Sizewell C Project

SIZEWELL C – Justification of Site Suitability Report

(100813434)

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Revision History

Revision	Purpose	Amendment	By	Date
Revision 1	To Support NSL Application	Completed NNB GenCo review and acceptance	[redacted]	29/06/2020
Revision 2	To Support NSL Application	Completed NNB GenCo review and acceptance	[redacted]	19/07/2021
Revision 3	To Support NSL Application	To account for ITA and NSC comments and feedback	[redacted]	29/09/2021

CONTENTS

1 Introduction

1.1 Background

NNB GenCo intends to build a twin UK-EPR new nuclear power station, at Sizewell in Suffolk. The plant, which will be known as Sizewell C (SZC), is to be located in close proximity to the existing Sizewell Nuclear Licensed Sites. The Sizewell B (SZB) Nuclear Licensed Site has an operational Pressurised Water Reactor (PWR). The Sizewell A (SZA) Nuclear Licensed Site contains twin Magnox reactors and associated plant that are currently being decommissioned. All fuel has been removed from the SZA site.

The SZC project has applied for a Nuclear Site Licence (NSL) for the proposed SZC site. As part of the application, a demonstration is needed to provide confidence that the site represents a suitable location from a nuclear safety point of view for hosting a twin UK-EPR nuclear power station, and that an adequate Safety Case can be made in the fullness of time.

1.2 Purpose

The overall justification for the suitability of the site is summarised in this Justification of Site Suitability Report (JSSR). The JSSR is a top tier report that summarises and consolidates the arguments and evidence which provide the required confidence that the site is suitable to host a twin UK-EPR nuclear power station.

The depth and level to which the arguments and evidence have been developed in the JSSR and its supporting documents are appropriate and proportionate to the NSL application stage. The JSSR is not a detailed Safety Case but instead aims to give confidence in the ability to make a Safety Case in the future. A SZC specific Pre-Construction Safety Report (PCSR) will be developed in due course following NSL granting.

1.3 Structure of the JSSR

1.3.1 Overall Structure

Learning from Experience (LFE) associated with the application for, and work required to enable granting of the NSL for Hinkley Point C (HPC) (and specifically the demonstration of the suitability of the HPC site), has been taken into consideration in the production of this JSSR for SZC. The LFE relates to the provision of the arguments and evidence necessary to give confidence in six claims related to site suitability. These are covered in Sections 2 to 7 of this report as follows:

- Section 2 - Claim 1: The site is of sufficient size to accommodate all necessary systems to ensure safe operation;
- Section 3 - Claim 2: The site can be connected to electricity grid supplies;
- Section 4 - Claim 3: Adequate cooling capability can be provided for all normal and fault conditions;
- Section 5 - Claim 4: There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC);
- Section 6 - Claim 5: The geology of the site provides secure long term support to the necessary structures, systems, components;
- Section 7 - Claim 6: Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining Nuclear Licensed Site (SZB).

A visual depiction of the JSSR, the 6 Claims, and the relationship of the claims with the Primary References is included in Figure 1 below. It is recommended that the JSSR is read in conjunction with the Primary References.

1.3.2 History

Three versions of this JSSR have been produced. Version 1 included the arguments and evidence available at the point of NSL application (June 2020). Versions 2 and 3 provide additional information to support the NSL application based on the ongoing work that has been undertaken across the project since June 2020. Version 2 was produced prior to Independent Technical Assessment and Nuclear Safety Committee advice, while Version 3 includes very minor changes resulting from those final steps in the governance process of the update.

1.3.3 Information Updated in Version 3 of the JSSR

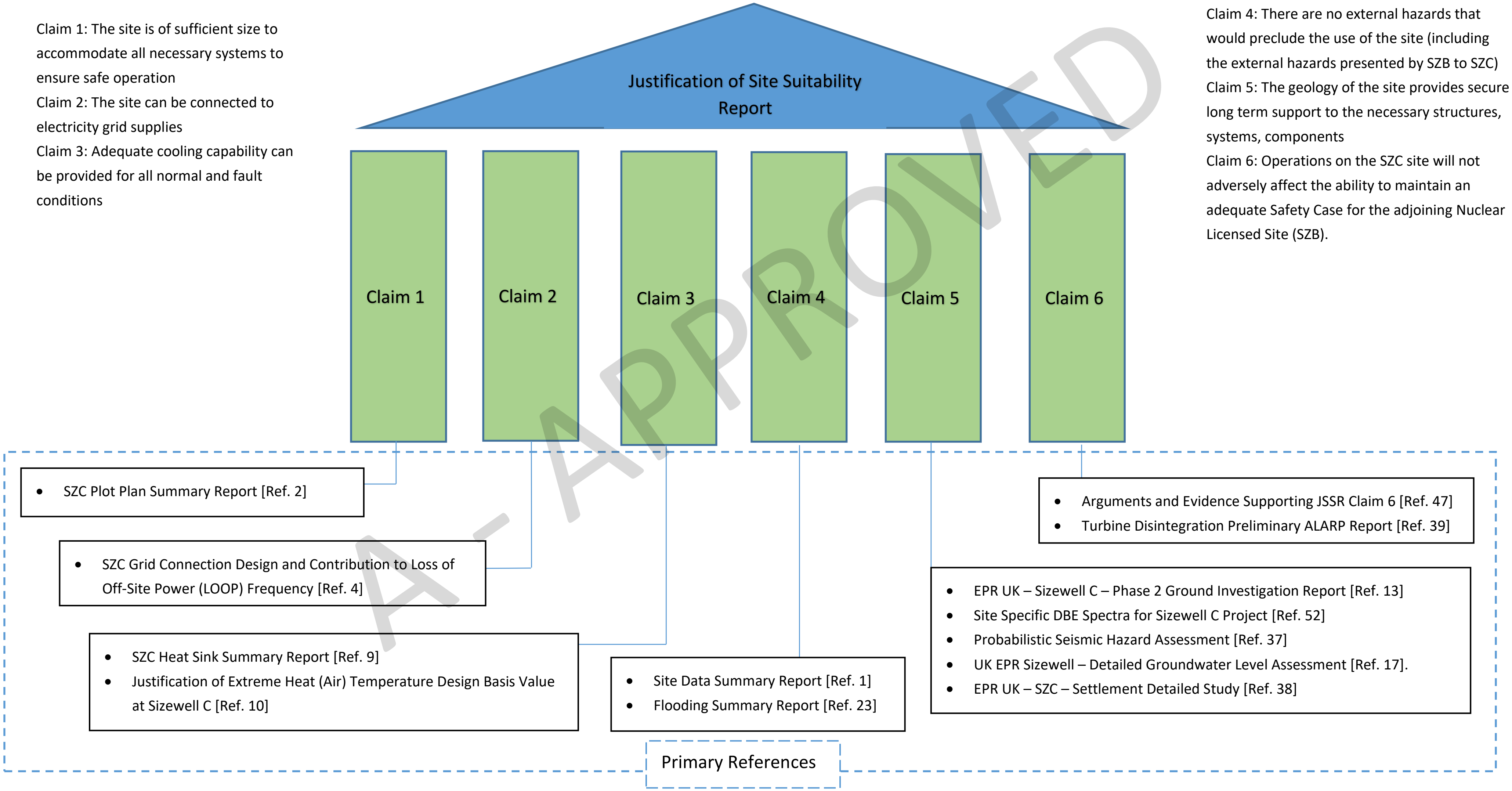
Version 3 of the JSSR benefits from the latest information from across the SZC project that was available for inclusion in the JSSR supporting references. This section gives a high level overview of the additional information that has been included in the update to support each Claim.

- Claim 1: The site is of sufficient size to accommodate all necessary systems to ensure safe operation:
  - Latest available SZC Plot Plan;
  - Design change process information and outputs.
- Claim 2: The site can be connected to electricity grid supplies:
  - Latest available SZC Plot Plan;
  - Grid code compliance strategy.
- Claim 3: Adequate cooling capability can be provided for all normal and fault conditions:
  - Design change process outputs supporting the Heat Sink Summary Report;
  - High sea temperature hazard characterisation results;
  - High air temperature hazard characterisation and Design Basis justification.
- Claim 4: There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC):
  - Complete external hazard characterisation activities;
  - Flooding Summary Report update;
  - Combined hazard preliminary analysis.
- Claim 5: The geology of the site provides secure long term support to the necessary structures, systems, components:
  - Geological characterisation;
  - Seismic hazard characterisation;
  - Groundwater characterisation.
- Claim 6: Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining Nuclear Licensed Site (SZB):
  - Update to the Claim 6 Report;
  - Turbine Disintegration workstream deliverable.

Figure 1 - Visual depiction of the JSSR, the 6 Claims, and the relationship of the Claims with the Primary References

Claim 1: The site is of sufficient size to accommodate all necessary systems to ensure safe operation
Claim 2: The site can be connected to electricity grid supplies
Claim 3: Adequate cooling capability can be provided for all normal and fault conditions

Claim 4: There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC)
Claim 5: The geology of the site provides secure long term support to the necessary structures, systems, components
Claim 6: Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining Nuclear Licensed Site (SZB).



1.4 Production, Review and Acceptance of the JSSR and its Supporting References

While the JSSR and its supporting references do not provide a detailed Safety Case but aim to provide confidence that a Safety Case will be made in the future, they have still been produced in line with Grade 2 verification requirements [Ref. 54]. As a result, all of the supporting references have been subject to full independent checking from stakeholders across the project within the UK and France; examples of key activities which have been subject to increased levels of review and verification are given below. Finally, the JSSR and its supporting references have undergone Independent Technical Assessment (ITA) [Ref. 53] and have been submitted to the Nuclear Safety Committee for advice [Ref. 55].

As stated above, there were specific cases where technical topics have been subject to higher levels of internal and external review; several examples are highlighted below.

- Probabilistic Seismic Hazard Assessment (PSHA) – This activity was undertaken by technical specialists in the topic area using an approach that was informed by relevant good practice. The technical team were supported by subject experts in carrying out their work as well as an external independent Peer Review Team. Further information is available in Section 6.2.2.
- External flooding – The characterisation of the external flooding hazard and the preliminary design verification is provided in the Flooding Summary Report [Ref. 23]. This report collates and captures the work from a range of specialists in flooding and flooding protection including the Centre for Environment, Fisheries, and Aquaculture Science (CEFAS), Royal Haskoning DHV (RHDHV), Atkins, and EDF R&D. Notably, independent means of assessing key parameters related to external flooding have been used and included in the preliminary design verification. Further information is available in Section 5.2.2.2.
- Seawater temperature – As a result of uncertainty in the results of early work on this parameter, an independent assessment of the analysis was carried out. This resulted in a further study being undertaken to provide robust results in line with the needs of the project. Further information is available in Section 4.2.2.

1.5 Replication at SZC

1.5.1 Overview of Replication

The SZC project objectives are to deliver a twin UK-EPR new build, safely, efficiently, right first time, with Nuclear Safety being the overriding priority. The strategy is therefore to base the SZC design on a very strong replication of the design being built at HPC i.e. the HPC 'Reference Configuration 2.0 (RC2.0) design'. Effectively, SZC will be a Next of a Kind (NOAK) nuclear power station that re-uses the mature and justified design already being built at HPC. More information on the Replication is available in the SZC Project Replication Manual [Ref. 48].

As well as being a necessity to ensure the commercial viability of the project, the NOAK / replication approach has the potential to realise significant safety, societal, and strategic benefits. Further information on the safety benefits are provided in Reference [29] and summarised below:

- Maximising replication helps avoid inefficiencies (with safety detriments) associated with operating nuclear power stations with divergent designs.
- Maximising replication reduces demands on cognitive abilities and organisational resources, such that the likelihood of the propagation of errors that could erode nuclear safety is minimised.

- Maximising replication enables the organisations involved in activities on both SZC and HPC to more easily apply the knowledge and expertise they have gained from one site to the other site and consequently minimises the potential for errors.
- Maximising replication enables Operational Experience (OPEX) and LFE gained from HPC / SZC to be more directly transferable between the two sites.
- Maximising replication enables a cooperative / collaborative approach to the management of obsolescence and design changes which enhances nuclear safety.
- Maximising replication maximises the safety benefits of using an existing mature and well developed Safety Case and design.
- Maximising replication minimises destabilising effect of design changes on nuclear safety.

1.5.2 ALARP Replication

Overall ALARP for the SZC project will formally demonstrated as a part of the development of the SZC PCSR. Nevertheless, a SZC Initial ALARP Position Paper [Ref. 29] has been produced as a means of gaining confidence prior to the Final Investment Decision (FID) such that the plant design brought forward from HPC under the replication strategy, and decisions made on what to replicate, adapt or change, will enable the risks to be demonstrated as being ALARP.

The key aim of Reference [29] is to provide confidence that design decisions made for HPC which were justified as delivering a risk that is ALARP for HPC, in general need not be re-opened / re-considered for SZC replicated plant. Where buildings and plant are being adapted or changed, Reference [29] also provides the necessary confidence that appropriate solutions are being chosen to ensure the risks are reduced to ALARP.

As a responsible future licensee and Nuclear Power Plant (NPP) operator at SZC, NNB GenCo has taken a proportionate and intelligent approach to replication, and the aim has been to make sensible decisions on what to replicate, adapt and change. A fully mature and fully acceptable safety case is expected to be available for HPC prior to commissioning and operation at HPC, and this gives strong confidence that a safety case for SZC which is based on strong replication of HPC will also be possible.

Where there are SZC specific changes or adaptations of the HPC design required (e.g. because of external hazard characterisation differences or because of the constraints of the land available for the proposed Nuclear Licensed Site), a proportionate design change governance process has been used during design solution selection, and will continue to be used to address ongoing design evolution on both HPC / SZC. Consequently, adequate consideration of ALARP (i.e. that is commensurate with the current stage of the project) has been / is being performed as a part of design solution selection and evolution. Therefore, in general, there is confidence that the selected design solutions will enable the risks to be more formally demonstrated ALARP as the SZC Safety Case and detailed designs of these solutions are developed further.

1.5.3 Site Specific Changes to the Reference Design

Whilst SZC will be a NOAK power station based on strong replication of HPC, there are differences in some site conditions (e.g. ground strata, the different tidal range, and the different shape of the SZC plot available for development as a Nuclear Licenced Site). As such, there is a need to adapt / change elements of the HPC RC2.0 design to accommodate these differences. These differences are discussed in the context of the 6 JSSR Claims below[1].

[1] Changes related to Emergency Planning and Radiological Releases are treated elsewhere within the NSL Application.

(1) There are differences in site layout compared to HPC. These are discussed in Section 2 under Claim 1: “The site is of sufficient size to accommodate all necessary systems to ensure safe operation”.

(2) There are differences in how SZC will be connected to the grid compared to HPC. These are discussed in Section 3 under Claim 2: “The site can be connected to electricity grid supplies”.

(3) There are differences in the Heat Sink design as a result of differences in Extreme High Water Levels (EHWL) and Extreme Low Water Levels (ELWL), and the platform height relative to these. These are discussed in Section 4 under Claim 3: “Adequate cooling capability can be provided for all normal and fault conditions”

(4) The differences in external hazards between SZC and HPC are discussed in Section 5 under Claim 4: “There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC)”. A key difference discussed is that relating to coastal flooding, and that the SZC site is considered to be a “protected site”.

(5) There are differences in the geology between the two sites. These are discussed in Section 6 under Claim 5: “The geology of the site provides secure long term support to the necessary structures, systems, components”

(6) SZC has an immediately adjacent Nuclear Licensed Site with an operating reactor (SZB. The external hazards posed to SZB by SZC are discussed in Section 7 under Claim 6: “Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining Nuclear Licensed Site (SZB)”.

2 Claim 1: The site is of sufficient size to accommodate all necessary systems to ensure safe operation

2.1 Claim 1: Introduction

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

2.2 Claim 1: Summary of Arguments and Evidence

2.2.1 Replication at SZC

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted]

- [redacted]

[redacted]

[redacted]

2.2.2 Confidence in ability to demonstrate ALARP for differences between SZC and HPC plot plan

[redacted]

2.2.2.1 SZC Plot Plan Constraints

[redacted]

2.2.2.2 Development and Management of SZC Plot Plan

[redacted]

[redacted]

[redacted]

- The Plot Plan Working Group.

[redacted]

- The SZC Plot Plan Committee.

[redacted]

- Holistic Safety reviews.

[redacted]

- The NCC and Design Change Review Process.

[redacted].

[redacted]

[redacted] operation".

2.2.3 Analysis of Building Location Differences Between SZC and HPC Plot Plan

[redacted]

[redacted]

Structure	Change versus HPC	Summary of Key Arguments / Evidence
[redacted]		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted].	[redacted]
[redacted]	[redacted]	[redacted]

Structure	Change versus HPC	Summary of Key Arguments / Evidence
		[redacted]
[redacted]		
[redacted]	[redacted]	[redacted] [redacted] [redacted] [redacted]

Structure	Change versus HPC	Summary of Key Arguments / Evidence
[redacted]	[redacted]	[redacted] [redacted]
[redacted])	[redacted]	[redacted] [redacted]
[redacted]	[redacted]	[redacted] [redacted]
[redacted]	[redacted]	[redacted]

Structure	Change versus HPC	Summary of Key Arguments / Evidence
	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Structure	Change versus HPC	Summary of Key Arguments / Evidence
		[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]

Structure	Change versus HPC	Summary of Key Arguments / Evidence
[redacted]	[redacted]	[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]

2.2.4 Overall ALARP Considerations due to Aggregated Effect of Building Movements

Classification of Buildings

[redacted]

Emergency Preparedness

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Drainage and Extreme Rainfall

[redacted]

[redacted]

General Discussion on Collapse of Buildings onto Other Buildings

[redacted]

Egress from buildings in fire scenarios

[redacted]

[redacted]

Fire Domino Effects

[redacted]

Aircraft Crash Risk with respect to SZC Plot Plan Versus HPC

[redacted]

SZC Turbine Missile Hazard with respect to SZC Plot plan

[redacted]

Consideration of Technical Galleries

[redacted]

2.2.5 Impact of Future Plot Plan Changes and Ability to Demonstrate ALARP in the future

Known Changes

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

<u>Unknown Changes</u>

[redacted]

2.2.6 Future ALARP Justification

[redacted]

2.3 Claim 1: Conclusion

[redacted]

[redacted]

[redacted]

3 Claim 2: The site can be connected to electricity grid supplies

3.1 Claim 2: Introduction

The Grid Connection Design and Contribution to Loss of Off-Site Power (LOOP) Frequency Report [Ref. 4] has been produced for the SZC project to specifically provide the arguments and evidence necessary to demonstrate confidence in Claim 2. It includes:

- An overview of the grid connection concept design for SZC.
- A description of how the UK-EPR is capable of being compliant with the UK grid code alongside an outline of how this programme of work at HPC will be replicated for SZC.
- The key differences between the SZC grid connection design and the HPC design and why they have no effect on the ability to demonstrate Claim 2.
- A demonstration that the SZC design has resilience with regards to the external and internal hazards that may be experienced at SZC, including the effects of future climate change on LOOP frequency.
- Analysis of the LOOP frequencies for SZC, the comparison with HPC LOOP and how these frequencies were derived.
- A conclusion in relation to Claim 2.

