HOLTEC BRITAIN

A Holtec International Company

Holtec Britain Ltd	HI-2240344
Sponsoring Company	**Document Reference**
0	30 September 2024
Revision No.	**Issue Date**
Report	Non-proprietary
Record Type	**Proprietary Classification**
ISO 9001	No
Quality Class	**Export Control Applicability**

Record Title:

PSR Part B Chapter 13 Radioactive Waste Management

Proprietary Classification

This record does not contain commercial or business sensitive information.

Export Control Status

Export Control restrictions do not apply to this record.

Revision Log

Revision	Description of Changes
0	First issue to regulators.

Table of Contents

List of Figures

No table of figures entries found.

List of Tables

13.1 INTRODUCTION

The Fundamental Purpose of the Generic Design Assessment (GDA) Safety, Security and Environment Case (SSEC) is to demonstrate that the generic Small Modular Reactor (SMR)-300 can be constructed, operated, and decommissioned on a generic site in the UK to fulfil the future licensee's legal duties to be safe, secure and protect people and the environment as defined in Holtec SMR GDA Preliminary Safety Report (PSR) Part A Chapter 1 Introduction [1].

The Fundamental Purpose is achieved through the Fundamental Objective of the PSR, which is to present and justify the safety standards and criteria, safety management and organisation, claims, arguments and intended evidence to demonstrate that the generic SMR-300 design risks to people are likely to be tolerable and As Low as Reasonably Practicable (ALARP).

Part B Chapter 13 of the PSR presents the Claims, Arguments and intended Evidence (CAE) for the design of Radioactive Waste Management Structures, Systems and Components (SSCs) and provisions that underpin the design of the generic SMR-300 for the operational phase of the reactor. This ensures safety functions and measures are delivered and radiation exposure and release of radioactive material are minimised So Far As Is reasonably Practicable (SFAIRP). This will support maintaining an appropriate Radioactive Waste Management strategy consistent with the lifecycle phase.

This chapter focuses primarily on Nuclear Liabilities Regulations (NLR) aspects, which is the vires of the Office for Nuclear Regulation (ONR). By contrast, the Preliminary Environmental Report (PER) Chapter 1 Radioactive Waste Management Arrangements [2] is the focus of the Environmental Agency (EA) and Natural Resources Wales (NRW).

13.1.1 Purpose and Scope

The Overarching SSEC Claims are presented in Holtec SMR GDA PSR Part A Chapter 3 Claims, Arguments and Evidence [3].

This chapter (Part B Chapter 13) links to the overarching claim through Claim 2.2 (via Sub-claim 2.2.3):

Claim 2.2: The design of the systems and associated processes have been developed taking cognisance of relevant good practice and substantiated to achieve their safety and non-safety functional requirements.

Claim 2.2.3: Adequate provision for the control of radiation exposure and control of release of radioactive material is incorporated into the design.

As set out in Part A Chapter 3 [3], Claim 2.2.3 is further decomposed across several engineering disciplines which are responsible for development of the design of relevant SSCs. This chapter presents the Radioactive Waste Management aspects for the generic SMR-300 and therefore directly supports a claim focused on the overall design of Radioactive Waste Management SSCs, Claim 2.2.3.5.

Claim 2.2.3.5: SSCs which support the safe management and storage of radioactive waste are designed to ensure safety functions and measures are delivered and radiation exposure and release of radioactivity are minimised SFAIRP.

Recognising that Radioactive Waste Management is a cross-cutting topic, this chapter also links to the overarching claims through Claim 2.3:

Claim 2.3: The design and safety assessment of the generic Holtec SMR-300 considers the entire reactor lifecycle.

Similar to Claim 2.2 and Claim 2.2.3, Claim 2.3 is further decomposed across several topics concerned with the reactor lifecycle. This chapter presents the provisions necessary for management of radioactive waste throughout the lifecycle of the generic SMR-300 and therefore supports Claim 2.3.3.

Claim 2.3.3: The overall Radioactive Waste Management strategy provides an appropriate means of safely managing operational activities throughout the lifecycle of the generic SMR-300.

The Radioactive Waste Management SSCs included within the scope of this chapter [4] are those within the Nuclear Island (NI), as shown below:

- Gaseous Radwaste System (GRW).
- Liquid Radwaste System (LRW).
- Radioactive Drain System (RDS).
- Solid Radwaste System (SRW).

This chapter covers the codes, standards and guidance associated with the provisions for Radioactive Waste Management and the design of the above mentioned SSCs (subchapter 13.4), the design of the SSCs with respect to reducing risk to ALARP (subchapter 13.5) and the strategy for managing radioactive waste throughout the entire reactor lifecycle (subchapter 13.6). Finally, a summary of considerations against the ALARP principle is provided, together with any forward actions or commitments that have arisen (subchapter 13.7).

The design of the generic SMR-300 is an evolution of the design of the SMR-160. The design transition to the generic SMR-300 is a developing process; however, the overall safety system architecture, including the applicable codes and standards, remains unchanged from the mature design of the SMR-160. Therefore, it is appropriate to use SMR-160 documents for the SMR-300 Radioactive Waste Management design. For further details of the design evolution, refer to the SMR-300 GDA Scope [4].

There are no novel aspects to the Radioactive Waste Management SSCs or operational activities identified within the scope of this document with respect to their application in the UK.

The Independent Spent Fuel Storage Installation (ISFSI) is excluded from the scope of this chapter [4] and is within scope of Holtec SMR GDA PSR Part B Chapter 24 Fuel Transport and Storage [5]. Furthermore, internal structures, equipment supports and the Radioactive Waste Building are excluded from the scope of this chapter; the latter of which forms part of the scope of Holtec SMR GDA PSR Part B Chapter 20 Civil Engineering [6].

A master list of definitions and abbreviations relevant to all PSR Chapters can be found in Holtec SMR GDA PSR Part A Chapter 2 General Design Aspects and Site Characteristics [7].

13.1.2 Assumptions

No assumptions are identified in this revision.

13.1.3 Interfaces with other SSEC Chapters

As with all safety case topic areas, Radioactive Waste Management both influences and is influenced by other topic areas. Key interfaces are described below.

Holtec SMR GDA PSR Part B Chapter 4 Instrumentation and Control Systems [8] concerns the electronic systems and instruments design of the generic SMR-300. Holtec SMR GDA PSR Part B Chapter 6 Electrical Engineering [9] concerns the electrical SSCs of the generic SMR-300. These chapters will interface with Radioactive Waste Management as the Radioactive Waste Management systems will incorporate some of these designs and SSCs.

Holtec SMR GDA PSR Part B Chapter 5 Reactor Supporting Facilities [10] contains descriptions of the auxiliary and steam & power conversion systems. This relates to Radioactive Waste Management as the Radioactive Waste Management SSCs receive inputs from some of these systems – including the Chemical and Volume Control System (CVC) and the Spent Fuel Pool Cooling System (SFC).

Holtec SMR GDA PSR Part B Chapter 9 Description of Operational Aspects and Conduct of Operations [11] concerns the operational requirements of the generic SMR-300 such as Examination, Inspection, Maintenance and Testing (EIMT). This relates to Radioactive Waste Management as EIMT of the Radioactive Waste Management systems will be required to allow the system to deliver its relevant functions throughout the operational life of the generic SMR-300.

Holtec SMR GDA PSR Part B Chapter 10 Radiological Protection [12] concerns the radiological protection of workers and operators of the plant as well as the public. During the design phase, design for Radioactive Waste Management systems should be considered to reduce the dose to operators during the operational phase of the plant.

There is also an interface between this topic and the PER. The Approach and Application of Best Available Techniques (BAT) Demonstration report [13] is applicable as this discusses Radioactive Substances Regulation (RSR) principles and the use of BAT. A number of environmental protection claims made in the PER are relevant to this PSR chapter, including: Claim 4.1 Generation of Radioactive Waste; Claim 4.2 Volume of Radioactive Waste; Claim 4.3 Activity of Radioactive Waste; Claim 4.4 Impacts of Radioactive Waste; and Claim 4.7 Monitoring and Sampling.

Holtec SMR GDA PSR Part B Chapter 14 Design Basis Accident Analysis [14] concerns accident scenarios of the generic SMR-300. Holtec SMR GDA PSR Part B Chapter 16 Probabilistic Safety Analysis [15] concerns probabilistic safety analysis of the generic SMR-300. As both these chapters take into account safety and accident scenarios, this will include the Radioactive Waste Management system and how it might function under various scenarios plus any associated risks it contributes to them.

Holtec SMR GDA PSR Part B Chapter 17 Human Factors [16] concerns human factors which will have input to all systems and ongoing RGP of the generic SMR-300. There is an interface with human factors considerations relating to the operation and maintenance of the Radioactive Waste Management systems.

Holtec SMR GDA Part B Chapter 19 Mechanical Engineering [17] concerns the SSCs that support the generic SMR-300 plant safety and mechanical claims. The mechanical design of the SSCs will have influence on the on the Radioactive Waste Management systems.

Holtec SMR GDA Part B Chapter 20 Civil Engineering [6] concerns Civil Engineering. The construction of the generic SMR-300 from a Civil Engineering perspective will influence the Radioactive Waste Management systems SSCs incorporation into the generic SMR-300.

Holtec SMR GDA PSR Part B Chapter 23 Reactor Chemistry [18] covers reactor chemistry. This has relevance to Radioactive Waste Management systems as the reactor chemistry will influence the characteristics of the wastes generated and the final waste forms produced.

Holtec SMR GDA PSR Part B Chapter 26 Decommissioning Approach [19] concerns the decommissioning approach and strategy of the generic SMR-300, as well as the application of design for decommissioning principles. This will be relevant to this chapter as it will include the future decommissioning of the radioactive waste systems.

13.2 DESCRIPTION OF RADIOACTIVE WASTE MANAGEMENT SSCs

The following provides a summary description of the Radioactive Waste Management SSCs that are within the scope of this PSR chapter. Further discussion on the buildings within which the Radioactive Waste Management Systems are housed can be found within PSR Part B Chapter 20 [6].

13.2.1 Liquid Radwaste System

13.2.1.1 LRW System Overview

The LRW is responsible for the collection, treatment and release or recycle of radioactive liquid wastes generated by the plant during all operations.

The various wastes arisings input to the RDS are segregated at source and then co-collected in the LRW. The treatment processes within the LRW are a combination of filtration and ion exchange.

Discharge of waste to the environment shall be subject to procedural and administrative controls. The details of these controls are to be defined at the site-specific stage.

The information below is taken from the System Design Description (SDD) for the LRW for the SMR-300 [20]. This document is currently being developed. More detailed information relating to the SMR-300 will be provided, where possible, in Chapter B13: Radioactive Waste Management at PSR Revision 1.

