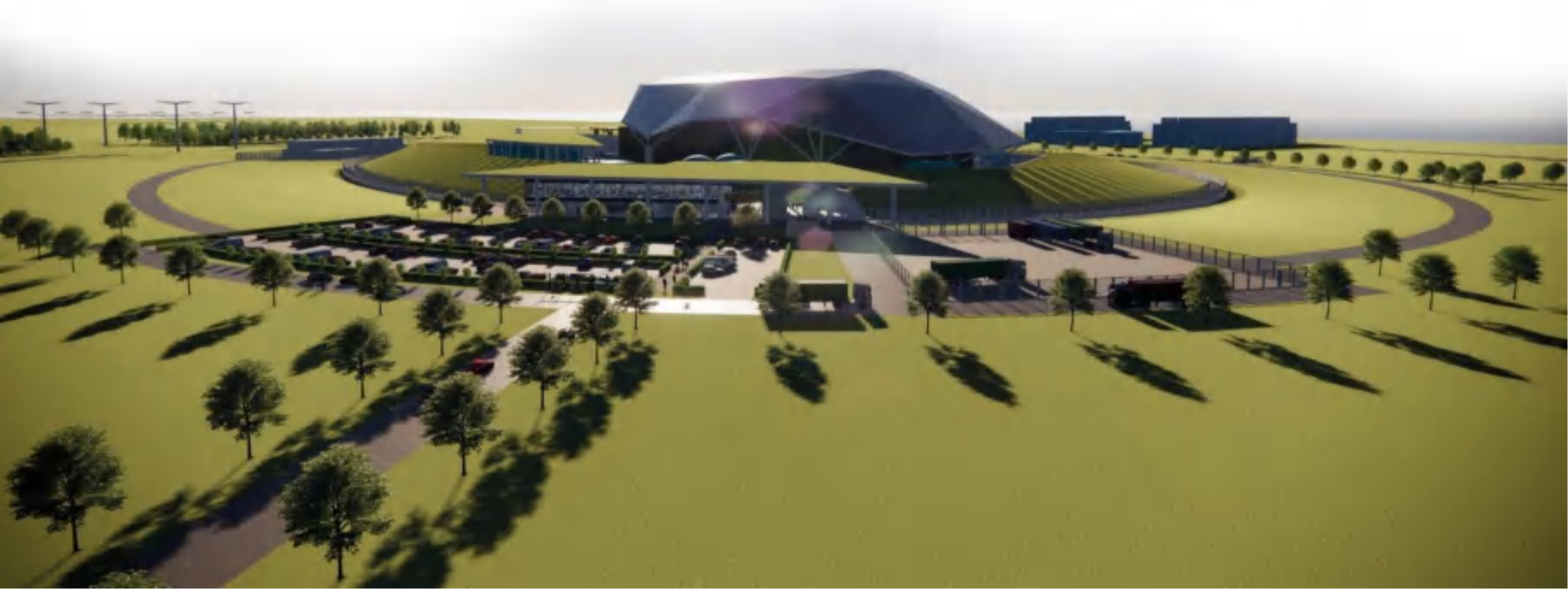
Environment, Safety, Security and Safeguards Case Version 3, Tier 1, Chapter 1: Introduction



Record of Change

Date	Revision Number	Status	Reason for Change
March 2023	1	Issue	First issue of E3S Case.
January 2024	2	Issue	Incorporates revisions of site, plant, and environmental information at Reference Design 7, aligned to Design Reference Point 1. Also reflects updated content from the E3S Case Development and Management Arrangements (SMR0000627) and E3S Requirements and Analysis Arrangements (SMR0009132).
May 2024	3	Issue	Updated to correct revision history status at Issue 2. Chapter changes include: • Additional detail for how the E3S design principles are embedded into processes (Section 1.1.2) • Clarifications on gate review processes for controlling maturing design (Section 1.3.5) • Alignment of radioactive effluent discharge point description to E3S Case Version 2, Tier 1, Chapter 28 (Section 1.7.5) • Alignment of liquid waste discharges description to E3S Case Tier 1, Version 2 Chapter 29 (Section 1.7.6) Minor template/editorial updates for overall E3S Case consistency.
August 2025	4	Issue	Updated for Version 3 of the E3S Case. Supports and incorporates revisions of site, plant and environmental information at Design Reference Point 4. Chapter changes include: • Increased clarity on golden thread and use of CAE and E3S requirements (Section 1.1.4) • Established V3 objective and consolidation with maturity discussion (Section 1.1.5). • Split vendor information (new Section 1.3) from project implementation (Section 1.2), replacing previous section on engineering framework. • Updated information on site and plant layout and footprint values at DRP4 (Sections 1.4 & 1.5). • Added plant overview description (Section 1.5) and moved more detailed breakdown (to Section 1.7). • Moved modes of operation into its own new section (Section 1.8). Minor editorial updates for overall consistency.

Executive Summary

This chapter presents the introduction to the Rolls-Royce Small Modular Reactor (RR SMR) generic Environment, Safety, Security, and Safeguards (E3S) Case. The generic E3S Case provides the overall justification that the fundamental objective 'to protect people and the environment from harm' can be achieved at all lifecycle stages of the power station, with risks reduced to As Low As Reasonably Practicable (ALARP), demonstration of Best Available Techniques (BAT), and ensuring security and safeguards by design, as well as sustainability in the design.

The generic E3S Case is being progressively developed alongside the maturing design and analysis programme. Therefore, the information presented in this Version 3 of the Case aims to provide confidence that the RR SMR design will be capable of delivering the E3S fundamental objective as the Case is developed through detailed design.

A holistic E3S approach is adopted through integrated E3S and engineering processes, the application of which results in an optimised design with respect to E3S. Benefits also include reduced repetition of information presented across the Case, and more holistic assessment of design developments and changes across the E3S disciplines.

The generic E3S Case is structured in a hierarchical manner with three tiers of information. Tier 1 provides an overarching summary and entry point to the E3S Case and is comprised of 33 chapters. Tier 2 presents the first level of underpinning arguments and evidence, signposting out to the detailed evidence in Tier 3. Traceability through the E3S Case documentation is demonstrated through both a high-level Claims, Arguments, Evidence (CAE) framework and the derivation, allocation, and verification of E3S requirements.

An introduction to the overall plant and layout description, novel aspects of the design, environmental aspects, and modes of operation are presented within this chapter, with reference out to relevant chapters of the E3S Case for further detail.

Version 3 of the generic E3S Case supports and incorporates Design Reference Point 4 (DRP4) and provides the basis for the detailed regulatory assessment during Step 3 of the Generic Design Assessment (GDA). It also provides the basis for the Environment Agency (EA) public consultation. Two further submissions of the generic E3S Case are planned during GDA Step 3. Version 4 will incorporate further underpinning evidence to support the arguments and evidence provided in Version 3, and will be the last substantial revision of the Case for GDA. Version 5 (if required) will be a minor update to close-out any outstanding regulatory queries, observations and issues.

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1.1 Introduction

1.1.1 Objective of E3S Case

Rolls-Royce SMR Limited are progressing the design and development of the Rolls-Royce Small Modular Reactor (RR SMR) power station, using Pressurised Water Reactor (PWR) technology. The design programme of the RR SMR is a phased design cycle, which commenced with the first reference design in 2015 and aims to deploy the First of a Fleet (FOAF) RR SMR in the early 2030s.

The RR SMR has a fundamental objective 'to protect people and the environment from harm'. The Environment, Safety, Security and Safeguards (E3S) Case provides the overall justification that the E3S fundamental objective can be achieved at all lifecycle stages of the power station.

The generic E3S Case provides the justification for deployment at a range of sites in Great Britain (GB), such that it facilitates a transition to a FOAF site-specific case that minimises the requirement for significant additional E3S justification.

1.1.2 Holistic E3S Approach

To protect people and the environment from harm and achieve the E3S fundamental objective, the Rolls-Royce SMR power station, layout and Structures, Systems and Components (SSCs) are designed and evaluated in accordance with the E3S design principles [1]. The sources of harm protected for E3S include both nuclear and conventional sources.

The E3S design principles are established based on United Kingdom (UK) and international Relevant Good Practice (RGP). This includes the Office for Nuclear Regulation (ONR) Safety Assessment Principles (SAPs), Security Assessment Principles (SyAPs) and Technical Assessment Guides (TAGs), Environmental Agency (EA) Radioactive Substances Regulation (RSR) objectives and principles, International Atomic Energy Agency (IAEA) safety guides, European Utility Requirements (EURs) and Western European Nuclear Regulators' Association (WENRA) Safety Reference Levels.

The E3S design principles are implemented to inform the design through the integration of E3S and engineering processes, including:

- Optioneering and the design decision-making process [2], which evaluates design options against E3S criteria to establish a design solution that supports demonstration of ALARP, BAT, secure by design, and safeguards by design, as well as sustainability in the design files.

- Iterative E3S analysis, which provides progressive insights for ongoing design development and improvements with respect to ALARP, BAT, secure by design and safeguards by design. The E3S Requirements and Analysis Arrangements [3] provide the detailed methods for how each analysis discipline informs the design through requirements and analysis, covering:

    - Fault Studies: hazard identification, Fault Schedule development, and categorisation and classification.

    - Deterministic Safety Assessment (DSA) through performance analysis.

    - Internal Hazards identification and analysis.

    - External Hazards identification and analysis.

  - Probabilistic Safety Assessment (PSA).
  - Severe Accident Analysis (SAA).
  - Radiation Protection.
  - Environmental Protection and demonstration of BAT.
  - Conventional Safety and Fire Safety.
  - Security analyses.
  - Safeguards analyses.
  - Human Factors Integration.
- Allocation of E3S requirements to SSCs derived directly from the E3S design principles and the E3S analysis, including both nuclear and conventional safety requirements.

This enables a holistic approach to embedding E3S into the design, whereby the benefits and disadvantages with respect to ALARP, BAT, secure by design and safeguards by design, as well as sustainability in the design, are considered as part of the design definition. This supports the optimisation of design outputs from early in the design process, rather than 'backfitting' later in the design programme. The design outputs document these considerations that can provide the same underpinning information for different E3S disciplines, reducing the need for repetition of information across the Case. It also enables the impact of design developments and changes to the E3S Case to be reviewed and assessed more holistically across the E3S disciplines.

The analysis and design approaches for E3S are described in E3S Case Tier 1, Chapter 3: E3S Objectives and Design Rules for SSCs [4]. The outputs of the approaches comprise the arguments and evidence, which when completed, will underpin claims across the E3S Case.

The term As Low As Reasonably Achievable (ALARA) is also a widely recognised acronym by worldwide organisations such as IAEA, the United States Nuclear Regulatory Commission (U.S. NRC), World Nuclear Association (WNA) etc, used to define the principle of minimising radiation exposure. In GB, the terminology is broadly synonymous, with both ALARA and ALARP incorporating considerations on economic, environmental, and societal factors. Within the RR SMR E3S Case, the terminology ALARP is used when relating to minimisation of risk, noting ALARA is used within environment focused chapters of the E3S Case when relating to impacts of waste and discharges.

So Far As Is Reasonably Practicable (SFAIRP) is interpreted as leading to a legal requirement that risks must be reduced to a level that is ALARP; these principles apply to the demonstration of the application of BAT, as part of compliance with Environmental Law. The terms SFAIRP and ALARP mean essentially the same thing and at their core is the concept of 'reasonably practicable'.

1.1.3 E3S Case Structure and Content

1.1.3.1 Overall Structure

The E3S Case comprises many documents, therefore, to ensure its usability and accessibility for the different users and stakeholders, it is being developed in a hierarchical manner, comprising the following 'tiers' of information:

- Tier 1: an entry point to the E3S Case that presents the decomposition of high-level claims with a proportionate, overarching summary of the arguments and evidence from lower tiers of the E3S Case.

