Environmental Permitting (England and Wales) Regulations 2016 (as amended).

624. SZC Co. has developed this Submission so that it can be considered in parallel with the other operational environmental permits and DCO for SZC, which are expected to enable the FID for SZC to be achieved. As required under the Euratom treaty, BEIS have also produced a parallel submission to the EC, known as Article 37, covering the impact of planned and accidental release of radioactive waste on member states.

625. On receipt of this Submission the EA, having assessed it to ensure it is complete will undertake a public consultation on the Submission, draft RSR environmental permit and draft decision document.

626. This document contains the relevant information to enable the Environment Agency to determine the application and includes information on:

- Systems and structures that are relevant to the generation, management, monitoring, storage and disposal of radioactive waste;
- Expected gaseous and liquid radioactive discharges and the proposed limits and QNLs we think are necessary to enable us to operate the plant safely and responsibly;
- Volumes and activity associated with the solid radioactive waste we would expect to be produced;
- Approach we have taken to ensuring the design, installation, commissioning, operation and decommissioning of the facilities have been optimised with respect to the environment and the demonstration that BAT have been applied;
- Methods we propose to use to ensure that we monitor, sample and assess the radioactive effluents so we can accurately report the discharges in order to demonstrate compliance with the limitations and conditions of the RSR environmental permit;
- Radiological impacts on members of the public and the environment from the discharge of gaseous and liquid radioactive effluents; and
- IMS to ensure appropriate controls, processes and procedures are in place. This includes a copy of the Company Manual incorporating all the elements of a Management Prospectus.

8.2 Forward Work Plan

8.2.1 Introduction

627. The FWP identifies activities, associated with radioactive waste disposal, necessary to achieve compliance with the RSR permit conditions from the point of permit grant and as appropriate at the relevant phases in SZCs lifecycle.

628. The FWP provides a route map of how SZC Co. will develop from a competent applicant to a competent and compliant permit holder and operator in a timely and appropriate fashion. The FWP is important to ensure the organisation focuses on the right things at the right time, the milestones included have been cross-referenced against the wider project milestones. This recognises the various phases of the development of the project and the evolution of the organisation through design, construction, commissioning, operation and decommissioning phases.

8.2.2 Commitments

629. In order to develop this FWP, a number of high-level commitments have been identified throughout the production of the RSR application documentation. These commitments have been identified by SZC Co. as areas of future work to ensure compliance. Each commitment has been reviewed by SZC Co. and considered as appropriate given the status of the SZC project. A FWP has been developed which sits under each commitment to demonstrate how the commitment will be resolved and the gap will be closed.

630. The high-level commitment themes for SZC are as follows:

- Commitment 1: Organisational Learning
- Commitment 2: Organisational Capability and Arrangements Development
- Commitment 3: Design Control
- Commitment 4: Monitoring Specifications
- Commitment 5: Environmental Radioactivity Monitoring Programme
- Commitment 6: Care and Maintenance Arrangements
- Commitment 7: Radioactive Waste Management Arrangements
- Commitment 8: Higher Activity Waste Management
- Commitment 9: Integrated Waste Strategy and Site Wide Environment Safety Case
- Commitment 10: Decommissioning Arrangements
- Commitment 11: Assessment of Feasibility of Removing Secondary Neutron Sources
- Commitment 12: Chemistry Specifications

631. The FWP for each commitment is presented under each commitment description in the following sections.

8.2.2.1 Commitment 1: Organisational Learning

632. SZC Co. will continue to be a learning organisation throughout the lifetime of the project with a strong nuclear safety and environmental safety culture. The SZC project will continue to apply lessons learnt from the HPC project and the wider EPR^{TM} series of reactors worldwide, to ensure a high level of environmental protection and deliver good environmental performance.

633. SZC Co. will continue to be learning organisation with a strong nuclear safety and environmental safety culture and will continue to apply lessons from the HPC project and the wider EPR^{TM} series of reactors worldwide to ensure a high level of environmental protection and deliver good environmental performance recognising the basis for replication from HPC to SZC affords the greatest opportunity for transferring lessons to be learned. This will include looking at future performance of other EPR^{TM}s and how this can

inform the SZC project. This commitment is delivered through the established organisational learning arrangements already in place on the SZC project and will continue through the lifetime of the project.