13.2.1.2 LRW System Boundaries

The primary interfaces for the LRW are shown below [20]:

Table 1 Summary of LRW Interfaces

System		Function
(CRS)	Circulating Water System (CRS)	Blowdown from the CRS is used as the water source to facilitate permitted discharges to the environment.
(CVC)	Chemical and Volume Control System (CVC)	Letdown from the CVC is directed to the LRW for collection, storage, and processing. The effluent holdup tanks are contained within the CVC.
(RDS)	Radioactive Drain System (RDS)	The RDS collects liquid wastes from equipment and floor drains and transfers them to the appropriate LRW subsystem for processing.
(SRW)	Solid Radioactive Waste System (SRW)	Spent resin from the ion exchangers is transferred to the SRW for storage and processing.

13.2.1.3 LRW System Description

The LRW is designed to protect plant personnel from radiation exposure as well as minimising the radioactive releases to the environment.

The LRW collects, processes, and stores the waste arisings produced throughout the plant during normal operations, including refuelling, plant startup and shutdown and maintenance operations, as well as during Anticipated Operational Occurrences (AOOs).

As well as providing capability for processing of the radioactive waste arisings, the LRW also has provision for storing the waste for processing by external, mobile equipment if required.

Prior to processing, the wastes are classified and segregated due to high and low conductivity within the RDS and CVC for collection and processing. By segregating the different arisings, this will allow for more effective collection and processing thereby minimising the quantity of solid radioactive waste produced by the system.

The waste arisings treated by the LRW comprise a mixture of liquids from high conductivity drains in the RDS, liquids from the Reactor Auxiliary Building (RAB) chemical drains in the RDS, and liquids from CVC letdown.

Non-radioactive wastes are excluded from LRW system scope and will instead be handled and processed by other systems.

13.2.1.3.1 Effluent and Waste Collection

Effluent Collection
Effluent collection is undertaken within the scope of the CVC via the effluent holdup tanks and is therefore outside of the scope of the LRW system. Notwithstanding, there is an interface between the LRW and CVC to allow CVC letdown to be processed through the LRW processing equipment if required. For further information on the CVC, please refer to the SDD [21].

Waste Collection
The wastes collected within the LRW consist of potentially contaminated RDS floor drains and other wastes containing higher volumes of suspended solids. These wastes include the residual water transferred from the spent resin from the SRW, various potentially contaminated building RDS floor drains and sumps, and other miscellaneous drains.

RDS floor drains inside containment and the spent fuel pool liner leakage are collected in the RDS containment floor sump. Wastes contained within the containment sump are transferred directly to the waste holdup tanks. Wastes within potentially contaminated RDS floor drains and other miscellaneous waste in the RAB are sent directly to the waste holdup tanks. They are segregated into these tanks due to their potentially high conductivity levels. Degasification takes place prior to entry into the LRW system, but a hydrogen monitor is present on each tank in the event that any Hydrogen passes through to the LRW.

There are also chemical and detergent wastes produced throughout the plant. Chemical wastes include inputs from laboratories and other small volume sources. These wastes are also collected within the waste holdup tanks. Provisions are included to transfer the tank contents to be processed through the LRW equipment. The chemical wastes may also be discharged if no processing is required or processed through temporary mobile equipment.

13.2.1.3.2 Effluent Processing

The effluent and waste from the holdup tanks are combined in a common pipe manifold into the inlet of the LRW processing equipment. The abatement equipment used to process the arisings is anticipated to consist of:

- Prefilter.
- Activated Carbon Filter.
- Ion Exchange Columns.
- After filter.

Any of the filters and vessels can be manually bypassed to add additional flexibility in operation and maintenance requirements.

13.2.1.3.3 Effluent Monitoring and Discharge

After the water has been appropriately treated, it is transferred to the monitoring tanks. These tanks are provided to allow for storage of the treated effluents and wastes for sampling prior to discharge. The contents of these tanks can be re-circulated and sampled. Based on the sampling results, the tank contents are discharged to the environment or reprocessed. Direct discharges to the environment will be minimised.

Where environmental discharge is required, the flow is directed to the CRS prior to direct discharge. Effluent radiation monitoring is installed in the outfall line, upstream of the interface with the CRS. Effluent release to the outfall is automatically isolated upon detection of high radiation by the effluent monitor. Direct operator intervention is required to restart the release to the outfall.

13.2.1.4 LRW System Operation

The LRW is required to operate during all normal operating conditions, including refuelling and maintenance outages. The system operation for the LRW is controlled via the Plant Control System (PCS) for all non-safety related equipment. Normal operations as well as AOO are summarised below.

13.2.1.4.1 LRW Operational Requirements

The operational requirements for the LRW can be found below:

- Alternative routings for chemical waste in the event of high radioactivity content shall be: (1) processed through LRW filter and ion exchangers, or (2) processed through a temporary mobile equipment skid.
- The LRW shall be designed to provide connections for the transfer of wastewater used for handling spent resin into the waste holdup tanks either for processing or routing to the temporary mobile equipment skid.
- A minimum flow of water for liquid radioactive waste releases to the outfall shall be required to permit discharges to ensure the permitted discharge is able to be adequately transported to the discharge point.

13.2.1.4.2 LRW Normal Operation

The operations associated with normal operation of the LRW are:

- The LRW processing systems receive effluent and waste and treat it to the required quality for discharge.
- Effluent discharge to the CRS.

Note: Sampling is required prior to any environmental discharge or re-use within the plant. Effluent radiation monitors in the system shall automatically terminate the release of radioactive waste upon detection of radiation levels above the predetermined setpoint in the discharge. The effluent discharge valve to the CRS shall fail closed in fault conditions.

13.2.1.4.3 LRW Startup Operation

There is no change in operation of the LRW during plant start up.

13.2.1.4.4 LRW Shutdown Operation

The LRW is sized to accommodate the increased radioactive waste volumes during shutdown operations. There is no system impact other than additional LRW processing requirements.

13.2.1.4.5 LRW Refuelling Operation

The LRW is sized to accommodate the increased radioactive waste volumes during refuelling operations. There is no system impact other than additional LRW processing requirements.

13.2.2 Gaseous Radwaste System

13.2.2.1 System Overview

The GRW is intended to treat all the gaseous radioactive wastes arisings from the primary circuit during normal plant operation. The gases to be processed are primarily hydrogen and nitrogen. These gases are the carrier gases for the small amounts of fission gasses produced during reactor operation.

More detailed information relating to the SMR-300 will be provided, where possible, in the next revision of Chapter B13: Radioactive Waste Management at PSR Revision 1.

13.2.2.2 System Boundaries

The Primary interfaces for the GRW are shown below [22]:

Table 2: Summary of GRW Interfaces

System		Function
CVC	Chemical and Volume Control System	The waste gas arisings requiring treatment within the GRW, are primarily transported to the GRW from the CVC.
NISS	Nitrogen Supply System	The NISS supplies nitrogen throughout the GRW to provide system purging and backup to the waste gas vent header for cover gas.
RBV	Radioactive Waste Building HVAC System	The processed gaseous effluents will be vented to the atmosphere through the RBV. A radiation monitor will be placed at the discharge vent with an interlock/ permissive to automatically close the discharge isolation valve in the GRW in the event of high radiation levels.
RMS	Radiation Monitoring System	The RMS provides radiation monitoring of the effluents within the GRW.

13.2.2.3 System Description

The GRW primarily collects gaseous waste arisings from the LRW degassing volume control tank and the Effluent Holdup Tanks within the CVC. The system provides holdup of the radioactive species present in the gas before processing, monitoring and discharging.

The processing equipment used to treat the waste gas arisings is in development and further information will be provided as the design of the SMR-300 develops. Notwithstanding, the strategy employed is to provide hold up for short-lived radionuclides to sufficiently decay prior to discharge.

Throughout the GRW, there are several interfaces with the NISS. This provides several functions: it provides backup to the cover gas system, maintains the pressure in the system and ensures that the hydrogen concentration within the system never reaches the lower flammability limit.

13.2.2.4 System Operation

The GRW is required to operate during all normal operating conditions, including refuelling and maintenance outages. The system operation for the GRW is controlled via the Plant Safety System (PSS) for any safety related equipment and the PCS for all non-safety related equipment. Normal and abnormal operations are summarised below.

A summary of the operations associated with normal operation of the GRW as well as how the GRW reacts to abnormal operation can be found below.

13.2.2.4.1 Normal Operation

During normal operation, the GRW:

- Receives gaseous waste from the operation of the SMR-300.
- Holds the gas up to allow for sufficient time to decay.
- Continuously monitors oxygen and hydrogen concentrations throughout the system.
- Analyses the gas to ensure that the activity of it is below the acceptable discharge limits.
- Discharges the waste gas through a radiation monitor and actuated valve to the RBV for discharge through a permitted discharge point.

13.2.2.4.2 Abnormal Operation

The response of the GRW to some foreseen abnormal operating conditions can be found below:

- If high oxygen levels are detected in the system, the inlet valve to the GRW is closed and a full nitrogen purge of the system is conducted. Manual restart of GRW processing is required once oxygen levels return to normal range.
- If radioactivity levels are exceeded in the outlet line from the GRW, the actuated valve automatically closes to prevent further discharge and nitrogen is injected in the discharge line to dilute the gas and provide circulation force. Manual restart of GRW discharge is required once activity levels return to normal range.

13.2.3 Radioactive Drain System

There is presently no design information available for the RDS. This will be provided within Revision 1 of this PSR Chapter when the SDDs are developed.

13.2.4 Solid Radioactive Waste System

13.2.4.1 System Overview

The SRW is designed to collect and process radioactive solid wastes produced by the plant during normal operation and AOOs. All equipment associated with the SRW is contained either within the RWB or the RAB.

The information below is taken from the SDD for the SRW for the SMR-300 [23]. This document is currently being developed. More detailed information relating to the SMR-300 will be provided, where possible, in the next revision of Chapter B13: Radioactive Waste Management at PSR Revision 1.

13.2.4.2 System Boundaries

The SRW interfaces with the following systems [24]:

Table 3: Summary of SRW Interfaces

System		Function
CVC	Chemical and Volume Control System	Spent resin and filter cartridges from the CVC are sent to the SRW for storage, processing, and disposal.
LRW	Liquid Radwaste System	Liquids removed from processing solid wastes are sent to the LRW for storage and treatment. Spent resin and filter cartridges from the LRW are sent to the SRW for storage, processing, and disposal.
PSL	Process Sampling System	The PSL samples the spent resin tanks for radioactivity.
RBV	Radioactive Waste Building HVAC System	Mobile equipment for processing SRW is vented to the RBV.
RCV	Radiologically Controlled Area HVAC	The spent resin tanks are vented to the RCV.
SFPC	Spent Fuel Pool Cooling System	Spent resin and filter cartridges from the SFPC are sent to the SRW for storage, processing, and disposal.