A summary of the above information is included below in Section 3.2.

3.2 Claim 2: Summary of Arguments and Evidence

3.2.1 Overview of the SZC Grid Connection Concept Design

The SZC grid connection design is still at concept stage. However, the proposed engineering design, and high-level layout of the gird connections which will connect SZC to the grid, are as follows:

- Electricity from the SZC generators will be stepped up to 400kV via the main transformer and then transferred via overhead lines (OHL) to the National Grid 400kV substation.
- The existing National Grid 400kV substation accommodates the generation output of SZB. An extension to the existing National Grid 400kV substation will be required to accommodate the additional generation output of SZC. Switchgear will also be provided within the National Grid 400kV substation to provide a link to SZB station[2].
- The OHL that currently terminate at the existing National Grid 400kV substation will be diverted into a new substation building built alongside and interconnected with the existing substation building so that the electricity generated by both the existing Sizewell B and new Sizewell C power stations can be exported to the National Electricity Transmission System.
- Connections will be provided from the proposed new National Grid 400kV substation building back to each reactor unit via underground cables. These connections act as a back-up to the auxiliary supply function of the main connection in planned and unplanned situations.

[2] The substation switchgear providing a link to SZB has been analysed within the Claim 6 Report [Ref. 21], which justifies that “operations on the SZC site will not adversely affect the ability to maintain an adequate safety case for the adjoining nuclear licensed site (SZB)”.

- The SZC grid connection design will use two double circuits (termed "4-circuit") [Ref. 27] and hence two trains of pylons and OHL off site will be used to transmit power to the wider national grid.

The expected design is partly reproduced in Figure 8 in Annex B – SZC SITE LAYOUT WITH PYLON AND OHL POSITIONS and shows the currently accepted pylon, OHL and national grid substation locations.

The Grid Connection at SZC will be designed, manufactured and installed in order to meet the requirements of the U.K. Security & Quality of Supply Standard (SQSS) [Ref. 5] which states:

"The onshore transmission system shall be operated under prevailing system conditions so that for the secured event on the onshore transmission system of a fault outage of:

- *A double circuit overhead line; or*
- *A section of busbar or mesh corner,*

There shall not be any of the following:

- *A loss of supply capacity greater than 1500MW,*
- *Unacceptable frequency conditions."*

The SQSS ensures that a LOOP should be unlikely as the standard ensures that a single failure (e.g. of a Pylon / OHL or a busbar) should not lead to failure of supply and unacceptable frequency conditions. Finally, the design of the electrical grid connections at SZC will also have to comply with the requirements of the U.K. National Grid Code [Ref. 6]. The U.K. National Grid Code is a technical specification which defines the parameters which any facility connected to the national grid must meet in order to ensure the secure and efficient functioning of an electrical system.

3.2.2 Grid Code Compliance at SZC

As stated above, one of the key enablers for the SZC project is to demonstrate that the UK-EPR can comply with the Grid Code [Ref. 6] and will therefore be permitted to connect to the UK national electricity transmission system. Compliance with the Grid Code is a standard condition for the granting of an Electricity Generation Licence.

An extensive programme of work has been initiated on the HPC project with respect to Grid Code compliance which, given the overall aim of replication of the HPC design at SZC, is highly relevant to demonstrating Grid Code compliance at SZC. The work at HPC with respect to grid code compliance has identified two areas where an application may need to be made to the Office of Gas and Electricity Markets (Ofgem) for derogation:

- Operating Frequency Range

  The Grid Code requires continuous operation when the system frequency is in the range 49Hz – 51Hz. The UK-EPR is designed to operate continuously in the range 49.5Hz – 50.5Hz.

- Frequency Response Capabilities.

  Frequency response refers to the automatic variation of power output in response to grid frequency. Discussions with National Grid have confirmed that such restrictions may require one or more derogations to be granted, if they could not be designed out.

HPC and SZC will need separate derogations to be issued to be Grid Code compliant. Hence the intended strategy for SZC is to progress these issues at HPC for application for derogation, noting that this will assist any subsequent SZC derogation. HPC project is currently seeking confirmation from Framatome and the Responsible Designer (RD) of the extent of the non-compliance versus the Grid Code requirements in order to progress any derogation. Additionally, HPC will instruct EDF Research and Development (R&D) to perform modelling work to assess the potential impact of the HPC capability deficit which will be used in future discussions with Ofgem and National

Grid with regards to derogation application. The current intent is for HPC project to be able to submit a derogation application by the end of 2021. The position of Ofgem and National Grid with respect to the derogation will consequently inform the SZC project.

In addition to the above, there are several issues with respect to Grid Code compliance which are specific to SZC as a result of the change to the Grid Code to comply with the EU Regulation "Requirements for Generators" (RfG) which came into force on 17th May 2016. This resulted in a new section being written into the Grid Code called the "European Connection Conditions" (ECC).

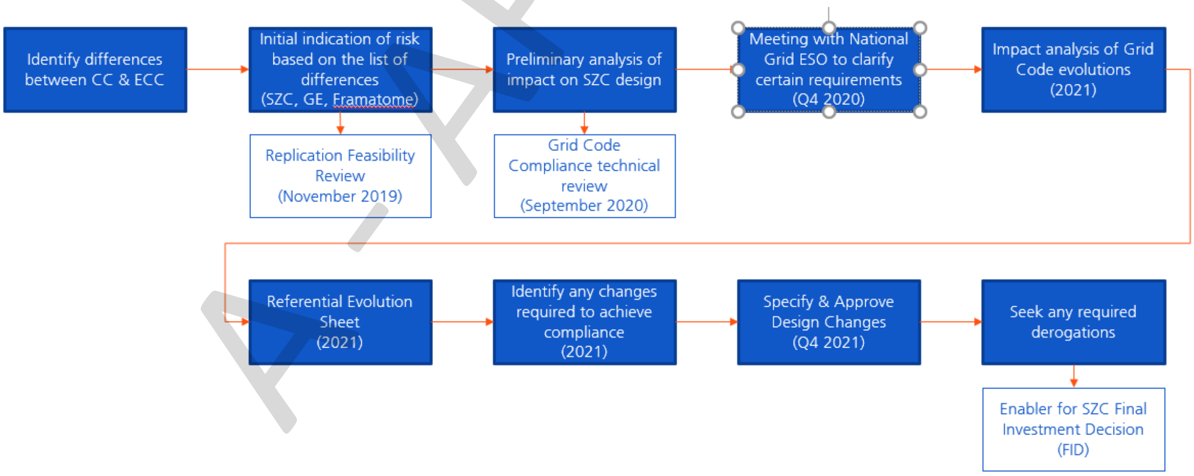
An initial review of the requirements of the ECC applicable to SZC was commenced in 2019 by Framatome and General Electric (key UK-EPR technology suppliers). This review identified several areas requiring further clarification and analysis. The majority of the issues identified in 2019 have been clarified with National Grid such that it is expected that design changes will not be required for them. However, at the time of writing there is one remaining issues to be addressed:

- Limited Frequency Sensitive Mode – Under-frequency (LFSM-U).

  This new requirement requires a plant operating at a set-point less than 100% nominal power to automatically increase power output in response to system frequency, where the frequency drops below 49.5Hz (the power increase only being limited when the plant reaches 100% nominal power output). This function is not required and has not been implemented at HPC. Current work is focussed on whether or not the UK EPR, or nuclear power plants more generally, would be capable of complying with this requirement. If not, it may be possible to make the case for non-compliance to National Grid without the need for a derogation.

In order to address the risks with regards to replication of the HPC design arising from the new requirements of the Grid Code applicable to SZC alone, a risk mitigation plan has been put in place by the SZC Project [Ref.28]. This mitigation plan is shown below in *Figure 2*

Figure 2 - New Grid Code Requirements Risk Mitigation Plan



Hence, whilst there are some remaining issues to be solved at HPC and SZC with respect to Grid Code compliance, an extensive programme of work has been initiated at HPC for issues common to HPC and SZC to support derogation application, the outcome of which will be used to inform the SZC project. There are also ongoing discussions with National Grid with regards to the Grid Code compliance issues specific to SZC as a result of the ECC, for which a risk mitigation plan is in place. Therefore, it is confidently expected that a solution will be found for the above issues (via submission of a structured case for non-compliance, submission of derogation, or via design change) prior to connection of the units at SZC to the UK National Electricity Transmission System.

3.2.3 Differences between SZC Grid Connection Design and HPC Design

Although the SZC project aims to replicate the HPC design as far as possible, this is not possible for the grid connection design, due to the requirements and design of the National Grid at site locations. The differences in the grid connection design between SZC and HPC are summarised below:

- Two double circuit connections (termed "4-circuit") feeding the National Grid substation at SZC versus three double circuit connections (termed "6-circuit") at HPC.
- National grid substation location and Pylon positions and OHL / cable routing at SZC different to those at HPC.

As a result of the 4-circuit design at SZC (versus 6-circuit at HPC) there is reduced redundancy at SZC for some LOOP inducing hazards. HPC uses a 6-circuit design due to the increase in electricity generating capacity in South-West England that results from the operation of HPC. To enable the national grid to handle the increased future load from HPC without breaching capacity and stability limits, the National Grid is building a new double circuit connection between Bridgwater and Seabank that adds to the existing two double circuits. In Suffolk in the East of England, no such limits will be breached for the two existing double circuits (4-circuit) when SZC starts generating and hence there is no requirement for a 3 double circuit (6-circuit) arrangement at SZC. Appendix H of the Construction Agreement between NNB (SZC) and National Grid [Ref. 27] details the upgrade works required to connect SZC to the wider electricity transmission system.

The national grid substation and pylon positional changes are primarily as a result of the reduced space on the SZC site versus the HPC site, which has led to site layout differences. The differences in the National grid substation position (highlighted yellow) and the differences in pylon positions between the two sites are shown in Figure *9* in Annex C. The positional changes of the pylons at SZC versus HPC are also shown in Figure 10 in Annex C . Reference [4] further explains that the pylon and cabling design with respect to temperatures and humidity is compatible for the SZC site and as a result no further discussion of these aspects is provided in the hazard analysis.

3.2.4 SZC Grid Connection Design Resilience

To demonstrate that the SZC site can be connected to the electrical grid, the adaptions of the grid connection design have been analysed in regard to the hazards that could be experienced at SZC. The hazards reviewed in detail in reference [4] are summarised below.

<u>Internal Grid Events</u>

Given the overall SZC design will be identical (apart from physical position changes and the two double circuits design) to that at HPC and may use more modern components in places, there is no reason that the generic UK value for internal grid event contribution to LOOP from HPC cannot be applied to HPC.

<u>External Hazards with Global Effects</u>

The following external hazards with global effects were assessed for their impact to LOOP frequency at SZC, and an estimation of risk and contribution to overall LOOP frequency for each hazard / cause is provided[3].

- Wind, Rain, Snow/Hail
- Seismic Events

[3] Combinations of external hazards and LOOP events are also discussed in this report in Section 5.2.4 with respect to Claim 4.

- Extremes of Air Temperatures (Hot and Cold)
- Solar Activity/ Space Weather

External Hazards with Localised Effects

The following external hazards with localised effects were analysed. As with the external hazards with global effects above, an estimation of risk and contribution to overall LOOP frequency is provided.

- Lightning
- Tornados
- Electromagnetic Interference
- Aircraft Crash
- External Missile
- External Explosion
- Off-site fire

Internal Hazards

The following internal hazards were analysed with regards to LOOP frequency:

- Direct vehicular impact
- Internal EMI/Radio Frequency Interference
- Internal Fire
- Internal Explosion
- Internal Missiles
- Dropped or Impacted Loads

Summary of Discussion of Hazard Induced LOOPs with respect to SZC Grid Design

The external hazards with localised effects are seen to have an extremely low small risk of inducing LOOP, as justified in reference [4], given the change in 4-circuit design utilised at SZC compared to 6-circuit design at HPC. The contribution of internal hazards to LOOP is expected to be negligible, the potential change in impact from vehicular impact due to design changes is expected to be minimal due to there being fewer pylons at SZC than at HPC.

Reference [4] demonstrates that the dominant contributor to overall LOOP frequency at SZC is external hazards with global effects (e.g. wind, rainfall, seismic as opposed to lightning and tornado which have more local effects). Reference [4] shows that the design changes at SZC are unlikely to lead to significant change in the LOOP hazard magnitude or overall LOOP frequency at SZC compared with the HPC assessments. This is because any severe natural external hazard events would impact the entire SZC (or HPC) site and could affect all equipment simultaneously. Hence a 6-circuit design versus a 4-circuit design, or the differences in layout, will not make an appreciable difference to LOOP frequency.

Effects of Future Climate Change on LOOP Frequency

As a result of the expected effects of climate change it is possible that the frequency and magnitude of natural external hazards that induce LOOP will increase. However, this increase will occur over relatively large timescales, allowing the future SZC operational safety case to take any changes in LOOP frequency into account. There is therefore confidence that LOOP frequencies at SZC in the future will not be significantly different from the currently accepted LOOP frequencies detailed below in section 3.2.5.

3.2.5 LOOP Frequencies

The accepted SZC site-specific LOOP frequencies from reference [8] are shown below in Table 2.The frequencies for Short and Long LOOP have been derived based on British Energy and UK Nuclear Reactor OPEX which showed that over 86% of Short and 100% Long LOOPs that have occurred in the UK were as a result of bad weather (i.e. external hazards with global effects).

Table 2 - SZC LOOP Frequencies

Event	Frequency Per Reactor-Year (pry) / Per Reactor Trip (prt)	Basis
Short LOOP	[redacted]	Historical U.K. OPEX from British Energy and Nuclear Reactor operation
Long LOOP	[redacted]	
Extended LOOP	[redacted]	GDA
Consequential LOOP	[redacted]	GDA – Based on Sizewell Data

In comparison to the HPC values, the SZC Site Specific Short and Long LOOP frequencies are comparable and in the same order of magnitude as the HPC frequencies, with the short LOOP frequency value lower for SZC and the Long LOOP frequency being slightly higher than HPC.

Finally, it is known at the time of writing that National Grid will provide an independent assessment of LOOP frequency based on the SZC grid connection design. The results of the National Grid LOOP frequency assessment will be compared to the accepted LOOP frequencies presented above in order to provide a cross-check and to ensure that the LOOP frequency values used within future SZC Probabilistic Safety Assessment (PSA) within the SZC PCSR are appropriately conservative.

3.3 Claim 2: Conclusion

There are a small number of remaining Grid Code compliance issues at SZC although there are mature programmes of work in place along with a risk mitigation plan and ongoing discussions between SZC and Ofgem / National Grid to ensure that these issues are adequately resolved prior to the units at SZC being connected to the UK National Electricity Transmission System.

Claim 2 presents the SZC LOOP frequencies and justifies that the design of the SZC grid connections does not contribute significantly to the overall LOOP frequency, which is dominated by external hazards. Claim 2 also justifies that the LOOP frequency for SZC as a result of grid connection design is not expected to be significantly different to HPC because the SZC grid connection design will have in-built redundancy, will conform to modern standards and specifications and is not significantly different to the design which will be used at HPC.

The overall conclusion at the NSL application stage is therefore that there is a high degree of confidence that “the site can be connected to electricity grid supplies”. Further work will take place as a part of development of the SZC PCSR, in order to demonstrate that hazards to the grid connections and risks associated with grid stability are ALARP.

4 Claim 3: Adequate cooling capability can be provided for all normal and fault conditions

4.1 Claim 3: Introduction

Provision of adequate cooling to the plant is a key aspect of fulfilling the Main Safety Functions [Ref. 33] and has the potential to be impacted by site-specific conditions due to the use of seawater and air as ultimate heat sinks. Confidence that adequate cooling capability can be provided at SZC for all normal and fault conditions is based on the following arguments:

- Cooling-related Structures, Systems and Components (SSCs) are part of an advanced EPR design that will be replicated at SZC (see Section 4.2).
- Site-specific conditions have been adequately characterised for SZC (see Section 4.2.2).
- Where different site-specific conditions compared to HPC have necessitated design changes for SZC, these changes are managed through robust change control arrangements, and an adequate safety demonstration will be able to be made (see Section 4.2.3).
- Where different site-specific conditions compared to HPC have not resulted in design changes, this is justified and an adequate safety demonstration will be able to be made (see Section 4.2.4).

The evidence to support these arguments is outlined in the sub-sections below.

4.2 Claim 3: Summary of Arguments and Evidence

4.2.1 Replication of HPC for SZC

As described in Section 1.4, SZC will be a NOAK nuclear power station that re-uses the mature and justified design already being built at HPC, and other sites around the world. This means that the overall design of the SSCs will be heavily based on a 'tried and tested' design, from which there will be no fundamental changes.

The SZC design is based on the HPC RC2.0 design, with design changes made where necessitated by SZC site-specific conditions. A summary of the key design changes made for SZC relative to HPC is provided in the Modifications Summary Report [Ref. 30]. The majority of SSCs are unaffected and the systems of the Nuclear Island are expected to be almost entirely unchanged from the HPC design.

Additionally, safety assessment principles, guidance and methodologies applied by HPC are either equally applicable to SZC, or will be replicated, including:

- The NSDAPs [Ref. 32], which are NNB's high-level principles for performing nuclear safety assessment, and which are equally applicable to HPC and SZC.
- The Safety Case Manual [Ref. 33], which provides further detail as to how the NSDAPs are applied through safety assessment and design substantiation, and which provides a link to a wide range of detailed safety assessment methodologies.
- Detailed methodologies for safety assessment, including for faults and hazards analysis, which will be replicated for SZC.