8.2.2.2 Commitment 2: Organisational Capability and Arrangements Development

634. SZC Co. will continue to develop its arrangements, organisation and resources to ensure compliance with all legal and regulatory requirements (including the RSR environmental permit), ensuring risk-informed and proportionate organisation and arrangements are fit for purpose for the relevant stage of the project. SZC Co. will develop its plans in advance of the next phase of the project to ensure the organisation is ready and able to deliver the project against the schedule. This commitment will be delivered through implementing a resourcing strategy and application of the hold-point process to demonstrate the organisation is ready before progressing to the next project phase.

635. Any significant changes that could affect compliance with the conditions of the RSR permit will be notified to the Environment Agency in compliance with Condition 4.3.5 of the template permit in accordance with the company's management of organisational change arrangements. The Environment Agency will be kept informed of organisation development arrangements through planned routine engagements.

636. SZC Co. will implement its procedure adoption plan in line with the Forward Plan Schedule to ensure that adequate arrangements are in place in advance of when they are needed.

8.2.2.3 Commitment 3: Design Control

637. SZC Co. will continue to exercise control over information used in the project and the design, including the adoption of design changes into the project to ensure the continued application of BAT and the IC role.

638. This will be delivered through robust IC arrangements that are already in place having been developed and tested on the HPC project. Risk-informed and proportionate assessment of design changes, including where appropriate, BAT assessments, will be undertaken. Design open points will be managed through an open point register to ensure tracking and timely closure. The Environment Agency will be kept informed of significant changes that could affect the application of BAT, as defined in this application, through planned routine engagements.

639. This commitment will be delivered through the established manage design change and manage environment case arrangements. A formal update to the Environment Case, including update to associated registers and strategies, incorporating RC1, will be undertaken after FID.

8.2.2.4 Commitment 4: Monitoring Specifications

640. SZC Co. will provide to the Environment Agency details of the specifications of the liquid, gaseous and solid radioactive waste monitoring, sampling and analytical equipment used to demonstrate compliance with the limits and conditions of the RSR permit. This applies to both discharge and in-process monitoring.

641. Techniques documents will be provided to the Environment Agency in accordance with Condition 3.2.1 (d) of the template permit in advance of the disposal of radioactive waste.

8.2.2.5 Commitment 5: Environmental Radioactivity Monitoring Programme

642. SZC Co. will develop and maintain an environmental monitoring programme on appropriate project timescales.

643. SZC Co. will review environmental radioactivity monitoring data and consider what, if any, additional sampling and monitoring may be required to establish a pre-operational baseline of environmental radioactivity around the site. SZC Co. will develop a risk-informed schedule of routine environmental radioactivity monitoring requirements accompanied by a BAT justification, along with a techniques documents in accordance with the condition of the RSR permit.

644. SZC Co. will provide evidence to the Environment Agency in advance of active commissioning in accordance with Condition 3.2.1 (b) (i) of the template permit.

8.2.2.6 Commitment 6: Care and Maintenance Arrangements

645. SZC Co. will continue to develop its care and maintenance arrangements to ensure EPE is suitably looked after as soon as it arrives on site, during erection and installation, through commissioning and in operation.

646. SZC Co. will provide evidence to the Environment Agency of its arrangements at relevant stages of the project via its planned routine regulatory engagement.

8.2.2.7 Commitment 7: Radioactive Waste Management Arrangements

647. SZC Co. will develop its radioactive waste management arrangements to ensure it can safely dispose of all radioactive wastes that are unavoidably produced in line with the IWS and Environment Case by: applying BAT to minimise the waste arisings in the first place; segregating waste to enable optimal management; and, using BAT to characterise and sentence waste.

648. SZC Co. will ensure its arrangements enable it to comply with the WAC of any suitably permitted waste receiving site with which SZC Co. has contracted. SZC Co. will provide the regulator with a copy of its radioactive waste management disposal readiness report before any disposals take place. These arrangements will be in place in advance of active commissioning.