13.2.4.3 System Description

The SRW is responsible for collecting several categories of solid waste. These are wet solid waste, dry solid waste, and miscellaneous solid waste. These wastes are packaged for temporary storage and shipment to off-site disposal facilities.

13.2.4.3.1 Wet Solid Waste

The wet solid waste arisings are foreseen to consist of spent resin, filter bed media, and filter cartridges from radioactively contaminated systems. The treatment of wet solid wastes has been separated into two different processes for the purposes of the SMR-300 design: spent resin handling and filter cartridge processing.

13.2.4.3.1.1 Spent Resin Handling

The spent resin handling system receives spent resin from the CVC, SFPC and the LRW. The system also receives filter bed media from the LRW. All equipment associated with the spent resin handling subsystem is located within the RAB.

The spent resin handling subsystem is comprised of the following equipment:

- Spent Resin Tanks.
- Transfer Pump.
- Resin Mixing Pump.
- Resin Fines Filter.
- Sampling Unit.

13.2.4.3.2 Dry Solid Waste

Dry solids wastes consist of HVAC filters, personal protective equipment (PPE) and any other dry components that are potentially contaminated. Redundant in-core components and decommissioning wastes are not processed by the SRW.

The procedure for treatment of dry solid wastes is:

- Solid wastes are collected at the point of generation and transported to the RWB for storage and processing.

- These wastes are sorted based on contact dose rate to determine processing and packaging requirements.
- Wastes are further sorted by waste type, such as compactible and non-compactible.
- High dose rate solid wastes are not sorted further, based on operator exposure ALARP considerations.

13.2.4.3.3 Miscellaneous Waste

Miscellaneous wastes are liquid or solid wastes not considered wet solid waste or dry solid waste. These consist of chemical wastes, contaminated oily wastes, and mixed wastes. Chemical waste is collected in the chemical waste tank in the LRW and sent to the SRW for processing via mobile equipment. Contaminated oily wastes and mixed wastes are directly packaged and stored.

13.2.4.3.4 Estimated Solid Radioactive Waste Volumes

The volumes are to be confirmed for anticipated solid waste arisings within Revision 1 of this PSR Chapter. An Expert View on the disposability of all solid SMR-300 wastes shall be sought from Nuclear Waste Services (NWS) via the Disposability Assessment process [25], which is intended to identify any fundamental risks or uncertainties on the future disposal of those wastes – including risks and uncertainties arising from proposed waste packaging or treatment processes.

13.2.4.3.5 Solid Waste Packaging

The design of the SMR-300 has been undertaken using the US guidelines and legislation as its basis. For that reason, the packaging solutions proposed within the design documentation may not be suitable for use in a UK regulatory context. Notwithstanding, the storage, transportation and disposal solutions employed for the solid LLW and ILW arisings will need to be in keeping with UK requirements and should be in accordance with RGP and guidance, for example that set out in the Logistics Services Brochure [26] and the Waste Package Specification and Guidance Documentation [27] prepared by NWS.

13.2.4.4 System Operation

The SRW is required to operate during all normal operating conditions, including refuelling and maintenance outages. The monitoring and control of the SRW equipment and components which perform non-safety functions is done by the PCS, with SRW instrumentation providing signal to the PCS directly. As the SRW does not perform a safety function, there is no interaction with the PSS.

A summary of the operations associated with normal operation and AOOs of the SRW can be found below.

13.2.4.4.1 Normal Operation

Spent Resin Processing Operations
Once the resin has been sufficiently exhausted such that it requires processing it is transferred to the spent resin tanks. The excess water is removed with a filter preventing resin from entering the downstream pipework.

When processing is required, the contents of the tank are recirculated. The resulting slurry is sampled by the PSL in order to identify further processing and storage requirements.

Once sampling has been completed, the resin is transported to the identified storage container. After the transfer, the resin lines are flushed using water supplied from the resin mixing pump.

Other filtration media, such as activated carbon, can be transferred to an empty spent resin tank or transferred directly to a storage container.

Dry Solid Waste Processing Operations
The following operations summarise the processing of dry solid waste arisings:

- Dry solid waste arisings are segregated based on contact dose rate.
- Non-radioactive wastes are removed where possible.
- Radioactive items which can be decontaminated for re-use are returned to the appropriate storage location; and those which cannot be re-used are processed as required.
- Any ILW arisings are not to be sorted further, so as to minimise operator dose, consistent with ALARP considerations; these are processed and stored appropriately.

Miscellaneous Solid Waste Processing
Mixed wastes and radioactive oily wastes are collected in storage containers and stored temporarily in the RWB prior to disposal off-site.

13.2.4.4.2 Startup Operation

There is no anticipated change in the SRW during startup operations.

13.2.4.4.3 Shutdown Operation

There is no anticipated change in the SRW during shutdown operations.

13.2.4.4.4 Refuelling Operation

There is no anticipated change in the SRW during refuelling operations.

13.3 RADIOACTIVE WASTE MANAGEMENT CLAIMS, ARGUMENTS, EVIDENCE

The primary purpose of a CAE approach is to capture the golden thread of a safety case narrative to demonstrate how plant and operational evidence is brought together and to justify that a high-level or fundamental claim is true. In the context of the GDA of the generic SMR-300, that is how the Fundamental Purpose of the overarching SSEC (presented in Part A Chapter 1) is achieved.

The Fundamental Purpose follows a golden thread throughout the SSEC to CAE via the objectives of the PSR, the PER and the generic Security Report (GSR) [28]. The overarching SSEC claims and the philosophy for their architecture is presented in Part A Chapter 3 [3].

This chapter links to the overarching claim through Claim 2.2 via Sub-claim 2.2.3. Claim 2.2 is focused on the demonstration of the design, and that the SSCs that form the design are developed to ensure they meet the relevant safety requirements and appropriate codes and standards. These demonstrations specific to the release of radioactive material and control of radiation exposure are addressed by Claim 2.2.3.

Claim 2.2: The design of the systems and associated processes have been developed taking cognisance of relevant good practice and substantiated to achieve their safety and non-safety functional requirements.

Claim 2.2.3: Adequate provision for the control of radiation exposure and control of release of radioactive material is incorporated into the design.

As set out in Part A Chapter 3 [3], Claim 2.2.3 is further decomposed across several engineering disciplines which are responsible for development of the design of relevant SSCs. This chapter presents the Radioactive Waste Management aspects for the generic SMR-300 and therefore directly supports a claim focused on the overall design of Radioactive Waste Management SSCs, Claim 2.2.3.5. Arguments will be developed to demonstrate this claim and will be outlined in Subchapter 13.5 in the next revision of this PSR chapter.

Claim 2.2.3.5: SSCs which support the safe management and storage of radioactive waste are designed to ensure safety functions and measures are delivered and radiation exposure and release of radioactivity are minimised SFAIRP.

Recognising that Radioactive Waste Management is a cross-cutting topic, this chapter also links to the overarching claims through Claim 2.3, which focusses on the demonstration that the whole lifecycle of the reactor is considered in design and safety assessments.

Claim 2.3: The design and safety assessment of the generic Holtec SMR-300 considers the entire reactor lifecycle.

Similar to Claim 2.2 and Claim 2.2.3, Claim 2.3 is further decomposed across several topics concerned with the reactor lifecycle. This chapter presents the provisions necessary for management of radioactive waste throughout the lifecycle of the generic SMR-300 and therefore supports Claim 2.3.3. Arguments will be developed to demonstrate this claim and will be outlined in Subchapter 13.6 in the next revision of this PSR chapter.

Claim 2.3.3: The overall Radioactive Waste Management strategy provides an appropriate means of safely managing operational activities throughout the lifecycle of the generic SMR-300.

Table 4 shows in which chapter of this PSR these claims are demonstrated to be met.

Table 4: CAE Chapters

Claim No	Claim	Chapter Section
2.2.3.5	SSCs which support the safe management and storage of radioactive waste are designed to ensure safety functions and measures are delivered and radiation exposure and release of radioactivity are minimised SFAIRP.	13.5 DESIGN OF RADIOACTIVE WASTE MANAGEMENT SSCs
2.3.3	The overall Radioactive Waste Management strategy provides an appropriate means of safely managing operational activities throughout the lifecycle of the generic SMR-300.	13.6 RADIOACTIVE WASTE MANAGEMENT STRATEGY

A summary of the current CAE route map for Part B Chapter 13 is provided in Appendix A and a further update on claim decomposition, argument development and evidence maturity will be provided in the subsequent update of the Chapter.

13.4 CODES, STANDARDS AND METHODOLOGY

This subchapter outlines the codes and standards used in the design of SMR-300 Radioactive Waste Management SSCs and provisions.

The Requesting Party (RP) has recognised that UK nuclear safety regulations are based on a non-prescriptive regime and consequently the technical codes and standards that must be used for nuclear power plant are not prescribed. However, the codes and standards must represent RGP. New codes and standards can be introduced where needed by say, novel design features. Use of such codes will be justified in each case.

13.4.1 Codes, Standards and Methodologies used for the Radioactive Waste Management SSCs of the SMR-300

The following US and international codes and standards have been used in the design of SSCs related to Radioactive Waste Management. These include US NRC guidelines identified in areas such as: radioactive waste systems, SDDs, Electric Power Research Institute (EPRI) Utility Requirements and others.

Table 5: Relevant Codes and Standards to the SMR-300

Document	Title	Revision
United States Nuclear Regulatory Commission, Regulatory Guide 1.26 [29]	Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste Containing Components of Nuclear Power Plants	Revision 6, December 2021
United States Nuclear Regulatory Commission, Regulatory Guide 1.21 [30]	Measuring, Evaluating, and Reporting Radioactivity in Solid Waste and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants	Revision 3, September 2021
United States Nuclear Regulatory Commission, Regulatory Guide 1.110 [31]	Cost-Benefit Analysis for Radioactive Waste Systems for Light-Water-Cooled Nuclear Power Reactors	Revision 1, October 2013
United States Nuclear Regulatory Commission, Regulatory Guide 1.143 [32]	Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants	Revision 2, November 2001
United States Nuclear Regulatory Commission, Regulatory Guide 4.21 [33]	Minimization of Contamination and Radioactive Waste Generation Life-Cycle Planning	Revision 0, June 2008
American National Standards Institute (ANSI) / American Nuclear Society (ANS)-40.37 [34]	Mobile Low-Level Radioactive Waste Processing Systems	2009
ANSI/ANS-55.1 [35]	Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants	1993 (R2017)
ANSI/ANS-55.4 [36]	Gaseous Radioactive Waste Processing System for Light Water Reactor Plants	1993 (R2007)
ANSI/ANS-55.6 [37]	Liquid Radioactive Waste Processing System for Light Water Reactor Plants	1993 (R2007)
Electric Power Research Institute, "Utility Requirements Document, Volume III, Chapter 12 [38]	Radioactive Waste Processing Systems	Revision 8

13.4.2 UK and International Guidance used in Development of the generic SMR-300

13.4.2.1 UK Regulatory Expectations

Nuclear safety, civil nuclear security and safeguards, and conventional health and safety at nuclear sites in the UK are regulated by ONR. The regulation of discharges and radioactive waste disposals, and the enforcement of environmental permits of nuclear sites are undertaken by the EA, NRW and the Scottish Environment Protection Agency (SEPA) in England, Wales, and Scotland, respectively.