- Tier 2: the first level of underpinning information, comprising the documents that present the arguments and/or evidence to underpin claims in the Tier 1 chapter, and also signpost out to the detailed evidence on Tier 3.

- Tier 3: the detailed evidence for different aspects of the E3S Case to underpin claims, supporting the arguments or evidence contained within Tier 2 documents.

The hierarchy is illustrated in Figure 1.1-1. Further information on the use of Claims, Arguments and Evidence (CAE) in the case is described in Section 1.1.4.

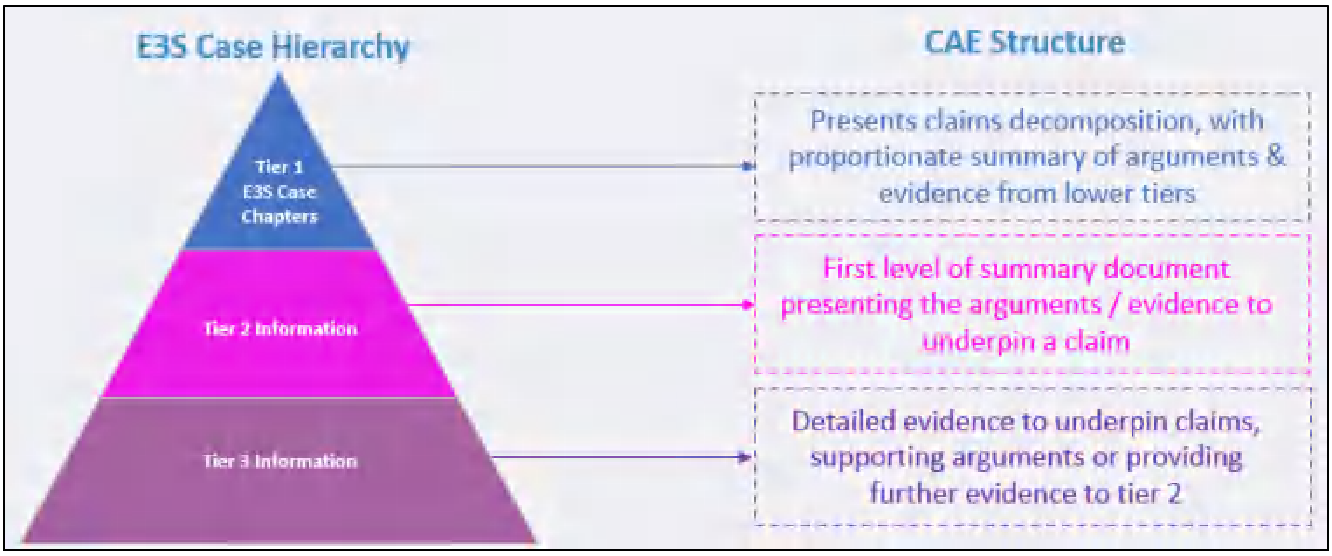


Figure 1.1-1: E3S Case Hierarchy

1.1.3.2 Tier 1

Tier 1 of the E3S Case is split into 'chapters' covering different topic areas within each of the E3S disciplines.

The content of the 'safety' focused chapters is broadly aligned to the IAEA Safety Standard Guide (SSG)-61 [5] and taking cognisance of the structure set out in the U.S. NRC Regulatory Guides 1.70 [6] and 1.206 [7], providing a standardised format that is acknowledged as good practice by the UK regulators and is used by international nuclear power station operators, thus supporting achievement of the Rolls-Royce SMR key design objectives to be both 'licensable in the UK' and 'capable of global expansion'.

For the generic E3S Case, the format and contents described in IAEA SSG-61 are adapted to ensure alignment with the UK context, including additional chapters to facilitate presentation of topic-specific information, including Chemistry, Conventional and Fire Safety, Structural Integrity, ALARP, Minimisation of Radioactivity, and Sustainability.

The content of the 'environment' focused chapters is aligned to EA guidance [8], covering the stipulated information requirements with some adaptations to ensure an integrated Case. The content of the 'security' focused chapter is informed by the ONR SyAPs [9] and international good practice set out in IAEA recommendations and guidance. The content of the 'safeguards' focused chapter is informed by the ONR Fundamental Safeguards Expectations (FSEs) [10] and IAEA guidance for safeguards by design [11].

Development of Tier 1 of the E3S Case as a series of integrated E3S chapters facilitates the holistic E3S approach described in Section 1.1.2, drawing upon a common base of information in the lower tiers, whilst minimising repetition of information across the chapters. The chapters provide an entry point to relevant stakeholders for different aspects of the overall case to provide confidence that the E3S fundamental objective can be met, whilst giving coherence to the overall suite of documentation.

The E3S Case chapters and the primary E3S disciplines contributing to development of that chapter is presented in Table 1.1-1. The maturity of each chapter at Version 3 of the E3S Case is described in Section 1.1.5.

Table 1.1-1: E3S Case Chapters

No.	Title	Safety	Environment	Security	Safeguards
1	Introduction	✓	✓	✓	✓
2	Generic Site Characteristics	✓	✓	✓	✓
3	E3S Objectives and Design Rules for Structures, Systems and Components	✓	✓	✓	✓
4	Reactor (Fuel & Core)	✓	✓	✓	✓
5	Reactor Coolant System and Associated Systems	✓	✓	✓	✓
6	Engineered Safety Features	✓	✓	✓	✓
7	Instrumentation and Control[1]	✓	✓	✓	✓
8	Electrical Power	✓	✓	✓	✓
9A	Auxiliary Systems	✓	✓	✓	✓
9B	Civil Engineering Works and Structures	✓	✓	✓	✓
10	Steam and Power Conversion Systems	✓	✓	✓	x
11	Management of Radioactive Waste	✓	✓	✓	✓
12	Radiation Protection	✓	✓	✓	✓
13	Conduct of Operations	✓	✓	✓	✓
14	Plant Construction and Commissioning	✓	✓	✓	✓
15	Safety Analysis	✓	✓	x	x
16	Operational Limits and Conditions	✓	✓	✓	✓
17	Management for E3S and Quality Assurance	✓	✓	✓	✓

No.	Title	Safety	Environment	Security	Safeguards
18	Human Factors Engineering	✓	✓	✓	✓
19	Emergency Preparedness and Response	✓	x	✓	x
20	Chemistry	✓	✓	x	x
21	Decommissioning and End of Life Aspects	✓	✓	✓	✓
22	Conventional and Fire Safety	✓	✓	✓	x
23	Structural Integrity	✓	x	x	x
24	ALARP Summary	✓	✓	x	x
25	Minimising Generation of Radioactivity	✓	✓	✓	x
26	Sustainability	x	✓	x	x
27	Demonstration of BAT	✓	✓	x	x
28	Sampling and Monitoring Arrangements	x	✓	x	x
29	Quantification of Radioactive Effluent Discharges and Proposed Limits	x	✓	x	x
30	Prospective Radiological Assessment	x	✓	x	x
31	Conventional Environmental Impact and Other Environmental Regulations	x	✓	x	x
32	Generic Security Report	x	x	✓	✓
33	Safeguards	x	x	✓	✓

[1] Instrumentation & Control (I&C) is used interchangeably with the UK term Control & Instrumentation (C&I)

Whilst the individual Tier 1 chapter's present information related to a specific discipline, there are naturally many interfaces and dependencies between them, and the totality of information presented across all 33 chapters (and lower tier information) form the overall Case. A simplified illustration of the contents and how information flows between chapters is presented in Figure 1.1-2; full details of chapter interfaces are described in the introduction section of each chapter.

It is noted the term 'systems engineering chapters' is used within the E3S Case to describe the engineering focused chapters 4 to 11.

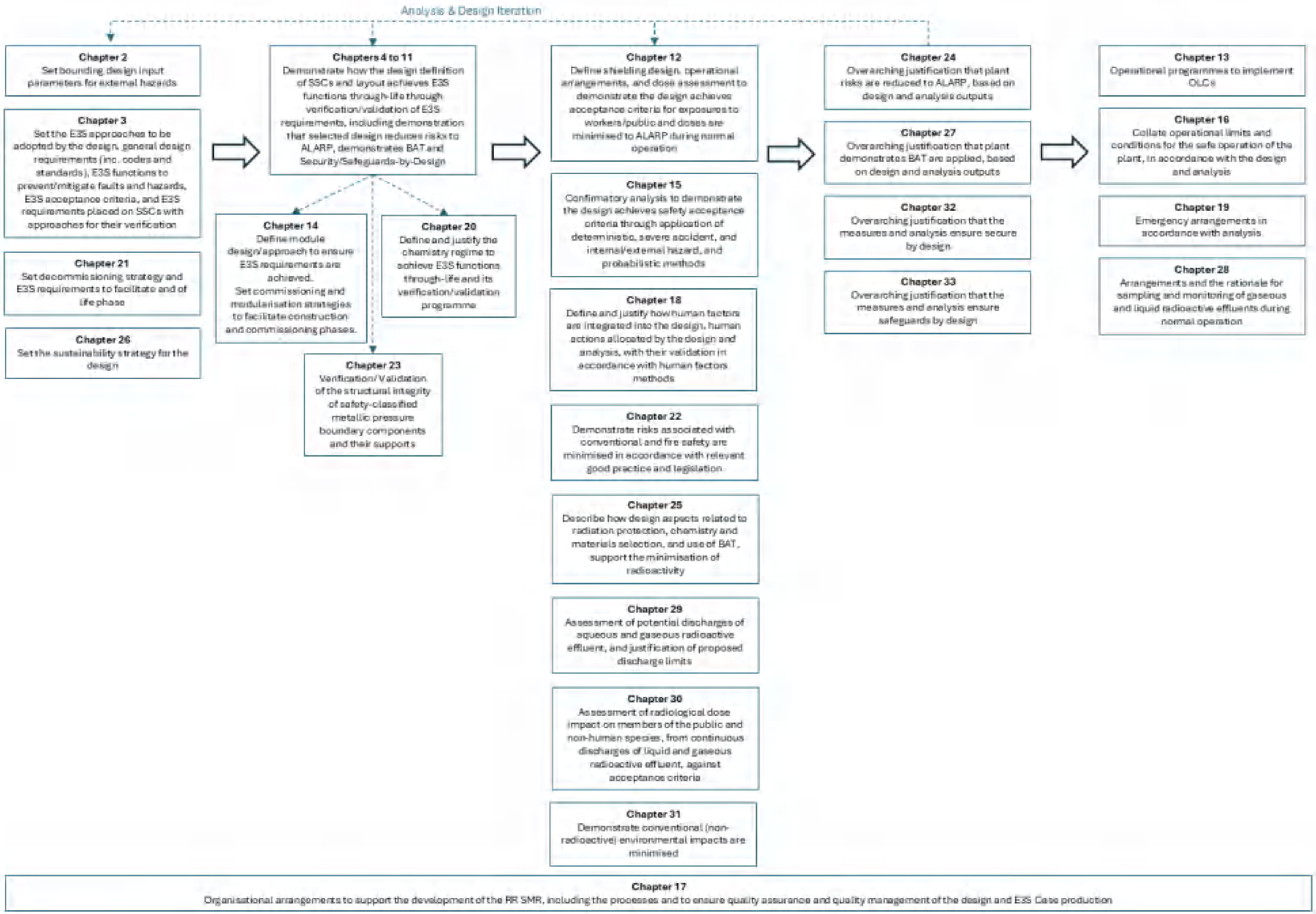


Figure 1.1-2: Simplified Flow of Information between E3S Case Chapters

1.1.3.3 Tier 2 and Tier 3

Much of the Tier 2 and Tier 3 information is developed through the application of the integrated E3S and engineering processes, described in Section 1.1.2 and the E3S Requirements and Analysis Arrangements [3].