Given the high level of replication in the design and in the approach to safety assessment, significant confidence can be taken from the safety assessment already performed for HPC. This includes:

- Faults analysis and normal operation analysis to confirm that the Safety Functional Requirements (SFRs) placed on SSCs, including cooling-related SSCs, have been correctly defined. Given the replication of design (in particular the Nuclear Island) and assessment methodology, these SFRs are expected to be fundamentally the same for SZC.

- Analysis demonstrating that cooling-related SSCs are capable of fulfilling their Safety Functional Requirements. This was provided for HPC at the PCSR3 stage. Given the replication of the design, there is high confidence that a similar demonstration can be provided for SZC.
- Hazards analysis demonstrating that the ability of SSCs, including cooling-related SSCs, to fulfil their SFRs is not significantly impacted by internal and external hazards. Hazards analysis was performed on the HPC basic design at the PCSR3 stage to de-risk the design, and is currently being performed on the HPC detailed design in support of development of the Pre-Commissioning Safety Report (PCmSR). Given the given the replication of design and approach to hazards assessment, there is high confidence that this assessment can be replicated for SZC, with a limited number of justifications where necessary by different SZC site-conditions. The ability of SZC to withstand site-specific external hazards is discussed in Section 5.

Additionally, the HPC design is currently undergoing a substantiation process to demonstrate that all identified design requirements, including SFRs , can be achieved by the design and the as-built plant. For cooling-related systems, the substantiation evidence is summarised in System Substantiation Summary Documents. Any design changes identified as necessary as a result of the HPC safety assessment and design substantiation will be incorporated into the SZC design as per the replication process.

In summary, the cooling-related SFRs and the method of delivering these SFRs will fundamentally be the same for SZC as for HPC, even if some adjustment is required to account for site-specific conditions. As such there is high confidence that "*Adequate cooling capability can be provided for all normal and fault conditions*" by the proposed SZC design, based on the assessment already performed for HPC.

4.2.2 Characterisation of Site-Specific Conditions

External hazards characterisation studies determining the SZC Site Challenge and Design Basis for each hazard have been performed for SZC and are summarised in the Site Data Summary Report [Ref. 1]. The characterisation process and the justification for adequacy of the characterisation for each hazard are discussed in Section 5, in support of JSSR Claim 4: "There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC)".

Whilst the majority of hazards have the potential to impact on cooling-related SSCs, the following external hazards in particular are of direct relevance to JSSR Claim 3:

- Extreme High Seawater Level and Extreme Low Seawater Level

The Design Basis Extreme High (still) Water Level for SZC for the year 2110 is taken to be +5.95mOD, whilst the Extreme Low Seawater Level is defined as -3.7mOD [Ref. 1]. This represents a narrower tidal range when compared with HPC as well as a lower difference between the Extreme High Water Level and the platform height, as shown in Table 3. These differences have the potential to impact the SZC cooling capability – this is discussed further in Section 4.2.3.

Table 3: Comparison of the SZC and HPC Design Basis Extreme Low and Extreme High Seawater Levels

Level / Height	HPC	SZC
Platform Height	14.00mOD	7.30mOD
Extreme High Water Level	9.73mOD	5.95mOD (2110 value)
Extreme Low Water Level	-7.08mOD	-3.70mOD (2110 value)

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

4.2.3 Safety Demonstration for Design Changes

A key objective of the SZC project is to replicate the HPC design as far as possible, and if the proposed platform height, sea water levels, and other local conditions were all the same as at HPC, then the HPC Heat Sink design would be fully replicated at SZC. However, there are aspects of the proposed location at SZC that means that that some changes cannot be avoided.

In particular, there are differences in:

- The altimetry of the site (i.e. the platform height): The SZC project has selected a 7.3mOD platform height (0.9m higher than the existing 6.4mOD SZB platform). A higher platform at SZC has been demonstrated as not reasonably practicable since the coastal flooding hazard can be adequately managed by the proposed sea defences.
- The Extreme High and Low Water Levels: SZC has narrower tidal range when compared with HPC, and also a lower difference between the Extreme High Water Level and the platform height, as shown in Table 3.

These differences drive changes to both the Heat Sink[4] design and the management of coastal flooding hazard relative to HPC. Confidence that a robust safety case can still be made is taken from:

- The comprehensive review process applied to SZC-specific design changes (described in Section 4.2.3.1 below);
- The dedicated assessment performed on changes to the Heat Sink design (described in Section 4.2.3.2 below);
- The justification provided under JSSR Claim 4 that, given the SZC site conditions and proposed design, an adequate safety demonstration for coastal flooding will be able to be made (described in Section5.2).

4.2.3.1 Design Change Process

As described in Section 4.2, all potential SZC-specific design changes are captured via design change documentation and are put through the SZC design change process detailed within the Modifications Summary Report (MSR) [Ref. 30]. This process ensures that:

- Potential design changes are categorised and thus receive an appropriate level of governance.
- Design change options for SZC are identified and compared appropriately.
- Impact analysis of any proposed change (including in terms of nuclear safety) is performed. At the current stage of the project, analysis is usually preliminary and, in many cases, records the need for detailed analysis to be performed on the proposed design change at a later stage.
- Preferred design change options are justified and can be demonstrated to reduce risk to ALARP.

All design changes are also passed through the SZC NCC for consideration, whose terms of reference are described within Reference [34], and whose purpose is to promote adherence to the SZC replication strategy.

The application of this process provides confidence that where there are changes at SZC versus HPC, a robust safety case can be constructed and an ALARP position demonstrated.

4.2.3.2 Heat Sink Design Change Assessment

Dedicated assessment has been performed to examine the key differences between the two Heat Sink designs to provide confidence that, notwithstanding these differences, it will still be possible, in principle, to demonstrate that the SZC "Heat Sink" will be capable of providing the necessary cooling for all relevant normal and fault conditions. In addition, because internal hazards can undermine cooling, there is a need to determine the

[4] 'Heat Sink' refers to the SSCs (both on-site and off-site) involved in the transmission, use, and return of seawater in the "open circuit" seawater cooling systems.

potential effect of the proposed changes to the Heat Sink design relative to HPC on the ability to make an internal hazards Safety Case for the proposed SZC Heat Sink.

It is recognised that a full detailed analysis of all the potential changes cannot be performed for the SZC Heat Sink buildings at this stage because a fully developed concept design is not yet available. Nevertheless, there is confidence that the major changes have been identified in the "Gap Analysis" documents, as well as Design Change documentation, produced by CNEPE, who are the EDF experts in the Heat Sink design.

The principal design change relative to HPC is the removal of a 5m 'slice' from the Pumping Station and Pumping Station Forebay (HP-HPF) (i.e. they will be less deep), due to the lower difference between Extreme High Water Level and the platform height, and the narrower tidal range at SZC. Additional design changes, due to the reduction in depth of HP-HPF and other site-specific factors including geotechnical conditions, affect the following buildings:

- Outfall Building (HCA)
- Marine Works
- Some Technical Galleries (HGX)
- Elements of CRF in the Turbine Hall

The Heat Sink Summary report [Ref. 9] provides a full overview of all the design changes. Due to these changes, the SZC project is unable to depend fully on the HPC demonstration of design adequacy of in HPC PCSR and ongoing HPC hazard verification studies.

Reference [9] provides a qualitative review of the potential impact on nuclear safety as a result of the more significant proposed changes. Reference [9] concludes that the currently identified Heat Sink design changes for SZC relative to HPC would not have a material impact on the ability to demonstrate that adequate cooling exists in normal conditions, fault conditions and following hazards, based principally on the following arguments:

- The necessary engineering changes to the Heat Sink buildings and equipment therein are deemed to be entirely feasible.
- The ability of the Heat Sink to fulfil its safety functions is not significantly impacted:
    - The relevant SFRs provided by the Heat Sink buildings remain the same, and moreover, the method of delivery of those SFRs will fundamentally be the same even if full replication with respect to layout / dimensions / positioning / sizing of SSCs is not possible.
    - None of the design changes could fundamentally undermine the ability of the Heat Sink systems to deliver their required safety functions.
- The design remains resilient to potential Heat Sink transients:
    - Transients that have been altered as a result of the design changes to the Heat Sink have all been assessed, including HCA overflow, forebay surge and CRF recirculation.
    - For some transients it is justified that no further design changes are required. In other cases where further design changes are identified as necessary, including for CRF recirculation, these have been defined and are summarised in Reference [9]. Therefore, there is confidence that a safety demonstration will be able to be made.
- The protection of the Heat Sink against hazards is not significantly impacted:
    - The protection against external hazards (which mostly constitutes the external envelope of buildings) will not be significantly impacted by the design changes. For seismic and airplane crash hazards, Reference [9] assesses the potential impact of the design changes on the hazard

protection and concludes that the design changes. Further details on external hazard protection for SZC are provided in Section 5.

- The impact of the design changes on the protection against internal hazards has been assessed in Reference [9] for each affected building, with the conclusion that the design changes do not significantly impact the ability to make a safety case.

In summary, by using the existing Safety Case work for HPC, and by qualitatively assessing the significant changes with respect to the ability to make a Safety Case and demonstrate ALARP in the future (as a part of the SZC PCSR production), Reference [9] demonstrates substantial confidence in Claim 3 at the NSL stage.

As the SZC Heat Sink design and associated Safety Case is developed further, appropriate detailed design work will be undertaken to ensure delivery of the designated safety functions. Studies substantiating the ability of these systems to deliver these safety functions will be performed in the fullness of time as a part of the SZC site-specific PCSR development. The judgements made in the Heat Sink Summary Report [Ref. 9] and this JSSR will be revisited and substantiated as necessary during the development of the PCSR and its underpinning detailed studies.

4.2.4 Safety Demonstration Where Design Changes are not Required

4.2.4.1 Seawater-cooled systems

As noted above in Section 4.2.2, the SZC Design Basis for Extreme Heat (Sea) can be set at the same value as the Design Basis for HPC (RC2). This is justified in Appendix 2 of the Sizewell C Extreme High Sea Water Temperatures report [Ref. 51) and summarised in the SZC Site Data Summary Report (SDSR) [Ref. 1].

Furthermore, seawater temperature is a gradual, predictable and measurable phenomenon, and as such responses to extreme seawater temperatures can be planned for ahead of time to ensure decay heat removal capability remains adequate. If necessary, operator restrictions could be placed on maintenance activities involving safety claimed seawater cooling chain equipment, or even initiate a power reduction and/or a controlled shutdown, if seawater temperatures surpass certain predetermined limits. There is therefore good confidence that any impact from slight differences in site conditions could be managed without significant changes to the design of seawater-cooled systems.

It is therefore concluded that adopting the HPC RC2 cooling system design is appropriate.

4.2.4.2 Air-cooled systems

As noted above in Section 4.2.2, the HPC RC2 Design Basis temperature values do not bound all of the SZC Site Challenge values to year 2110s. Reference [10] therefore provides further consideration of the conservatisms and margins present to confirm that adoption of the HPC Design Basis values for extreme high air temperature is appropriate for SZC. These are summarised below:

- The use of data from Wattisham in the characterisation of the present day 1E-4 p.a. extreme high air temperature is conservative when compared to the SZC site.
  - Wattisham is an inland site, and therefore generally experiences higher temperatures than a coastal site (Section 5.1 Reference [10]).
- The climate change adjustment factor has been defined conservatively.
  - The climate change adjustment factor has been defined using RCP8.5 which is a scenario characterised by a level of greenhouse gas emissions that can only be reached through an increase above the present-day emission rates (Section 5.2 of Reference [10]).

  - The model that has been used to estimate the climate change adjustment factor runs hotter than other equally valid and robust global climate models from the Coupled Model Intercomparison Project 5 (CMIP5) (Section 5.2 of Reference [10]).

- When taking into account the diurnal cycle of extreme temperature events as characterised by longer averaging periods and the heatwave profile, the resulting temperatures are significantly below the temperatures used in the HVAC system margin assessments (Section 5.3 of Reference [10]).
- Margin assessments carried out on the HPC design demonstrate that when considering very conservative scenarios, the assessed HVAC systems provide sufficient cooling with margin to ensure their safety functions (Section 5.4 of Reference [10]). Notably, for the Safety Chilled Water System (DEL), even when there is a continuous 44°C external temperature, when all DEL trains (main and backup) are available and in-service, a cooling power margin of at least 40% is available[5].
- The SZC project lifecycle will provide multiple systematic opportunities, ensured through Licence Condition (LC) arrangements, to reassess and reconfirm the adequacy of the SZC safety demonstration in regard to the extreme heat hazard (Section 5.5 of Reference [10]).

It is therefore judged that replicating the existing design of HVAC at SZC, with sizing based on the same input data as HPC, would result in designs that would still provide a considerable cooling capacity margin compared to the SZC extreme heat (air) Site Challenge. Given the conservatisms and margins discussed above, it is concluded that adopting the HPC RC2 Design Basis values for the SZC Design Basis remains appropriate, and that there is no identified need to change the elements of HPC design (e.g. the DEL chillers) that include consideration of these Design Basis values [Ref. 10]. Further studies will be performed as a part of the development of the site-specific PCSR.

Concerning the definition of Design Basis values for enthalpy and temperature beyond 2110 and up to 2140 (such as the ISFS) this is required in line with the design and safety case schedule of the SZC project. For context, the HPC ISFS is not required until approximately 10 years after the start of operation, a similar timeline is expected for SZC. Therefore, there is an advantage in carrying out this activity closer to when it is required for design activities in order to fully benefit from the latest climate change science, modelling and data that will be available at that time.

4.3 Claim 3: Conclusion

There is good confidence that adequate cooling capability can be provided at SZC for all normal and fault conditions, based on the following arguments:

- Cooling-related SSCs are part of an advanced EPR design that will be replicated at SZC.
- Site-specific conditions have been adequately characterised for SZC.
- Where different site-specific conditions compared to HPC have necessitated design changes for SZC, these changes are managed through robust change control arrangements, and an adequate safety demonstration will be able to be made.
- Where different site-specific conditions compared to HPC have not resulted in design changes, this is justified and an adequate safety demonstration will be able to be made (see Section 4.2.4).

Additional safety studies will be performed as a part of the development of the SZC PCSR which will verify that the proposed SZC nuclear power station delivers a risk that is ALARP.

[5] The DEL system margin assessments were carried out for the HPC Reference Configuration 1.2. It is recognised that there has been a reduction in cooling power margin in HPC Reference Configuration 2 for the DEL system. Nevertheless, significant margin will remain in the system even in the very conservative scenarios considered in the analysis.

5 Claim 4: There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC)

5.1 Claim 4: Introduction

External hazards characterisation studies determining the SZC Site Challenge and Design Basis have been performed for SZC and these are summarised in the Site Data Summary Report (SDSR) [Ref. 1].

A hazard identification and screening exercise was carried out in 2015 to identify potential external hazards affecting the SZC site [Ref. 26]. The exercise was completed by generating a comprehensive list of external hazards by reviewing a variety of relevant information sources and screening out those which do not have the potential to affect the SZC site. The screening exercise led to the identification of hazards specifically requiring deterministic consideration for SZC; these have been characterised in the SDSR[6] [Ref. 1].

The justification for selecting SZC Design Basis values is performed in the SDSR by first characterising the Site Challenge based on the conservative requirements set out in Section 3.1 of the SDSR. The Site Challenge is then used to define and justify the Design Basis values. In general, this is done by either adopting the Site Challenge as the Design Basis or including additional inherent margin between Site Challenge and the Design Basis, such that the Design Basis value is more conservatively defined. Where additional inherent margin has been included in the Design Basis, this is often to align the HPC and SZC Design Basis values to aid and support the overall Replication Strategy[7].

The sections below provide further detail on the information within the SDSR and explain how this information supports Claim 4 ‘There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC)’.

5.2 Claim 4: Summary of Arguments and Evidence

5.2.1 Summary of SDSR Data

A summary of the conclusions of the SDSR [Ref. 1] is included in Table 5 below.

For the majority of the external hazards, the SDSR and its supporting references demonstrate that it is appropriate for the SZC Design Basis to be aligned with the HPC Design Basis. This is typically because the SZC Site Challenge is bound by the HPC Design Basis, and therefore the SZC and HPC Design Basis can align. In this case, there can be a very high degree of confidence in Claim 4 ‘There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC),’ because SZC will be a replication of HPC, which has already been designed to be robust to the required hazard Design Basis levels.

For the other external hazards which have a SZC Design Basis value aligned with the SZC Site Challenge (e.g. external flooding), further discussion is provided in the Section 5.2.2 below to provide confidence in the adequacy of the design such that a hazard does not preclude the use of the site.

[6] Certain hazards identified in [Ref. 26] have not been characterised in the SDSR. The justification for this is provided in Appendix A of the SDSR [Ref. 1].

[7] Only one hazard (Extreme Heat (Air)) has not followed the general approach. For that hazard, a specific analysis has been carried out to justify the Design Basis values [Ref. 10]. Further information is available in Section 4.2.3.

Table 5 – Summary of SZC and HPC Hazard Design Basis Alignment. SZC hazards which will not result in an evolution of the reference design are highlighted in green. SZC hazards which have differing local conditions, and which therefore do result in an evolution of the reference design are highlighted in yellow.