The primary legislation that forms the UK nuclear regulatory regime is outlined in more detail in Reference [39]. However, the focus of the PSR chapters is directed to ONR regulation. Where essentially ONR inspectors are given a set of Safety Assessment Principles (SAP), which are supported by Technical Assessment Guides (TAG), which they follow in their regulatory assessment process. Technical Inspection Guides (TIG) are also available to provide guidance in meeting the requirements of site license conditions. Whilst not aimed for use by the RP, the RP can use these to help develop the PSR section of the safety case in a way that will satisfy the ONR regulatory assessment process.

As part of the site-specific licensing process, the prospective licensee must comply with all the nuclear site licence conditions (LC). The LC which is directly applicable to the Radioactive Waste Management Topic area is LC 34 – Leakage and escape of radioactive material and radioactive waste [40]. The requirement placed on the site licence holder in order to comply with LC 34 is that radioactive material and radioactive waste on site is adequately controlled, SFAIRP, such that it cannot leak or escape from control or containment. Further, should any material leak or escape it shall not do so without being detected by the monitoring systems in place.

In addition to LC 34, the following LCs are applicable to the Radioactive Waste Management topic area:

- LC 4 – Restrictions on nuclear matter on the site.
- LC 32 – Accumulation of radioactive waste.
- LC 33 – Disposal of radioactive waste.

13.4.2.2 Relevant ONR Safety Assessment Principles

A list of the ONR’s Safety Assessment Principles (SAP) [41] which are relevant to Radioactive Waste Management can be found below within Table 7.

13.4.2.3 Relevant ONR Technical Assessment Guides

Below can be found a list of the ONRs Technical Assessment Guides (TAGs) [42] which are relevant to Radioactive Waste Management:

- **NS-TAST-GD-005 (Issue 11.2)** – Guidance on the Demonstration of ALARP (As Low As Reasonably Practicable).
- **NS-TAST-GD-024 (Issue 7.2)** – Management of Radioactive Material and Radioactive Waste on Nuclear Licensed Sites.
- **NS-TAST-GD-036 (Issue 6)** – Redundancy, Diversity, Segregation and Layout of Structures, Systems and Components.

- **NS-TAST-GD-094 (Issue 2)** – Categorisation of Safety Functions and Classification of Structures and Components.

13.4.2.4 Relevant National and International Guidelines

Below can be found a non-exhaustive list of relevant national and international guidance applicable to the Radioactive Waste Management aspects of the SMR-300 design. The following is considered to represent RGP in the UK with IAEA and WENRA guidance specifically referenced throughout the ONR TAGs:

- International Atomic Energy Agency (IAEA) safety standards:
  - IAEA Fundamental Safety Principles: Safety Fundamentals SF-1, IAEA, Vienna, 2006 [43].
  - General Safety Requirements Part 5: Predisposal Management of Radioactive Waste, No. GSR Part 5, IAEA, Vienna, 2009 [44].
  - Specific Safety Guide No.40 Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors, SSG-40, IAEA, 2016 [45].
  - Storage of Radioactive Waste, Safety Guide, WS-G-6.1, IAEA, Vienna, 2006.
- WENRA guidance:
  - Safety Reference Levels for Existing Reactors, WENRA, February 2021 [46].
  - Reactor Harmonisation Working Group Report on Safety of New NPP Designs, WENRA, March 2013 [47].
  - WENRA Report on Treatment and Conditioning Safety Reference Levels, 2018 [48].
  - Decommissioning Safety Reference Levels, version 2.3, WENRA, 2024 [49].
  - Waste and Spent Fuel Storage Safety Reference Levels, version 2.3, WENRA, 2024 [50].
- Department of Energy & Climate Change (DECC):
  - UK Strategy for the Management of Solid Low Level Waste from the Nuclear Industry, 2016 [51].
- Department for Energy Security & Net Zero (DESNZ):
  - UK Policy Framework for Managing Radioactive Substance and Nuclear Decommissioning, 2024 [52].

13.4.2.5 ONR SAPs vs EA RSR Principles

A comparison of the ONR's Radioactive Waste Management SAPs against the EA's RSR principles is provided below to demonstrate commonality across the safety and environmental regulatory principles within the UK, highlighting the common interest of both sets of regulators in the field of Radioactive Waste Management.

Table 6: Comparison of ONR SAPs and EA RSR Principles

ONR Safety Assessment Principles		EA RSR Principles	
RW1	Strategies for radioactive waste	RSMDP1	Radioactive substances strategy
RW2	Generation of radioactive waste	RSMDP3	Use of BAT to minimise waste
RW3	Accumulation of radioactive waste	RSMDP5	Actions having irreversible consequences
RW4	Characterisation and segregation	RSMDP8 RSMDP9	Segregation of wastes Characterisation
RW5	Storage of radioactive waste and passive safety	RSMDP10	Storage
RW6	Passive safety timescales	RSMDP10 RSMDP11	Storage Storage in a passively safe state
RW7	Making and keeping records	RSMDP14	Record keeping

13.4.3 US-UK Regulatory Gap Analysis

Table 7 below compares the relevant ONR SAPs to the US NRC legislation, under whose assessment framework the SMR-300 has been designed. Primarily, 10 CFR 20 and 10 CFR 50 were used for comparison to the UK legislation. Where gaps are identified these have been carried forward to the Forward Action Plan.

Table 7: Summary of ONR SAPs vs US NRC Regulations

Radioactive Waste Management SAPs (ONR)			Potential Gap vs US NRC Regulations
RW.1	Strategies for radioactive waste	A strategy should be produced and implemented for the management of radioactive waste on a site.	US industry standards for Radioactive Waste Management in PWRs form the basis for the SMR-300 design (e.g. US regulatory guidance, ANSI standards, EPRI guidelines). For the SMR-300, an integrated waste strategy shall be developed by PSR Revision 1. This will give confidence that wastes generated have suitable waste routes identified in the UK system as well as highlight if there is the potential for any problematic wastes being generated.
RW.2	Generation of radioactive waste	The generation of radioactive waste should be prevented or, where this is not reasonably practicable, minimised in terms of quantity and activity.	There is consistency between UK SAPs and US NRC Regulations. Estimates of generation of radioactive wastes are available in relevant industry guidance (e.g. ANSI standards in the US).
RW.3	Accumulation of radioactive waste	The total quantity of radioactive waste accumulated on site at any time should be minimised so far as is reasonably practicable.	Estimated quantities of generated radioactive wastes for PWRs are available in relevant industry guidance (e.g. ANSI standards in the US). These wastes shall be categorised according to UK regulatory context.
RW.4	Characterisation and segregation	Radioactive waste should be characterised and segregated to facilitate its subsequent safe and effective management.	US requirements are available for characterisation and categorisation for wastes for disposal. For the SMR-300, suitable design features and arrangements for characterisation and segregation are subject to design development.
RW.5	Storage of radioactive waste and passive safety	Radioactive waste should be stored in accordance with good engineering practice and in a passively safe condition.	This is a recognised gap due to the differences in disposal routes. The US do not have a requirement for on-site storage of ILW in a passively safe manner and instead are able to directly ship this off site. In order for the SMR-300 to comply with UK regulatory context, it will be subject to a disposability assessment of wastes. The findings of this assessment will be addressed through development of the SMR-300 design.

Radioactive Waste Management SAPs (ONR)			Potential Gap vs US NRC Regulations
RW.6	Passive safety timescales	Radiological hazards should be reduced systematically and progressively. The waste should be processed into a passive safe state as soon as is reasonably practicable.	This is a recognised gap due to the differences in disposal routes. The US do not have a requirement for on-site storage of ILW in a passively safe manner and instead are able to directly ship this off site. In order for the SMR-300 to comply with UK regulatory context, it will be subject to a disposability assessment of wastes. The findings of this assessment will be addressed through development of the SMR-300 design.
RW.7	Making and keeping records	Information that might be needed for the current and future safe management of radioactive waste should be recorded and preserved.	Within NRC document 10 CFR 20 (Subpart L - Records) the requirements placed on the licensee for keeping and maintaining records are established. The required records to be maintained include records of waste disposal. This is applicable across the Radioactive Waste Management systems. Detailed provisions shall be made for the available UK disposal routes.

13.4.4 Categorisation and Classification

The UK expectation under SAP ECS.2 [41] is that SSCs that deliver safety functions should be identified and classified on the basis of those functions and their significance to safety.

(REDACTED)

An exercise will have been undertaken by PSR Revision 1 to align safety functions in accordance with UK regulatory expectations. The safety classification of an SSC will be determined by fault studies (see PSR Part B Chapter 14 [14] and Holtec SMR GDA PSR Part B Chapter 15 Beyond Design Basis and Severe Accident Analysis, and Emergency Preparedness [53]), PSA (see PSR Part B Chapter 16 [15]), Internal Hazards (see Holtec SMR GDA PSR Part B Chapter 22 Internal Hazards [54]) and External Hazards assessments (see Holtec SMR GDA PSR Part B Chapter 21 External Hazards [55]).

Categorisation and classification is discussed in detail in PSR Part A Chapter 2 [7].

13.5 DESIGN OF RADIOACTIVE WASTE MANAGEMENT SSCs

Claim 2.2.3.5: SSCs which support the safe management and storage of radioactive waste are designed to ensure safety functions and measures are delivered and radiation exposure and release of radioactive material are minimised SFAIRP.

This subchapter outlines the analysis methodologies used in the design of SMR-300 Radioactive Waste Management SSCs. It considers:

- **Functional Requirements of Radioactive Waste Management SSCs**, which determine the classification of Radioactive Waste Management SSCs. Chapter A2 [7] introduces the SMR-300 high-level plant functions.
- **Design Codes and Standards** applied to the Radioactive Waste Management SSCs.
- **Design Methodology** to demonstrate that the design meets the requirements of the design codes and standards and are commensurate to the safety categorisation and classification.
- **Consideration of the ALARP Principle** during design development.