8.2.2.8 Commitment 8: Higher Activity Waste Management

649. SZC Co. will apply BAT to minimise the generation of Higher Activity Waste (HAW) and ensure it is managed to enable it disposal.

650. SZC Co. will engage with Radioactive Waste Management (RWM) Limited to progress LoC for disposal of HAW, taking advantage of lessons learned from HPC, and ensuring that final LoC is in place for ILW waste prior to the first ILW campaign.

651. SZC Co. will develop and maintain a RWMC in line with regulatory guidance [Ref 73]. The first version of the RWMC will build on the HPC RWMC and be updated post-FID to reflect SZC RC1.

8.2.2.9 Commitment 9: Integrated Waste Strategy and Site Wide Environment Safety Case

652. SZC Co. will update its IWS to incorporate non-radioactive wastes and address the necessary relevant requirements for a WMP to demonstrate compliance with Condition 1.1.3 of the RSR template permit. SZC Co. will develop and maintain the SWESC to manage and maintain its land quality arrangements to support the ultimate surrender of the RSR permit.

653. SZC Co. will provide develop its initial SWESC post FID. The SWESC will be a live document that is then maintained throughout the life of the station.

8.2.2.10 Commitment 10: Decommissioning Arrangements

654. SZC Co. will continue to develop its decommissioning arrangements and the submission of its FDP, including a DWMP. These are requirements under the Energy Act required prior to beginning nuclear construction.

655. This commitment will be managed through established decommissioning plan arrangements.

8.2.2.11 Commitment 11: Assessment of Feasibility of Removing Secondary Neutron Sources

656. SZC Co. will undertake an assessment of the feasibility of removing secondary neutron sources from the reactor 1 year after the end of the 3rd fuel cycle of unit 1.

657. This commitment addresses the last outstanding GDA Finding (UKEPR-AF03) raised by the Environment Agency on the UK EPR™. This wording is consistent with the parallel information condition (HPC IC03) in the HPC RSR permit. This commitment requires site specific operational information to be available to enable its close out.

8.2.2.12 Commitment 12: Chemistry Specifications

658. SZC Co. will develop it chemistry specifications (covering commissioning, start-up and shut down, as well as normal operations), demonstrating that the generation of corrosion products is ALARP.

659. SZC Co. will provide evidence to the Environment Agency to demonstrate the application of BAT in advance of active commissioning.

8.2.3 Commitment Schedule and Governance

660. SZC Co. have a number of internal governance and assurance processes in place, such as the hold point process, as part of its management and control of the design, organisation and BAT. As well as normal business, continual assurance arrangements, it is expected that at relevant step changes in risk for the project there will be additional assurances undertaken, as explained in Section 7.2 above. Therefore, the development of the SZC project is controlled and coordinated, as appropriate for the status of the project. The Commitments described above are managed via the Manage Project Commitments procedure, as discussed in Section 7.2 above.

661. It is recognised that the Environment Agency may decide to implement pre-operational conditions as part of their permit determination, which would require completion of specific activities prior to operation of the nuclear power plant. This ensures that the necessary checks and balances are in place prior to generation and disposal of radioactive wastes.

8.2.4 Forward Work Plan

662. The FWP presents the delivery of the commitments made as part of this application. It outlines key tasks in the delivery of each commitment relative to the project phases and milestones, see Figure 8-1.

663. The FWP will be reviewed and updated as necessary. It is understood that the Environment Agency may include permit conditions and the FWP and associated commitments may need to be updated.

664. The commitments described above have been broken down into tasks to describe the expected plan for resolution, these have been linked to relevant and appropriate project phases and milestones which will be tracked and updated as the project progresses.