External Hazard		SDSR Section	SZC Design Basis and HPC Design Basis Aligned? (Yes / No-Differing Local Conditions/ NA-below Design Basis)	Comment
Earthquake		3.2	NA – Differing Local Conditions	The seismic hazard at SZC is different to HPC and it has therefore been characterised specifically considering local conditions.
Accidental Aircraft Crash		3.3	Y	None.
Hazards Associated with the Industrial Environment	External Explosion	3.4.1	Y	None.
	External Missile (including missiles from SZB e.g. turbine disintegration missiles)	3.4.2	Y	None.
	Offsite Fire	3.4.3	NA – Below Design Basis	The SDSR shows that the magnitude of offsite fire associated with events with a 1.0E-5p.a. or less frequency, could not challenge nuclear safety. Hence, this fault need not be included in the SZC Design Basis.
	Chemical Release	3.4.4	NA – Below Design Basis	The SDSR shows that the magnitude of external chemical releases associated with events with a 1E-5/year or less frequency, could not challenge nuclear safety. Hence, this fault need not be included in the Design Basis.
	Radiological Release	3.4.4	Y	None.
	Animal Infestation	3.4.5	Y	None.
External Flooding	Coastal Flooding	3.5.1	No – differing local conditions	Local conditions are substantially different and this necessitates a potentially modified means of managing these hazards (and
	Rainfall and Surface Runoff	3.5.2	No – differing local conditions	

External Hazard		SDSR Section	SZC Design Basis and HPC Design Basis Aligned? (Yes / No-Differing Local Conditions/ NA-below Design Basis)	Comment
	High Groundwater Level	3.5.3	No – differing local conditions	hence a different design and Design Basis).
Extreme Climatic Conditions	Snow	3.6.1	Y	None.
	Wind[8]	3.6.2	Y	None.
	Tornado[9]	3.6.3	Y	None.
	Volcanic Ash	3.6.4	NA – Below Design Basis	Hazard not included for HPC. Hazard dismissed on low frequency grounds as being below the Design Basis for SZC.
	Extreme Heat Air	3.6.5	Y	SDSR shows Site Challenge to be slightly elevated above HPC Design Basis. However, the identification of conservatisms in its derivation and in the design means that the HPC design can be retained. See Section 5.2.1 above for further details.
	Extreme Cold Air	3.6.6	Y	None.
	Fog	3.6.7	NA – Below Design Basis	Hazard not included for HPC. Hazard dismissed on low frequency grounds as being below the Design Basis for SZC.
Lightning and EMI	Lightning	3.7.1	Y	None.
	External HEL	3.7.2	Y	None.
Solar Activity	Geomagnetically Induced Current	3.8.1	No – differing local conditions	The site challenge value for SZC is higher than for HPC. However, as a result of the time period of the event being equivalent for the two sites, and the conservative sizing of the potentially affected components, the increase in the site challenge at SZC does not have an effect on the design [Ref. 35].
	Ground Level Enhancement	3.8.2	Y	Work to define the Design Basis of this hazard is ongoing for both

[8] Section 3.6.2 of [Ref. 1] includes the required information for the definition of the wind generated missile hazard.
[9] Section 3.6.3 of [Ref. 1] includes the required information to verify that the tornado hazard effects at SZC are no greater than those considered in the Reference Design.

External Hazard		SDSR Section	SZC Design Basis and HPC Design Basis Aligned? (Yes / No-Differing Local Conditions/ NA-below Design Basis)	Comment
				HPC and SZC. Due to the nature of the hazard no site-specific differences are expected.
Heat Sink Specific Hazards	Extreme Heat Sea	3.9.1	Y	None.
	Extreme Cold Sea	3.9.2	Y	None.
	Frazil Ice	3.9.3	Y	None.
	Silting	3.9.4	Y	None.
	Fauna and Fauna or Anthropic	3.9.5	Y	None.
	Ship Collision	3.9.6	Y	Although the frequency of a collision involving any number of intake heads (1.88E-6/year) is significantly lower than the 1E-5/year requirement for man-made external hazards, ship collision is considered a Design Basis hazard.
	Hydrocarbon Pollution	3.9.7	Y	None.
	Underwater Explosion	3.9.8	Y	None.
	Extreme Low Sea Level	3.9.9	No – differing local conditions	Local conditions are substantially different and this necessitates a different design and Design Basis.
	Extreme Low Sea Level (Tsunami)	3.9.10	NA – below Design Basis.	Hazard dismissed on low frequency grounds as being below the Design Basis for SZC.

5.2.2 Discussion of SZC External Hazards which have a different Design Basis relative to HPC.

5.2.2.1 Earthquake

Further information on the seismic hazard can be found in Section 6.2.2. In regard to Claim 4, the seismic hazard has been characterised such that the Design Basis has been defined and justified in the SDSR. While the Design Basis for the hazard is different relative to HPC and therefore replication of the HPC safety demonstration at SZC is not automatic, early SZC design work has ensured site-specific inputs are used in the engineering sequences such that the safety requirements will result in a robust design to the hazard. This provides a high degree of confidence in Claim 4 and ensures that an adequate safety demonstration for SZC SSCs will be able to be made in the SZC PCSR.

5.2.2.2 External Flooding

A Flooding Summary Report [Ref. 23] has been produced which summarises the work that has been done to date to characterise the external flooding hazard and ensure that the design is robust to it. This report, which is summarised below, demonstrates that the external flooding hazard will not preclude the use of the site, and therefore it provides a high degree of confidence in Claim 4.

Coastal Flooding

With respect to Coastal Flooding, Reference [23] explains that the key difference between SZC and HPC is due to the natural lie of the land at Sizewell relative to the sea level. At SZC it is necessary to locate the SZC site behind a sea defence, in order to provide protection against wave overtopping effects, and to set the platform height above the extreme still sea water level. The SZC site is therefore considered to be a "protected site" as defined by the IAEA. This is different to HPC where the site naturally sits on top of a small cliff. Therefore, for HPC it was decided to set the platform height at 14.0m OD where it could provide protection against the extreme still sea water level and wave effects. HPC is therefore considered to be a 'dry site' as defined by the IAEA.

Reference [23] summarises and explains the studies which are currently available to demonstrate how the safety objectives will be met when considering the site-specific coastal flooding hazard. Notable key points are summarised below:

- Section 2.1 describes the activities that have been undertaken to characterise the coastal flooding hazard in line with relevant good practice and guidance. These activities have been used to conservatively define adequate Design Basis values for the hazards which have been used as part of design activities.
- Section 3.2.2 provides information on the adequacy of the SZC platform height.
- Section 3.2.3 explains the decoupling overtopping criteria that has been set (in line with results of platform flooding studies which show acceptable levels of flooding for a given overtopping rate) to assess the adequacy of protection provided by the sea defences. This approach ensures that overtopping rates below that criteria will not result in water on the platform higher than the door threshold height (+0.2m above the platform level).
- Sections 3.2.4 and 3.2.5 provide an overview of the independent and diverse overtopping analyses that have been undertaken. All of which provide confidence that when considering reasonably foreseeable climate change, any overtopping on the platform will remain below the conservatively defined decoupling criteria. Concerning sea level rise above what has been considered in the design (RCP8.5 at the 95th centile), the sea defences include the provision to be raised to 16.4m Above Ordnance Datum (AOD) which corresponds to a design case aligned with the H++ credible maximum level of sea level rise.
- Section 3.2.6 summarises the analysis of the tsunami hazard which shows that the protection against this hazard (platform height and sea defences) is adequate.
- Section 3.2.7 discusses hazard combinations including rainfall and overtopping for which the latest studies provide a high degree of confidence that with the planned mitigations in place, water levels on the platform will remain below the +0.2m door threshold heights. There remains approximately 10cm freeboard when a 10,000-year rainfall is combined with 3l/m/s overtopping of the sea defence, which is considered to be conservative since there is very low correlation between extreme rainfall and the coastal flooding hazard events, thus providing margin for building settlements if required.

Reference [23] concludes that the verification activities carried out to date provide a high degree of confidence that an adequate safety demonstration for the coastal flooding protection will be made ahead of any on site construction activities.

The design work on the flood defences continues, such that the justification of the sea defence design will be provided in line with the project schedule. It is expected that this will be done in the "First Safety Related Structure" safety report. Nevertheless, as a result of the ongoing design work and safety analyses summarised in Reference [23], SZC has a high degree of confidence in the adequacy of the design and its ability to provide a safety demonstration in the future such that the risks will ultimately be demonstrated to be ALARP.

Rainfall / Surface Run-off

Reference [23] summarises and explains the studies which are currently available to demonstrate how the safety objectives will be met when considering rainfall and surface run-off. Notable key points are summarised below:

- Section 2.2 of Reference [23] describes the activities that have been undertaken to characterise rainfall and surface run-off in line with relevant good practice and guidance. These activities have been used to conservatively define adequate Design Basis values for the hazard which have then been used as inputs to design and analysis activities.
- Section 3.3 of Reference [23] covers the assessments that have carried out to assess pluvial flooding. The work carried out to date shows that even when considering very conservative inputs, flooding on the platform remains below the +0.2m door threshold height for rainfall alone and when in combination with 2l/m/s of overtopping. It is therefore concluded that a safety demonstration for pluvial flooding will be able to be made once the mitigations have been defined and included in the modelling.
- Section 3.4 of Reference [23] covers the assessments that have been carried out to assess fluvial flooding. These show that water levels remain below the platform level thereby ensuring that water on the platform is able to drain and keep flooding below the required limits.

In conclusion, the verification activities carried out to date and discussed above provide a high degree of confidence that an adequate safety demonstration for rainfall and surface run-off will be made ahead of any on site construction activities.

Design work continues on the passive surface water drainage. Nevertheless, based on assessments carried out to date, SZC has a high degree of confidence in the adequacy of the design and its ability to provide a safety demonstration in the future. such that the risks will ultimately be demonstrated to be ALARP.

High Groundwater

Further information on this hazard is available is provided below under Sections 6.2.3 and 6.2.4 (Claim 5: The geology of the site provides secure long term support to the necessary structures, systems, and components).

5.2.2.3 Solar Activity

Geomagnetically Induced Current

Section 3.8.1 of the SDSR provides a summary of the site characterisation activities that have been carried out. There are a number of site-specific factors that can affect the severity of this hazard including: ground conditions; the connection to the electric grid, and the earth electric field. As discussed within the SDSR, the SZC Design Basis for this hazard has been defined in line with the SZC Site Challenge value. The SZC Site Challenge has been conservatively defined by considering an event with a return period of 1E-4p.a. and by conservatively including the maximum level of uncertainty from both the electric grid and electric field models. An assessment of the site-specific Design Basis on potentially affected equipment [Ref. 35] has concluded that the SZC Design Basis will not affect the design. Therefore, there is a high degree of confidence in Claim 4 and that a safety demonstration for this hazard will be made in the SZC PCSR.

Ground Level Enhancement

Section 3.8.2 of the SDSR provides a summary of the information available on GLE. Due to the specific phenomenology of the hazard, the characterisation activities that have been carried out at HPC are also applicable to SZC. Work is being carried out by NNB to develop a safety case for this hazard that will be applicable to both SZC and HPC[10]. Therefore, there is a high degree of confidence in Claim 4 and that a safety demonstration for this hazard will be made in the SZC PCSR.

5.2.2.4 Extreme Low Sea Level

Extreme Low sea level is a parameter used in the design and function of the heat sink. Therefore, it is important that the SZC design adopts a Design Basis value that is aligned with the local conditions rather than adopting a value from the reference design. The SZC Design Basis for this hazard is -3.7m AOD (which was originally the GDA value for Extreme Low Seawater Level). This value comfortably bounds the Site Challenge value which was characterised as -3.4m AOD. Therefore, there is a high degree of confidence in Claim 4 and that a safety demonstration for this hazard will be made in the SZC PCSR. Further information on how the Heat Sink has been adapted to site-specific conditions please refer to Section 4.2.3.2.

5.2.3 Combined Hazards

Preliminary work has been undertaken by the SZC project to assess combined hazards based on the detailed information available for HPC and Revision 1 of the SDSR [Ref. 36]. This work will be progressed through normal business so as to be completed and reported in line with the needs of the SZC PCSR.

For HPC, the justification of hazard combinations to be considered are included in Reference [24] and the general framework for the assessment of these combinations is given in Reference [25]. The SZC project aims to apply the same doctrine and utilise the Hazard Verification Studies performed for HPC as far as possible in the production of the SZC PCSR.

In regard to combined hazards, there is a high degree of confidence that they will not preclude the use of the site for two main reasons. The first is that the alignment between the SZC and HPC hazards and, for the majority, their Design Basis levels along with the high level of design replication generally ensures the applicability of the HPC hazard combination justifications in Reference [24] to SZC. The second is that, based on a set of assumptions rooted in the SZC Replication Strategy, the preliminary work that has been undertaken to assess the applicability of the existing hazard combination work to SZC has found only six combinations that require further investigation.

Of those six combinations, three are related to external flooding. A site-specific external flooding safety demonstration will be produced which will cover these combinations. Further information on external flooding is available in Reference [23]. The other three combinations are related to an external hazard (external explosion, wind generated missile and tornado) causing a pipework leak or break. For these combinations the ongoing normal business design work is expected to confirm that, due to the high degree of design replication at SZC, the justification for these hazard combinations (which is rooted in features of the design) will be replicable. Further information on these specific hazard combinations, as well as all others, will be provided in the SZC PCSR.

[10] It should be noted that it is acknowledged by the ONR that the topic of space weather as an External Hazard is a relatively immature field in terms of characterising the event and engineering the protection [Ref. 50].

Therefore, there is a high degree of confidence that there are no external hazard combinations that will preclude the use of the site, and that an adequate safety demonstration for SZC SSCs will be able to be made in the SZC PCSR.

5.2.4 External Hazards and Loss of Offsite Power

The link between external hazards and LOOP is considered in two ways. The first has been discussed in Section 3.2.5under Claim 2 where the contributors to the LOOP frequency at SZC are discussed. Work has been performed in [Ref. 4] to assess potential causes of LOOP [Ref. 4] including estimation of risk and contribution from each potential hazard. It demonstrates that the dominant contributor to overall LOOP frequency at SZC is external hazards with global effects (e.g. wind, rainfall, seismic as opposed to lightning and tornado which have more local effects) and concludes that the SZC grid connection design is unlikely to lead to significant changes in the LOOP frequency as a result of hazards compared with HPC.

The second way in which external hazards and LOOP events are considered is through combined events (see Section 5.2.3). Further information on this is available in References [7] and [24]. Essentially, where it is considered that a LOOP could occur at the same time or as a result of an external hazard, the external hazard safety requirements necessitate the combination to be assessed. This ensures that, where required, the protection provided against LOOP is robust to external hazards, and that the protection provided against external hazards will function in a LOOP. Given the high degree of design and safety demonstration replication (where applicable) between SZC and HPC, this approach is expected to result in a SZC design which is equally as robust to external hazard – LOOP combinations as HPC.

Therefore, as a result of: the hazard combination work discussed in Section 5.2.3; the analysis of external hazards on the SZC grid connection summarised in Section 3.2.4 [Ref. 4]; and the SZC Replication Strategy, there is a high degree of confidence that the combination of external hazards and LOOP will not preclude the use of the site, and that an adequate safety demonstration for SZC SSCs will be able to be made in the SZC PCSR.

5.3 Claim 4: Conclusion

The overall conclusion at the NSL application stage is a high degree of confidence that "*there are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC)*". Further work will be undertaken as part of normal business engineering activities to ensure a design that is robust to external hazards and for which there is an adequate safety demonstration in the SZC PCSR.

6 Claim 5: The geology of the site provides secure long term support to the necessary structures, systems, components

6.1 Claim 5: Introduction

Evidence already exists, and further evidence is in the process of being finalised in order to demonstrate that the site will be capable of providing long term support to the necessary nuclear safety important structures, systems, and components.

Information on the existing evidence that provides confidence in Claim 5 is presented in Section 6.2 below.

6.2 Claim 5: Summary of Arguments and Evidence

6.2.1 Geological Characterisation

A comprehensive programme of Onshore and Offshore site investigations has been undertaken at SZC. Site Investigation studies have been planned and executed in controlled stages to build up a detailed geological understanding of the site and its environment. This work has established the geotechnical properties of the soils and rocks, and enabled understanding of the hydrogeological conditions. Relevant data has been obtained from the following sources:

- Existing geological, hydrogeological and geotechnical information, including:
    - Geological mapping;
    - Borehole logging surveys;
    - Soil maps;
    - Geological, geotechnical and geophysical reports;
    - Subsidence records;
    - Existing piezometers at the SZC site;
    - Hydrogeological maps, hydrological and tidal data; and
    - Seismic data and historical earthquake records.
- Experience of ground conditions and performance at the SZA and SZB sites.

The findings of the Phase 1 site investigations are reported in the Preliminary Onshore Investigations - Ground Investigation Report [Ref. 11]. This report formed the basis for the production of the Step 1 Interpretative Report [Ref. 12].

The findings of the Phase 1 investigations informed a second programme of more comprehensive investigations to characterise the SZC site (Phase 2). The results of the Phase 2 investigations are presented in the Phase 2 Ground Investigation Report [Ref. 13], which provides a summary of the ground investigations undertaken between 1957 and 2018, and presents the results from the most recent onshore and offshore ground investigations undertaken in 2019. Given all these studies the geology of the site is well understood. A more detailed overview of the geological conditions at SZC is given in Reference 1.

From the considerable amount of work undertaken to date to characterise the geology of the site, no geological challenges have been identified that preclude the SZC site from providing secure long term support to the necessary SSCs. Furthermore, this statement remains true within the constraints of the replication strategy outlined in Section 1.4.

It should also be noted that the understanding of the geological conditions from the ongoing geological characterisation work provides input data to the normal business civil engineering design process activities. This workstream will ultimately demonstrate a robust civil design, given the geological conditions.

6.2.2 [redacted]

[redacted]

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

The work done to characterise the ground motion seismic hazard, which has resulted in the production of the PSHA study and the SZC specific DBE, provides a high degree of confidence that this hazard does not preclude the site from providing secure long term support to the necessary SSCs.

6.2.3 Groundwater Characterisation

Groundwater refers to the water present underneath the ground surface, within the soil, for example that absorbed following rainfall events. The High Groundwater Level hazard refers to the maximum height reached by the groundwater table at SZC at a given return period.

The SZC main site consists of a permeable aquifer (Crag) overlain by impervious upper layers (peat and clay deposits). The main site therefore requires the casting of a cut-off wall (geotechnical enclosure), prior to earthworks, for the purposes of dewatering and to allow unsuitable soil layers to be removed and substituted by backfilling with permeable materials of a suitable quality. The hydrogeological conditions on the SZC main site will therefore be modified and this necessitates a thorough understanding of the expected groundwater conditions.

Rainfall recharge provides the driving mechanism for groundwater flow. Groundwater can seep or spring out if the water table intercepts the surface against outcrops of lower permeability strata and also provides base flow to surface watercourses.

The assessment of Groundwater Levels (GWL) is based on knowledge of the hydrogeological site investigations that were carried out alongside the geological investigations between 2010 and 2011 [Ref. 15], and between 2013 and 2014 [Ref. 16]. These investigations installing a network of 21 piezometers to study the hydrogeological characteristics across the entire proposed SZC site.

GWLs are estimated in operational phase conditions i.e. after construction, accounting for earthworks, building foundations, changes in recharge condition and site drainage, for the remaining lifetime of the plant (including decommissioning). The 2110 GWL values (applicable to all structures except HHI and HHK) proposed for the SZC main site inside the cut-off wall and the 2140 GWL values (applicable to HHI and HHK) are presented in Table 6. These GWLs are design values based on numerical modelling and are defined without any mitigation of groundwater levels [Ref. 17].