13.5.1 Liquid Radwaste System Design

13.5.1.1 Functional Requirements

13.5.1.1.1 System Requirements

Below can be found the overall system requirements for the LRW [20]:

- All discharge of liquid radioactive wastes to the environment shall be made via tanks wherein the contents of the tank may be mixed, sampled and proven to be acceptable in relation to discharge limits prior to discharge.
- The LRW shall be able to receive input at all times and during all plant operational states.

13.5.1.1.2 Safety Functions

The LRW does not perform any safety function, it is not credited for mitigation of design basis accidents and has no active safe shutdown functions [20].

13.5.1.1.3 Non-Safety Functions

The non-safety functions of the LRW system are to [20]:

- Collect, control, process, handle, store, and dispose of liquid radioactive waste.
- The LRW receives, treats, and disposes of radioactive liquid wastes generated as a result of plant operations, including anticipated operational occurrences.

13.5.1.2 Design Codes and Standards

The LRW shall conform to the quality requirements and the Codes, Standards, and Seismic requirements of Regulatory Guide 1.143 [56]. The principal design parameters for the LRW subsystems are summarised within the LRW SDD [20]. Preliminary sizing calculations [57] have been conducted for the LRW in accordance with ANSI/ANS-55.6 [37].

13.5.1.3 Design Methodology

13.5.1.3.1 Materials

The material selection requirements for the LRW can be found below:

- Materials shall be selected to meet the corrosion, transient, and environmental conditions anticipated in the specific equipment and systems under both normal and off-standard conditions.
- Material selection where wastes are recycled shall be consistent with water quality requirements, e.g., materials shall not contribute corrosion products which would degrade the water quality.

It is envisaged that the majority of SSCs in contact with liquid radioactive waste will be constructed from stainless steel to satisfy the above requirements. Other materials shall be considered where stainless steel is not suitable.

13.5.1.3.2 Mechanical / Structural Considerations

The Mechanical / Structural Requirements for the LRW can be found below:

- No possibility of gravity or siphon flow from radioactive waste systems to the site and off-site environment shall exist.
- Process and service connections shall be provided so that mobile equipment may be connected in the event of unusual waste quantities, impurity content, or prolonged equipment failure.
- Remotely operated shut-off valves shall be ball or eccentric plug valves.

13.5.1.3.3 Chemistry

The chemistry regime shall prevent and minimise waste generation, including corrosion and activation products. This will ensure that the LRW can suitably abate the radiological contaminants from effluent streams prior to release to the environment. For further information on the chemistry regime of the plant, see PSR Part B Chapter 23 [18].

The functions of the CVC ensure the water quality through use of ion exchange columns and filters. For further information on the CVC, see PSR Part B Chapter 5 [10].

13.5.1.3.4 Instrumentation and Control

Below can be found the Instrumentation and Control (I&C) requirements for the LRW:

- Valves in process piping in the LRW which must change position during normal operation (e.g., processing the contents of collection tanks through normal processing equipment, recirculation of tank contents, etc.) shall be remotely operated from a local radioactive waste control room panel.
- Initiation of discharge shall involve two separate steps – Opening of the valve followed by the start of the pump.
- Effluent radiation monitors in the system shall automatically terminate the release of radioactive waste upon determination of high radiation (above a predetermined setpoint) in the discharge.
- Valves controlling discharge flow shall fail closed on loss of power.

The I&C boundary is at the connection of the LRW instruments to the PCS or PSS. These are discussed further in PSR Part B Chapter 4 [8]. Additional Information on radiation monitoring can be found within PSR Part B Chapter 10 [12].

13.5.1.4 ALARP Considerations

The LRW is being designed in accordance with Regulatory Guide 1.143 [56] which is considered good practice in the US. Furthermore, the principles applied to the design of the LRW through compliance with US NRC legislation, primarily 10 CFR 20 [58] and 10 CFR 50 [59], are broadly consistent with the relevant ONR SAPs [41] and EA RSR Principles [60] as demonstrated in Table 7. As such, there is confidence that risk will be reduced ALARP through implementation of these principles.

ALARP considerations regarding the LRW will be provided in a future revision of this chapter noting that the design of the LRW is ongoing.

13.5.2 Radioactive Drain System Design

There is presently no design information available for the RDS. This will be provided within Revision 1 of this PSR Chapter when the SDDs are developed.

13.5.3 Gaseous Radwaste System Design

13.5.3.1 Functional Requirements

13.5.3.1.1 System Requirements

The system requirements for the GRW will be defined within Revision 1 of this PSR Chapter, once the design documentation for this system is available.

13.5.3.1.2 Safety Functions

The GRW does not perform any safety function, it is not credited for mitigation of design basis accidents and has no active safe shutdown functions.

13.5.3.1.3 Non-Safety Functions

The non-safety related functions of the GRW are [22]:

- Receive and collect radioactive waste gases generated during normal operation.
- Condition waste gases prior to treatment.
- Retain off-gases for radioactive decay.
- Transport processed gases to the monitored release point.

13.5.3.2 Design Codes and Standards

Table 1 of Regulatory Guide 1.143 [56] and Table 1 of ANSI/ANS-55.4 [36] provide the equipment codes and standards for the design of the GRW. Sizing calculations for the GRW use ANSI/ANS-55.4 [36] as the basis. Principal design parameters for the design of the GRW for the SMR-300 will be provided within the next revision of the PSR.

13.5.3.3 Design Methodology

13.5.3.3.1 Materials

The codes and standards for materials, welding procedures and seismic design will be taken from ANSI/ANS-55.4 [36] and NRC Regulatory Guide 1.143 [32].

13.5.3.3.2 Instrumentation and Control

Below can be found the Instrumentation and Control (I&C) requirements for the GRW:

- After manual initiation, the GRW shall be automatically controlled and shut down from the Main Control Room (MCR).
- Positive operator action shall be required to initiate any controlled discharge to the environment.
- I&C) shall provide the automatic termination of releases to the atmosphere when necessary.
- Manual override capabilities shall be provided in the MCR.
- Parallel gas analysers shall be used to detect the formation or buildup of explosive mixtures, and the analysers shall annunciate both locally and in the MCR.
- The automatic valve in the discharge line used for release of gas to the RBV stack shall be designed to fail closed upon loss of power.

The I&C boundary is at the connection of the LRW instruments to the PCS or PSS. These are discussed further in PSR Part B Chapter 4 [8].

13.5.3.4 ALARP Considerations

The GRW is being designed in accordance with Regulatory Guide 1.143 [56] which is considered good practice in the US. Furthermore, the principles applied to the design of the LRW through compliance with US NRC legislation, primarily 10 CFR 20 [58] and 10 CFR 50 [59], are broadly consistent with the relevant ONR SAPs [41] and EA RSR Principles [60] as demonstrated in Table 7. As such, there is confidence that risk will be reduced ALARP through implementation of these principles.

ALARP considerations regarding the GRW will be provided in a future revision of this chapter noting that the design of the GRW is ongoing.

13.5.4 Solid Radioactive Waste System Design

13.5.4.1 Functional Requirements

13.5.4.1.1 System Requirements

The requirements of the SRW include those extracted from Volume III, Chapter 12, Section 4 of the Electric Power Research Institute Utility Requirements Document (EPRI URD) [61], ANSI/ANS-55.1 [35].

13.5.4.1.2 Safety Functions

The SRW is a non-safety system and performs no safety function. Notwithstanding, through processing and treatment of solid radioactive waste, the dose to operator and public as well as overall solid waste volume should be minimised to ALARP.

13.5.4.1.3 Non-Safety Functions

The non-safety functions performed by the SRW are to:

- Collect, hold, process, sample, package, and store wet, dry, and miscellaneous solid radioactive wastes.
- Provide the space and support services required for mobile processing systems.
- Provide sufficient storage space for packaged solid wastes.
- Provide the means to return excess radioactive liquid waste to the LRW.

13.5.4.2 Design Codes and Standards

The SRW is designed in accordance with the guidance provided in Regulatory Guide 1.143 [56], EPRI URD [61], and ANSI/ANS-55.1 [35].

13.5.4.3 Design Methodology

13.5.4.3.1 Mechanical / Structural

Equipment and piping for radioactive service and welding constituting the pressure boundary of pressure-retaining components shall be designed and constructed in accordance with the requirements of the applicable codes and standards given in Table 1 of ANSI/ANS-55.1 [35] and shall comply with the welding and material requirements of ANSI/ANS-55.1.

13.5.4.3.2 Instrumentation and Control

I&C shall be provided to permit operation of the SRW from a central control panel located in a continuously accessible area. The I&C boundary is at the connection of the LRW instruments to the Plant Control System (PCS) discussed further in PSR Part B Chapter 4 [8].

13.5.4.4 ALARP Considerations

The SRW is being designed in accordance with Regulatory Guide 1.143 [56] which is considered good practice in the US. Furthermore, the principles applied to the design of the LRW through compliance with US NRC legislation, primarily 10 CFR 20 [58] and 10 CFR 50 [59], are broadly consistent with the relevant ONR SAPs [41] and EA RSR Principles [60] as demonstrated in Table 7. As such, there is confidence that risk will be reduced ALARP through implementation of these principles.

ALARP considerations regarding the SRW will be provided in PSR noting that the design of the SRW is ongoing.

13.5.5 CAE Summary

Further work and design development is required to demonstrate Claim 2.2.3.5 to the extent required for a PSR. Notwithstanding, the Radioactive Waste Management SSCs will be designed in accordance with good practice within the US using regulatory guides and ANSI/ANS standards. This good practice broadly aligns with UK context RGP. As such, there is confidence that safety functions (where identified) will be met and exposure to radiation and release of radioactivity will be controlled and minimised SFAIRP through application of the design principles stated within this chapter.

13.6 RADIOACTIVE WASTE MANAGEMENT STRATEGY

Claim 2.3.3: The overall Radioactive Waste Management strategy provides an appropriate means of safely managing operational activities throughout the lifecycle of the generic SMR-300.

13.6.1 Integrated Waste Strategy

An Integrated Waste Strategy (IWS) shall be developed at PSR Revision 1 as part of the demonstration that the SMR-300 design allows radioactive waste arising from normal operations and AOOs to be managed safely throughout its lifecycle in a manner that is consistent with UK policy and modern standards and practices. This includes demonstrating the avoidance or minimisation of generation of radioactive waste, consideration of the entire waste lifecycle including waste routes; and the inclusion of suitable and sufficient design features to support Radioactive Waste Management, specifically related to handling, accumulation and storage.

The scope of the IWS shall cover the through-life management of all radioactive material and wastes in normal operating modes and AOOs for the SMR-300 in line with UK Radioactive Waste Management expectations.