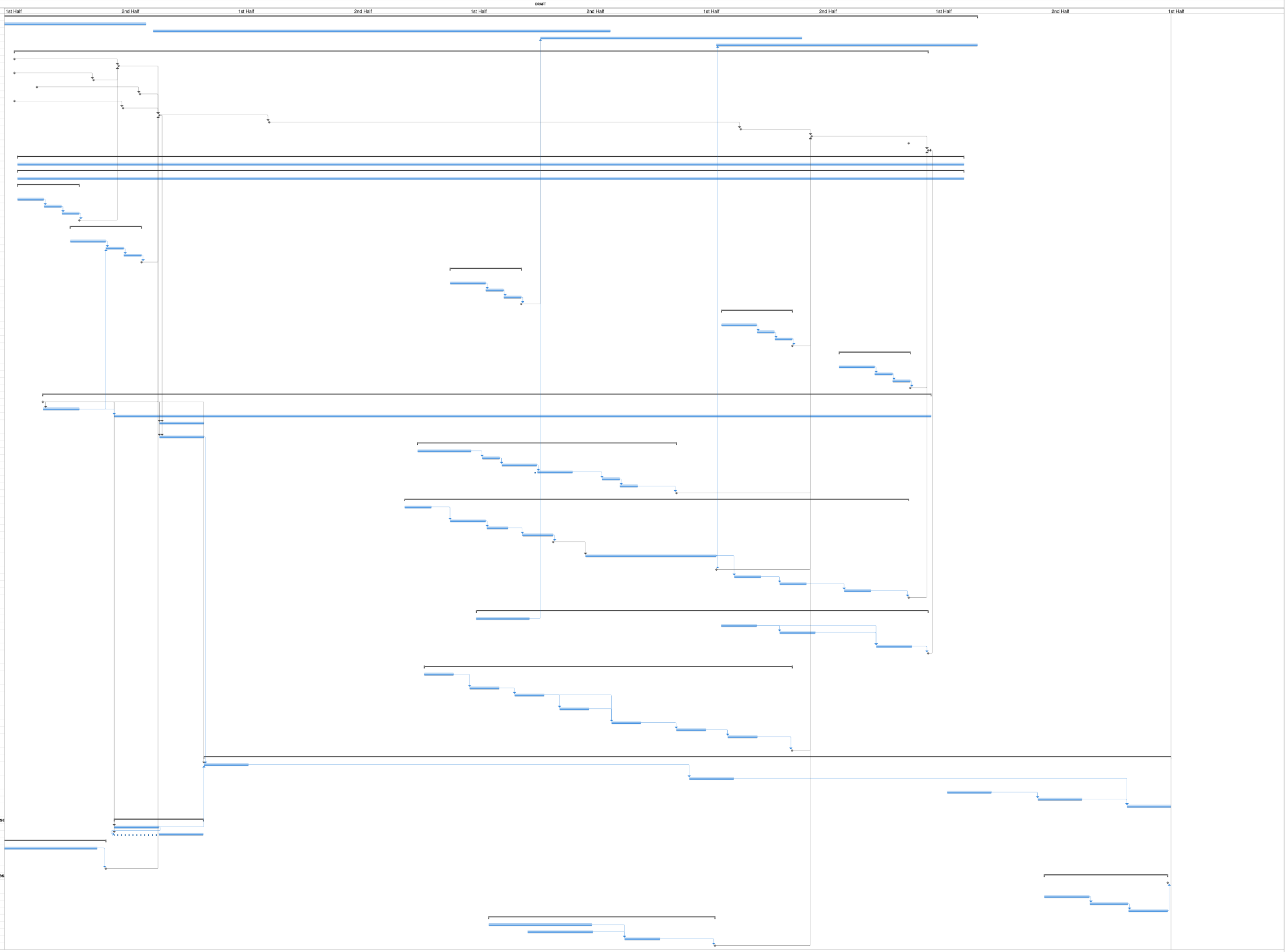
665. The plan for land ownership of the RSR permitted boundary (interim and final) has been described in Section 1. The point at which SZC Co. intended to apply for a variation in the RSR permit regarding the RSR permitted boundary is not yet fixed and will occur as in agreement with Nuclear Generation and the Environment Agency.