Table 6 - Detailed Groundwater Level Assessment for the SZC Main Site Inside the Cut-Off Wall

Groundwater Designation	Definition	Proposed GWLs (mAOD)	
		2110	2140
$G_{k,wl}$ Permanent level	Permanent actions due to the permanent level of groundwater table. This is the GWL that will not be exceeded for 50% of plant design working life.	+1.05	+1.21
$Q_{k, wl, EF}$ Frequent (high) level	Frequent value of effects due to the variations of level of the groundwater table from its mean value. This value is associated with the groundwater table level which may be exceeded for only 1% of plant design working life.	+1.48	+1.78
$Q_{k, wl, EH}$ Characteristic (high) level	Characteristic value of effects due to the variations of level of the groundwater table from its mean value. This value is associated with a return period of 100 years.	+2.11	+2.61
$A_{d, wl}$ Accidental level	Design value of action due to flooding. This value is associated with a return period of 10,000 years.	+2.21	+2.72

The SZC Site Challenge GWLs inside the cut-off wall have been compared in Reference [17] to the geotechnical limit stated for HPC (i.e. the Design Basis for HPC). These Accidental level values are presented in Table 7 below. A positive number indicates that the GWL is higher at SZC than at HPC.

Table 7: Comparison of design GWLs between HPC and SZC

ETC-C + UK CD Designation	**Difference between HPC and SZC GWLs with respect to platform level**				
	NI	**East of NI 1**	**HM/HF**	**HBX**	**HP/HPF**
$A_{d,\,wl}$ Accidental level (1 in 10,000 year return period)	-2.8	-0.1	**+0.7**	**+0.2**	**+0.7**

The design values are favourable for the Nuclear Island since the GWL is lower relative to the platform at SZC than at HPC. The design values are less favourable for the CI-BOP since the GWL is higher relative to the platform at SZC than at HPC. However, this does not necessarily translate into uplift on civil structures. This is discussed further in Section 6.2.4 below.

6.2.4 Ground Bearing Capacity and Building Global Stability

For the purpose of the SZC onshore geotechnical pre-application report [Ref. 19], bearing capacity checks are proposed by comparing the quasi-permanent building loads to the "creep" bearing resistance. This type of checking is mentioned in Eurocode 7 [Ref. 18] in order to limit excessive displacement and to ensure that the ground behaves as an elastic medium. This type of check is not systematically the most onerous case, however it is the only check that can be carried out at this stage, taking into account the input data available (i.e. dead loads of buildings). The pre-application report [Ref. 19] shows that no exceedance of bearing resistance is expected for any SZC building.

All the major SZC buildings (all NI buildings and the HM building) are founded on a distribution slab (called R1++ backfill), which is cement bound and much stiffer than ordinary granular backfill. The solution is similar to what has been done at Gravelines in France or Dungeness in the UK. A detailed settlement analysis [Ref. 38] has been carried out and despite the presence of the R1++ backfill, modelled absolute settlements are shown to be high; the maximum calculated absolute settlement is 150mm around CRX area. A workstream is currently ongoing to investigate potential measures to counteract this high absolute settlement to ensure that it does not impact the 200mm door thresholds that are required to protect the buildings against flooding. The detailed settlement analysis [Ref. 38] also reports on differential settlements, the maximum differential settlement occurs between the HQB and the HVL and is equal to 11mm. Differential settlements are small and will therefore not challenge any equipment crossing joints between buildings. Moreover, the 11mm displacement is the maximum differential displacement and does not consider any displacement that will have been absorbed during the construction of the buildings before any equipment is installed between any two buildings.

Despite the higher groundwater level at SZC (assuming no groundwater mitigation measures) compared to HPC (which has a drainage gallery), global stability checks that have been carried out on the buildings within the replication study scope have not shown any sensitivity to uplift. Detailed global stability checks will be carried out on a building-by-building basis as part of the detailed design. A report was produced for HPC ("Hinkley Point - Supplementary study on the groundwater levels for design studies (new design of the peripheral gallery)") [Ref. 20] which concluded that, if the HPC GWL control system failed, and GWL rose to platform level, there would not be significant issues with uplift for the structures on the site. Given the embedment of structures is similar at SZC, the results of the HPC assessment are valid and can provide confidence in the robustness to uplift of the SZC structures.

Groundwater mitigation measures are not being proposed at SZC. The projected GWLs are affected by climate change, so significant margin exists in the levels for the first decades of operation. Monitoring would allow a recalibration and the introduction of mitigation measures if necessary. The SZC project remains confident that there are options available to manage the potential impact of this hazard if they are required, and that an appropriate solution would be identified. This is because the unmitigated hazard at SZC is less significant than the unmitigated hazard at HPC, and feasible solutions would exist (e.g. groundwater mitigation measures, or civil changes) should they be required. (Note that if a groundwater mitigation system is required at SZC it would not include a drainage gallery due to differences in geology, hydrogeology, rainfall recharge and the altimetry of the site).

6.3 Claim 5: Conclusion

The overall conclusion at the NSL application stage of the project is therefore that there is confidence that "*the geology of the site provides secure long term support to the necessary structures, systems, components*". Detailed geotechnical assessments (as recorded in the GIR [Ref. 13] and pre-application reports [Ref. 19]), hydrogeological studies (as recorded in the groundwater levels assessment report [Ref. 17]), seismological studies (as recorded in the PSHA [Ref. 37] and capable faulting studies) and settlement studies (as recorded in the detailed settlement study report Ref. 38]) have concluded, and provide confidence that the SZC Project can make the above Claim.

7 Claim 6: Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining Nuclear Licensed Site (SZB).

7.1 Claim 6: Introduction

The SZC site is located adjacent to the SZB site and therefore introduces new external hazards or changes existing external hazards considered in the SZB Safety Case. The external hazards environment around SZB will change throughout the construction period for SZC and then reach a relatively stable / permanent state as SZC becomes operational.

In order to provide the information and understanding necessary to demonstrate confidence that operations at SZC site will not adversely affect the ability to maintain an adequate Safety Case for SZB, SZC Design Authority (DA) Safety Case Branch and the Hazards SQEPs at ENGL DA and the SZB site, as well as other areas of the SZC project, have been proactively engaging. From these ongoing discussions with ENGL, the key potential impacts to the SZB External Hazards Safety Case, as a result of the construction and operation of SZC have been identified. A report produced in 2020 in support of JSSR Version 1 entitled “Preliminary Arguments Supporting JSSR Claim 6” [Ref. 21] was produced in order to review these impacts. It aimed to provide confidence that potential impacts would not lead to the inability of SZB to provide an adequate Safety Case which demonstrates any elevation in risk can be controlled in accordance with the principle of ALARP, and will be either tolerable / broadly acceptable. This preliminary analysis concluded that for the majority of impacts identified during SZC construction and operation, there is strong confidence in the ability of SZB Nuclear Licensed Site to maintain an adequate Safety Case. It also identified two areas upon which further work was required to more rigorously underpin the Claim 6 assertion, and to provide more substantial confidence at the NSL application stage. The two topics were Turbine Disintegration and Pluvial Flooding.

As a result of the conclusions of Reference [21], a substantial program of work has been undertaken in regard to the two topics corresponding to their relative risk. This work, reported in the following sections with reference to key supporting documentation, enables a more thorough and robust demonstration of Claim 6 in support of the SZC NSL application. The supporting deliverables are a dedicated analysis of the Turbine Disintegration topic [Ref. 39], capturing the latest outputs from the associated workstream, and an update to Reference [21] which captures the latest project information relevant to the ways in which SZC could potentially affect the SZB safety case during construction and operation including pluvial flooding [Ref. 47].

As well as being involved as key stakeholders in the program of work related to Turbine Disintegration, ENGL DA and SZB Site have reviewed References [39] and [47] to provide confidence that the deliverables adequately capture and represent their perspectives.

7.2 Claim 6: Summary of Arguments and Evidence

7.2.1 Overview

As stated above, the SZC site is located adjacent to the SZB site and therefore introduces new hazards or changes existing hazards considered in the SZB Safety Case. A comprehensive review has been undertaken to identify the potential risks SZC poses to SZB. These have been investigated to provide an analysis of the ways in which SZC construction and operation could affect SZB’s external man-made and natural hazards Safety Case. The assessment provides a high degree of confidence for each of the hazards considered, that SZC site will not adversely affect the ability of SZB to be able to maintain an adequate Safety Case. The topics covered by the assessment are:

- SZC-SZB Interface – Discussed further below;
- Changes potentially affecting external man made hazards Safety Case for SZB during operation of SZC:
    - SZC turbine disintegration (this is covered by a separate report [Ref. 39]) – Discussed further below;
    - Explosion, missiles, and fire hazards during operation of SZC;
    - Internal flooding on SZC causing surface run-off to SZB;
    - Nuclear accidents and radiological releases on SZC impacting SZB;
    - SZC pylon collapse potentially impacting SZB
    - Other man-made hazards from SZC (during operation) impacting SZB;
- Changes potentially affecting natural external hazards Safety Case for SZB during operation of SZC:
    - Changes to pluvial flooding of SZB during operation of SZC – Discussed further below;
    - Changes to flood defences for SZB during operation of SZC;
    - Potential changes to groundwater levels at SZB resulting from the presence of SZC;
- Changes potentially affecting external man made hazards Safety Case for SZB during construction of SZC:
    - SZC construction hazard management;
    - Grid Connection Impact on SZB;
    - Increase in shipping activities during SZC construction;
- Changes potentially affecting natural external hazards Safety Case for SZB during construction of SZC:
    - Changes to pluvial flooding of SZB during construction of SZC;
    - Changes to flood defences of SZB during construction of SZC;
    - Potential changes to groundwater levels at SZB during construction of SZC.

For the topics which have undergone significant development since Version 1 of the JSSR, further information is provided in the sections below.

7.2.2 SZC-SZB Interface

7.2.2.1 Overview

For the construction and operation of SZC, there is a need for a transfer of land from ENGL who own and operate SZB to NNB Generation Company (SZC) Limited ("SZC"). This land transfer to SZC is required to demonstrate security of tenure and it is a prerequisite to SZC obtaining a Nuclear Site Licence. This land transfer is part of a package of legal agreements between SZC and ENGL which will be put in place ahead of commencement of construction activities on the SZC site. Those agreements that can be considered to relate to Claim 6 are discussed below. As the signature of the package of legal agreements is linked to the FID of the SZC project, the agreements have not been finalised. However, as they have undergone thorough review from both organisations, there is a high degree of confidence that they accurately represent the intent of both organisations.

Both organisations recognise the importance of their shared interface to nuclear safety. Hence the legal agreements discussed in the sections below have received the required level of scrutiny from SQEP individuals within both organisations. It is expected that as the SZC project continues to develop, the management of the interface will mature in line with the needs of both organisations.

7.2.2.2 Nuclear Safety Co-Operation Agreement

The (advanced draft) Nuclear Safety Co-Operation Agreement (NSCA) broadly follows the form of NSCAs used in respect of other generating stations, and is mainly focused on facilitating co-operation between SZB / SZC to ensure ENGL and SZC, in discharging their own nuclear safety regulatory requirements, do not adversely impact the other's nuclear safety regulatory requirements. This agreement is facilitated by information sharing, regular meetings, identifying areas which might require further contracts, and agreeing specific minimum requirements. The NSCA will apply from the moment SZC obtains its NSL and continues until delicensing.

7.2.2.3 Operational Protections Agreement

The Operational Protections Agreement (OPA) supplements the NSCA by providing additional protections in respect of the potential impacts on SZB connected with the construction of Sizewell C. In particular, it facilitates the two organisations' desire to co-operate to ensure appropriate mitigation measures (Operational Protections) are agreed and implemented to seek to ensure that the risk of the site construction activities potentially having a detrimental effect upon the safe operation of SZB is to the required standard.

Effectively, the OPA requires SZC to agree with ENGL and implement operational protections (e.g. mitigation plans) before undertaking or continuing work which could potentially have a detrimental effect on SZB. It should be noted that while the scope of the OPA includes risks associated with nuclear safety, the scope of the agreement also covers other 'detrimental effects' as defined in the OPA. Therefore, only a subset of the potential risks within the OPA could affect nuclear safety.

The OPA has undergone thorough review by relevant individuals within both the SZC and SZB organisations. The identified risks are all judged to be low probability but potentially high consequences and will therefore be subjected to mitigations such that they are managed to the standards required by both parties. Mechanisms are in place to ensure that SZC construction activities are shared with SZB to identify potential risks, with the level of Operational Protection agreed between the two parties being commensurate to the risk posed.

7.2.2.4 Licence Condition 19 Arrangements

SZC is putting arrangements in place in line with the requirements of having a Nuclear Site Licence, intelligently replicating arrangements used at HPC regarding the interaction with adjacent sites, SZA and SZB. This includes the arrangements for LC19 'construction or installation of new plant'. The SZC NSL Compliance Matrix [Ref. 40] shows how SZC complies (or intends to comply) with the 36 LCs. In regard to LC19 the Compliance Matrix identifies a number of procedures, including 'Communicate with Adjacent Facilities'. The purpose of this procedure will be to ensure effective communication of future planned activities to the adjacent nuclear facilities and to promote co-operation between the adjacent licensee organisations. The procedure will also be an enabler to the effective conduct of the cross-site modifications process. These arrangements will be implemented in accordance with the SZC LC Compliance Matrix [Ref 40], meeting the requirements of the SZC Licensing and Radioactive Substances Regulation (RSR) Permitting Strategy [Ref 41].

7.2.2.5 SZB / SZC Joint Project Board

In order to facilitate the management of risk as a result of the construction and operation of the UK-EPR at SZC next to the adjoining SZB nuclear licensed site, a SZB / SZC Joint Project Board has been put in place. The purpose of the Joint Project Board is to oversee the engineering, consents & licensing, procurement, construction and commissioning, and SZB support for all the elements of the SZC Development, including the resolution of any potential impacts on the operations of the Sizewell B station. It should be noted that SZC and ENGL will continue to develop the arrangements associated with the Joint Project Board and the supporting organisation. Therefore, the information in this section represents the current understanding and is subject to change.

The intent of the Joint Project Board is to act as the forum for the review of project performance against targets, including those set by Nuclear Generation, Sizewell B, SZC Project Board and the SZC GenCo Board. The Joint Project Board reports to the SZC Project and GenCo boards. The Joint Project board is expected to be a forum for sharing key information to enable effective coordination of SZC project and SZB operational activities. The forum is expected to provide strategic guidance on the proposed solutions to the project issues raised [Ref. 42].

7.2.2.6 Summary of the SZB / SZC Interface

As discussed above, there will be the legal agreements (OPA / NSCA), arrangements under LC19 (Communicate with Adjacent Facilities), and a governance structure (SZB/SZC Joint Board) to manage risks to SZB as a result of SZC for its entire lifecycle. Therefore, there is a high degree of confidence that risks to SZB as a result of SZC construction and operation can be effectively managed and reduced to ALARP and hence there is also a high degree of confidence in JSSR Claim 6. "Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining nuclear licensed site (SZB)".

7.2.3 Pluvial Flooding

Preliminary work was undertaken by RHDHV to model 1 in 10,000 year return period pluvial flooding of SZB as a result of SZC being present [Ref. 15]. This work was reported in Version 1 of the JSSR. It showed elevated pluvial flooding of SZB in the year 2055 as a result of SZC being present. This was largely due to the loss of surface run-off from SZB platform to the north of SZB where SZC will be situated.

The RHDHV work was performed in a conservative manner. For example, it assumes the platform topography is completely flat, without an overall gradient which would act to improve the flow of platform flooding off the SZC platform. In addition, no credit has been taken for the SZB road and surface drains (i.e. the 'primary drainage system') in the modelling, which would serve to remove floodwater. Finally, the modelling used inputs based on confidence bands and climate change projections from the SZC safety case which are considered to be conservative. The RHDHV work [Ref. 15] showed that the maximum increase as a result of SZC being present is approximately 50mm and 140mm with and without concept mitigation in place. The mitigation measures modelled include amongst other things, a simple ditch and retaining wall to the north of SZB and south of SZC, and a culvert under the proposed ramped road between SZB and SZC.

Since the preliminary pluvial flooding studies discussed above were completed, two parallel and complementary work streams have been launched. The first is led by SZB to provide an updated pluvial flooding analysis on the SZB extant safety case in advance of their Periodic Safety Review (PSR) and future life extension work. The second is led by SZC as part of the roads and networks design package of activities (further information on this activity is available in the Flooding Summary Report [Ref. 23]). This design package includes the platform topography which dictates the flow of water on the SZC platform surface as well drainage channels. These two work streams are complementary as they allow the impact of SZC to be understood so that adequate mitigations can be put in place. There are regular interactions between the project teams involved in this work to ensure good practice and knowledge is shared while maintaining an independence of analysis.

The SZC project remains optimistic that these ongoing design activities will provide the necessary confidence that a Safety Case can be made for SZB with respect to pluvial flooding including consideration of SZC. This is because the existing work by RHDHV shows an increase to flooding on SZB of only 50mm (with simplified concept mitigation) and that has been derived from highly conservative assumptions. Design work continues using highly conservative inputs with the intent of not increasing the maximum water depth on SZB. The preliminary results of this analysis indicate that this is an achievable objective even while maintaining the conservatisms. Further iterations of the design work and modelling will refine these results, until an adequate solution is finalised.

Following the finalisation of design work, the required engineering activities will be defined and integrated into the construction sequence such that adequate protection against pluvial flooding for SZB is maintained during SZC construction as well as during SZC operation.

As a result of the conservatisms in the preliminary analysis, and the results of the ongoing design work, there is a high degree of confidence that changes to the SZB pluvial flooding risk as a result of SZC construction and operation will be effectively managed by the design solutions being investigated. Hence, there is also a high degree of confidence in JSSR Claim 6, i.e. "Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining nuclear licensed site (SZB)".

7.2.4 Turbine Disintegration

This section represents the latest output from the ALARP process currently being undertaken in regard to the Turbine Disintegration hazard. It provides a summary of the work to date under a series of high-level arguments to demonstrate confidence in Claim 6 [Ref. 39].

