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Pre-Construction Safety Report

Chapter 3

Generic Site Characteristics

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3.1 List of Abbreviations and Acronyms

DBE	Design Basis Earthquake
ECS	Extra Cooling System [ECS]
EMI	Electromagnetic Interference
EUR	European Utility Requirements
GDA	Generic Design Assessment
GIC	Geomagnetic Induced Current
I&C	Instrumentation and Control
ONR	Office for Nuclear Regulation (UK)
PCER	Pre-Construction Environmental Report
PCSR	Pre-Construction Safety Report
PGA	Peak Ground Acceleration
RGP	Relevant Good Practice
RRI	Component Cooling Water System [CCWS]
SEC	Essential Service Water System [ESWS]
UHS	Ultimate Heat Sink
UK HPR1000	UK version of the Hua-long Pressurised Reactor

System codes (XXX) and system abbreviations (YYY) are provided for completeness in the format (XXX [YYY]), e.g. the Component Cooling Water System (RRI [CCWS]).

3.2 Introduction

The purpose of this chapter is to present a set of generic site characteristics that envelop suitable sites for the new nuclear power plants construction in the UK. It presents the parameter values of UK version of the Hua-long Pressurised Reactor (UK HPR1000) design related to the potential site conditions. These parameter values are also the inputs of the design and safety assessment for the UK HPR1000 in the Generic Design Assessment (GDA).

A generic UK site is established based on the potentially suitable sites, which are provided by the UK Government, in Reference [1]. In the GDA of the UK HPR1000, the generic site is developed from three potential sites which are Bradwell, Sizewell and Hinkley Point.

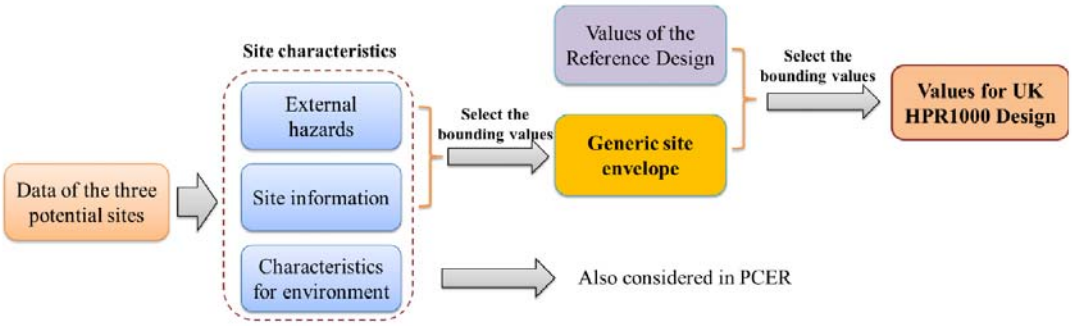
Site characteristics are split into three groups:

a) **External hazards**: External hazards are those natural or man-made hazards to a site and facilities that originate externally to both the site and its processes, such as a tornado or an accidental aircraft crash. The design basis and safety assessment of external hazards is presented in the Pre-Construction Safety Report (PCSR) Chapter 18.

b) **Site information**: Site information covers the features of the site which can be defined on a generic basis. This could include the heat sink, grid connections, geotechnical parameters as well as density and distribution of local population.

c) **Site characteristics for environment**: Site characteristics for the environmental issues are presented in the Pre-Construction Environmental Report (PCER) Chapter 2.

This chapter focuses on external hazards and site information. The external hazards and site information of the three potential sites are analysed to produce the generic site envelope. Generally, the parameter values for the UK HPR1000 design are determined from selecting the bounding values between the generic site envelope and the Reference Design. The approach to the generic site envelope for the UK HPR1000 is described in Sub-chapter 3.4. The general relationship of the site characteristics, generic site envelope and values for the UK HPR1000 design is shown in F-3.2-1.



F-3.2-1 General Relationship of the Site Characteristics,

Generic Site Envelope and Values for the UK HPR1000 Design

This document is produced based on the version 3 of the UK HPR1000 Design Reference (DR3), as described in the *UK HPR1000 Design Reference Report*, Reference [2].