NOT PROTECTIVELY MARKED

Figure 8-1 SZC RSR Permit Application Forward Work Plan

DRAFT

ID	Notes	Task Name
1		**Project Phases (approximate timing)**
2		Development
3		Construction
4		Erection
5		Commissioning
6		**SZC Milestones (dates to be confirmed)**
7		RSR Permit Application Submission
8		RSR Permit Grant
9		Article 37 Submission
10		Article 37 Opinion received
11		NSL Application
12		NSL Grant
13		DCO Submission
14		DCO Grant
15		SZC FID
16		First Safety Concrete
17		Non-Active Commissioning
18		Active Commissioning
19		First Criticality
20		Commercial Operation U1
21	**SZC RSR CMT 1**	**Organisational Learning**
22		Organisational Learning
23	**SZC RSR CMT 2**	**Organisational and Arrangements Development**
24		Organisation development
25		Phase 1a - Management arrangements development (Prior to Minded to Consultation)
26		Review and adopt arrangements
27		Training on arrangements
28		Shadow Working
29		Implementation of arrangements
30		Phase 1b - Management arrangements development (Prior to FID)
31		Review and adopt arrangements
32		Training on arrangements
33		Shadow Working
34		Implementation of arrangements
35		Phase 2 management arrangements development (Prior to Erection)
36		Review and adopt arrangements
37		Training on arrangements
38		Shadow Working
39		Implementation of arrangements
40		Phase 3 management arrangements development (Prior to Active Commissioning)
41		Review and adopt arrangements
42		Training on arrangements
43		Shadow Working
44		Implementation of arrangements
45		Phase 4 management arrangements development (Prior to Operation)
46		Review and adopt arrangements
47		Training on arrangements
48		Shadow Working
49		Implementation of arrangements
50	**SZC RSR CMT 3**	**Design Control**
51		SZC RC1
52		Configuration control development RC1
53		Design Change Review
54		Environmental Protection Function Register Migration & RC1 Update
55		Environment Case Update
56	**SZC RSR CMT 4**	**Monitoring Specifications**
57		Monitoring Specifications
58		OPEX Review
59		Monitoring equipment justification
60		Develop Techniques Documents
61		Training
62		Shadow Working
63		Implement Plant Monitoring Arrangements
64	**SZC RSR CMT 5**	**Environmental Radioactivity Monitoring Programme**
65		Environmental Radioactivity Monitoring Strategy
66		Data Review
67		Monitoring Programme and BAT Justification
68		Develop Techniques Document
69		Implement Pre Commissioning baseline Monitoring Programe
70		Baseline Environmental Monitoring Programme
71		Completion of Baseline Environmental Monitoring Programme
72		Lessons learned and arrangements Review
73		Training
74		Shadow Working
75		Implement Operational Environmental Radioactivity Monitoring Programme
76	**SZC RSR CMT 6**	**Care and Maintenance Arrangements**
77		Implement Construction C&M arrangements
78		Operational Maintenance Strategy
79		Develop Operational Maintenance arrangements
80		Operational Maintenance Schedule
81		Implement operational maintenance arrangements
82	**SZC RSR CMT 7**	**Radioactive Waste management Arrangements**
83		Review of waste management routes and existing arrangements (inc HPC)
84		Assessment of waste service providers
85		Development of waste management arrangements
86		Radioactive Waste Operating Procedures Report
87		Training
88		Shadow Working
89		Radioactive Waste Management and Disposal Readiness Report
90		Implementation
91	**SZC RSR CMT 8**	**Higher activity waste management**
92		Develop Radioactive Waste Management Case V1
93		Develop Radioactive Waste Management Case V2
94		Develop iLoC (ILW)
95		Develop fLOC (ILW)
96		Develop Radioactive Waste Management Case V3
97	**SZC RSR CMT 9**	**Integrated Waste Strategy and Site Wide Environment Safety Case**
98		Update IWS (post SZC RC1)
99		Develop interim SWESC (post RC1)
100	**SZC RSR CMT 10**	**Decommissioning Arrangements**
101		Develop detailed Decommissioning Waste Management Plan and associated funding arrangements
102		Approval of Decommissioning arrangements
103	**SZC RSR CMT 11**	**Assessment of feasibility of removing secondary neutron sources**
104		Assessment of feasibility of removing secondary neutron sources
105		OPEX review (inc. HPC)
106		Review of SZC Data
107		BAT Report
108	**SZC RSR CMT 12**	**Chemistry Specifications**
109		OPEX Review
110		C14 Mass Balance Assessment
111		BAT assessment of chemistry parameters
112		Implement Chemistry arrangements



Project: SZC RSR FWP
Date: Thu 12/12/19

Task | Split | Milestone | Summary | Project Summary | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Deadline | Progress | Manual Progress

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8.3 Conclusion

666. The project at SZC is to build 2 UK EPR^{TM} nuclear reactors capable of producing low-carbon electricity to tackle climate change that will provide around 7% of the UKs electricity, enough of approximately 6 million homes. The replication of the HPC design which has already been approved makes it cheaper to build and finance and means it is competitive with other low carbon technologies. The total lifecycle emissions from SZC will be around 5g CO_2 per kilowatt hour, lower than many renewable energy forms[13].