In general, Tier 2 documents are summaries that provide the first level of information to underpin a claim (or multiple claims) in the Tier 1 chapters. This could be arguments that provide the link to detailed evidence on Tier 3, or a summary of detailed evidence. An example of a Tier 2 document could include a PSA summary report that documents the outputs of detailed PSA modelling, which underpins claims that the design achieves its numerical safety objectives and corroborates that overall plant architecture reduces risks to ALARP. Alternatively, it could be a System Design Description (SDD) that documents the design of a SSC, which provide the arguments that underpin claims that the SSC is designed to achieve its E3S functions.

Tier 3 provides the detailed evidence to underpin a claim (or multiple claims) in the Tier 1 chapters. It may provide the evidence to support arguments that are presented in Tier 2 documents, or it may provide detailed underpinning evidence summarised in a Tier 2 document. Examples of Tier 3 documents could include a design decision record for an SSC, which provides underpinning evidence to support the arguments presented in the Tier 2 SDDs that the SSC is designed to achieve its E3S functions through a solution that reduces risks to ALARP and demonstrates BAT. Alternatively, it could include the individual hazard identification studies to support the consolidated evidence summarised in a Tier 2 hazard log, or it could be a verification report to substantiate an SSC meets its E3S requirements.

The content and format for Tier 2 and Tier 3 documents are presented according to the defined scope and information the document is intending to present. Given the broad range of information in these tiers, it is presented in a combination of many formats, such as reports of prose text (such as topic reports), data spreadsheets (such as hazard identification outputs), and bespoke software outputs (such as PSA modelling outputs).

There is no expectation to use a defined ‘CAE’ structure to present Tier 2 or Tier 3 information, and often a simple narrative to present an argument or evidence to underpin a higher-level claim is sufficient. However, it may be used if deemed beneficial for the purposes of presenting content in a clear and logical manner.

Security documents at Tier 2 and Tier 3 may contain sensitive nuclear information, these documents are classified and restricted accordingly on a need-to-know basis.

1.1.3.4 Reference Designation System

Reference designation for SSCs within the RR SMR power station scope is implemented in accordance with the Standard Reference Designation System for Power Plants (RDS-PP®). RDS-PP® is internationally recognised and is referenced within the International Electrotechnical Commission (IEC)/International Organization for Standardization (ISO) 81346 series of standards. RDS-PP® provides a unique designation for each plant object throughout planning, licensing, construction, operation, maintenance, and decommissioning. Within the E3S Case, SSCs are referred to by their RDS-PP® code using one or more capital letters enclosed within a square bracket ‘[XX]’.

1.1.4 Golden Thread

1.1.4.1 Definition

The ‘golden thread’ in the E3S Case is the demonstration of traceability from the overall E3S objective ‘to protect people and the environment from harm’ through to the detailed underpinning evidence, in a structured manner through tiered documentation. This is demonstrated and managed within the E3S Case through both a high-level CAE framework and the derivation, allocation, and verification of E3S requirements.

1.1.4.2 CAE Framework

The CAE framework is a hierarchical structure within which the E3S Case documentation sit. Claims are high-level objectives for the Tier 1 chapters of the E3S Case, which are derived from the E3S design principles. The claims are decomposed logically into more granular sub-claims, to a level where they point to Tier 2 documents containing underpinning arguments and evidence. Ultimately, the complete set of claims, arguments and evidence demonstrates compliance with the E3S design principles.

From a top-down perspective, the claims set the expectation or purpose of the arguments and evidence required in the lower tier E3S Case documentation. This also enables bottom-up traceability, where any piece of detailed information can be linked back to the high-level claim it underpins.

The CAE framework spans the entire Case with CAE structures developed for each chapter. The CAE structure for Chapter 3 provides the starting point for the decomposition of all claims from the E3S design principles. Recognising that much of the arguments and evidence to underpin claims are presented across chapters of the E3S Case, Chapter 3 provides the necessary links out to CAE structures for other chapters, where a claim may be decomposed further.

The CAE framework is presented in the E3S Case Route Map [12], which is maintained and updated as the underpinning documentation is developed [13]. Whilst full details of the CAE structures are not repeated within each chapter, each introduction section provides a narrative of the key claims pertinent to that chapter, with reference to the relevant sections that pull together and summarise the arguments and evidence from underpinning documentation. It also lists the interfacing chapters where relevant claims are addressed.

1.1.4.3 E3S Requirements

E3S requirements are specific assertions that an SSC (or human) will achieve an E3S function or exhibit a property to meet an E3S design principle. E3S requirements are a sub-set of the wider requirements set generated through the integrated E3S and engineering processes [3]. E3S requirements include:

- E3S categorised functional requirements, which are requirements derived through analysis and allocated to an SSC to deliver an E3S function, e.g. ‘SSC X shall safely remove decay heat for relevant faults and shall be operable following relevant hazards’.
    - Non-functional performance requirements are linked to E3S categorised functional requirements, e.g. availability and response times.
- Non-functional system requirements, which are derived directly from the E3S design principles and specify the architecture or property of an SSC according to its E3S classification, e.g. redundancy levels, functional independence, or autonomy duration.

E3S requirements are derived, allocated to SSC and verified in a manner that is analogous to a CAE chain of reasoning as follows:

- An **E3S requirement** allocated to an SSC (analogous to a **claim**) that performs a function or constrains a system or function. This includes 'validation' to demonstrate it is correctly allocated from its source, for example, the Fault Schedule or the E3S design principles.
- The design definition describes the **compliance rationale** for how the SSC achieves the set of E3S requirements placed upon it (analogous to an **argument**), in addition to why the selected design definition reduces risks to ALARP, demonstrates BAT, and is secure/safeguards by design.
- **Verification** of the design definition to provide the substantiation (analogous to **evidence**) that the design can achieve its E3S requirements. Verification activities will vary depending on the E3S requirement or group of E3S requirements it aims to verify, for example, safety analysis undertaken using RELAP5-3D and GOTHIC codes, or physical test rigs, or simulations.

The role of the key engineering documentation within the E3S Case is summarised in Figure 1.1-3.

Figure 1.1-3: Engineering Documentation Role within the E3S Case

At Version 3 of the generic E3S Case, verification activities are specified and documented within a Tier 2 'Design Verification Strategy', with evidence of outputs where available. As the detailed design progresses and verification strategies continue to be implemented, the 'Design Verification Strategy' will ultimately develop into a 'Design Verification Compliance Report', to compile and reference the full suite of Tier 3 verification evidence reports.

Within the Tier 1 chapters, the E3S requirements are described within E3S Case Version 3 Tier 1, Chapter 3: E3S Objectives and Design Rules for SSCs [4]. Evidence of their allocation and verification is summarised for SSC within the systems engineering chapters, with reference to any relevant analysis chapters where further details of verification evidence is provided.

Importantly, the CAE framework and E3S requirements are complementary approaches to demonstrate the golden thread. The CAE structure does not repeat the E3S requirements, it links to their derivation and verification as evidence to underpin higher level claims that E3S functions can be achieved by the design.

Further details of how the golden thread is managed in the E3S Case are described in the E3S Case Development and Management Arrangements [14].

1.1.5 Maturity and Objective of Version 3

Rolls-Royce SMR is not based on an existing reference plant and is maturing through detailed design. The E3S Case is also being progressively matured alongside the design with increasing levels of justification. The generic E3S Case is being progressed prior to development of site-specific Cases. Version 3 of the E3S Case (this version) provides a snapshot of the engineering programme following the Reference Design 9 (RD9) internal baseline, supporting and incorporating Design Reference Point 4 (DRP4) described in Section 1.2.2.

The scope of the generic E3S Case covers all SSCs that have a potential impact on E3S across the full breadth of the power station [15], i.e. those SSCs that attract an E3S classification. The generic E3S Case provides more focus to those SSCs with higher safety classifications, and SSCs that deliver an environment protection function (e.g. safety class 3 waste systems important to environment). The SSCs within scope of the generic E3S Case and their associated chapter are listed in Appendix A (Section 1.11).

Given the maturing design programme, the depth of design, analysis and verification information that provides arguments and evidence to underpin claims in the E3S Case naturally varies across the plant. The introduction section of each chapter describes the scope and maturity in relation to the generic E3S Case and site-specific Case.

Whilst the arguments and evidence presented in the generic E3S Case will continue to be enhanced, the information presented in Version of the Case aims to achieve the following objective:

To provide confidence that the RR SMR design will be capable of delivering the E3S fundamental objective as it is developed through detailed design. The Case shall demonstrate that risks are capable of being reduced to As Low As Reasonably Practicable, using Best Available Techniques, will be secure/safeguarded by design, and demonstrate sustainability for current and future generations.

The conclusions of each chapter provide an evaluation of the arguments and evidence presented against this objective, with a forward look to further underpinning evidence.

Further versions of the generic E3S Case are planned during GDA, described in Section 1.2.1.

1.2 Project Implementation

1.2.1 GDA Background

The GDA is a voluntary process whereby requesting parties (RPs) submit their designs for a new nuclear power station design to the regulators: the ONR, EA, and Natural Resources Wales (NRW)/Cyfoeth Naturiol Cymru. The regulators jointly review the designs to assess its acceptability for use in GB for safety, security, safeguards, environmental protection and waste management.

The objective of the process is to provide confidence that a design is capable of being constructed, operated, and decommissioned in GB in accordance with the required standards for safety, security, and environmental protection. Further details of the GDA process are provided in [16].

Rolls-Royce SMR Limited entered the three-step GDA process in April 2022. Familiarisation and detailed planning during GDA Step 1 were completed in March 2023, and fundamental assessment of the design during GDA Step 2 was completed in July 2024 based on Version 2 of the E3S Case. GDA Step 3 commenced immediately following Step 2.

Three further submissions of the generic E3S Case are planned during GDA. Version 3 (this version) reflects outcomes of assessment in GDA Step 2 and forms the basis for the detailed regulatory assessment during GDA Step 3. It is also the basis for the EA public consultation. Version 4 will incorporate further underpinning evidence to support the Case for GDA, and Version 5 will be a minor update to close-out any outstanding regulatory queries, observations and issues.

1.2.2 Design Reference Point

Rolls-Royce SMR Limited is required to define a Design Reference (DR) for GDA to define the baseline design reference configuration that the GDA submissions refer to at a point in time, known as a Design Reference Point (DRP). Multiple DRPs can be declared at defined intervals throughout GDA in agreement with the regulators.

The first DRP was established during GDA Step 2 and comprised Tier 2 and 3 design documentation used to develop Version 2 of the generic E3S Case. Two subsequent DRPs have been declared to align with internal baselines of the design and to capture design changes. The latest DRP, DRP4 [17], has been declared to align with Version 3 of the E3S Case.

1.2.3 Change Control

SSCs are subject to a change control process [18] for design changes that are outside progressive design development, which assesses the E3S impact of the change and documents impact on the generic E3S Case documentation. This process is described further in E3S Case Version 3, Tier 1 Chapter 17: Management of E3S and Quality Assurance [19].

1.2.4 Management Arrangements

The Rolls-Royce SMR Limited management and organisational arrangements for production of the E3S Case are summarised in E3S Case Tier 1 Chapter 17: Management for E3S and Quality Assurance [19], including details of the governance and assurance arrangements for the generic E3S Case. This includes GDA-specific arrangements and project operating instructions for response to Regulatory Queries (RQs), Regulatory Observations (ROs), and Regulatory Issues (RIs).

1.2.5 Assumptions and Commitments for the Future Dutyholder / Licensee / Permit Holder

An essential element of the generic E3S Case development process is the capture and tracking of assumptions and commitments that need to be passed on to a future Dutyholder / Licensee / Permit Holder at site-specific stage. These include matters such as transfer of operating rules, maintenance requirements, training programmes, or emergency preparedness. They are defined as:

- Assumption: statements that enable work to continue but need validation before they can be confirmed as true.
- Commitment: an assumed obligation on a future Dutyholder / Licensee / Permit Holder to conduct a specified activity.