The IWS shall support application of the waste management hierarchy and will be consistent with other key radioactive waste management principles outlined in Holtec SMR GDA PER Chapter 1 Radioactive Waste Management Arrangements [2]. The IWS shall identify all waste streams expected to be produced during normal operations and AOOs; and shall develop appropriate strategies for the management of each waste stream, to an extent commensurate with a PSR.

The IWS shall also contribute to the demonstration of BAT. This may be done, for instance, by identifying specific design features which support application of the waste management hierarchy, such as selection of technology to minimise radioactive waste generation.

With specific regards to SSCs that support Radioactive Waste Management operations, the SMR-300 design features and methods for waste prevention, abatement, storage, disposal, and discharge have been specified in accordance with US standard industry practice. These include ANSI nuclear standards, US NRC guidance, and EPRI Utility Requirements for radioactive waste processing systems in light water reactor plants (see Section 13.4.1 for more details). In support of the development of the IWS in PSR Revision 1, these standards shall be evaluated in the context of UK regulatory expectations by comparing and assessing them against RGP and Operating Experience (OPEX). It is a requirement of the joint regulatory guidance on “The Management of Higher Activity Radioactive Waste on Nuclear Licensed Sites” [62] to demonstrate that a strategy can be implemented in line with UK RGP for the management of wastes over the whole lifecycle of the site.

With respect to Claim 2.3.3, an outcome of the development of the IWS shall be to support the demonstration that all wastes generated during normal operations and AOOs of the SMR-300 can be managed using current techniques and are of a type or form compatible with currently available storage or disposal technology – while taking cognisance of the need to avoid foreclosure of other management options. The need to avoid foreclosure is of particular relevance following the recent update to the UK Government’s policy on the management of radioactive substances and nuclear decommissioning, which identifies that some less hazardous ILW may be disposed of in a near surface facility where it is safe to do so; as opposed to the previous policy, which identified that all ILW would need the isolation and containment afforded by a GDF. Finally, the strategies developed for all waste streams identified in the IWS shall take into account safe handling and passively safe storage requirements.

13.6.2 Sources of Radioactive Waste

The following radioactive waste streams are expected to be generated by the SMR-300 in normal operating modes, including expected events such as any fuel failure, and are managed in the scope of the LRW, GRW, SRW and RDS processes. There are other identified wastes and liabilities outside the scope of these systems, such as the management of spent fuel and redundant in-core components which are detailed in PSR Part B Chapter 24 [5] in this PSR.

Table 8: Summary of Sources of Solid Radioactive Waste

Waste Stream	Description	Management Process
Spent resins	Spent ion exchange media from coolant purification in the CVC and SFPC systems, and decontamination of effluents by the LRW system.	Collection in SRW spent resin tanks prior to processing into passively safe state.
Spent filter bed media	Spent deep bed filter media from decontamination of effluents by the LRW system.	Collection in SRW spent resin tanks prior to processing into passively safe state.
Spent filter cartridges	Spent filter cartridges from coolant purification in the CVC and SFPC systems, and decontamination of effluents by the LRW system.	Collected in RWB using a shielded filter transfer cask prior to processing into a passively safe state.
Dry solid wastes	HVAC filters, PPE, paper, cloth, wood, plastic, rubber, glass, and metal components that are potentially contaminated. (Excludes major plant equipment such as redundant in-core components).	Collected in RWB for sorting and segregation. Processing routes are dependent on the contact dose rates, and the waste characteristics (e.g., compactible vs non-compactible) and are subject to design development.
Miscellaneous wastes	Chemical wastes, contaminated oily wastes, and mixed wastes.	Collected in the LRW chemical waste tank and sent to the SRW.
Treated aqueous wastes	Decontaminated liquid effluents and wastes sentenced for discharge (not suitable for reuse in plant).	Collected in LRW monitoring tanks and discharged to the outfall following confirmation of discharge limit compliance.
Treated gaseous wastes	Decontaminated gaseous wastes from the primary circuit.	Discharged to the plant stack via the RBV system.

13.6.3 Disposal of Waste

Categorisation of wastes is not currently available for the waste streams listed in Subchapter 13.6.2 due to the differences in the regulatory contexts between the US and the UK. An estimation of activity concentrations shall be provided as part of the development of a Radioactive Waste Inventory in PSR Revision 1; this will inform the categorisation of waste streams arising from normal operations and AOOs (including stemming from any fuel failures).

To align with the new UK Government policy on the management of radioactive substances and nuclear decommissioning, ILW streams shall in the first instance be processed into a passively safe state for on-site storage, pending the availability of a future Geological Disposal Facility (GDF). However, cognisance shall be taken of the need to avoid foreclosure of other management options, given that the new policy identifies that some less hazardous ILW may be disposed of in a near surface facility where it is safe to do so; as opposed to the previous policy, which identified that all ILW would need the isolation and containment afforded by a GDF. In reality, there is neither a near surface disposal facilities that currently accept ILW for disposal, nor a strict definition of “less hazardous ILW”; and, as such, it is assumed that ILW will be disposed of to a future GDF. Separately, boundary wastes with activity concentrations close to the LLW/ILW threshold may be applicable for disposal at the Low Level Waste Repository (LLWR), e.g. following a period of decay storage.

Regarding ILW management, at PSR Revision 1 it has been identified that there is a design gap, which is a result of the differences in the activity limits for waste categories in the US and the UK. US LLW limits are generally far less restrictive than UK LLW limits (with the exception of alpha-emitters, which are of lower concern generally for power station waste streams, particularly for modern reactors where incidence of failed fuel is extremely low). This has the consequence that the majority of operational light water reactor waste streams that would be considered ILW in the UK can be safely disposed of as LLW in the US to, for instance, an existing surface or near surface disposal facility for radioactive waste. As a consequence of this, the NRC does not require the RP to develop an interim storage strategy; and as a result, the SMR-300 design does not include an ILW store (or any specifications regarding conditioning or packaging). This gap shall be addressed in PSR Revision 1 and options for ILW management (including conditioning, packaging and storage) will be presented in Revision 1 of the PSR, with a view to future option selection at the site-specific stage – with non-foreclosure of management options for, e.g. “less hazardous” ILW, given due consideration in line with the new UK Government policy.

LLW streams shall be processed and dispatched off-site for disposal using all available and applicable waste routes within the UK in line with BAT considerations (including diversion routes such as VLLW landfill, incineration and metal treatment) and in support of the application of the waste management hierarchy. This will ensure minimisation of wastes consigned for direct disposal at the LLWR, preserving the capacity within the Repository for those wastes which actually require the level of containment it provides.

None of the sources of waste outlined above in the scope of LRW, GRW, SRW and RDS systems are expected to be HLW. Any HLW that might be generated by the SMR-300 would take the form of redundant in-core components, which is covered in the scope of PSR Part B Chapter 24 [5].

13.6.4 BAT Considerations

It should be noted that NLR is a specific technical specialism within the ONR with particular focus on the long timescales over which radioactive waste and materials management and decommissioning can take place; with issues such as potential degradation of facilities, legacy wastes and clean-up. As such, NLR PSR chapters within this GDA have claims which address primarily safety design aspects and regulatory requirements as applied by the ONR. However, due to the cross-cutting aspects of NLR, this chapter also supports environment claims as set out within the PER – particularly related to the prevention/minimisation of radioactive wastes and their related impacts.

All environment claims, applicable to both the PER and PSR, reside within the BAT topic area and will be presented in both the Approach and Application to the Demonstration of BAT document [13] and the provisionally named PER ‘Demonstration of BAT’ chapter. This chapter is involved in a continuous collaborative process with the BAT topic area and has already provided relevant technical details and information from which the environment claims were constructed. This collaboration is expected to provide arguments and limited evidence in PSR Revision 1. The collective process is further supported by the Holtec SMR GDA PSR Part B Chapter 11 Environmental Protection [63] which provides a 'golden thread' between the Safety Case and Environment Case and relevant claims, arguments and evidence found in the PER for PSR chapters. More specifically, environmental protection claims made in the PER relevant to this PSR chapter include: Claim 4.1 Generation of Radioactive Waste; Claim 4.2 Volume of Radioactive Waste; Claim 4.3 Activity of Radioactive Waste; Claim 4.4 Impacts of Radioactive Waste; and Claim 4.7 Monitoring and Sampling.

13.6.4.1 Liquid Radwaste System

This section provides some early indicative BAT demonstration of the design of the LRW. This shall be built upon through the development and issue of design documentation for the system, with greater detail on BAT demonstration to be provided in PSR Revision 1.

Using the LRW system, liquid wastes produced by the SMR-300 shall be processed, treated and disposed of using BAT, through segregation at source using the RDS and co-collection of wastes in the LRW system. The use of segregation at source ensures that BAT is applied, with each of liquid waste being characterised before processing and the appropriate treatment route being selected for the processing of each waste stream – dependent on its characteristics. This avoids the mixing of different waste streams (e.g. lightly contaminated liquid, heavily contaminated liquid, chemically contaminated liquid) and avoids undesired or premature blinding of resins and filters. This optimises the waste management operations by minimising solid waste arisings and enabling liquid waste to be recycled and reused, where possible.

Characterisation of liquid waste, through sampling and monitoring, also ensures compliance with acceptance criteria for recycling and reuse within the reactor, and with discharge limits.

This process aligns with Environment Agencies' Radioactive Substances Management Developed Principles (RSMDPs) expectations.

13.6.4.2 Gaseous Radwaste System

This section provides some early indicative BAT demonstration of the design of the GRW. This shall be built upon through the development and issue of design documentation for the system, with greater detail on BAT demonstration to be provided in PSR Revision 1.

Gaseous wates are contained by the GRW system to decay to permitted levels prior to discharge via a monitored release path. The application of BAT within this system can be seen by following the Environment Agencies' RSMDPs, such as RSMDP12 - limits and levels on discharges, where all decayed gas will be monitored before release to ensure compliance with discharge limits.

Further, the HVAC system which forms part of the GRW system utilises exhaust filters, such as HEPA filters, to trap any particulates preventing their release to the environment. This provides further evidence that BAT has been applied by minimising impact to the environment through entrapment of particulate, which can then be routed via the SRW instead of being released to the environment.

13.6.4.3 Solid Radioactive Waste System

This section provides some early indicative contribution towards BAT demonstration of the design of the SRW. This shall be built upon through the development and issue of design documentation for the system, with greater detail on BAT demonstration to be provided in PSR Revision 1.