7.2.4.1 The Turbine Missile Risk Is Characterised

Section 4 of Reference [39] presents a comprehensive review of the SZC turbine missile risk in the context of SZB. This includes demonstration that:

- The specific risk context for SZC to SZB missile generation is understood;
- Initiating event frequencies are well defined;
- Missile characteristics are defined;
- Missile penetrability of SZB targets is defined;
- Consequences of impacts on SZB are understood;
- Assumptions are identified and their significance is understood.

These items underpin the decision making described in Reference [39]. It is judged that the definitions and understanding presented form a strong basis for a risk informed decision to be made. Therefore, the elements presented below that provide confidence that the operation of SZC will not affect SZB's ability to maintain an adequate safety case are suitably supported by the problem statement definition.

7.2.4.2 [redacted]

[redacted]

[redacted]

[redacted]

7.2.4.3 A Robust ALARP Process Has Been Undertaken

In response to the increase in risk identified at SZB, a robust and proportionate ALARP process has been undertaken. This is demonstrated throughout Reference [39].

An ALARP approach based upon NNB recognised good practice [Ref. 43] has been identified, and this has been supplemented with NGL documents 'ALARP Decision Making for Safety Cases and Implementation of Modifications' [43], 'Optioneering Process for use during Investment Projects' [Ref. 44] and 'Guidance to Practitioners on ALARP Decision Making' [Ref. 45].

The fundamental steps required in an ALARP demonstration process have been identified and appropriate activities to support those steps required before JSSR have been performed.

1. Define and characterise the scope of the issue to be addressed
2. Generate the potential options to address the issue
3. Assess the options and their merits
4. Identify and justify the best option or options
5. Implement the selected options

Each of these steps is addressed in Reference [39] with an introductory paragraph provided for each section linking its purpose to the defined steps of the ALARP process.

It is noted that in line with the purpose of Reference [39] (i.e. preliminary demonstration of ALARP and provision of confidence that an ALARP case can be made), step 5 'Implement the selected options' is not addressed. This stage will be progressed further in parallel with the submission of Reference [39] and this version of the JSSR.

Therefore, it is judged that a suitable and sufficient ALARP process has been undertaken such that there is confidence that the risk to SZB will be reduced ALARP. This in turn supports the judgement that the operation of SZC will not affect SZB's ability to maintain an adequate safety case.

7.2.4.4 Reasonably Practicable Options to Reduce Risk Have Been Identified And Will Be Progressed By The SZC Project To Ensure Risk Is Reduced ALARP

The comprehensive optioneering process described in Reference [39] has resulted in appropriate down-selection of options that are both likely to be practicable and have potential to reduce risk across the spectrum of missile events identified in the problem statement definition. The measures down-selected at this stage are preferentially weighted towards the 'prevent' end of the hierarchy of risk reduction in line with best practice and so there is confidence that the risk due to every type of missile event can be reduced ALARP.

While all these options require further design development and detailed assessment of practicability, the project is committed to undertaking this next phase of work to prepare solutions for implementation. A post-JSSR update of this ALARP topic (exact form to be confirmed) will address these next steps in the process and additional supporting analysis will re-quantify the residual risk to SZB following confirmation and implementation of the selected solutions.

The developed options will be reassessed for holistic practicability once further information of risk reduction vs cost, time and trouble is known. Based on the options retained at this stage, there is a high degree of confidence that it will be possible to develop an appropriate multi-legged case based upon some combination of the identified solutions at this point. Hence, there is a high degree of confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

It is noted that several options have been screened out on the basis of gross disproportion at the early stages of the optioneering. These options are discussed in Section 6.3 of Reference [39], with the conclusions summarised as follows.

- **Do Nothing / No Reasonably Practicable Measures** - The 'Do nothing' option was not technically removed from the process at this stage. It is a key aspect of the SZC development that design replication is pursued as far as is reasonably practicable to enable the business case for the project to be made. Instead of an option to assess the relative merits of, 'Do nothing' is the end result of an ALARP process where it is demonstrated that no reasonably practicable options exist to reduce the risk. Therefore, while 'Do nothing' is not considered further in the optioneering programme, it is retained throughout the process (as 'No reasonably practicable measures') in line with the SZC No Change Committee procedures.

- **Build SZC on a different site** - Building an EPR on a different site has no obvious issues. In fact, supporting the development of EPRs elsewhere in the UK could be considered a long-term goal for EDF. However, the scope of the issue addressed by the task force relates specifically to the SZC site. An EPR constructed elsewhere in the UK would by definition not be SZC and so this option does not address the issue at hand.

  In addition, the significant cost and effort expended to date on developing the enabling works, engineering, and organisational structure for SZC would need to be largely repeated for a new site. The multi-year delay this would cause would clearly result in insurmountable damage to the business case

- **Relocate / Rotate SZC Turbine Halls** - This option would have major schedule, government engagement and Development Consent Order (DCO) impacts, requiring several years of rework, a significant increase in overall project risk with the associated impacts on investment and overall SZC business case. Even considering the significant 'budget' afforded by the risk reduction value of this option, the time, trouble and effort would run to £billions (turbine hall contract alone is in excess of £1bn) or be terminal to the project. This is grossly disproportionate to the benefit by any reasonable factor of gross disproportion.

  An additional significant consideration for this option is the potential increase in risk to SZC. Currently the UK EPR Nuclear Island and heat sink layouts are well optimised for turbine disintegration. Rotation of the turbine halls would threaten this and, dependent on the resultant layout, would reduce the overall risk reduction. In the worst case, the negative impact on SZC would exceed the positive impact on SZB.

- **Don't Build SZC** - Not building SZC eliminates the hazard but has the obvious cost of eliminating the benefits associated with building SZC. This option is also effectively outside of the scope of the issue addressed by the task force as it does not actually contribute to the development of the project. The benefits of building SZC are outlined in Section 6.3.1 of Reference [39]. In quantitative terms, by inspection the lifetime generation of an EPR grossly outweighs the risk reduction value.

- **Re-locate SZC site to a more favourable position (Translation, Rotation etc) -** This option was included on the pre-screened list after Workshop #1. However, it has been revisited several times through the optioneering process to ensure that the decision to not progress it further is robust and well supported.

  Major issues with options to adjust the whole site are the significant space constraints and boundary conditions at the SZC site. The overall size of the permanent SZC site is about 30.2ha, compared to HPC which is 66.1ha. The site is also bordered by the sea to the east, SZB to the south and Sites of Special Scientific Interest (SSSI) to the north and west. No more land can be taken for the development of SZC and this puts a significant constraint on potential layout options for the project. The site is longer in the north-south axis and so simple rotation while retaining layout is not possible. Translation in any direction is not possible due to the boundary conditions at each edge. Both of these options would also likely lead to increased heatsink tunnel and technical gallery lengths and a significant departure from replication of the optimised layout.

It has been noted that the rotation or translation of the site would be easier were there only a single EPR unit. However, the SZC business case is predicated on the basis that two units will be developed. Removing one of these would half the generating capacity of the plant and therefore the revenue. However, design costs would not be similarly reduced (potentially increasing with departure from replication) land and licensing costs would also remain the same. It is clear that the business case would be detrimentally affected by this change and this would likely be terminal for the SZC project. Quantitatively, the lifetime generation of an EPR unit would grossly exceed the RRV of such a change.

This option would have major schedule, government engagement and DCO impacts, requiring several years of rework, a significant increase in overall project risk with the associated impacts on investment and overall SZC business case. Even considering the significant 'budget' afforded by the risk reduction value of this option, the time, trouble and effort would run to £billions or be terminal to the project. This is grossly disproportionate to the benefit by any reasonable factor of gross disproportion.

- **Close SZB once SZC is commissioned. No concurrent operation of SZC turbines and SZB reactor -** Closing SZB once SZC is commissioned, while solving the turbine disintegration issue, is clearly not practicable. It is for obvious reasons not an option that can be endorsed by SZB, and clearly indicates a failure to meet the stated aim of Claim 6 (for SZB to be able to maintain an adequate safety case). Furthermore, the lost revenue associated with no plant extension (assumed to be 20 years) is highly likely to be grossly disproportionate to the risk reduced.

- **Combine SZC units into a single turbine hall -** This option was included on the pre-screened list after Workshop #1. However, it has been revisited several times through the optioneering process to ensure that the decision to not progress it further is robust and well supported.

  The intention of this option was for one turbine to afford protection from missiles from the other. Upon review, this is deemed to offer very little (potentially negative) safety benefit as the range of missiles blocked would be minimal, and consequential missiles from impact on the adjacent turbine would likely increase the risk. On top of this, the option would be a major redesign of the turbine hall and interfacing plant, effectively requiring full redesign on £billions of contracts. Based upon this information the option was clearly not suitable for further consideration.

7.2.4.5 The Currently Claimed SZC Brittle IEF Is Conservative

As described in Section 4.5 of Reference [39], the brittle failure Initiating Event Frequency (IEF) claimed for SZC is still largely based upon the work done by Spencer H. Bush for the US NRC in 1978 [39]. The historical OPEX that is used to derive the recommended frequency relates to turbine designs that are obsolete and have significant differences in design, materials and manufacture to the SZC Arabelle turbine.

This induced conservatism was addressed for SZB. A report was produced for SZB in 1988 which references values of $1x10^{-4}$ for NOS and $4.5x10^{-5}$ for ROS being used across the UK fleet based on the work done by Bush [Ref. 39].

The SZB report [23] noted improvements in rotor design, metallurgy and inspection, the use of monobloc rotors as well as governing and protection systems, and proposed a reduction factor of 4 be applied. It did also note that a factor of 8 was considered to be realistic.

Despite the significant time that has passed since this assessment, no further benefit has been claimed for further improvements to the modern turbine design for the EPR. The HPC turbine missile case [Ref. 46], justified the use of the extant SZB turbine disintegration frequencies for the HPC UK EPR turbine. This case does make and evidence the argument that 'The Risk of Turbine Disintegration at Normal Speeds is Minimised by Integrity Considerations'. Details of this argument are provided in Section 6.12.5 of Reference [39]. The HPC case (and by replication the current SZC case) concludes:

Considering the above qualitative evidence and details given in sub-section 5.2.1.1, including analytical calculations, design optimisations and robustness of QA during the manufacturing process, the frequency of brittle failure has been minimised and therefore the risk of a turbine brittle failure is judged to have been reduced to ALARP.

As described in Section 6.12.5 of Reference [39], GE have provided an analysis of the turbine missile probability for the Arabelle shaft-line according to the U.S. NRC requirements. The probability is determined by means of fracture mechanics, considering as probabilistic quantities the variables involved in the evaluation such as critical crack sizes, crack growth rates, stresses and temperatures. These properties and details are well documented in the case of turbine rotors. This analysis has found that the probability of missile generation due to brittle fracture failure is of the order of 10^{-6} /yr. This is significantly lower than the current SZC value. A review of OPEX supports this conclusion, as no failure events and no indications of stress corrosion cracking in the relevant radial-axial plane from comparable rotors have been identified.

As a result of the above, there is confidence that the currently claimed IEF for missile generation via brittle failure at SZC is conservative. This contributes to the confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

7.2.4.6 An Improved Brittle IEF Can Be Claimed For SZC

Following on from Section 7.5 Reference [39], it is recognised that there is a body of evidence based on analysis, OPEX and procedure, that can be drawn upon to make a case for claiming a lower value for the brittle failure IEF at SZC. In much the same way as was done for SZB, a holistic review of the frequency taking into account all contributory factors can be performed to determine a more best-estimate and less conservative value. This activity would likely include review of similar factors investigated for SZB, such as:

- Rotor design;
- Metallurgy and inspection;
- Failure modes;
- Analysis of OPEX.

The SZC project will pursue the development of such a case in the next phase of work. Given the supporting evidence already available, in terms of existing 'soft' claims, analysis and OPEX, there is a high level of confidence that a case can be made for claiming an improved brittle failure IEF. This contributes to the confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

7.2.4.7 The Currently Claimed SZC Ductile IEF Is Conservative

The HPC case [46] makes the arguments that the risk of missile generation by ductile failure is minimised by both integrity and protection. It concludes that due to the robustness of the TG set design and its auxiliaries, and the solid protection measures, the risks of a ductile failure event is considered to be extremely low. Further noting that given the equipment testing and monitoring in operation that enables the reduction of the frequency associated with an overspeed event, the frequency of occurrence of a turbine ductile failure event for the HPC TG set can be shown to be lower than the 10^{-5}/(r.y.) value. This conclusion is supported by the de-risking calculations undertaken for the HPC turbine protection system [Ref. 46].

Reference [49] provides a reliability assessment of the overspeed protection intended to identify any early issues with meeting the requirements of the safety case. This will be updated and integrated into the overall validation of the HPC system later in the project lifecycle. Reference [46] finds that the Probability of Failure on Demand

(PFD) of the protection system is of the order of 10^{-5}. This is an order of magnitude improvement on what is claimed in the HPC/SZC case (noting that overall IEF is grid reliability x protection system PFD) but doesn't respect all rules on limiting the reliability of smart devices.

The above items provide confidence that the risk of a ductile failure event is extremely low and the IEF used in the SZC case is conservative. This contributes to the confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

7.2.4.8 An Improved Ductile IEF Can Be Claimed For SZC

While it is recognised that the current ductile failure IEF is conservative in Section 7.7 of Reference [39], it is unlikely that an improved value can be claimed without material change to the relevant systems. As detailed in Section 6 of Reference [39], two options have been retained at this stage to address both the integrity and protection elements of ductile failure IEF:

- Option #2 – Improve reliability of the Turbine Protection and Control System (TPCS); and
- Option #2a - Improve turbine rotor integrity such that ductile failure speed is not reached in an overspeed event.

The SZC project will continue investigation of the practicability of both of these options in the next phase of work with a view to implementing one or both in the design. Hence, there is a high level of confidence that a case can be made for claiming an improved brittle failure IEF. This contributes to the confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

7.2.4.9 Protect Line / Barrier Type Option Judged Practicable At This Stage Will Be Further Developed

As detailed in Section 6 of Reference [39], significant work has gone into identifying a barrier type option that is not easily ruled out on practicability grounds. The retained option (#18a – build a missile barrier within the HM building) is thought to be practicable at the current level of understanding, noting that significant design development is required to confirm this judgement. The SZC project will continue to investigate the practicability of this option with specialist support as required, with a view to implementing the option in the design if practicable. The suitability of this option (which is a protect line option and so less preferred than the other prevent line options) will be reassessed when details of all options are more developed, as part of a multilegged case.

At this stage it is recognised that while this option is protect line, it offers significant deterministic benefits for a subset of the problem statement (i.e. it could eliminate certain missile trajectories), in addition to a probabilistic benefit (it would reduce the overall quantitative risk contribution of SZC to SZB). Furthermore, there is potential opportunity to revisit currently excluded barrier options should Option #18a prove to not be reasonably practicable. The steel reinforced HM wall sub-option of Option #7a has been identified as the preferred option in this case.

Given the inclusion of this option in the next phase of work for the SZC project, there is a high degree of confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

7.2.4.10 RGP Has Been Reviewed And Given Due Consideration Through Optioneering And Application Of ALARP, And A Suitable Comparison Against Relevant Good Practice Has Been Undertaken

A dedicated review of relevant good practice was commissioned in support of this workstream. This is reported in [45] and summarised in Section 5 of Reference [39]. Reference [45] presents the output of the relevant good practice review workstream and represents a key step in the demonstration of ALARP process. A detailed understanding of Relevant Good Practice (RGP) has influenced the decision making reported in Reference [39] in the following ways:

- The underlying problem statement definition is heavily dependent and in line with RGP. Missile characteristics such as speed, size, direction and number are all in line with RGP.
- The extant SZC position has been reviewed against international and UK best practice and a comparative review is presented in in Section 5 of Reference [39].
- Throughout the optioneering process RGP has been considered in introduction, assessment, screening and selection of the solutions. This has resulted in preferred options that are in line with RGP as far as is reasonably practicable.

The RGP review concluded that the SZC site falls within the definition of an unfavourable layout with respect to turbine disintegration effects on the neighbouring SZB site. This has effectively driven the work described in Reference [39].

In other aspects of RGP, particularly within regard to turbine reliability and conservatism of assessment, the SZC design is aligned. The current assessments undertaken for SZC are conservative with respect to OPEX from around the world; particularly the choice to consider multiple missiles impacting a single target, the claimed reliability of the turbine machine to both brittle and ductile type failures and the inclusion of high trajectory missile contributions. This finding will be addressed by further refinements to the problem statement in the next phase of work.

The conclusion that aspects of the SZC case (other than the overall layout with respect to SZB) are in line with RGP, that the options taken forwards are supported by RGP and that the SZC problem statement is conservative in comparison to RGP contributes to the confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

7.2.4.11 Further Work

Reference [39] describes the output of the robust ALARP process that has been applied to address the hazard of SZC Turbine Disintegration generated missiles impacting the SZB site for the JSSR. It is recognised that further work on this issue will be undertaken following submission of the JSSR.

Throughout the process opportunities and requirements for further development and refinement have been identified and tracked. These items are largely driven by the following:

- Conservatisms and points of difference in approach identified in the RGP review;
- Recommendations made in the supporting analysis workstreams;
- Problem statement assumptions identified for challenge;
- Options identified as being on hold for the future assessment;
- Options down-selected for further development.

Recommendations for further work to ensure that SZC will not affect SZB's ability to maintain an adequate safety case post JSSR submission are collated in Table 35 of Reference [39]. The continuation of the work on this topic in parallel with the submission of Reference [39] and the JSSR provides confidence that SZC will not affect SZB's ability to maintain an adequate Safety Case.

7.2.4.12 Turbine Disintegration Conclusion

Reference [39] concludes by summarising the current situation. It assesses the risk posed by SZC turbine disintegration events to SZB and defines the problem statement, drawing on knowledge from the existing HPC case and commissioned analysis as appropriate.

The overall SZB site risk remains within the tolerable if ALARP region but the balance of risk as well as the change to total risk is heavily impacted by the inclusion of SZC as a missile source. Therefore, it is judged in principle that the operation of SZC will not affect SZB's ability to maintain an adequate safety case providing adherence to the principle of ALARP is demonstrated [Ref. 39].