The assumptions and commitments are captured within each chapter of the E3S Case and summarised in the conclusion sections. They are also logged in an ‘Assumptions and Commitments for future Dutyholder / Licensee / Permit Holder Register’ [20] in accordance with the relevant Integrated Management System (IMS) Standard [21].

1.3 Identification of Interested Parties regarding Design, Construction and Operation

Rolls-Royce SMR Limited is the vendor of the integrated nuclear power station. Rolls-Royce SMR Limited is also the RP for the technology that is submitted into the GDA process. The company comprises shareholders who have significant experience and pedigree in design, manufacture, and operation of nuclear reactors. Collectively, this includes design, manufacture, and delivery of over one hundred reactor cores across six different plant generations for use in the UK's Royal Navy Submarine programme, design and manufacture of safety critical control and instrumentation systems and emergency diesel generators for civil nuclear plants globally, and the operator for the United States' (US) largest fleet of nuclear plants.

Within the Rolls-Royce SMR organisation, the Safety & Regulatory Affairs Directorate is responsible for the provision of all safety, security, safeguards, and environmental input into the design development undertaken by the Engineering Directorate in an integrated manner. With respect to GDA, the Safety & Regulatory Affairs Directorate is also responsible for the delivery of the GDA programme.

The Engineering Directorate is responsible for the design and integration of the power station solution, configuration control of the design, the design analysis and engineering justification. Furthermore, the Engineering Directorate is responsible for ensuring product safety.

The Safety & Regulatory Affairs and Engineering Directorates are supported in the execution of their programmes by enabling functions within the organisation, including the Talent and Human Resources Directorate that is responsible for setting up frameworks to demonstrate Rolls-Royce SMR have Suitably Qualified and Experienced Personnel (SQEP) appropriately deployed in roles that have key responsibilities in delivering nuclear safety, conventional health and safety, security, safeguards, and environmental protection in the design.

The structure of the Regulatory Affairs organisation and the associated interfaces are outlined in the Regulatory Affairs Group Functional Manual [22].

The future Dutyholder / Licensee / Permit Holder will be responsible for the construction, operation, and decommissioning of the plant in accordance with the site-specific E3S Case. As part of the site license and permit application process, the future Dutyholder / Licensee / Permit Holder is required to implement suitable management and governance arrangements to develop its core organisational capabilities, prior to being awarded the necessary licenses, permits, and planning permissions from regulatory bodies to begin nuclear construction activities. Control and oversight of all nuclear and radiological safety, environmental, and security activities must be demonstrated, including 'intelligent customer' capability to oversee and accept products and services from contractors in the supply chain.

Further information on the future Dutyholder / Licensee / Permit Holder and primary contractors will be provided in this section of the site-specific E3S Case.

1.4 Information on the Plant Layout and Other Aspects

The general layout of the RR SMR site is designed to maintain a compact site footprint (Table 1.5-2). The overall site layout for the RR SMR is presented in Figure 1.4-1 [23]. General arrangement drawings for the site are presented in [24] and [25].

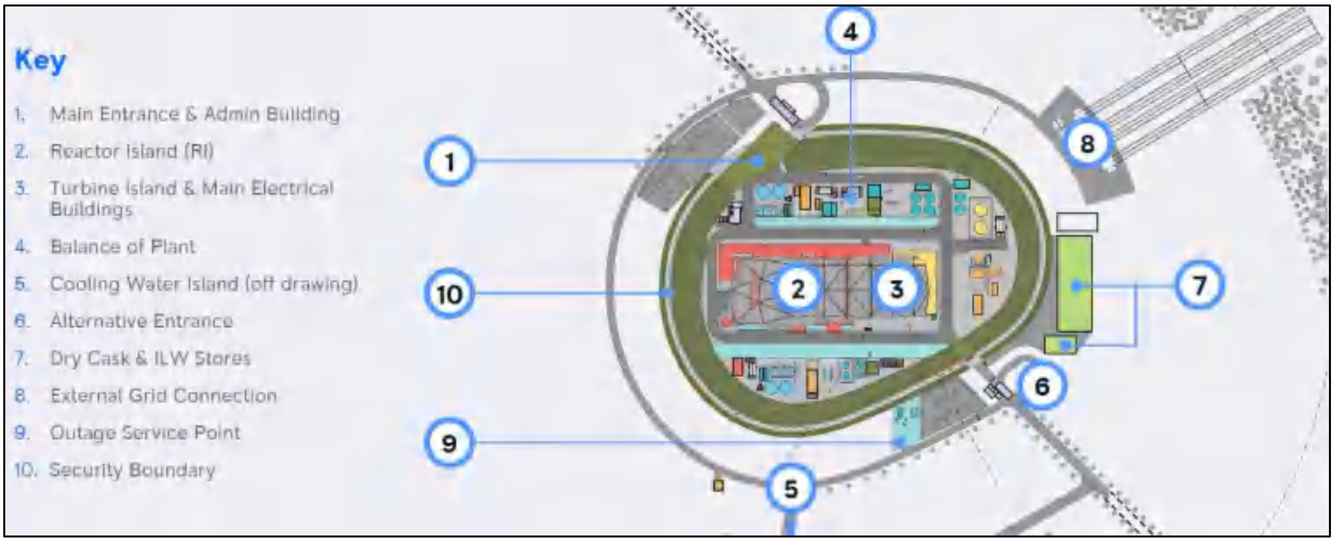


Figure 1.4-1: RR SMR Site Layout

The nuclear reactor is located in the Reactor Island, which is located centrally and adjacent to the Turbine Island to enable ease of connection and routing to maximise electrical output. An architectural shell roof covers, and is wholly supported by, the Reactor Island and Turbine Island structures.

The layout of Balance of Plant to the north of the Reactor Island is informed by operational needs for auxiliary services. Support buildings are situated around the Reactor and Turbine Islands, all within a protective raised groundworks berm.

The Cooling Water Island for the generic design consists of indirect cooling using cooling towers, located to the south[1] of the site and outside the berm, providing flexibility of installation of the RR SMR on an extensive range of inland and coastal sites. A clear zone is maintained within the layout to allow for cooling water pipe routings into and out of the Turbine Island.

The transmission area containing the external grid connection is positioned directly adjacent to the Turbine Island to minimise power losses.

The primary pedestrian and vehicular access point to the site is to the north-west of the Reactor Island, nestled within the berm, with an alternative access point to the south-east. These security-controlled entrances provide access for service vehicles linking to circulation routes around the site. The access points are separated from the cooling water island and associated connections to the south and external grid connections to the east.

The main security risks are associated with the presence of nuclear fuel and other radioactive materials. These materials are located primarily within the Reactor Island, which is located centrally to aid in a layered Defence-in-Depth approach to nuclear security, comprising both physical and cyber security measures as components of an Integrated Security System (ISS). Distances to nuclear

[1] Directions are relative to the site orientation

material storage areas from the Reactor Island are minimised where practicable to minimise movements, noting the dry cask waste stores present a high radiation source and are located external to the protective berm, providing segregation from the main occupation of the site.

Sufficient spacing is allocated between buildings to enable emergency response actions, with provision of an emergency response zone to allow emergency services to gather and respond efficiently and effectively.

A Turbine Disintegration Zone (TDZ) is established, illustrated in red and labelled ‘2’ in Figure 1.4-2. The site layout strategically locates key equipment outside the TDZ, including the safety classified SSCs within the Reactor Island, the Essential Service Water System (ESWS) [PB] and backup diesel generators (labelled ‘1’ in Figure 1.4-2), the fire protection building and water tanks (labelled ‘3’ in Figure 1.4-2), and the external grid connection. This reduces the risk of turbine disintegration and any resulting missiles causing damage that may challenge delivery of E3S functions.

The two redundant trains of both the ESWS [PB] and backup diesel generators are located to the north and south of the site, also illustrated in Figure 1.4-2, providing maximum separation between trains whilst being as close to the Reactor Island as possible.

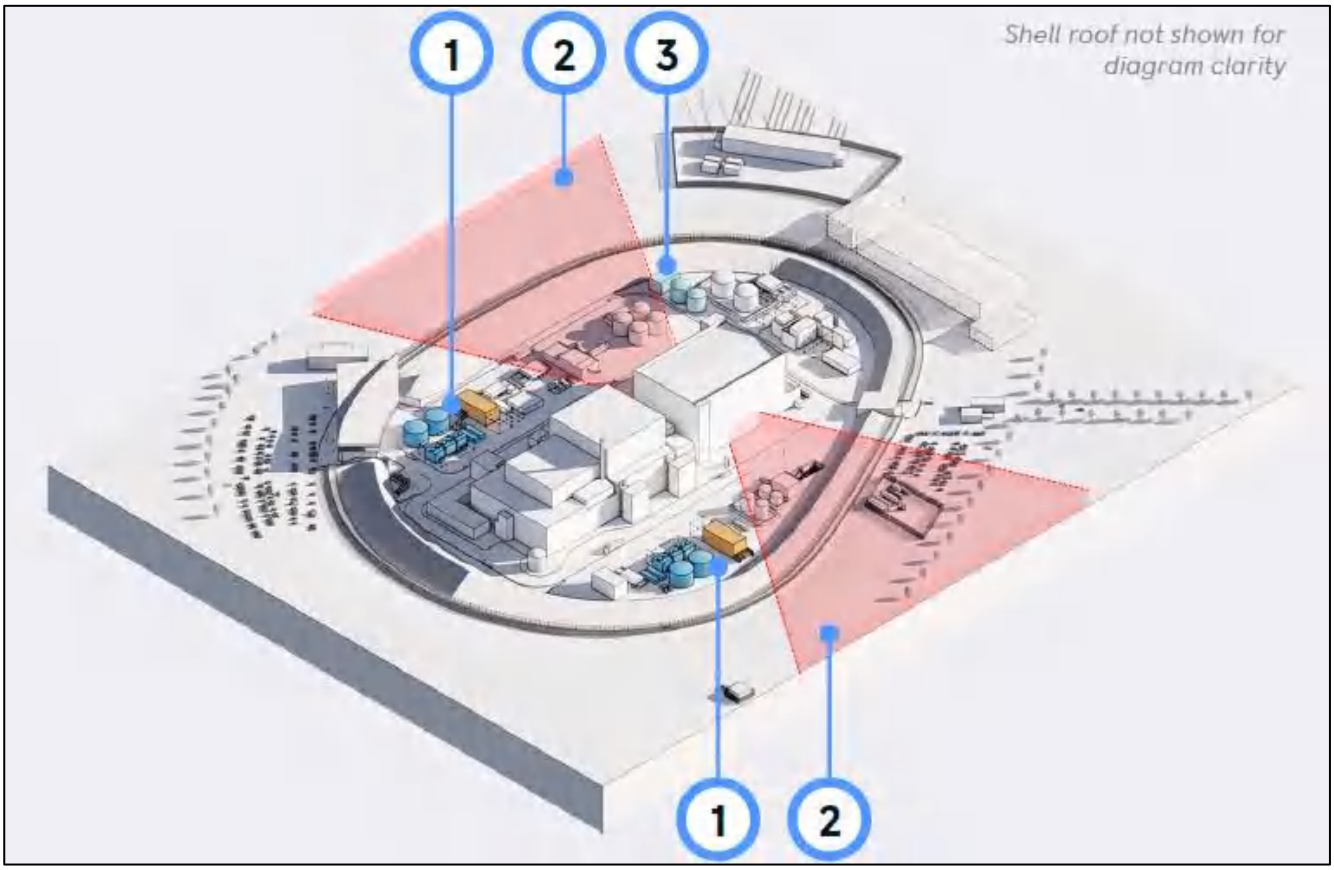


Figure 1.4-2: Site Layout & Turbine Disintegration Zone

The site layout is developed alongside a site construction logistics plan to ensure adequate space for Site Factory™ and construction activities. Roads and laydown areas are positioned strategically across the site to allow for crane access. Areas are also allocated for decommissioning stores.