As there are multiple sources of solid radioactive waste, the following contributions towards demonstration of BAT are listed:

- Spent resin is stored in tanks, which allows for batch testing. This enables individually tested batches to be routed to the most relevant processing/packaging system and storage location, depending on its characteristics. Further, each batch is then dewatered prior to sealing the package(s), thus minimising the number of packages by optimising the use of space in each package.
- Filters are tested and stored in similar manner to above.
- Contaminated solid wastes are segregated based on contact dose rates to facilitate efficient packaging and for storage prior to processing, which aligns with the requirements of waste management hierarchy. The categorisation of this waste type is not clear at this point in the design whilst the waste inventory is being developed.

During the development of the IWS by PSR Revision 1 (see Section 13.6.1), the management strategy for each waste stream shall align with the EA's RSMDP expectations as part of the contribution towards demonstration of BAT for the SRW.

13.6.4.4 Radioactive Drain System

Through design evolution of the SMR-160, the RDS was introduced as a SSC in the SMR-300 design. At an earlier point in design evolution, the RDS effectively formed a sub-system of the LRW. The RDS provides the function of segregation at source for radioactive waste arisings; and allows individual waste streams to be categorised prior to treatment within the LRW. The inclusion of the RDS as a SSC of its own right (as opposed to a sub-system of the LRW) contributes to the demonstration of BAT within the SMR-300 design by clearly highlighting RP's cognisance of the role that upstream sorting and segregation plays in optimising Radioactive Waste Management operations; and it also contributes towards compliance with relevant RSMDPs, including RSMDP8 (segregation of wastes) and RSMDP 9 (characterisation).

13.6.5 CAE Summary

As the IWS for the SMR-300 is still to be developed, this claim cannot be fully demonstrated within this revision of the PSR. Notwithstanding, through development of the IWS, assessment of the packaging options for ILW arisings and engagement with NWS through the Disposability Assessment process, there is confidence that the overall Radioactive Waste Management strategy shall provide an appropriate means of safely managing operational activities across the lifecycle of the SMR-300.

13.7 CHAPTER SUMMARY AND CONTRIBUTION TO ALARP

This sub-chapter provides an overall summary and conclusion of the Radioactive Waste Management Chapter and how this Chapter contributes to the overall demonstration of ALARP for the generic SMR-300. Holtec SMR GDA PSR Part A Chapter 5 Summary of ALARP [64] sets out the overall approach for demonstration of ALARP and how contributions from individual Chapters are consolidated.

This subchapter therefore consists of the following elements:

- Technical Summary.
- ALARP Summary:
  - Review against Relevant RGP;
  - Risk Reduction Options;
  - Evaluation of Risk (where applicable);
  - GDA Commitments and Forward Actions.
- Conclusion.

A review against these elements is presented below under the corresponding headings.

13.7.1 Technical Summary

PSR Chapter B Part 13, Revision 0 demonstrates that the Radioactive Waste Management SSCs within the scope of this report will meet the high-level Claims of the SSEC and that the SSCs can be substantiated at Pre-Construction Safety Report (PCSR) stage. This is demonstrated through the following sub-claims:

Claim 2.2.3.5: SSCs which support the safe management and storage of radioactive waste are designed to ensure safety functions and measures are delivered and radiation exposure and release of radioactivity are minimised SFAIRP.

Claim 2.3.3: The overall Radioactive Waste Management strategy provides an appropriate means of safely managing operational activities throughout the lifecycle of the generic SMR-300.

Radioactive Waste Management SSCs are inherently required to control exposure to radiation of workers and the public and minimise releases of radioactivity to the environment such that risk is reduced SFAIRP. They are also required to support demonstration of environmental claims such that exposure of radioactivity to people and the environment are ALARA, largely through contributing towards the demonstration of BAT. This chapter recognises the cross-cutting nature of NRL and shows, to the extent possible, how the following SSCs will be designed taking cognisance of the ALARP principle and BAT:

- Gaseous Radwaste System (GRW).
- Liquid Radwaste System (LRW).
- Radioactive Drain System (RDS).
- Solid Radwaste System (SRW).

It should be noted that the Radioactive Waste Management SSCs are still being developed as part of the design evolution to the SMR-300. As such, there is limited evidence to support demonstration of the claims at the time of writing.

Currently, there are no safety functions identified for any of the Radioactive Waste Management SSCs; however, fault studies will be undertaken by PSR Revision 1 (see PSR Part B Chapter 14 [14] and Part B Chapter 15 [53], PSA (see PSR Part B Chapter 16 [15]), Internal Hazards (see PSR Part B Chapter 22 [54]) and External Hazards assessments (see PSR Part B Chapter B21 [55]).Should safety functions be identified for the SSCs concerned in this chapter, these will be categorised and classified in accordance with UK regulatory expectations.

ALARP considerations will be identified in PSR Revision 1. Nevertheless, given that the Radioactive Waste Management SSCs will be designed in accordance with 10 CFR 20 [58] and 50 [59], respectively, there is confidence that risk will be reduced SFAIRP noting that this is good practice in the US and the design principles stated within these regulations broadly align with UK RGP.

An IWS is required to demonstrate how radioactive waste will be managed throughout the reactor lifecycle. Similar to consideration of the ALARP principle, BAT considerations are to be developed further in PSR Revision 1. Notwithstanding, high level BAT considerations have been identified in this Chapter with further considerations to be incorporated into the IWS during its development.

PSR Revision 1 will present how the principles identified in this revision have been incorporated into the design such that risk is reduced to ALARP and how radioactive waste will be managed through the entire reactor lifecycle through contribution towards demonstration of BAT.

13.7.2 ALARP Summary

13.7.2.1 Demonstration of RGP

The design of the SMR-300 Radioactive Waste Management SSCs will comply with RGP and US NRC requirements applicable in the US. The design adopts nuclear-specific codes and standards endorsed by the US NRC. The principal codes and standards identified within subchapter 13.4.1 broadly align with RGP by the UK nuclear industry (see 13.4.2). This is based on existing practices adopted on UK nuclear licensed sites, application in earlier and successful GDAs, as well as recognition as RGP by ONR TAGs.

Nevertheless, a gap analysis of UK and US RGP (see Table 7) identified a gap due to the differences in disposal routes. The US do not have a requirement for extended duration on-site storage of ILW in a passively safe manner and instead are able to directly ship this off site; however, there is technological capability within the US to do so, e.g., use of HI-SAFE casks to store resins and filters in HICs. For the SMR-300 to comply with UK regulatory context, it will be subject to a disposability assessment of wastes.

Forward actions will form the basis for setting out the process to justify any gaps from UK RGP. Forward Actions have been collated and are managed via the process described in Holtec SMR GDA PSR Part A Chapter 4 Lifecycle Management of Safety and Quality Assurance [65].

13.7.2.2 Demonstration Against Risk Targets

The numerical targets against which the demonstration of ALARP is considered can be found in PSR Chapter A2 [7]. Whilst no safety functions have currently been identified for the Radioactive Waste Management SSCs, should they be identified through the fault studies undertaken by PSR Revision 1, the SSCs will contribute to the demonstration of ALARP by comparison against the risk targets in two ways:

- By fulfilling safety functions for normal operations (e.g., shielding and containment), and thereby contributing to achieving Targets 1-3;
- By achieving their safety classification as a duty system or a protection system, where claimed, they will contribute to the achievement of accident risk, Targets 4-9.

Risks below the Basic Safety Objectives (BSOs) are considered broadly acceptable and would Satisfy ONR. However, if reasonably practicable to do so the duty holder by law must reduce risks further.

13.7.2.2.1 Evaluation of Risk

Evaluation of risk is not applicable to the Radioactive Waste Management SSCs. The safety classification of the Radioactive Waste Management SSCs will be associated with a probability of failure on demand (PFD), which is then used to calculate the overall comparison against the risk targets as described above.

At this time, the evaluation of the normal operations and accident risks against Targets 1-9 has not been provided. This information will be presented in PSR Chapter B10 [12] for normal operations, and PSR Chapters B14 [14], B15 [53], B16 [15] for accident conditions.

13.7.2.3 Risk Reduction Options

This is a placeholder to identify and review relevant Position Papers and Design Decision Papers with a view to demonstrate which option(s) is/are ALARP.

It will summarise those option evaluations, and it will briefly explore if other risk reduction options have or could be considered and either:

- Present the ALARP argument for why those options have not been implemented.
- Present the ALARP argument for why those options will be implemented in future.
- Create a Forward Action to consider the option(s) at some future point (noting this still must be a point where a meaningful design improvement could be made).

The process for the assessment of risk reduction options is presented in Holtec SMR-300 Generic Design Assessment Reference Design Process and GDA Prospective Design Change Register [66]. Part A Chapter 5 of this PSR [64] considers the holistic risk-reduction process for the generic SMR-300.

13.7.2.4 GDA Commitments and Forward Actions

There are no GDA commitments identified for Chapter B13, Radioactive Waste Management.

Forward Actions have been collated and are managed via the process described in PSR Chapter A4, [65]. PSR Chapter A5 [64] describes the contribution of the forward actions to the ALARP argument.

13.7.3 Conclusion

The conclusion of this Chapter of the PSR is that:

- There is confidence that the Chapter Claims identified will be met to a maturity aligned with a preliminary safety report following close out of Forward Actions.

Further claims, arguments and evidence will be presented in due course as the design develops.

- Functional requirements have been identified for the Radioactive Waste Management SSCs; however, no safety functions are currently identified.
- Should safety functions be identified through the fault studies, a systematic classification system will be applied to the SSCs commensurate with their importance.
- The classification system will allow the appropriate design codes and standards to be identified.
- The Radioactive Waste Management SSCs will be designed to US standards that are considered good practice and broadly align with UK RGP.
- The substantiation against the identified codes and standards is likely to result in a design that contributes to the demonstration that risks to people during normal operations and accident conditions are tolerable and ALARP.
- An IWS will be produced in accordance with UK RGP to demonstrate how Radioactive Waste will be managed throughout the reactor lifecycle, how the operational activities associated with Radioactive Waste Management shall contribute towards the demonstration of BAT and how gaps between US and UK regulation will be addressed.

Part A Chapter 5 of this PSR [64] concludes that it can be demonstrated that the generic SMR-300 reduces risks to ALARP and that the Fundamental Purpose of the SSEC has been fulfilled.

13.8 REFERENCES

[1] “Holtec Britain, "HI-2240332, Holtec SMR GDA PSR Part A Chapter 1 Introduction," Revision 0, August 2024”.

[2] “Holtec Britain, "HI-2240360, Holtec SMR GDA PER Chapter 1 Radioactive Waste Management Arrangements," Revision 0, August 2024”.

[3] “Holtec Britain, "HI-2240334, Holtec SMR GDA PSR Part A Chapter 3 Claims, Arguments and Evidence," Revision 0, August 2024”.

[4] Holtec Britain, “HI-2240121, GDA Scope Report, Revision 0, March 2024”.