3.2.1 Chapter Route Map

The ***Fundamental Objective*** of the UK HPR1000 is that: *the Generic UK HPR1000 could be constructed, operated, and decommissioned in the UK on a site bounded by the generic site envelope in a way that is safe, secure and that protects people and the environment.*

To underpin this objective, five Level 1 claims and several Level 2 claims are developed and presented in PCSR Chapter 1. This chapter supports the ***Claim 1.1*** derived from the high-level ***Claim 1***. To facilitate the clear traceability of the claim, arguments and evidences of PCSR Chapter 3, the route map form has been presented as follows.

Claim 1*: The generic site characteristics for the UK HPR1000 design reflect a generic UK site that bounds suitable locations.*

Claim 1.1*: The site characteristics are identified in a systematic method and the characteristics of the three potential UK sites produce an appropriate generic site envelope.*

To support ***Claim 1.1***, two relevant arguments have been developed in this chapter:

a) ***Argument 1.1.SC03-A1****: The process of identifying the generic site characteristics is based on Relevant Good Practice (RGP) and requirements from the UK context.*

b) ***Argument 1.1.SC03-A2:*** *The information used to produce the envelope values that are reviewed from a bounding analysis is taken from UK databases and codes.*

The evidences of the arguments are provided in Sub-chapter 3.3 and Sub-chapter 3.4.

3.2.2 Chapter Structure

This chapter provides the proposed envelope for the UK HPR1000, which will bound the three potential sites across the UK. A generic site is established first, as described in Sub-chapter 3.3. The characteristics of the potential sites are then identified, screened, and derived to produce the generic site envelope via a systematic approach, as introduced in Sub-chapter 3.4. Sub-chapter 3.5 explains the generic site envelope in detail, including external hazards and site information. Sub-chapter 3.6 defines the parameter values for the UK HPR1000 design in GDA.

The contents of every sub-chapter are shown as follows:

a) Sub-chapter 3.1 List of Abbreviations and Acronyms:

   This section lists abbreviations and acronyms which are presented in PCSR Chapter 3.

b) Sub-chapter 3.2 Introduction:

   This section presents a brief introduction to the chapter route map, structure and interfaces with other chapters.

c) Sub-chapter 3.3 Establishment of the Generic Site for the UK HPR1000:

   This section establishes the generic site for the UK HPR1000, and shows the

logic of the establishment.

d) Sub-chapter 3.4 General Approach to Generic Site Envelope:

This section presents the general approach to producing the generic site envelope, including the screening process and derivation of external hazards and site information.

e) Sub-chapter 3.5 Generic Site Envelope:

This section explains the generic site envelope in detail, which is gained from Sub-chapter 3.4.

f) Sub-chapter 3.6 Values for the UK HPR1000 Design:

This section presents the values for the UK HPR1000 design in GDA.

g) Sub-chapter 3.7 Concluding Remarks:

This section presents the concluding remarks.

h) Sub-chapter 3.8 References:

This section presents the references of this chapter.

3.2.3 Interfaces with Other Chapters

The interfaces with other chapters are listed in T-3.2-1.

T-3.2-1 Interfaces between Chapter 3 and Other Chapters

PCSR Chapter	Interface
Chapter 1 Introduction	PCSR Chapter 1 provides the fundamental objective, level 1 claims and level 2 claims. Chapter 3 provides chapter claims and arguments to support the Claim 1.1 in Chapter 1.
Chapter 7 Safety Systems	PCSR Chapter 3 provides a brief description of the heat sink associated with Extra Cooling System (ECS [ECS]). Chapter 7 provides the detailed description of the ECS [ECS].
Chapter 9 Electric Power	PCSR Chapter 3 provides the values for site related parameters for the UK HPR1000 design applied in chapter 9 and gives a preliminary description of grid connection, which is further detailed in Chapter 9.