The layout of the Reactor Island is illustrated in Figure 1.4-3 [26]. More detail on the layout of SSCs within the Reactor Island to achieve claims made in the E3S Case, including internal and external hazards, radiation protection, Examination, Maintenance, Inspection & Testing (EMIT), and conventional safety, is summarised within the Tier 1 systems engineering chapters.

Figure 1.4-3: Reactor Island Layout

1.5 General Plant Description

1.5.1 Plant Overview

The RR SMR is a single unit, three-loop PWR providing a target power output of 470 MW_e, using industry standard Uranium Dioxide (UO_2) fuel enriched up to 4.95 % U-235.

Duty reactivity control is provided solely by control rods and the use of the negative moderator temperature coefficient inherent to PWRs. No concentration of soluble boron is maintained in the primary coolant for duty reactivity control. The chemistry regime uses Potassium Hydroxide (KOH) as a pH raiser in conjunction with boron-free reactivity control, instead of Lithium Hydroxide (LiOH) that is commonly used in PWRs.

The fuel assemblies are held in the core barrel within the Reactor Pressure Vessel (RPV) [JE]. There is an upper core plate connected to an upper plenum bulkhead by support columns. The Control Rod Housing Columns (CRHC) supports the control rods and control rod drive shafts, consisting of a lower column between the upper core plate and upper plenum bulkhead with an upper column above the bulkhead.

The Reactor Coolant System (RCS) [JE] contains three-loops, each with a vertical u-tube Steam Generator (SG) located around the circumference of the RPV. The single pressuriser is connected to the pipework hot leg. A centrifugal Reactor Coolant Pump (RCP) [JEB] is mounted directly to the outlet nozzle of each SG. Each SG is elevated above the RPV [JE] to ensure that a sufficient thermal driving head is available for natural circulation flow, for situations where pumped flow from the RCPs [JEB] is unavailable. The three RCPs [JEB] providing forced RCS [JE] flow utilise a seal-less design.

The primary circuit pressure is controlled by electrical heaters located at the base of the pressuriser and spray from a nozzle located at the top. Steam and water are maintained in equilibrium to provide the necessary overpressure. The pressuriser is a vertical, cylindrical vessel constructed from low alloy steel, sized to provide passive fault response for bounding faults, with rapid and significant cooldown or heat-up accommodated.

The E3S philosophy for the RR SMR is to optimise and enhance the use of proven PWR technology to minimise risks. Plant simplicity is prioritised with inherent safety, security, safeguards, and environmental protection adopted where reasonably practicable. Significant layers of DiD are integral to the design through independent and diverse safety systems, with multiple redundant trains per system. This includes at least two independent and diverse safety measures for frequent initiating events (>1E-03 per year) that cause fault conditions within the design basis. The hierarchy of controls is applied to the design of safety measures with an emphasis on the design of passive safety measures, supported by active safety measures for diverse defence in depth. Passive safety measures are designed to deliver their functions autonomously without reliance on the operator for at least 72 hours.

For decay heat removal during fault conditions, both passive and active systems can be employed to cool the primary plant. The High Temperature Heat Removal (HTHR) [JN03] safety measure utilises much of the same equipment used for steam condensing during normal power operation where available following a fault, including the SGs and either the normal duty steam condenser or atmospheric steam dumping to remove heat. Passive Decay Heat Removal (PDHR) {JN02} is a dedicated safety measure that utilises the SGs and a Local Ultimate Heatsink System (LUHS) [JNK] elevated water store to cool the reactor: heat rejection is closed loop between the RPV and the SGs, and decay heat is passed from the core through either pumped reactor circuit flow or natural circulation flow. A further diverse Emergency Core Cooling (ECC) [JN01] safety measure for decay heat removal can be demanded, which depressurises the RCS [JE] and supplies a sustained injection of coolant by gravity feed. The ECC [JN01] function includes three accumulators connected directly to the RPV [JE], with emergency blowdown provided by the Automatic Depressurisation System (ADS) [JNF], and heat transfer from containment to the environment via the Passive Containment Cooling System (PCCS) heat exchangers connected to the LUHS [JNK].

For reactivity control during fault conditions, both active and passive safety measures with automatic initiation can be demanded. The primary safety measure, Scram [JD01], inserts control rods comprising solid neutron absorbers into the core, and the diverse emergency boron injection system, the Alternative Shutdown Function (ASF) [JD02], uses a pumped configuration to rapidly inject soluble potassium tetraborate into the reactor. Both systems are capable of independently providing full shutdown and hold down margin to cold zero power for applicable fault and accident conditions.

For Confinement of Radioactive Material (CoRM) during fault and accident conditions, the reactor circuit and other key systems are located within a steel containment vessel. Containment isolation valves prevent the release of radioactive material through fluid system containment penetrations during fault and accident conditions.

Design extension conditions without significant fuel degradation, arising from very low frequency events or complex conditions, are protected through diversification of equipment in the mechanical, electrical and C&I systems. These deliver safety functions using fundamentally different principles and phenomena. Design extension conditions with core melt are addressed through an in-vessel retention approach, which is supported by active and passive independent heatsinks to remove heat from containment.

Reactivity control for new and spent fuel is provided in a soluble boron-free environment using geometric spacing and solid neutron poison racks. Passive boil-off of the spent fuel pool inventory provides at least 72-hour decay heat removal for loss of fuel pool cooling faults. The demand on this safety measure is reduced by an active fuel pool cooling system, comprising two independent trains each sized to deliver the fuel pool cooling function. Mechanical handling equipment is used for refuelling activities, including a fuel handling machine inside containment (and another outside containment) and a polar crane, which are designed with trips and interlock features to prevent and protect against dropped loads.

The waste treatment systems are based on the use of proven technologies and BAT to minimise active and non-active wastes and discharges. Standardised waste treatment system components and modules are used to achieve the flexibility required for the waste informed design. Operation without soluble boron in the primary coolant allows significant reduction in environmental discharges and simplification of the waste treatment systems.

Independent and diverse C&I systems can provide shutdown, decay heat removal and containment functions in response to fault conditions. The Diverse Protection System (DPS) [JQA] is a hardwired, non-programmable electronics system that provides the primary means of reactor protection. The Reactor Protection System (RPS) [JRA] is nuclear qualified programmable electronics system that enables complex functions to be used in the calculation of protection trip functions, providing a secondary means of reactor protection. Post accident and severe accident management systems within the nuclear C&I System provide clear plant status displays, over the days and months following a postulated accident.

A standby Alternating Current (AC) power supply [BD_] comprising two diesel generators can provide 168 hours of continuous power to supply safety systems such as the PDHR following a Loss of Offsite Power (LOOP). Low voltage Uninterruptable Power Supplies (UPS) from batteries can provide 24 hours of power to deliver C&I functions and actuation of safety systems such as the ECC [JN01] and containment isolation valves, and those required during startup of the standby AC generators. Low voltage UPS from batteries can provide 72 hours of power to deliver post-accident monitoring functions. During a Station Blackout (SBO) and failure of the standby AC supply, an alternate AC system can supply required loads such as the water tank makeup pumps and can supply AC power to recharge the UPS batteries.

The civils design incorporates protection measures for external hazards, including an aseismic bearing that provides base isolation to attenuate the horizontal seismic ground motion and limit the peak acceleration transmitted to the structures located above it. A reinforced concrete hazard shield is located around safety classified equipment on Reactor Island to provide protection against design basis aircraft impacts and other external hazards.

The layout of the plant provides protection against internal hazards through segregation of redundant trains of SSCs. It also supports minimisation of normal operational doses through distance between radiation sources and operational areas, with further dose minimisation through the design of an optimised water chemistry, materials selection and suitable levels of shielding to attenuate doses.

Within the Reactor Island, the Main Control Room (MCR) is the primary location for all monitoring and control activities for the reactor. A Supplementary Control Room (SCR) provides a secondary location with the capability to shut down the reactor to maintain a safe shutdown state.

1.5.2 Fundamental Characteristics

The major technical parameters of the RR SMR [27] are summarised in Table 1.5-1, with site footprint parameters are listed in Table 1.5-2.

Table 1.5-1: RR SMR Major Technical Parameters

Parameter	**Value**
Thermal Capacity	1358 MW_{th}
Net Electrical Power (dependent on configuration and site)	450 – 470 MW_e
Design Life	60 years
Expected Capacity Factor	>90 %
Coolant / Moderator	Light Water
Primary Circulation	Pumped at power Natural Circulation for backup decay heat removal
Primary System Operating Pressure	15.5 MPa
Primary System Design Pressure	17.6 MPa
Fuel Cycle	18 months
Fuel Type / Assembly Array	Industry standard Uranium Dioxide fuel in 17x17 array
Fuel Active Length	2.8 m
Number of Fuel Assemblies	121
Fuel Enrichment (Maximum)	< 4.95 %

Parameter	Value
Reactivity Control Mechanism	89 Control rods for primary control and alternative boron shutdown system as backup
Outage Duration	18 days (target)
Containment Type	Steel Containment
RPV Height	7.82 m
RPV Diameter	Overall Diameter (outer flange): 4.20 m Maximum Diameter (safe end nozzles): 4.62 m
Number of Steam Generators	3

Table 1.5-2: RR SMR Site Footprint Parameters

Parameter	Value
Site footprint area – under the shell	15,300 m^2
Site footprint area – inside berm	77,145 m^2
Site footprint area – inclusive of berm	100,000 m^2

1.5.3 Construction & Build Certainty

The RR SMR is designed as a modular and standardised power station product to facilitate a rapid and cost-effective build programme. The generic design ensures each RR SMR is substantively the same, so far as is possible within the constraints of site-specific geography. To achieve this design outcome, the RR SMR civil design is split into two: groundworks/foundations, and power station modules and buildings.

The groundworks and foundations supporting the RR SMR are necessarily bespoke and matched to local site conditions. They support an aseismic bearing, upon which the critical modules and buildings reside.

The modules and buildings are identical from site to site and consist of factory produced modules and components that are assembled into a functioning RR SMR on-site. The modular approach implements the E3S-informed layout, with modules designed to bounding E3S requirements where applicable to ensure E3S functions can be achieved.

During construction, most RR SMR structures and equipment will be enclosed within a ‘site factory’, which minimises the impact of factors such as adverse weather conditions on programme schedules, whilst enabling 24/7 working. The site factory provides both isolation of the site from the environment, and isolation of the environment from the site.

1.6 Comparison with other Plant Designs

The RR SMR programme commenced in 2015, with key design principles established early that were driven by market requirements and lessons learnt from previous nuclear power plant programmes. This led to the 20 key design objectives being established for RR SMR, which have been consistently applied as the basis for design optioneering [28].

The RR SMR is a FOAF design and not based on a currently operating reference plant. The design is, however, fundamentally based on proven PWR technology, using industry standard uranium dioxide fuel. The initial reference design baseline, RD1, was established in 2015, reflecting fundamental decisions such as the selection of PWR technology. The design definition for the RR SMR has since significantly increased in maturity through extensive optioneering and design decisions, considering RGP, Operating Experience (OPEX), and E3S analysis to reduce risks to ALARP, demonstrate BAT, and ensure secure by design and safeguards by design.

The main innovations for RR SMR are in the fabrication and construction of the modular nuclear power station, incorporating use of proven techniques and RGP from other industries. In comparison to existing PWR power stations, the RR SMR incorporates notable innovations, including:

- Passive and diverse heat removal systems (the ECC [JN01] and PDHR [JN02]) to provide decay heat removal in response to fault conditions, each with significant internal redundancy (with no reliance on essential services supplied from on-site mobile equipment) for 72 hours or from off-site equipment for 168 hours.

- Boron-free chemistry, with full shutdown margin provided by the control rods alone, which allows for a simplified design with a reduction in human error induced faults, and eliminates risks associated with boric acid, boron dilution faults, and the environmental impact of boron discharge. The use of KOH to provide an alkaline pH raiser rather than LiOH that is used in conjunction with boric acid in traditional PWRs, also offers benefits such as a reduction in the tritium source term and minimisation of fuel cladding corrosion.