Reference [39] details the robust ALARP process being applied to the problem statement, summarising the comprehensive optioneering programme delivered in support. It provides details of several options that are down-selected from an initial longlist through several stages of expert review and refinement, with the following options retained for further development in support of implementation:

- Option #2 – Improve reliability of TPCS;
- Option #2a – Improve turbine rotor integrity such that ductile failure speed is not reached in an overspeed event;
- Option #18a – Steel barrier within HM Building;
- Option #33 – Improve brittle failure reliability.

In conclusion, the potential impact on the SZB Safety Case, as a result of the missiles generated during operation of SZC has been reviewed. The analysis and optioneering presented supports the preliminary development of a robust ALARP case. Reference [39] demonstrates that options and forward actions are identified such that there is a high degree of confidence that the risk of turbine disintegration can be reduced to ALARP. This gives confidence in the ability of SZB nuclear licenced site to maintain an adequate safety case. Therefore, as a result of the information presented in Reference [39] it is judged that "Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining nuclear licensed site (SZB)".

7.3 Claim 6: Conclusion

It is recognised that the SZC site is located adjacent to the SZB site and therefore introduces new external hazards or changes existing external hazards considered in the SZB Safety Case. In order to assess the potential risks to SZB, a preliminary assessment was undertaken in 2020 [Ref. 21]. This led to the development of additional workstreams whose outputs have been captured in a dedicated analysis of the Turbine Disintegration hazard [Ref. 39] and an update to the overall preliminary analysis to include the latest information across the project [Ref. 47].

As a result of this work, for all the potential hazards except turbine disintegration, the assessments have comprehensively demonstrated that for the external hazards environment around SZB as a result of SZC construction and operation, *"the ability to maintain an adequate Safety Case for SZB"* would not be adversely affected.

In regard to Turbine Disintegration, as summarised in Section 7.2.4.12, the overall SZB site risk remains within the tolerable if ALARP region but the balance of risk as well as the change to total risk is heavily impacted by the inclusion of SZC as a missile source. Therefore, it is judged in principle that the operation of SZC will not affect SZB's ability to maintain an adequate safety case providing adherence to the principle of ALARP is demonstrated. Given that the analysis and optioneering carried out to date supports the preliminary development of a robust ALARP case, and that options and forward actions are identified in Reference [39], there is a high degree of confidence that the risk of turbine disintegration can be reduced to ALARP. This gives confidence in the ability of SZB nuclear licenced site to maintain an adequate safety case. Therefore, as a result of the information presented in Reference [39] it is confidently judged that "Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining nuclear licensed site (SZB)".

8 Overall Conclusions and Future Work

This document (Version 3 of the JSSR), is the top tier report representing the culmination of the characterisation work, and studies performed to date on the suitability of the SZC site from a nuclear safety point of view. This document and its Primary References have been tailored towards providing the necessary confidence in the six claims. The conclusions for each individual claim are presented in Table 8 below.

It should be noted that while SZC design, engineering and safety case activities that are related to the six claims in this report will continue, no further work related to Claims 1-5 is planned for submission between now and NSL Grant. In regard to Claim 6, the further work that is planned for submission is limited to the Turbine Disintegration topic on which the project intends to progress the associated engineering activities and produce a safety demonstration. Further details on this will be shared through the routine interactions with the ONR.

Table 8 – Status of Confidence in the '6 Claims' and Planned Further Work

Claim	Conclusion	Future Work
Claim 1: The site is of sufficient size to accommodate all necessary systems to ensure safe operation	It has been comprehensively demonstrated in Version 3 of the JSSR that *"the site is of sufficient size to accommodate all necessary systems to ensure safe operation"*	Further safety studies will be performed as a part of the development of the SZC PCSR. Notable ongoing activities related to Claim 1 include hazard studies related to the plot plan layout.
Claim 2: The site can be connected to electricity grid supplies	It has been comprehensively demonstrated in Version 3 of the JSSR that *"the site can be connected to electricity grid supplies"*	Further safety studies will be performed as a part of the development of the SZC PCSR. Notable ongoing activities related to Claim 2 include interactions with National Grid and Ofgem regarding Grid Code Compliance.
Claim 3: Adequate cooling capability can be provided for all normal and fault conditions	It has been comprehensively demonstrated in Version 3 of the JSSR that *"adequate cooling capability can be provided for all normal and fault conditions"*	Further safety studies will be performed as a part of the development of the SZC PCSR. Notable ongoing activities related to Claim 3 include detailed design of the heat sink and the fault studies safety demonstration.
Claim 4: There are no external hazards that would preclude the use of the site (including the external hazards presented by SZB to SZC)	It has been comprehensively demonstrated in Version 3 of the JSSR and Version 3 of the SDSR that there are no external hazards that would *"preclude the use of the site"*.	Further safety studies will be performed as a part of the development of the 'First Safety Related Construction' Sea Defences Report and the SZC PCSR. Notable ongoing activities related to Claim 4 include the development of the hazards safety case to account for site specific differences.

<table>
<tr><th>Claim</th><th>Conclusion</th><th>Future Work</th></tr>
<tr><td>Claim 5: The geology of the site provides secure long term support to the necessary structures, systems, components</td><td>It has been comprehensively demonstrated in Version 3 of the JSSR that “The geology of the site provides secure long term support to the necessary structures, systems, components”</td><td>Further safety studies will be performed as a part of the development of the ‘First Safety Related Construction’ Sea Defences Report and the SZC PCSR.

Notable ongoing activities related to Claim 5 include the integration of the site-specific ground conditions into the design to ensure safety requirements can be substantiated.</td></tr>
<tr><td rowspan="2">Claim 6: Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining Nuclear Licensed Site (SZB).</td><td>It has been comprehensively demonstrated in Version 3 of the JSSR that for most changes to the external hazards environment around SZB as a result of SZC being constructed and operated, “the ability to maintain an adequate Safety Case for SZB” would not be adversely affected.</td><td>Further safety studies will be performed to support the development of the SZC PCSR

Notable ongoing activities related to Claim 6 include the development of the means of managing the interface between SZC and SZB as well as the management of the interfaces themselves.</td></tr>
<tr><td>The SZC to SZB turbine disintegration hazard remains the most significant issue in JSSR Version 3. Nevertheless, it is judged in principle that the operation of SZC will not affect SZB’s ability to maintain an adequate safety case providing adherence to the principle of ALARP is demonstrated. Given that the analysis and optioneering carried out to date supports the preliminary development of a robust ALARP case, and that options and forward actions are identified, there is a high degree of confidence that the risk of turbine disintegration can be reduced to ALARP. Therefore, there is a high degree of confidence that “Operations on the SZC site will not adversely affect the ability to maintain an adequate Safety Case for the adjoining Nuclear Licensed Site (SZB)”.</td><td>Further work is planned prior to NSL Grant in relation to SZC turbine disintegration hazard. See Section 7.2.4.11 for further details on this planned work.</td></tr>
</table>

The depth and level to which the arguments and evidence have been developed in this report and its supporting documents is appropriate and proportionate to the NSL application stage. The JSSR is not a detailed Safety Case but instead aims to give confidence in the ability to make a Safety Case in the future through a SZC specific PCSR that will be developed in due course following NSL grant. As a result of the information summarised and consolidated throughout this report, and the conclusions in terms of each individual claim, this report meets its stated purpose and provides the required confidence that the SZC site is suitable to host a twin UK-EPR nuclear power station.

9 ACCRONYMS AND ABBREVIATIONS

AFoE	Annual Frequency of Exceedance
ALARP	As Low as Reasonably Practicable
AOD	Above Ordnance Datum
BOP	Balance of Plant
CDM	Construction, Design and Management Regulations (2015)
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CFS	Capable Faulting Study
CI	Conventional Island
CI-BOP	Conventional Island-Balance of Plant
CMIP5	Coupled Model Intercomparison Project 5
CNEPE	Le Centre national d'équipement de production d'électricité
CRF	Circulating Water System
DA	Design Authority
DBE	Design Basis Earthquake
DFSS	Dry Fuel Storage System
ECC	European Connection Conditions
EDF	Electricite de France
EHWL	Extreme High Water Level
ELWL	Extreme Low Water Level
EMI	Electro-magnetic Interference
ENGL	EDF Nuclear Generation Limited
EPR	Trade name for the PWR design proposed at SZC.
FA3	Flamanville 3
FID	Financial Investment Decision
FRT	Fault Ride-Through
GDA	Generic Design Assessment
GMRS	Ground-Motion Response Spectrum
GWL	Ground Water Level
Ha	Hectare
HBX	Operational Service Centre
HCA	Outfall Building
HDU	Emergency Response Energy Centre
HEG	National Grid Substation
HF	Conventional Island Electrical Building
HGS	Drainage Gallery
HGX	Technical Galleries
HHA	Warehouse
HHD	Contaminated Tool Storage
HHE	Back up Emergency Equipment Store
HHG	Handling Facilities Garage
HHI	Intermediate Level Waste Store
HHK	Interim Spent Fuel Store
HHL	Transit area of Very Low and Low Level Waste
HHW	Conventional Waste Storage
HHX	HHK Equipment Storage Building
HL	Safeguard Auxiliary Buildings
HM	Turbine Hall

HOJ	Fire Fighting Water Distribution Building
HOR	Raw and Potable Water Supply / Storage
HP	Pumping Station
HPC	Hinkley Point C nuclear licensed site
HP-HPF	Pumping Station and Pumping Station Forebay
HPH	Chlorination Facility
HR	Reactor Building
HUA	Main Access Control Building
HUB	Secondary Access Control Building
HUC	Auxiliary Administration building
HUD	Security Administration Centre
HUM	Emergency Response Centre
HVAC	Heating, Ventilation and Air Conditioning
HWL	High Water Level
HXE	Sewage Treatment Plant
HZC	Chemical Products Storage
HZG	Oil and Grease Storage
HZH	Hydrogen Storage
IAEA	International Atomic Energy Agency
IEF	Initiating Event Frequency
JSSR	Justification of Site Suitability
LC	Licence Condition
LFE	Learning From Experience
LFSM-U	Limited Frequency Sensitive Mode – Under-frequency
LOOP	Loss of Off-Site Power
MSOL	Minimum Stable Operating Level
MSR	Modifications Summary Report
NCC	No Change Committee
NGL	Nuclear Generation Ltd.
NI	Nuclear Island
NOAK	Next of a Kind
NPP	Nuclear Power Plant
NSCA	Nuclear Safety Co-Operation Agreement
NSDAP	Nuclear Safety Design Assessment Principles
NSL	Nuclear Site Licence
Ofgem	Office of Gas and Electricity Markets
OHL	Overhead Line
ONR	Office for Nuclear Regulation
OPA	Operational Protections Agreement
OPEX	Operational Experience
PGA	Peak Ground Acceleration
PCSR	Pre-Construction Safety Report
PCmSR	Pre-Commissioning Safety Report
PFD	Probability of Failure on Demand
prt	Per Reactor Trip
pry	Per Reactor-Year
PSHA	Probabilistic Seismic Hazard Assessment
PSR	Periodic Safety Review
PWR	Pressurised Water Reactor
R&D	Research and Development

RC	Reference Configuration
RD	Responsible Designer
RCP	Representative Concentration Pathway
RfG	Requirements for Generators
RFI	Radio Frequency Interference
RGP	Relevant Good Practice
RHDHV	Royal Haskoning DHV
RRI	Component Cooling Water System
RSR	Radioactive Substances Regulation
SAPs	Safety Assessment Principles
SCC	Structures, Systems and Component
SDSR	Site Data Summary Report
SEC	Essential Service Water System
SFR	Safety Functional Requirement
SQEP	Suitably Qualified and Experience Personnel
SQSS	Security and Quality of Supply Standard
SRU	Ultimate Cooling Water System
SSC	Structure, System or Component
SZA	Sizewell A nuclear licensed site
SZB	Sizewell B nuclear licensed site
SZC	Sizewell C nuclear licensed site
TPCS	Turbine Protection and Control System
UHS	Uniform Hazard Spectra
UK	United Kingdom

10 REFERENCES

Ref	Title	Location	Document Reference
1	Site Data Summary Report, Rev 4	EDRMS	SZC-NNBGEN-XX-000-REP-100022 (Teamcenter 100812635)
2	SZC Plot Plan Summary Report. Rev 4	EDRMS	SZC-SZ0100-XX-000-REP-100033 (Teamcenter ID 100905187)
3	Forward Work Plan for SZC NSL Application, Version 1.0, June 2020	EDRMS	Teamcenter reference 100200229
4	SZC Grid Connection Design and Contribution to Loss of Off-Site Power (LOOP) Frequency. Rev 5	EDRMS	SZC-SZ0100-XX-000-REP-100043 (Teamcenter ID 100905014)
5	National Electricity Transmission System Security and Quality of Supply Standard. Version 2.5, 01/04/2021	Website	www.nationalgrid.com
6	The Grid Code. Issue 6, Revision 1, 18/03/2021.	Website	www.nationalgrideso.com
7	HPC PCSR3: Chapter 13 – Hazards Protection. Sub-Chapter 13.1 – External Hazards Protection. 2017	EDRMS	HPC-NNBOSL-U0-000-RES-100074
8	Site Specific Short and Long LOOP Frequency Updates for HPC and SZC EPRs. Version 1.0, August 2016.	EDRMS	HPC-UKX-NNBOSL-U0-GEV-RET-100000
9	SZC Heat Sink Summary Report. Rev 5.	EDRMS	SZC-SZ0100-XX-000-REP-100032 (Teamcenter ID 100911267)
10	Justification of Extreme Heat (Air) Temperature Design Basis Value at Sizewell C. Rev 4	EDRMS	SZC-SZ0100-XX-000-REP-100031 (Teamcenter ID 100905189)
11	UK EPR Sizewell – Preliminary Onshore Investigations (phase 1) – Ground Investigation Report. CEIDRE-TEGG, 2011. Revision A.	EDRMS	SZC-EDTEGG-AU-000-RET-000106
12	EPR UK – Sizewell C – Pre-existing geotechnical data synthesis and Interpretative Report (Step 1). Revision A, May 2014	EDRMS	SZC-EDTGGX-AU-000-RET-000530
13	EPR UK – Sizewell C – Phase 2 Ground Investigation Report. Revision A, 2020.	EDRMS	SZC-DIXXXX-XX-000-RET-200010 (Teamcenter ID 100638318)
14	Jacobs Technical Report: Sizewell CFS & PSHA – Interim PSHA. Issue 1, Revision 2. May 2020.	EDRMS	200527_60SC0001 SZC-006
15	Sizewell C Flood Risk Assessment – Main Development Site Fluvial Modelling Update. Royal Haskoning DHV, Revision 6, March 2020.	EDRMS	SZC-SZ0200-XX-000-REP-100141
16	Sizewell Site C: Conceptual Site Model of the Hydrogeological Regime. Atkins, Revision 5, June 2015.	EDRMS	SZC-SZ0500-XX-000-REP-100004
17	UK EPR Sizewell – Detailed Groundwater Level Assessment for Design. Revision B, June 2020.	EDRMS	SZC-DIXXXX-XX-000-RET-200014 (Teamcenter ID 100638393)

Ref	Title	Location	Document Reference
18	Eurocode 7 EN 1997-1 & EN 1997-2 “Geotechnical design”	N/A	N/A
19	SZC onshore geotechnical pre-application report (basic stage), Revision A, July 2019.	EDRMS	SZC-DIXXXX-XX-000-RET-200004
20	UK EPR Hinkley Point C - Permanent Ground Water Control Summary Report. CNEPE. Revision F, December 2016	EDRMS	HPC-ETGCXX-U0-000-REP-000316
21	Preliminary Arguments and Evidence Supporting JSSR Claim 6. Revision 1, June 2020.	EDRMS	SZC-SZ0100-XX-000-REP-100030
22	Sizewell C Project Book 8 Planning Statement (8.4)	PINS	EN010012
23	Sizewell C, Flooding Summary Report. Rev 4	EDRMS	SZC-SZC-NNBOSL-XX-000-REP-100005 (Teamcenter ID 100813392)
24	HPC – Rules for inventory of combined events in relation to internal and external hazards.	EDRMS	UKX-SEPTEN-AU-ALL-NOT-000304
25	ENG 2.9M – General Framework for application of the combined and consequential hazards doctrine into the HPC Design.	EDRMS	HPC-CNENXX-AU-ALL-NOT-203674
26	Sizewell C Hazard Listing Report, Hyder Consulting (UK) Ltd.	EDRMS	SZC-NNBGEN-XX-000-REP-100003
27	The Connection and Use of System Code Construction Agreement in respect of Sizewell C at Sizewell North 400kV GIS Substation. (Consolidated 23rd July 2019).	N/A	A/BEGL/07/5253 - 02EN(0)
28	Grid Code Compliance Strategy Rev 1	EDRMS	Teamcenter ID 100876621
29	SZC Initial ALARP Position Paper	EDRMS	Teamcenter ID 100884543
30	Modifications Summary Report Rev 3	EDRMS	Teamcenter ID 100897228
31	SZC Company Document. SZC DDB Statement of Decisions. Revision 02 (Draft).	EDRMS	SZC-NNBGEN-U0-000-REP-100000 (Teamcenter ID 100809565).
32	Nuclear Safety Design Assessment Principles Rev 3	EDRMS	Teamcenter ID 100109532
33	The Safety Case Manual Rev 3	EDRMS	Teamcenter ID 100787883
34	SZC No Change Committee Terms of Reference	EDRMS	SZC-SZ0100-XX-000-REP-100022 (Teamcenter ID 100812977)
35	Proposal for a mitigation plan linked to the increase of Geomagnetically Induced Current (GIC) level on SZC	EDRMS	Teamcenter ID 100857416
36	SZC Combined and Consequential Hazards MoM Rev 1	EDRMS	Teamcenter ID 100905025
37	Probabilistic Seismic Hazard Assessment for Sizewell Rev 1	EDRMS	100638736