PCSR Chapter	Interface
Chapter 10 Auxiliary Systems	PCSR Chapter 3 provides the values for site related parameters for the UK HPR1000 design to auxiliary systems design presented in Chapter 10 and presents a preliminary description of heat sink. Chapter 10 presents the detailed auxiliary system design (such as heat sink systems) using the parameter values for the UK HPR1000 design.
Chapter 13 Design Extension Condition and Severe Accident Analysis	PCSR Chapter 3 provides inputs to safety evaluation reference for Design Extension Condition and Severe Accident Analysis presented in Chapter 13.
Chapter 14 Probabilistic Safety Assessment	PCSR Chapter 3 provides generic site data for the hazards Probabilistic Safety Assessment in Chapter 14.
Chapter 16 Civil Works & Structures	PCSR Chapter 3 provides the values for site related parameters for the UK HPR1000 design applied in Chapter 16 for Civil Work and Structures design, and presents a preliminary description of seismic and soil characteristics.
Chapter 18 External Hazards	PCSR Chapter 3 characterises external hazards to be used in external hazard protection design presented in Chapter 18.
Chapter 23 Radioactive Waste Management	PCSR Chapter 3 provides the values for site related parameters for the UK HPR1000 design for design conditions of Radioactive Waste Management presented in Chapter 23.
Chapter 29 Interim Storage of Spent Fuel	PCSR Chapter 3 provides the values for site related parameters for the UK HPR1000 design for Spent Fuel Interim Storage presented in Chapter 29.

3.3 Establishment of the Generic Site for the UK HPR1000

The potential locations within the UK are set out in Reference [1], and they have been identified as suitable sites for a nuclear power plant. These sites are all on or adjacent to existing (or decommissioned) nuclear power plants, namely, Bradwell, Hartlepool, Heysham, Hinkley Point, Oldbury, Sizewell, Sellafield and Wylfa.

The generic site for the UK HPR1000 does not represent any particular location in the UK, rather it represents the envelope of the potential UK site conditions. For the UK HPR1000, these potential sites are Bradwell, Sizewell and Hinkley Point. As Bradwell, in Essex, is the target site for the UK HPR1000, it is important to ensure that the generic site bounds this site. In addition, Sizewell is relatively close to Bradwell

geographically, and some of the data envelopes for the two sites overlap significantly. It is therefore deemed appropriate to draw data from it in support of the generic site. Moreover, Hinkley Point is included as a comparison and supplement for the two aforementioned sites.

In order to appropriately define the characteristics of the three sites and ensure their completeness, a document titled *UK HPR1000 Generic Site Report* (Reference [3]) is issued to support this chapter.

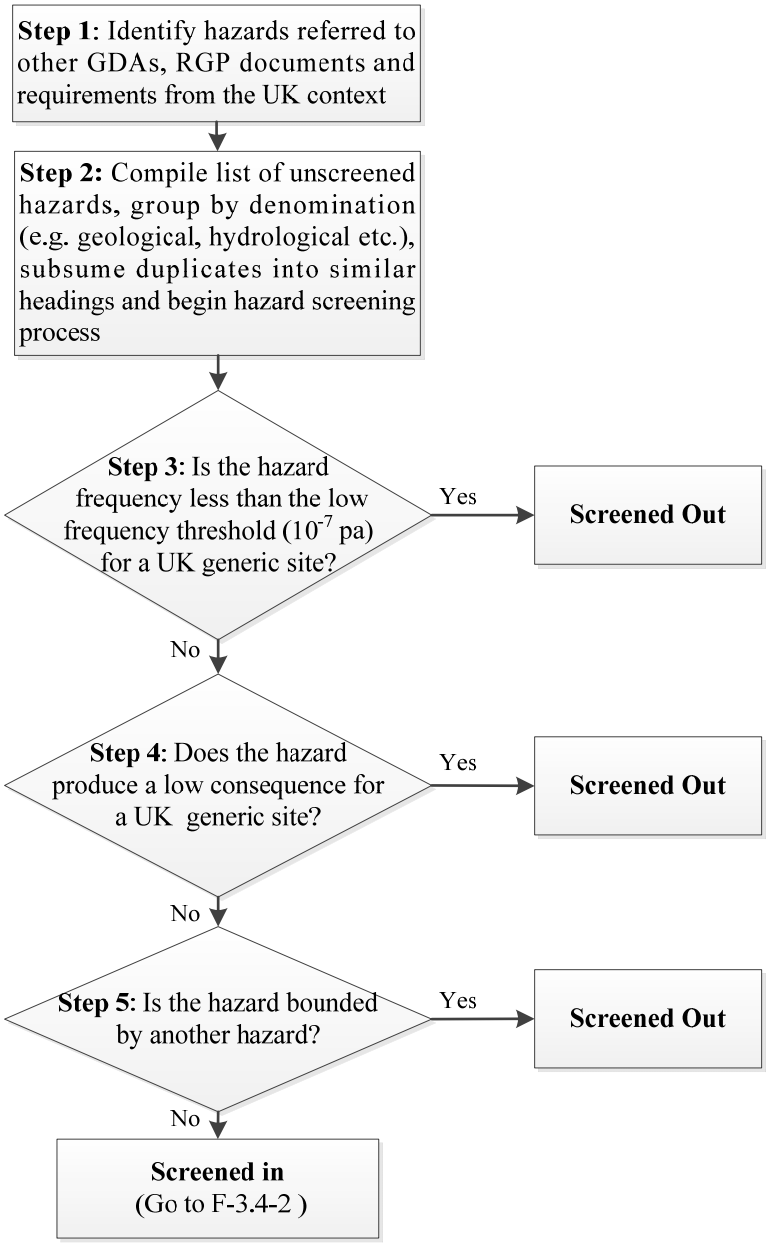
3.4 General Approach to Generic Site Envelope