[5] “Holtec Britain, "HI-2240353, Holtec SMR GDA PSR Part B Chapter 24 Fuel Transport and Storage," Revision 0, August 2024”.

[6] “Holtec Britain, "HI-2240357, Holtec SMR GDA PSR Part B Chapter 20 Civil Engineering," Revision 0, August 2024”.

[7] “Holtec Britain, "HI-2240333, Holtec SMR GDA PSR Part A Chapter 2 General Design Aspects and Site Characteristics," Revision 0, August 2024”.

[8] “Holtec Britain, "HI-2240338, Holtec SMR GDA PSR Part B Chapter 4 Control and Instrumentation Systems," Revision 0, August 2024”.

[9] “Holtec Britain, "HI-2240339, Holtec SMR GDA PSR Part B Chapter 6 Electrical Engineering," Revision 0, August 2024”.

[10] “Holtec Britain, "HI-2240777, Holtec SMR GDA PSR Part B Chapter 5 Reactor Supporting Facilities," Revision 0, August 2024”.

[11] “Holtec Britain, "HI-2240340, Holtec SMR GDA PSR Part B Chapter 9 Conduct of Operations," Revision 0, August 2024”.

[12] “Holtec Britain, "HI-2240341, Holtec SMR GDA PSR Part B Chapter 10 Radiological Protection," Revision 0, August 2024”.

[13] “Holtec Britain, "HI-2240516, Holtec SMR GDA PER Approach and Application to the Demonstration of BAT," Revision 0, August 2024”.

[14] “Holtec Britain, "HI-2240345, Holtec SMR GDA PSR Part B Chapter 14 Design Basis Accident Analysis," Revision 0, August 2024”.

[15] “Holtec Britain, "HI-2240347, Holtec SMR GDA PSR Part B Chapter 16 Probabilistic Safety Assessment," Revision 0, August 2024”.

[16] “Holtec Britain, "HI-2240348, Holtec SMR GDA PSR Part B Chapter 17 Human Factors," Revision 0, August 2024”.

[17] “Holtec Britain, "HI-2240356, Holtec SMR GDA PSR Part B Chapter 19 Mechanical Engineering," Revision 0, August 2024”.

[18] “Holtec Britain, "HI-2240352, Holtec SMR GDA PSR Part B Chapter 23 Reactor Chemistry," Revision 0, August 2024”.

[19] “Holtec Britain, "HI-2240355, Holtec SMR GDA PSR Part B Chapter 26 Decommissioning Approach," Revision 0, August 2024”.

[20] Holtec International, “HI-2240497-R0 - System Design Description for Liquid Radwaste System,” 2024.

[21] Holtec International, “HI-2240166-R0 System Design Description for Chemical and Volume Control System,” 2024.

[22] Holtec International , “HI-2200451-R1 - System Design Description for Gaseous Radwaste System,” 2020.

[23] Holtec International, HI-2240582, System Design Description for Solid Radwaste System, Revision 0, 2024.

[24] Holtec International, “HI-2200695-R0 - System Design Description for Solid Radwaste System,” 2021.

[25] Radioactive Waste Management Ltd, “Preparation of Expert Views to support Step 2 of the Generic Design Assessment Process. RWPR63-WI11, Revision 0.,” 2023.

[26] Nuclear Waste Services, “Logistics Services Brochure,” 29 February 2024. [Online]. Available: https://assets.publishing.service.gov.uk/media/65e08bfa2f2b3b00117cd788/Logistics_Services_Brochure.pdf. [Accessed 26 April 2024].

[27] Nuclear Waste Services, “WPS/300/05 - Specification for Waste Packages Containing Low Heat Generating Waste Part D - Container Specific Requirements,” 2022.

[28] “Holtec Britain,"SMR-300 Generic Security Report for the Generic Design Assessment," Revision 0, May 2024”.

[29] US Nuclear Regulatory Commission, “Regulatory Guide 1.26 - QUALITY GROUP CLASSIFICATIONS AND STANDARDS FOR WATER-, STEAM-, AND RADIOACTIVE-WASTE-CONTAINING COMPONENTS OF NUCLEAR POWER PLANTS, Revision 6,” 2021.

[30] US Nuclear Regulatory Commission, Regulatory guide 1.21 - MEASURING, EVALUATING, AND REPORTING RADIOACTIVE MATERIAL IN LIQUID AND GASEOUS EFFLUENTS AND SOLID WASTE, 2021.

[31] US Nuclear Regulatory Commision, Regulatory Guide 1.110 - COST-BENEFIT ANALYSIS FOR RADWASTE SYSTEMS FOR LIGHT-WATER-COOLED NUCLEAR POWER REACTORS, 2013.

[32] US Nuclear Regulatory Commission, “Regulatory Guide 1.143 - Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants, Revision 2,” 2001.

[33] US Nuclear Regulatory Commission, Regulatory Guide 4.21 - MINIMIZATION OF CONTAMINATION AND RADIOACTIVE WASTE GENERATION: LIFE-CYCLE PLANNING, 2008.

[34] American Nuclear Society, ANSI/ANS-40.37-1993 Mobile Radioactive Waste Processing Systems, American Nuclear Standards Intitute, 1993.

[35] American Nuclear Society, “ANSI/ANS-55.1 Solid Radioactive Waste Processing for Light-Water-Cooled Reactor Plants,” American National Standards Institute, 2021.

[36] American Nuclear Society , “ANSI/ANS-55.4 Gaseous Radioactive Waste Processing Systems for LIght Water Reactor Plants,” American National Standards Institute, 1993.

[37] American Nuclear Society, ANSI/ANS-55.6-1993 Liquid Radioactive Waste Processing System for Light Water Reactor Plants (R2007), 2007.

[38] Electric Power Research Institute, Utility Requirments Document,Volume III, Chapter 12.

[39] “100110593-ENG1-0039 | C | HI-2240126. Codes and Standards Report.,” 2024.

[40] ONR, Licence Condition Handbook, 2017.

[41] Office for Nuclear Regulation, “Safety Assessment Principles for Nuclear Facilities,” 2020.

[42] Office for Nuclear Regulation, “Technical Assessment Guides (TAGs) - Nuclear Safety (full list),” 2024.

[43] IAEA, “IAEA Fundamental Safety Principles: Safety Fundamentals SF-1, IAEA, Vienna,” 2006.

[44] IAEA, “General Safety Requirements Part 5: Predisposal Management of Radioactive Waste, No. GSR Part 5, IAEA, Vienna.,” 2009.

[45] IAEA, “Specific Safety Guide No. SSG-40 - Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors,” 2016.

[46] WENRA, “Safety Reference Levels for Existing Reactors,” 2021.

[47] WENRA, “Reactor Harmonisation Working Group Report on Safety of New NPP Designs,,” 2013.

[48] WENRA, “Report on Treatment and Conditioning Safety Reference Levels,” 2018.

[49] WENRA, “Decommissioning Safety Reference Levels, version 2.3,” 2024.

[50] WENRA, “Waste and Spent Fuel Storage Safety Reference Levels, version 2.3,” 2024.

[51] Department of Energy and Climate Change, "UK Strategy for the Management of Solid Low Level Waste from the Nuclear Industry," 2016.

[52] Department for Energy Security & Net Zero et al, "UK Policy Framework for Managing Radioactive Substance and Nuclear Decommissioning," 2024.

[53] "Holtec Britain, "HI-2240346, Holtec SMR GDA PSR Part B Chapter 15 BDBA, Severe Accidents Analysis and Emergency Preparedness," Revision 0, August 2024".

[54] "Holtec Britain, "HI-2240351, Holtec SMR GDA PSR Part B Chapter 22 Internal Hazards," Revision 0, August 2024".

[55] "Holtec Britain, "HI-2240350, Holtec SMR GDA PSR Part B Chapter 21 External Hazards," Revision 0, August 2024".

[56] U. NRC, *Regulatory Guide 1.143, Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants, U.S. Nuclear Regulatory Commission (USNRC), Revision 2, November 2001.*

[57] Holtec International, "HI-2200450-R0 - Liquid Radwaste System Tank Sizing Calculation," 2020.

[58] US NRC, "Code of Federal Regulations, Title 10 CFR Part 20 - Standards for Protection Against Radiation".

[59] US NRC, "Code of Federal Regulations, Title 10 CFR Part 50, Domestic Licensing of Production and Utilization Facilities".

[60] Environment Agency, "Radioactive substances regulation (RSR): objective and principles," 2021. [Online]. Available: https://www.gov.uk/government/publications/radioactive-substances-regulation-rsr-objective-and-principles/radioactive-substances-regulation-rsr-objective-and-principles. [Accessed 22 July 2024].

[61] EPRI, "Advanced Nuclear Technology: Advanced Light Water Reactor Utility Requirements Document, Revision 13," 2014.

[62] ONR, NRW, SEPA, EA, "The management of higher activity radioactive waste on nuclear licensed sites, Revision 2.1," 2021.

[63] "Holtec Britain, "HI-2240342, Holtec SMR GDA PSR Part B Chapter 11 Environmental Protection," Revision 0, August 2024".

[64] "Holtec Britain, "HI-2240336, Holtec SMR GDA PSR Part A Chapter 5 Summary of ALARP," Revision 0, August 2024".

[65] "Holtec Britain, "HI-2240335, Holtec SMR GDA PSR Part A Chapter 4 Lifecycle Management of Safety and Quality Assurance," Revision 0, August 2024".

[66] Holtec Britain, "HPP-3295-0017-R0, Holtec SMR-300 Generic Design Assessment Reference Design Process and GDA Prospective Design Change Register".

13.9 LIST OF APPENDICES

Appendix A CAE Route Map

A summary of the SSEC claims for the Radioactive Waste Management area is presented in Table 9.

Table 9: Chapter B13 CAE Route Map

Overarching SSEC Claim	Chapter Claim/s	Chapter Sub-Claim/s	Chapter Section
Claim 2.2 The design of the systems and associated processes have been developed taking cognisance of relevant good practice and substantiated to achieve their safety and non-safety functional requirements.	**Claim 2.2.3** Adequate provision for the control of radiation exposure and control of release of radioactive material is incorporated into the design.	**Claim 2.2.3.5** SSCs which support the safe management and storage of radioactive waste are designed to ensure safety functions and measures are delivered and radiation exposure and release of radioactive material are minimised SFAIRP.	13.5 Design of Radioactive Waste Management SSCs
Claim 2.3 The design and safety assessment of the generic Holtec SMR-300 considers the entire reactor lifecycle.	**Claim 2.3.3** The overall Radioactive Waste Management strategy provides an appropriate means of safely managing operational activities throughout the lifecycle of the generic SMR-300.		13.6 Radioactive Waste Management Strategy