- The majority of the Reactor Island is supported by a basemat which sits on aseismic bearings, which form the Seismic Isolation System (SIS). The SIS reduces the seismic hazard for the safety significant SSCs in the Reactor Island through attenuation of the horizontal seismic ground motion, to limit the peak acceleration transmitted to the SSCs located above it.

- A forced draught cooling system, which is adaptable to different cooling water constraints such that the RR SMR is deployable across a wide range of sites.

- Emergency blowdown relies on a mechanical valve design that provides reactor coolant relief in conditions where ECC [JN01] is demanded. The design of this valve practically eliminates a spurious opening of the blowdown line fault and minimises the safety requirements placed onto the C&I systems.

The innovations for the RR SMR with respect to the benefits and disadvantages of reducing risks to ALARP and demonstration of BAT are described further in E3S Case Tier 1, Chapter 24: ALARP Summary [29] and Chapter 27: Demonstration of BAT [30].

1.7 Drawings and Other More Detailed Information

1.7.1 Introduction

A brief description of the main power station systems and equipment and their purpose is presented below, with reference to relevant chapters of the E3S Case for more detailed descriptions and basic technical and schematic drawings.

1.7.2 Reactor Island [R01]

The Reactor Island [R01] includes the systems that form the reactor, transfer and storage of new and used fuel, and any associated nuclear auxiliary systems. The purpose of the Reactor Island [R01] is to use the heat from a controlled nuclear fission reaction to generate steam, which is then passed to the Turbine Island [T01]. Reactor Island [R01] includes the Reactor Plant [J], Handling of Nuclear Equipment [F] and Nuclear Auxiliary Systems [K].

The Reactor Plant [J] comprises:

- Reactor System [JA], containing the systems and components that generate and transfer nuclear heat in a safe, controlled manner. It comprises a RPV [JAA] of very high reliability, an Integrated Head Package (IHP) to facilitate core loading and core unloading, and RPV Internals [JAC10] to hold the fuel assemblies in place. Descriptions of the associated systems and core components are summarised in E3S Case Tier 1, Chapter 4: Reactor (Fuel & Core) [31].

- RCS [JE], comprising a three-loop system each with a SG, associated pipework and a single pump. The configuration of the SG pipework and pump layout in each loop ensures a robust thermal driving head for natural circulation flow in fault conditions. The system also contains a pressurising system with a heater and pump induced spray configuration and associated pressure relief system. Descriptions of the associated systems and components are summarised in E3S Case Tier 1, Chapter 5: Reactor Coolant System & Associated Systems [32].

- Reactor Reactivity Control Systems [JD], which provide the Control of Reactivity (CoR) Fundamental Safety Function (FSF). This includes the Scram Function [JD01], which uses control rods to provide neutron absorption during normal operating modes and rapid shutdown in the event of a fault, and the independent and diverse ASF [JD02], which injects potassium tetraborate into the Reactor System [JA] at high pressure during relevant fault conditions. Descriptions of the associated systems are summarised in E3S Case Tier 1, Chapter 6: Engineered Safety Features [33].

- Reactor Plant Containment Systems [JM], comprising the systems that ensure the CoRM FSF in normal and fault conditions, including the containment vessel, isolation valves, and in-vessel retention. Descriptions of the associated systems are summarised in E3S Case Tier 1, Chapter 6: Engineered Safety Features [33].

- Reactor Heat Removal Systems [JN], containing the systems that provide decay heat removal to provide the Control of Fuel Temperature (CoFT) FSF in response to fault conditions. This includes the ECC [JN01], which is the principal means of providing passive decay heat removal in the event of an intermediate or large Loss of Coolant Accident

(LOCA), and the PDHR [JN02], which provides decay heat removal in the event of an intact circuit fault. Descriptions of the associated systems are summarised in E3S Case Tier 1, Chapter 6: Engineered Safety Features [33].

- Reactor Island C&I [JQ][JR][JS][JT][JY], containing the nuclear C&I systems for control, monitoring and protection of SSCs delivering a nuclear safety function. Descriptions of the C&I systems are summarised in E3S Case Tier 1, Chapter 7: Instrumentation & Control [34].

The Handling of Nuclear Equipment [F] includes those systems that cover the fuel route from initial receipt of new fuel to final disposal, summarised in E3S Case Tier 1, Chapter 9A: Auxiliary Systems [35].

The Nuclear Auxiliary Systems [K] comprises of auxiliary systems supporting Reactor Plant [J] operations, including:

- Component Cooling Systems [KA] and associated coolant treatment and sampling, to transfer heat from reactor components to the ultimate heat sink in a safe manner. Descriptions of the associated systems are summarised in E3S Case Tier 1, Chapter 9A: Auxiliary Systems [35].

- Heating, Ventilation and Air Conditioning (HVAC) systems [KL] summarised in E3S Case Tier 1, Chapter 9A: Auxiliary Systems [35].

- Reactor Coolant Sampling System [KU] summarised in summarised in E3S Case Tier 1, Chapter 9A: Auxiliary Systems [35].

- Solid Waste Treatment [KM], Liquid Waste Treatment [KN], Gaseous Waste Treatment [KP] and Collection & Drainage Systems [KT] summarised in E3S Case Tier 1, Chapter 11: Management of Radioactive Waste [36].

A detailed composite Piping & Instrumentation Diagram (P&ID) of Reactor Island [R01] is presented in [37].

1.7.3 Turbine Island [T01]

The Turbine Island [T01] provides the link between the Reactor Island [R01] where steam is generated, and the electrical connections where generated electricity is provided to the power grid. The primary equipment in the Turbine Island [T01] is the steam turbine and generator arrangement, where the mechanical energy of steam is converted into electrical energy. The Turbine Island [T01] includes the Steam, Water, Condensate System [L] and Main Turbine Generator System [M].

The main systems within the Steam, Water, Condensate Systems [L] include:

- Feedwater System [LA], Steam System [LB], Condensate System [LC], and Condensate Polishing System [LD] summarised in E3S Case Tier 1, Chapter 10: Steam & Power Conversion Systems [38].

- Emergency Feedwater System [LJ], which provides an independent feedwater provision following loss of main feedwater due to a fault, summarised in E3S Case Tier 1, Chapter 6: Engineered Safety Features [33].

The Main Turbine Generator System [M] is housed within a dedicated turbine hall along with other turbine equipment. Its purpose is to convert steam into mechanical energy through centrifugal action. The key systems include the Steam Turbine System [MA], the Generator System [MK], and Auxiliary Systems [MU], summarised in E3S Case Tier 1, Chapter 10: Steam & Power Conversion Systems [38].

1.7.4 Cooling Water Island [C01]

The Cooling Water Island [C01] provides the primary means of removing heat from the power station, passing it to the ultimate heat sink, relying on the external environment to provide a means of cooling. Rolls-Royce SMR's aim is to provide a standardised product that can operate on a wide range of sites through minimal adaption and optimisation of a single design, where such sites potentially including inland, lake, river, estuarine and coastal locations. The generic design is an indirect system at a coastal site.

Cooling Water Systems [P] are summarised in E3S Case Tier 1, Chapter 9A: Auxiliary Systems [35], comprising:

- Main Cooling Water System (MCWS) [PA].
- Auxiliary Cooling & Make-up System (ACMS) [PE].
- Essential Service Water System [PB].
- Turbine Island Closed Cooling Water System [PG].
- Common Systems for the Cooling Water Systems [PU].

1.7.5 Balance of Plant [B01]

The Balance of Plant [B01] systems support the availability of the power station by providing a range of support functions to the rest of the plant, which are of low safety significance but important to maximising output and plant efficiency and minimising environmental impacts. This includes the provision of chemicals, utilities, water and sampling services, and general storage areas. The facilities include the Water Supply, Disposal, Treatment System [G], Auxiliary Systems [Q], Storage Systems [V] and Ancillary Systems [X]. The Balance of Plant [B01] systems in scope of GDA are summarised in E3S Case Tier 1, Chapter 9A: Auxiliary Systems [35].

1.7.6 Electrical, Control and Instrumentation Systems [E01]

Electrical, Control and Instrumentation Systems [E01] includes systems relating to grid connection and intra-site electrical distribution, including the Grid Transmission System [A], Electrical Power System [B], Generator Transmission Main Connection [MS] and Earthing and Lightning Protection System [XF].

The Electrical Power System [B] includes the provision of emergency power supplies, including diesel generators and battery-backed uninterruptible power supplies, which provide backup power in the event of LOOP and SBO faults.

Descriptions of electrical power systems are summarised in E3S Case Tier 1, Chapter 8: Electrical Power [39] and C&I systems are summarised in E3S Case Tier 1, Chapter 7: Instrumentation & Control [34].

1.7.7 Civil, Structural & Architectural Systems [CIV]

Civil, Structural & Architectural Systems [CIV] provide the physical structures which house, support and protect all other systems across the power station. This includes the base isolation system delivered by the aseismic bearings, and the hazard shield providing protection from external hazards.

Descriptions of the associated structures for the power station are summarised in E3S Case Tier 1, Chapter 9B: Civil Structures [40].

1.7.8 Summary of Environmental Aspects

1.7.8.1 GDA Information Requirements

Table 1.7-1 maps the 'General information about the RP and the design' requested in the GDA guidance to RPs to the relevant chapters where such information is presented. More detailed requirements are mapped in subsequent sections.

Table 1.7-1: Map of Information Requirements to E3S Case

GDA Information Requirements	Chapter of E3S Case
Details about the RP, including its company structure and its experience of reactor design and plants in service are provided	E3S Case Tier 1, Chapter 1 (Section 1.2 and 1.3)
A simple, outline description of the design including schematic diagrams is provided	E3S Case Tier 1, Chapter 1 (Sections 1.5 and 1.7)
A brief history of the design of traditional PWR and the main design changes from this plant	E3S Case Tier 1, Chapter 1 (Section 1.6)
Identification of discharge points to the environment for gaseous and aqueous radioactive wastes	E3S Case Tier 1, Chapter 1 (Section 1.7.8.5) E3S Case Tier 1, Chapter 29 E3S Case Tier 1, Chapter 11
A summary of the proposed disposals of radioactive waste and their potential impact on members of the public and non-human species at the generic site	E3S Case Version 3 Tier 1, Chapter 1 (Section 1.7.8.7) E3S Case Tier 1, Chapter 11 E3S Case Tier 1, Chapter 29 E3S Case Tier 1, Chapter 30
A summary of the proposed conventional environmental impacts	E3S Case Tier 1, Chapter 1 (Section 1.7.8.8) E3S Case Tier 1, Chapter 31
A description, and the characteristics, of the generic site (or sites) that the RP will use for its assessment of radiological and conventional impacts on people and the environment	E3S Case Tier 1, Chapter 1 (Section 1.7.8.2) E3S Case Tier 1, Chapter 2
The EA and NRW expect to see relevant sustainability considerations taken into account in the design of new nuclear power plants.	E3S Case Tier 1, Chapter 26

1.7.8.2 Generic Site Description

The Generic Site Description (GSD) describes the characteristics of a generic site for the purposes of the GDA. This includes associated location parameters, that will form the basis for assessing radiological and conventional impacts on people and the environment, predicted to arise from operating the RR SMR. The generic site is assumed to be a rural coastal site, set on a flat plain with no freshwater bodies within or close to the site, and no freshwater courses traversing the site. The GSD also assumes that there are no designated sites or species of conservation importance within or close to the site, nor is there contamination of the ground or groundwater.