The generic site envelope for the UK HPR1000 is defined via selecting the envelope values of the characteristics of the three potential sites. The general approach to the generic site envelope includes identification, screening and value derivation, which are obtained through a systematic methodology and based on RGP and requirements from the UK context. This sub-chapter introduces the general approach. More details about the approach are described in Reference [3].

3.4.1 External Hazards Identification and Screening

The identification and screening process of external hazards is outlined below in F-3.4-1. The review in Step 1 of F-3.4-1 involves many sources of guidance such as those from International Atomic Energy Agency, Office for Nuclear Regulation (ONR), Western European Nuclear Regulators Association as well as other Requesting Party GDA submissions. The list of the guidance, including the RGP and UK context requirements, is in Reference [3].

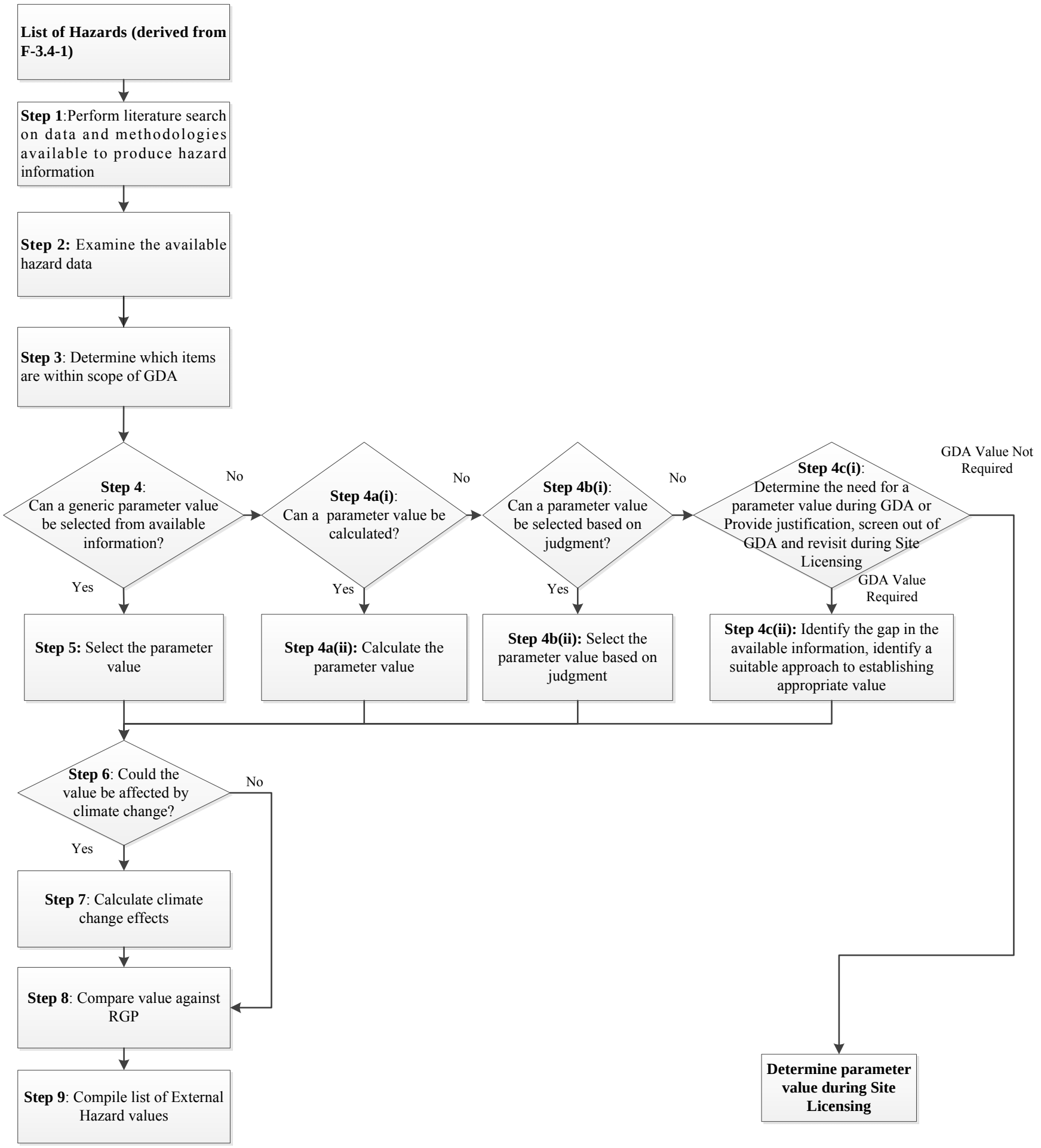
From these RGP and requirements from the UK context, potential external hazards are identified, and grouped in Step 2 and then screened against the series of screening criteria outlined in Step 3 to Step 5. A small number of external hazards are screened out in the UK HPR1000 design.