Ref	Title	Location	Document Reference
38	EPR UK – SZC – Settlement Detail Study	EDRMS	SZC-DIXXXX-XX-000-RET-200013 (Teamcenter ID 100638508)
[redacted]	[redacted]	[redacted]	[redacted]
40	Nuclear Site Licence Compliance Matrix- Sizewell C	EDRMS	Teamcenter ID 100200248
41	SZC Licensing and RSR Permitting Strategy	EDRMS	Teamcenter ID 100877641
42	SZB/C Joint Project Board Terms of Reference Rev 3	EDRMS	SZC-SZ0100-XX-000-REP-100027 (Teamcenter ID 100813089)
43	ALARP Decision Making for Safety Cases and Implementation of Modifications Rev 2	EDRMS	NNB-202-GUI-000032
44	Optioneering Process for use during Investment Projects' Rev 1	EDRMS	*INV/GN/008*
45	SZC Turbine Disintegration Safety Case Support - Review of Relevant Good Practice, Rev 01	EDRMS	Teamcenter ID 100894168
46	UK EPR HPC - Combined Deterministic / Probabilistic assessment of the Turbine Missile hazard Rev E	EDRMS	HPC-ETSIMX-U0-ALL-NOT-001250 (Teamcenter ID 100547768)
47	Arguments and Evidence Supporting JSSR Claim 6 Rev 2	EDRMS	Teamcenter ID 100908822
48	Sizewell C Project Replication Manual Rev 2	EDRMS	Teamcenter ID 100813141
49	Overspeed protection reliability assessment, Rev. B, 2019.	EDRMS	HPC-UK3011-AU-GRE-CAL-100008 (Teamcenter ID 100413649)
50	ONR Technical Assessment Guide – External Hazards Rev 7	Online	NS-TAST-GD-013
51	Sizewell C extreme high sea water temperatures, Revision 3, 2021	EDRMS	Teamcenter ID 100897283
52	Site Specific DBE Spectra for Sizewell C Project, Rev. 1	EDRMS	100912552
53	Independent Technical Assessment Report - SZC Justification of Site Suitability Rev. 2	EDRMS	100493583
54	Quality Plan for the update to the SZC Justification of Site Suitability Report (JSSR) and its supporting references Rev. 3	EDRMS	100879844
55	SZC Nuclear Safety Committee Minutes of Meeting 24.8.21 Rev. 1	EDRMS	100928639
56	Sizewell C CFS & PSHA, Capable Faulting Study	EDRMS	100638766
57	Sizewell C CFS & PSHA, Site Response Analysis (Volume 2 – Results)	EDRMS	100909351

11 Annex A - VISUAL GUIDE TO KEY SZC PLOT PLAN CHANGES VERSUS HPC

- HHK – Interim Spent Fuel Store
- HHI – Intermediate Level Waste Interim Store
- HHL – Transit Area for Very Low and Low Level Waste
- HHD – Contaminated Tool Storage
- HZH – Hydrogen Storage Units 1&2
- HZC – Chemical Products Storage
- HZG – Oil and Grease Storage
- HHW – Conventional Waste Store
- HEG – National Grid Substation (not on SZC map)
- HXE – Sewage Treatment Plant
- HHP – Operational Store (New to SZC)
- HPH – Chlorination Plant (New to SZC)
- HUC – Auxiliary Administration Building (New to SZC)
- HHE – Emergency Equipment Store
- HUA – Main Access Control Building
- HUB – Secondary Access Control Building
- HHX – Equipment Storage Building

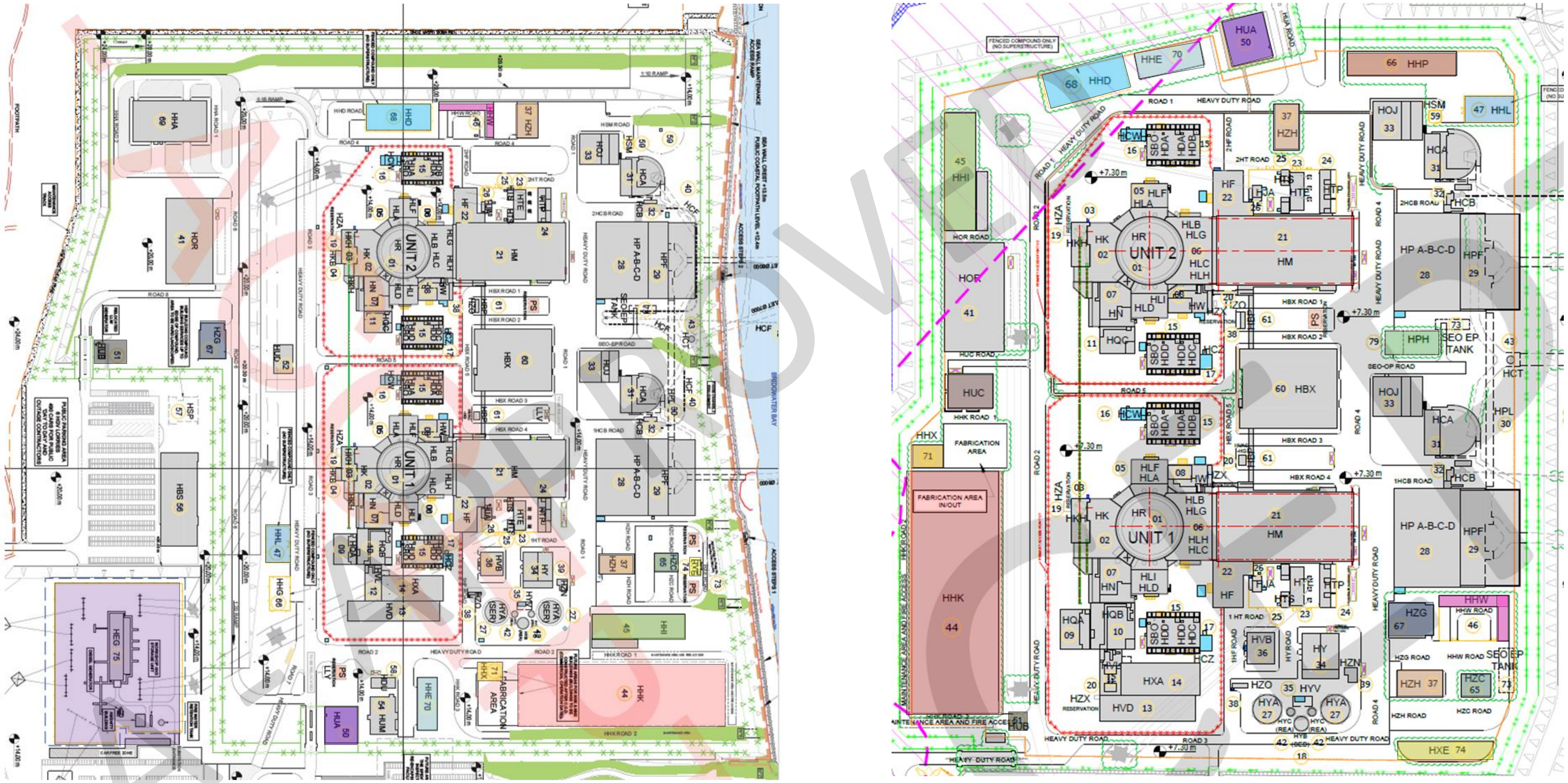


Figure 7 - Key SZC Plot Plan (Right) Changes versus HPC (Left)

12 Annex B – SZC SITE LAYOUT WITH PYLON AND OHL POSITIONS

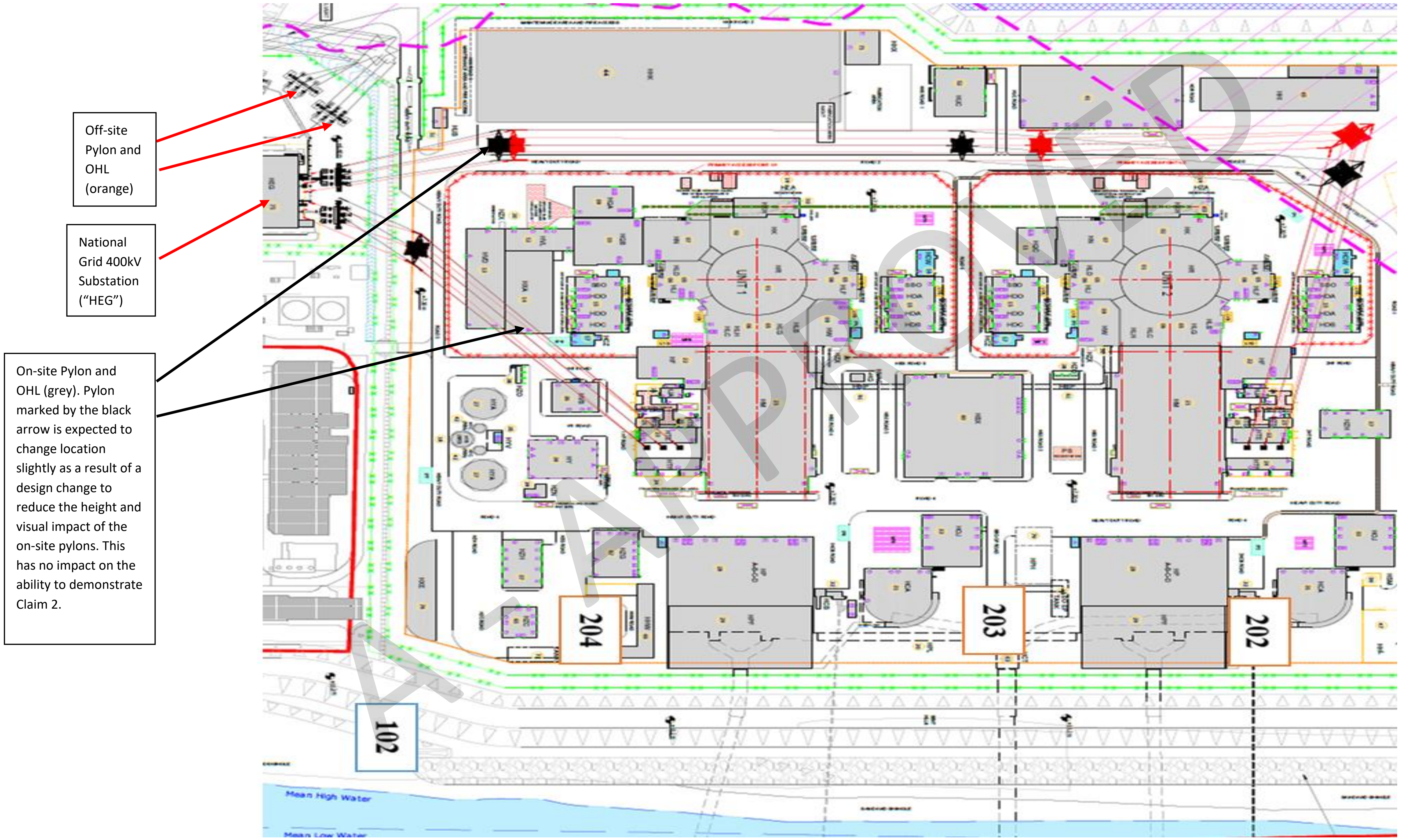


Figure 8 - SZC Site layout with pylon and OHL positions

13 Annex C – Differences in National Grid Substation and Pylon Position for HPC and SZC

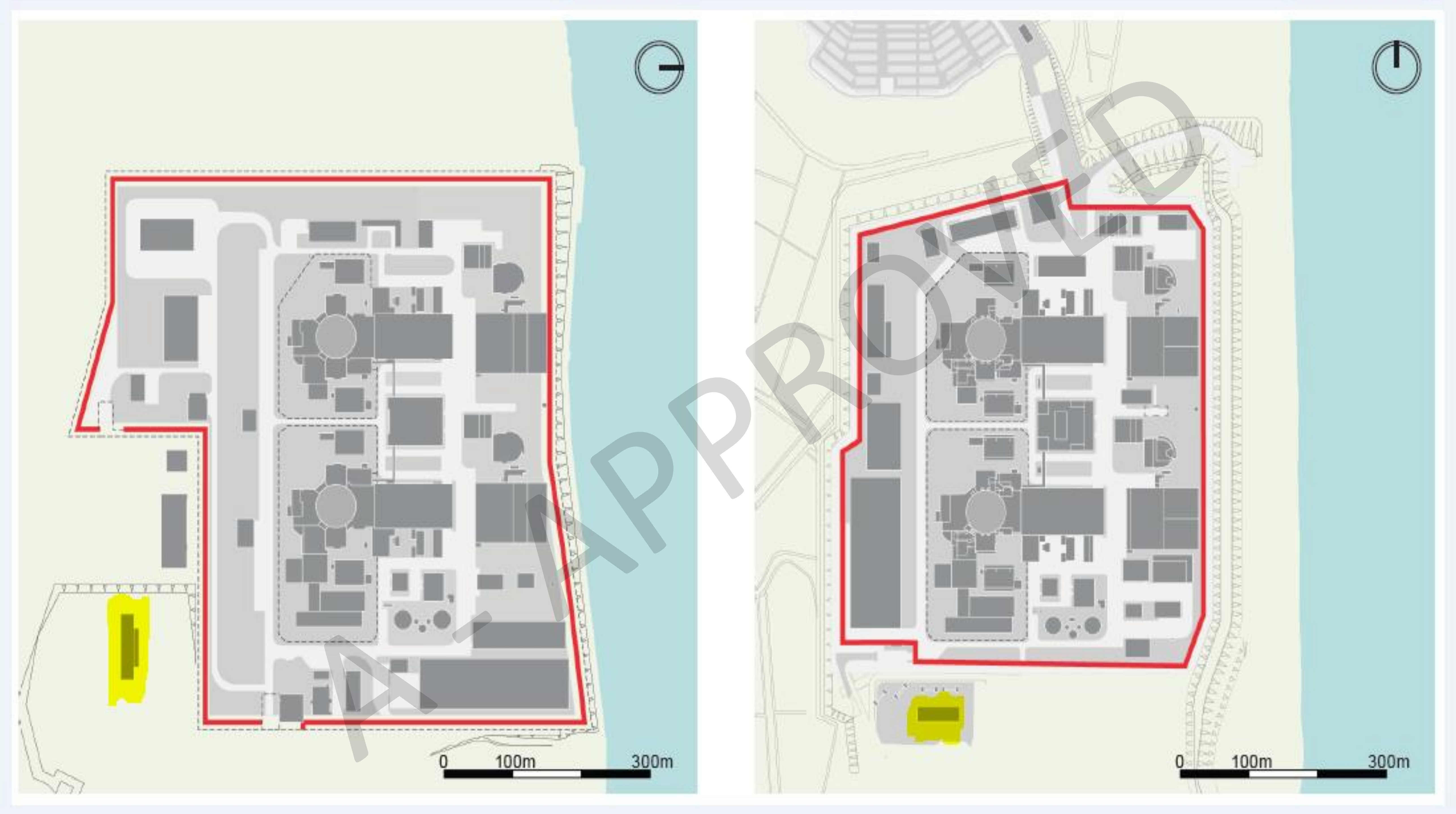


Figure 9 -Difference in National Grid Substation Position for HPC (left) and SZC (right)

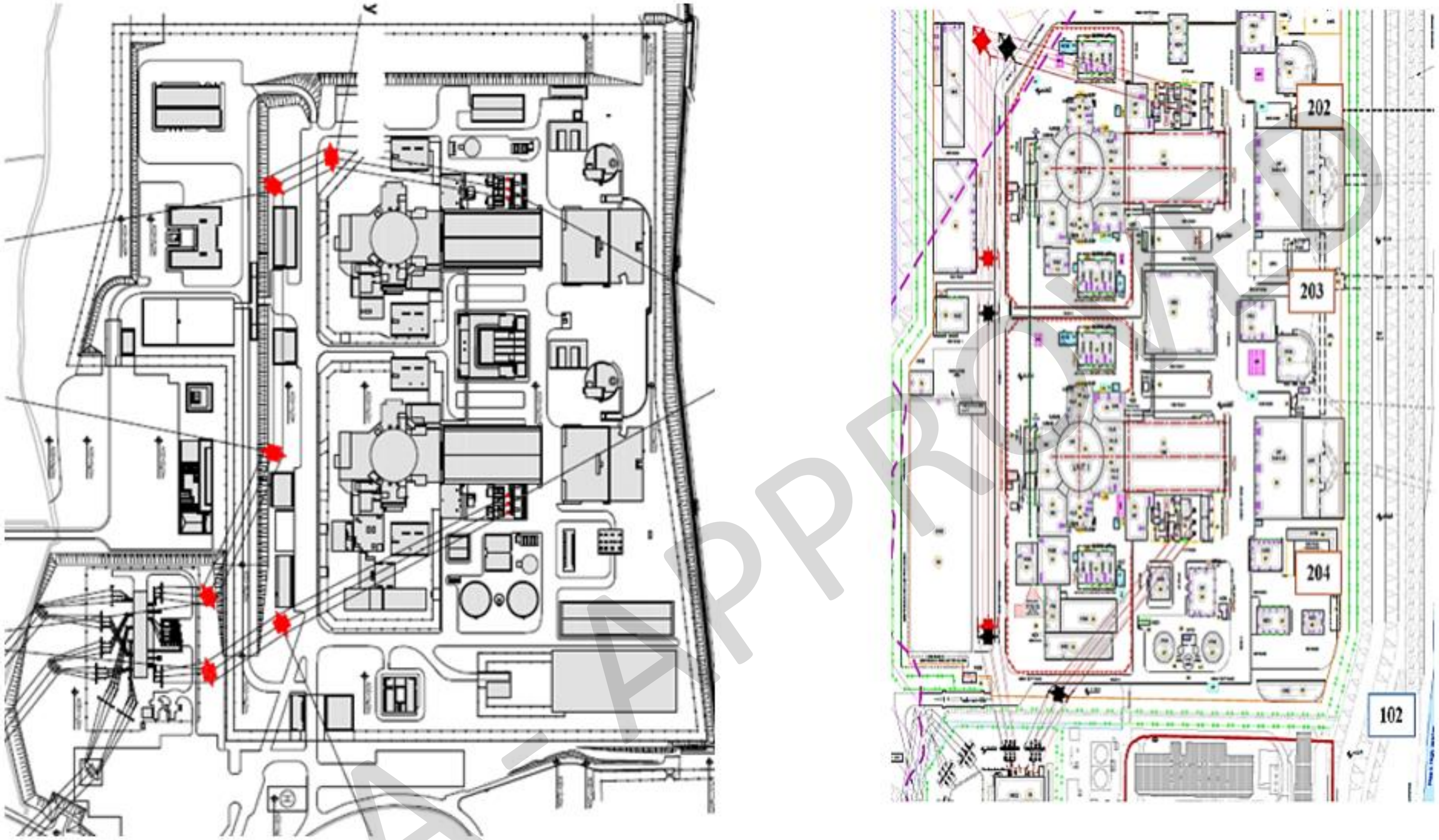


Figure 10 - Pylon Positions and OHL at HPC (left) and SZC (right)