Geographical parameters and site characteristics defined in the GSD are typical of GB coastal locations, where the RR SMR plant is assumed to be situated for purposes of the GDA, and include information such as:

- Meteorological and other parameters which affect the dispersion and deposition of gaseous discharges from the RR SMR.
- Hydrographic and other parameters which affect the dispersion of aqueous discharges from the RR SMR.
- The habitation of local exposure groups and their food source locations, relative to the RR SMR plant.
- Food consumption rates and other human habits data.
- A list of reference organisms assumed to be present in the vicinity of the site (for the assessment of radiological impacts on non-human biota).

Details of the GSD are presented in E3S Case Tier 1, Chapter 2: Generic Site Characteristics [41].

1.7.8.3 Radioactive Waste Management Arrangements

An Integrated Waste Strategy (IWS) [42] outlining the proposed approach for managing conventional and radioactive wastes arising from RR SMR is developed and maintained. The IWS presents a summary of predicted RR SMR waste inventory, and strategies for managing the different waste streams making up this inventory (including radioactive and conventional wastes in solid, liquid, and gaseous form, and materials that could become waste), and covers all phases of the plant lifecycle.

The IWS also describes how the strategy has been developed and applied in the context of the political, regulatory, and business requirements associated with the operation of new nuclear power stations in the UK.

Further, Rolls-Royce SMR have initiated engagements with the Nuclear Waste Services (NWS) to support the development and assessment of the disposability case. These engagements support the demonstration that predicted arisings of higher activity waste and spent fuel can be disposed of in a future Geological Disposal Facility (GDF), and anticipated Low Level Waste (LLW) arisings will have an appropriate disposal route [43].

The IWS and disposability assessment form the key inputs into the radioactive waste management arrangements, along with the radioactive waste systems, details of which are presented in E3S Case Tier 1, Chapter 11: Management of Radioactive Waste [36].

1.7.8.4 Demonstration of BAT

The application of BAT in the context of the RR SMR design development is framed around four fundamental radiological claims, which seek to demonstrate that the RR SMR design:

- Eliminates or reduces the generation of radioactive waste.
- Minimises the amount of radioactivity discharged or disposed of to the environment.
- Minimises the volume of radioactive waste disposed to other premises.
- Minimises the impacts on the environment and members of the public from radioactive waste discharged or disposed of to the environment.

The approach to BAT is fully integrated into the engineering design process. Details of the approach for, and demonstration of, the use of BAT in the RR SMR design are presented in E3S Case Tier 1, Chapter 27: Demonstration of BAT [30].

1.7.8.5 Radioactive Effluent Discharges Points

Aqueous radioactive effluent will be discharged via a single discharge line to the cooling water outfall prior to release into the receiving environment. The accountancy points for final discharge of all aqueous radioactive effluent are currently going through engineering design process (optioneering). Flow proportional sampling equipment to enable samples to be taken to comply and flow measurement will be located to achieve compliance with future permits.

At DRP4, gaseous radioactive effluent will be discharged to the environment through a main exhaust emission stack at the top of the Reactor Island building, described in E3S Case Tier 1, Chapter 28: Sampling and Monitoring Arrangements [44]. A discharge outlet from the Turbine Island will vent non-radiological effluents arising from normal operation, with the potential to vent from the Air Removal and Evacuation System (ARES) [MAJ] following an expected event such as a steam generator tube leak.

The main exhaust stack will receive gaseous effluents from the Gaseous Radioactive Effluent Treatment System [KPL] and the nuclear HVAC system [KL]. It is supported by atmospheric dispersion modelling to ensure that the stack is optimised to minimise the impact of discharges on people and the environment, consistent with the use of BAT.

Details of the RR SMR radioactive waste treatment systems and associated structures is presented in E3S Case Tier 1, Chapter 29: Quantification of Radioactive Effluent Discharges and Proposed Limits [45], with the demonstration of BAT for these systems and structures presented in E3S Case Version 3, Tier 1, Chapter 27: Demonstration of BAT [30].

1.7.8.6 Discharges of Liquid and Gaseous Radioactive Effluent to the Environment

An assessment of potential discharges of liquid and gaseous radioactive effluent from the RR SMR to the environment, under normal operating conditions, is performed. Annual discharge limits are also proposed for significant radionuclides present in the predicted discharges to the environment.

Normalised discharges of liquid waste to the environment are well below the maximum values reported at a range of operational light water reactors, and within the range of predicted discharges from other GDA candidate reactors. The normalised annual discharge of gaseous radioactive effluent from the RR SMR is broadly consistent with the average of forecast or reported discharges from other PWR plants. Higher values reported for some selected radionuclides are a consequence of conservative assumptions made in relation to primary source term radionuclide concentration, abatement technology or radionuclide speciation, and are expected to reduce as detailed information on the primary source term and reactor design develops.

Details of the quantification of radioactive effluent discharges to the environment, including an overview of the approach, underlying assumptions, parameter values and design information are presented E3S Case Tier 1, Chapter 29: Quantification of Radioactive Effluent Discharges and Proposed Limits [45].

1.7.8.7 Prospective Impacts of Radioactive Discharges on Members of the Public and Non-Human Species

A detailed assessment of prospective radiological impacts associated with discharges of aqueous and gaseous radioactive effluent from the RR SMR (at proposed annual limits) is performed using the EA's initial radiological assessment tool. Conservative assumptions account for data such as the contribution from direct radiation pathways.

The prospective annual dose to a representative member of the public (based on continuous discharge of radioactive effluents) is well below the source dose constraint of 300 μSv/yr. The dose rate to the worst affected non-human organism is significantly less than the screening dose rate of 10 μGy/hr and the guideline dose rate of 40 μGy/hr.

Details of the radiological assessment are presented in E3S Case Version 3 Tier 1, Chapter 30: Prospective Radiological Assessment at the Proposed Limits for Discharges and for any On-Site Incineration [46].

1.7.8.8 Conventional Environmental Impacts

An appraisal of other environmental regulations and associated environmental impacts is performed based on DRP4. The appraisal considered the GDA information requirements for other environmental regulations and included a preliminary review of conventional (i.e., non-radioactive) environmental aspects of the RR SMR in the following topic areas:

- Water use and abstraction.
- Discharges to surface water.
- Discharges to groundwater.
- Operation of installations (combustion plant and incinerators).
- Fluorinated greenhouse gases and ozone-depleting substances.

Each of these topics, and details of the other environmental regulations and conventional environmental aspects, are presented in E3S Case Tier 1, Chapter 31: Conventional Impact Assessment [47].

1.8 Modes of Normal Operation of the Plant

1.8.1 Applications

The baseline application for the RR SMR, and scope of the generic E3S Case and GDA, is electricity production. The RR SMR is designed for full compliance with the UK Grid Code [48], including connection conditions for 'flexibility' of the power station:

- Limits on the minimum and maximum power output.
- Withstanding grid frequency and voltage variations.
- Grid fault ride-through capability.
- The capability to operate in a frequency-sensitive mode in which power output is automatically adjusted in response to the grid frequency.

The design basis for RR SMR includes the capability of the design to operate in load following mode between 50 % and 100 % power at a rate of 3-5 % per minute, however, this is outside the scope of the generic E3S Case. The RR SMR is also designed to enable other applications including steam offtake, e-fuels, and desalination, which are outside the scope of the generic E3S Case.

A summary of the applications and capabilities for the RR SMR is provided in the power station operating philosophy [49].

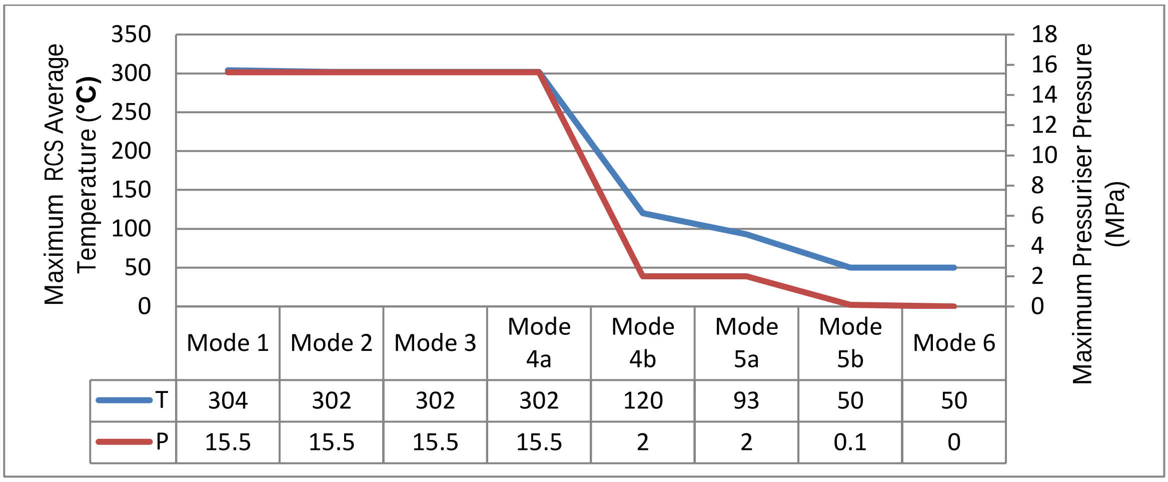
1.8.2 Modes of Operation

Fundamentally, the power station operates in distinct modes of Power Operations or Shutdown Operations. The modes are developed further and characterised by RCS [JE] temperature, pressure, and refuelling status:

- Mode 1 – Power Operation.
- Mode 2 – Low Power.
- Mode 3 – Hot Standby.
- Mode 4A – Hot Shutdown – Steaming.
- Mode 4B – Hot Shutdown – Non-Steaming.
- Mode 5A – Cold Shutdown (Pressurised).
- Mode 5B – Cold Shutdown (Depressurised).
- Mode 6A – Refuelling with Reduced Water Level above Fuel.
- Mode 6B – Refuelling with Water Level above Fuel at Nominal Full.

The power station is safely shutdown when the control rods are fully inserted on the transition from Power Operations (Modes 1 and 2) to Shutdown Operations (Modes 3-6). The power station remains shutdown in Modes 3-6, and on the return to Power Operations the control rods are first withdrawn in Mode 2.

The RCS [JE] temperature and pressure for each operating mode is presented in Figure 1.8-1.



	Mode 1	Mode 2	Mode 3	Mode 4a	Mode 4b	Mode 5a	Mode 5b	Mode 6
T	304	302	302	302	120	93	50	50
P	15.5	15.5	15.5	15.5	2	2	0.1	0

Figure 1.8-1: Operating Mode Parameters

There will be a clear distinction between each of these modes for Reactor Island [R01], with changes in RCS [JE] temperature, pressure and alignment or release of systems. Other areas may be required to provide different functions to Reactor Island [R01] across each of the modes.

The means by which the plant and operator maintain control of key functions across the operating modes are outlined in further detail in the concept of operations [50] and E3S Case Tier 1, Chapter 13: Conduct of Operations [51].

1.8.3 RR SMR Lifecycle

The RR SMR has a planned lifetime of approximately 60 years, with refuelling and maintenance required periodically. Refuelling is carried out when the reactor is offline and not producing power. The frequency and duration of outages is minimised as far as is safe and practicable to optimise the availability of the RR SMR, with an 18-day outage target.

Maintenance is completed throughout the lifetime of the power station; depending on the activities required these can be completed whilst the reactor is on-line or off-line. On-line maintenance is permitted where safe to do so, noting availability requirements of safety systems may only permit off-line maintenance – the availability and configuration arrangements for SSCs are described in the system engineering chapters, and reflected in the Operational Limits and Conditions (OLCs) described in E3S Case Tier 1, Chapter 16: Operational Limits and Conditions [52].

1.8.4 Monitoring and Control

Monitoring and control of the RR SMR will be centralised within the MCR, located within the Reactor Island [R01]. From here, the operators monitor the reactor response to changes in turbine load, driven by demand from the facility which the RR SMR is supporting (for example, the electricity grid).

From the MCR, the operators can take action to correct identified deviations, however, the design of the plant means that no remote operator actions are required within the first 30 minutes of a fault being identified. In addition, no local operator actions will be required within the first hour of a fault being identified. Whilst actions are not required to support the E3S Case, the operators will be able to act if they are able to correctly diagnose the fault, and procedures are available to support them.