F-3.4-1 External Hazards Identification and Screening Process Flow

3.4.2 External Hazard Value Derivation

The remaining external hazards that have passed the screening criteria are then subjected to a second process to determine how parameter values should be derived. The process is detailed below in F-3.4-2.



F-3.4-2 External Hazards Parameter Values Derivation Process Flow

The values selected for each parameter have been specified from standards, practice of previous GDA projects, appropriate databases or relevant studies undertaken by nuclear operators and some of the values have been determined by comparison with the details from previous GDAs. In all cases, the processes put forward are examined against values defined in other GDA projects and applicable databases to ensure that they are appropriate.

A summary of the outcomes of the external hazard identification, screening and value derivation process is presented in T-3.4-1 to T-3.4-3. Parameters which pass all of the screening criteria in F-3.4-1 and can be derived according to F-3.4-2 are included in the GDA phase, as shown in T-3.4-1. Parameters which are to be included in the UK HPR1000 design but cannot be derived until specific site information is known are included in the nuclear site licensing phase, which is shown in T-3.4-2. Hazards which fail the screening process in F-3.4-1 are included in the Screened-out Group in T-3.4-3. The hazard groups presented in the tables are based on the hazard groups presented in Reference [4].

T-3.4-1 External Hazard Parameters in the GDA Phase

Treatment	Group	Hazard Parameter
GDA	Seismic	Response spectra, Shear wave velocity
	Hydrological	Flooding (including rainfall)
	Man Made	Accidental aircraft crash, Electromagnetic Interference (EMI), Missiles(1)
	Meteorological	Extremes of air temperature, Humidity, High wind(2), Tornado(3), Extreme hail / Sleet / Snow, Extremes of sea or river temperature, Icing, Lightning(4), Drought, Space weather(5)

Note:

(1) The protection measures of missiles are considered in GDA phase, while missiles caused by other industrial facilities are site-specific issues that are not be considered during GDA.

(2) “High wind” includes the wind-borne missiles.

(3) “Tornado” includes the missiles generated by tornado.

(4) “Lightning” includes the naturally occurring EMI caused by lightning.

(5) “Space weather” includes the naturally occurring EMI, Solar Energetic Particles (SEP) and Geomagnetic Induced Current (GIC).