667. SZC Co. is developing it decommissioning plans in line with the requirements set out in the Energy Act 2008. This means that the operator, SZC Co., must meet the full cost of decommissioning, waste management and waste disposal [Ref 10].

668. SZC Co. is submitting applications for other relevant consents and licences, including the NSL regulated by the ONR, alongside this application for the disposal of radioactive waste.

669. SZC Co. believe that this submission contains sufficient information to enable the Environment Agency to determine whether an RSR environmental permit can be granted, and to enable the Environment Agency to undertake a public consultation during the permit determination process.

670. We believe we have demonstrated that the performance of the two UK EPR^{TM}s and associated facilities at SZC have been optimised and that BAT has been applied and demonstrated. SZC Co. will maintain its environment case so as to demonstrate the continued application of BAT.

671. The highest impact from radioactive discharges to a member of the public from the activities under RSR EP regulations was to an adult member of a fishing family living close to the Sizewell site. The dose from exposure to the combined aqueous and gaseous discharges at proposed permitted limits and from exposure to direct radiation from SZC was 13 µSv/y. The dose to the representative person from the site (i.e. SZB and SZC) was 17 µSv/y, which is 3.4% of the site dose constraint (500 µSv/y),

672. The highest dose resulting from exposure to short-term discharges of gaseous radionuclides from SZC, summed across the relevant terrestrial pathways, was to infant member of the farming family at 6.9 µSv/y.

673. This is considerably below the dose limit of 1mSv/y set out in the BSSD [Ref 59] and well below the dose constraints issued in the legislation for both SZC (source constraint of 300 µSv/y) and in-combination effect of SZB and SZC (site constraint of 500 µSv/y).

674. The impact of radiological discharges on the environment was also assessed. The worst affected organism from discharges from SZC (polychaete worm occupying a marine habitat) was 0.8 µGy/h, well below the regulatory criteria (40 µGy/h) and international advisory level (10 µGy/h).

675. The UK EPR^{TM} design proposed at SZC has successfully concluding the regulators' GDA process. The NI design at SZC is replicated from the already permitted HPC project. A thorough demonstration of the application of BAT at SZC is presented in Document A1. The RIA shows that the receiving environment,

[13] The UK Parliamentary Office of Science and Technology (No. 383, June 2011) details carbon footprint of electricity generation over the whole lifecycle. Solar photovoltaic systems range from 75 to 116 gCO_2e/kWh. Geothermal ranges from 15 to 53 gCO_2e/kWh. Marine (wave and tidal) range from 10 to 20 gCO_2e/kWh. Off-shore wind ranges from 9 to 13 gCO_2e/kWh. Hydro ranges from 2 to 13 gCO_2e/kWh. For comparison, coal ranges from 786 to 990 gCO_2e/kWh.

pathways and receptors are not significantly different to warrant alternative limits. Taking all of these factors into account, SZC Co. has applied for discharge limits in line with those granted for HPC, its sister station.

676. The implementation of the full compliance arrangements is not required at the point of Permit Application but a limited set of compliance arrangements will be in place for RSR Management System Arrangements at the point of permit grant. These arrangements clearly define the SZC Co. requirements and assign responsibilities for ensuring compliance with RSR. The Compliance Matrix, Appendix E1, identifies the SZC Co. Arrangements, for each milestone in the SZC lifecycle, which ensure full and appropriate compliance with the RSR Management System Arrangements.

677. We are submitting this document to the Environment Agency for them to undertake a determination of this application, including a public consultation on our submission. We will respond to any requests for clarification and information from the regulator in a timely and efficient manner to enable them to complete their process.

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