If the MCR is uninhabitable (e.g., due to fire), then the operators can transfer to the SCR. The SCR is also located within the Reactor Island [R01], such that a single incident should not threaten both control rooms (for example, with appropriate separation and segregation) but also to allow safe transfer of personnel. The SCR will include monitoring and control of safety related systems, to ensure a safe shutdown state is achieved and maintained. The SCR is not intended for continuing normal power operations.

The RR SMR also includes an emergency control centre (and associated facilities) on-site for managing events. An off-site emergency control centre may be shared between power stations dependent on location. A security control centre (and additional access control points) provides the ability to monitor the site and control access.

1.8.5 Fleet Approach

The RR SMR is a single design, deployable across regions and customers without significant design modifications. One of the benefits which this approach delivers is the potential to share data and knowledge across the RR SMR operators, supporting optimisation of various aspects such as operations, maintenance, or staffing.

The various options for a fleet support approach will be implemented in conjunction with licensees, which could range from individual RR SMR stations that are co-ordinated by the licensee through to options for centralised hubs and data centres which can share data, equipment, and resource across multiple SMRs and licensees. In all operating models, the licensee retains their Duty Holder / Design Authority responsibilities.

1.9 Conclusions

This chapter presents the introduction to the suite of 33 chapters that comprise Version 3 of the generic E3S Case. It outlines the holistic approach to E3S that is adopted for the RR SMR, and the overall structure of the Case to demonstrate the golden thread. It provides an overview of the layout and plant systems and equipment and the modes of operation for the RR SMR.

The objective of Version 3 of the generic E3S Case is to provide confidence that the RR SMR will be capable of delivering the E3S fundamental objective, ‘to protect people and the environment from harm’, as it is developed through detailed design. It shall demonstrate that risks are capable of being reduced to ALARP, using BAT, can be secure/safeguarded by design, and demonstrate sustainability for current and future generations.

Version 3 of the generic E3S Case provides the basis for submissions as part of the GDA, aligned to DRP 4 that was declared during GDA Step 3. The Case is progressively developed alongside the design programme, therefore the full suite of arguments and evidence summarised in the chapters remains in development at Version 3. The conclusions of each chapter provide an evaluation of the information presented in Version 3 against the objective, with a forward look of information to be presented in future revisions of the generic E3S Case.

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1.11 Appendix A: E3S Case Chapter and associated Measures / SSCs

Table 1.11-1: E3S Case Chapter and Associated SSCs

Primary Chapter	RDS-PP®	SSC
4	JAC10	Reactor Vessel Internals
	JAC20	Fuel Assemblies
	JAC30	Neutron Sources
	JDE	Control Rods
5	JAA	Reactor Vessel System
	JE	Reactor Coolant System
	JEA	Steam Generation System
	JEB	Reactor Coolant Pump System
	JEC	Reactor Coolant Pipework System
	JEF	Reactor Coolant Pressurising System
	JEG	Reactor Coolant Pressure Relief System
	JNA	Cold Shutdown Cooling System
	KB	Chemical and Volume Control System
	KBA	Level and Volume Control System
	KBD	Chemistry Control System
	KBE	Coolant Purification System
6	JD01	Scram
	JD02	Alternative Shutdown Function
	JM01	Faulted Containment
	JM02	Severe Accident Containment
	JN01	Emergency core cooling system
	JN02	Passive Decay Heat Removal System
	JN03	High Temperature Heat Removal
	JN04	Low Temperature Decay Heat Removal
	KAX	Safety Measure Supply System
7	JRA	Reactor Protection System
	JQA	Diverse Protection System
	JRQ	Accident Management System

Primary Chapter	**RDS-PP®**	**SSC**
	JSA	Reactor Plant Control System
	JSS	Reactor Monitoring System
	MY	Turbine Island Control and Protection System
	LY	Feedwater, Steam and Condensate Control and Protection System
	PY	Cooling Water Island Control and Protection System
	KY	Radioactive Waste Management System C&I
	FY	Fuel Route C&I
8	A	Grid Transmission System
	AC	400kV Grid Transmission Connection System
	B	Electrical Power System
	BB	High Voltage Main AC Supply System
	BC	High Voltage Main AC Standby Supply System
	BD	High Voltage Essential AC Standby Supply System
	BF	Low Voltage Main AC Supply System for Process Equipment
	BG	Low Voltage Main AC Supply System for Non-Process Equipment
	BK	Low Voltage Essential AC Standby Supply System
	BL	Low Voltage Essential AC Alternate Supply System
	BM	Low Voltage Uninterruptible AC Supply System
	BP	Low Voltage Uninterruptible DC Supply System
	BQ	Low Voltage Uninterruptible DC Supply System for Safety Services
	MS	Generator Transmission Main Connection
	XF	Earthing and Lightning Protection System
	XQ	Lighting Systems
9A	F	Handling of Nuclear Equipment
	FA	Internal Fuel Storage
	FAA	New Fuel Receipt and Inspection Area
	FAB	Storage of Spent/Irradiated Fuel Assemblies and Other Radioactive Parts System
	FAE	Refuelling Cavity
	FAF	Refuelling Pool
	FAK	Spent Fuel Cooling System
	FAL	Spent Fuel Coolant Purification System

Primary Chapter	RDS-PP®	SSC
	FAM	System for Removal of Surface Contaminants on Components in Fuel Assembly Storage
	FAT	Coolant Supply System
	FB	Handling of Fuel Assemblies and other Reactor Core Internals
	FBA	Fuel Inspection, Repair and Cleaning System
	FBC	Cleaning System for Fuel Assemblies (Also Includes Reflector Assemblies)
	FCJ	System for Conveyance of Fuel Assemblies/Internals within Reactor Area
	FCK	System for Conveyance of Fuel Assemblies/Internals between Reactor and Storage Areas
	FCL	System for Conveyance of Fuel Assemblies/Internals within Storage Area
	FDB	External Dry Storage of Filled Casks System
	FKA	Component Decontamination System
	KA	Nuclear Auxiliary Systems
	KJ	Nuclear Chilled Water Systems
	KL	HVAC Systems in Controlled Areas and Exclusion Areas
	KU	Reactor Coolant Sampling System
	KTQ	Fuel Pool Leak Detection System
	PA	Main Cooling Water System
	PB	ESWS
	PE	Auxiliary Cooling and Make-Up System
	PG	Turbine Island Closed Cooling Water System
	PU	Common Systems for the Cooling Water Systems
	G	Water Supply Disposal and Treatment System
	GA	Water Supply System
	XBF	Space Heating System in Structures for Handling of Nuclear Equipment
	XBJ	Space Heating System in Structures for Nuclear Heat Generation
	XBK	Space Heating System in Structures for Nuclear Auxiliary Systems
	XG	Fire Extinguishing System
	XK	Chilled Water System
	XM	Mechanical Handling System

Primary Chapter	**RDS-PP®**	**SSC**
	XV	Rainwater Systems
9B	U	Structures and Areas for Systems Inside of the Power Plant Process
	U01	Reactor Island Structures and Areas
	UW	Structures for Common Systems
	UWA	Seismic Isolation System
	UWB	Foundation and Basemat
	UWC	Retaining Wall
	UWD	Hazard Shield
	UF	Structures for the Handling of Nuclear Equipment
	UFA	Structure for Internal Storage of Fuel Assemblies (if separate from Reactor Building [UJA])
	UJ	Structures for Reactor Plant
	UJA	Reactor Building Interior
	UK	Structures for Reactor Auxiliary Systems
	UKA	Reactor Auxiliary Building
	UKB	Reactor Ancillary Building
	UPJ	Structures for Cooling Towers (Auxiliary and Secondary Processes)
	UPJ10	ESWS Cooling Tower 1
	UPJ20	ESWS Cooling Tower 2
	UBM	Structures For Power Generation for Safety Services
	UBM01	Backup Generation 1 And Fuel Store
	UBM02	Backup Generation 2 And Fuel Store
10	L	Steam Water Condensate System
	LA	Feedwater system
	LB	Steam system
	LC	Condensate system
	LD	Condensate polishing system
	LJ	Emergency feedwater supply system
	LX	Fluid Supply Systems for Control and Protection Systems
	M	Main Turbine Generator System
	MA	Steam Turbine System
	MK	Generator System
	MU	Common Systems of the Main Turbine Generator System

Primary Chapter	RDS-PP®	SSC
11	KMA	Solid Radioactive Waste Processing System
	KME	Solid Radioactive Waste Storage System
	KNF	Liquid Radioactive Effluent Treatment System
	KPL	Gaseous Radioactive Effluent Processing Systems
	KTA	Reactor Island Collection and Drainage System

1.12 Abbreviations

AC	Alternating Current
ACMS	Auxiliary Cooling and Make-up System
ADS	Automatic Depressurisation System
ALARA	As Low As Reasonably Achievable
ALARP	As Low As Reasonably Practicable
ARES	Air Removal and Evacuation System
ASF	Alternative Shutdown Function
BAT	Best Available Techniques
C&I	Control and Instrumentation
CAE	Claims, Arguments, Evidence
CoFT	Control of Fuel Temperature
CoR	Control of Reactivity
CoRM	Confinement of Radioactive Material
CRHC	Control Rod Housing Column
DC	Direct Current
DiD	Defence-in-Depth
DPS	Diverse Protection System
DRP	Design Reference Point
E3S	Environment, Safety, Security and Safeguards
EA	Environment Agency
ECC	Emergency Core Cooling
EMIT	Examination, Maintenance, Inspection and Testing
ESWS	Essential Service Water System
EUR	European Utility Requirements
FOAF	First of a Fleet
FSE	Fundamental Safeguards Expectations
FSF	Fundamental Safety Function

GB	Great Britain
GDA	Generic Design Assessment
GDF	Geological Disposal Facility
GSD	Generic Site Description
HTHR	High Temperature Heat Removal
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
I&C	Instrumentation & Control
IAEA	International Atomic Energy Agency
IEC	International Electrotechnical Commission
IHP	Integrated Head Package
IMS	Integrated Management System
ISS	Integrated Security System
IWS	Integrated Waste System
LLW	Low Level Waste
LOCA	Loss of Coolant Accident
LOOP	Loss of Off-site Power
LUHS	Local Ultimate Heatsink System
LV	Low Voltage
MCR	Main Control Room
MCWS	Main Cooling Water System
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
NRW	Natural Resources Wales
NWS	Nuclear Waste Services
OLCs	Operating Limits and Conditions
ONR	Office for Nuclear Regulation
OPEX	Operating Experience

P&ID	Piping & Instrumentation Diagram
PDHR	Passive Decay Heat Removal System
PSA	Probabilistic Safety Assessment
PWR	Pressurised Water Reactor
RCS	Reactor Coolant System
RD	Reference Design
RDS-PP®	Reference Design System – Power Plants
RGP	Relevant Good Practice
RI	Regulatory Issue
RO	Regulatory Observation
RP	Requesting Party
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RQ	Regulatory Query
Rolls-Royce SMR Limited	Rolls-Royce Small Modular Reactor Limited (Organisation)
RR SMR	Rolls-Royce Small Modular Reactor (Design)
RSR	Radioactive Substances Regulation
SAPs	Safety Assessment Principles
SBO	Station Blackout
SCR	Supplementary Control Room
SDD	System Design Description
SFAIRP	So Far As Is Reasonably Practicable
SG	Steam Generator
SIS	Seismic Isolation System
SQEP	Suitably Qualified and Experienced Personnel
SSC	Structure, System & Component
SSG	Safety Standard Guide
SyAPs	Security Assessment Principles
TDZ	Turbine Disintegration Zone
UPS	Uninterruptible Power Supply

US	United States
WENRA	Western European Nuclear Regulators' Association
WNA	World Nuclear Association