T-3.4-2 External Hazard Parameters in the Nuclear Site Licensing Phase

Treatment	Group	Hazard Parameter
Nuclear Site Licensing	Seismic	Extended period ground motion
	Hydrological	Dam failure, Instability of the coastal area, Storm surge, Wind generated waves, Changes in river channel or obstruction of river channel, Bore, Snow melt, Water course containment failure, Tidal effects, Tsunami, Sea level, Seiche
	Biological	Biological fouling, Seaweed, Fish, Jellyfish, Marine growth, Infestation, Airborne swarms, Crustacean or mollusc growth, Biological flotsam, Microbiological corrosion, Water debris
	Man Made	Impacts from adjacent sites, Gas clouds, Liquid release, Fires, Explosions, Structural failure, Transport, Pipelines, Vibrations, Malicious activity, Industrial plants, Military facilities, Transport of nuclear material, Forest fire, Ship collision, Unexploded ordnance, Hydrocarbon pollution
	Meteorological	Extremes of ground temperature, Sand storms, Air pressure, Low groundwater, Low sea water level, Water spout, Surface ice on lake or sea, Mist, Fog, Freezing fog, Salt storm
	Geological	Contaminated land, Landslides (slope instability), Radon / Methane, Groundwater flooding
	Landscape Change	Windblown sand and dune movement, Coastal erosion, Longshore drift, Shingle mounding, Sediment deposition, Water course erosion, Water course path change, Water table movements, Changes in land use and water use

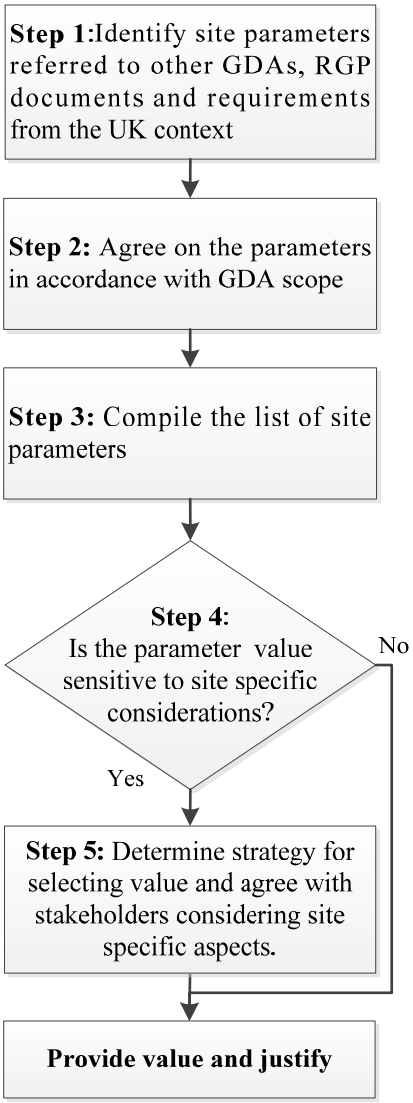
T-3.4-3 Screened-out External Hazard Parameters

Treatment	Group	Hazard Parameter
Screened-out	Meteorological	Meteorite, Solar flare (bounded by Space weather)
	Geological	Volcanoes

3.4.3 Site Information Identification and Screening

The identification and screening process of site information is outlined below in F-3.4-3. The range of the RGP and requirements in Step 1 of F-3.4-3 is the same as that used in the identification and screening process of external hazards, mentioned in

Sub-chapter 3.4.1.



F-3.4-3 Site Information Screening Process Flow

After the process above, a summary of the processing of each parameter can be found below in T-3.4-4, T-3.4-5 and T-3.4-6. The parameter value derivation process of the site information takes the most conservative conditions into account, as detailed in Reference [3].

T-3.4-4 Site Information in the GDA Phase

Treatment	Group	Site Information
GDA	Geological	Soil bearing capacity
	Others	Heat sink, Grid connections / Loss of Offsite Power, Density and distribution of local population, Emergency arrangements

T-3.4-5 Site Information in the Nuclear Site Licensing Phase

Treatment	Group	Site Information
Nuclear Site Licensing	Seismic	Local site effects, Soil structure interaction, Liquefaction, Surface faulting / Ground rupture, Dynamic compaction, Permanent ground displacement
	Geological	Settlement, Ground heave, Groundwater, Leaching, Unstable soils, Properties of sub-strata, Characteristics of subsurface material, Soil erosion

T-3.4-6 Screened-out Site Information

Treatment	Group	Site Information
Screened-out	Geological	Mining, Caverns, Sinkholes

3.5 Generic Site Envelope

The generic site envelope in this sub-chapter, consisting of external hazards and site information, is based on the three potential sites as described in Sub-chapter 3.3.

According to Reference [3] and Appendix 3 in Reference [5], based on the screening process mentioned in Sub-chapter 3.4, the following parameters have been taken into account:

a) External hazards

   1) Meteorology;

   2) Flooding;

   3) Seismic;

   4) Man made.

b) Site information

   1) Grid connections;

   2) Heat sink;

   3) Density and distribution of local population;

   4) Soil.

3.5.1 External Hazards

3.5.1.1 Meteorology

The meteorological parameters considered are shown in T-3.4-1. According to Reference [6], the effects of climate change on air temperature, wind, rainfall, water temperature and enthalpy need to be considered. The detailed values are shown in T-3.5-1.

T-3.5-1 Climate Change Effect on Parameters

Parameters		Values not including Climate Change	Climate Change Effect	Unit
Air temperature	Maximum (Dry bulb)	41.5	+7	℃
	Minimum (Dry bulb)	-22	---(1)	
	Average (Dry bulb)	10	---	
Rainfall	1h	163	+53 (+32.6%)	mm
	24h	228	+74 (+32.6%)	
Enthalpy	Maximum hourly enthalpy	78.4	+12.1	kJ/kg
	Maximum 6h mean enthalpy	78.4	+12.1	
	Maximum 12h mean enthalpy	78.1	+12.1	
Seawater temperature	Maximum	28	+5.5	℃
	Minimum	-2	---(1)	
	Average	13	---	
Wind Speed	3-second gust	41.66	2(2)	m/s

Note:

(1) Minimum temperatures (including air and seawater) are predicted to increase due to climate change (Reference [3]), and therefore the climate change values are not considered in minimum temperatures for conservative design.

(2) For wind speed, the impact of climate change cannot be clearly identified, and the climate change effect value here is defined using judgement, so a peak anomaly value has conservatively been selected.

The generic site envelope relating to meteorological conditions is shown in T-3.5-2, except for the drought parameter which is qualitative rather than quantitative. Space weather may result in LOOP or interfere with the performance of Instrumentation and Control (I&C) equipment. T-3.5-2 lists the parameter of GIC. Other detailed

information will need to be further determined in the nuclear site licensing phase.

T-3.5-2 Generic Site Envelope about Meteorology

Parameters		Generic Site Envelope	Unit
Air temperature	Maximum	48.5	℃
	Minimum	-22	
Humidity	Maximum	100	%
	Minimum	12	
Enthalpy	Maximum hourly enthalpy	90.5	kJ/kg
	Maximum 6h mean enthalpy	90.5	
	Maximum 12h mean enthalpy	90.2	
Rainfall	1h	216	mm
	24h	302	
Seawater temperature	Maximum	33.5	℃
	Minimum	-2	
Wind Speed	3-second gust	43.66	m/s
Tornado	Speed	65	m/s
	Pressure drop	2.6	kPa
	Tornadic missile speed	24 (Schedule 40 Pipe, 0.168 m dia×4.58 m long, 130 kg)	m/s
		24 (Automobile, 1178 kg)	
		6 (Solid steel sphere, 0.0254 m)	
Snow	Snow load	1.5	kPa
Ice	Clear ice thickness	117	mm
	Clear ice density	9	kN/m^3
Lightning	Current	300	kA
	Mean flash frequency	N_G=1.3	flashes/ km^2/yr
	Thunderstorm days	13	days/yr
Space weather (for GIC)	Horizontal Magnetic Field Strength	6080	nT
EMI	Naturally occurring due to lightning strike or solar flares.	No numerical value defined in GDA	---

3.5.1.2 Flooding

There are several causes of flooding on the site. The main causes are sea water, river inundation, rainfall or a combination of them. The flooding caused by rainfall is considered in GDA phase. The potential height that could be reached by the flood water needs to be determined further through site investigation in the nuclear site licensing phase.

3.5.1.3 Seismic

During the GDA phase, the European Utility Requirements (EUR) spectra are adopted as the Design Basis Earthquake (DBE) input motion for the seismic analysis. The DBE of the UK HPR1000 is designed with a Peak Ground Acceleration (PGA) of 0.30g (Reference [3]). The vertical PGA is 2/3 of the horizontal PGA. The selection of response spectra are detailed in Reference [7]. In the nuclear site licensing phase, the applicability of the design response spectra will be analysed and used for the seismic assessment and protection design.

The seismic conditions of the generic site envelope cover shear wave velocity, and the range of values needs to be defined via site investigation in the nuclear site licensing phase. The generic site envelope for seismic efforts is shown in T-3.5-3.

T-3.5-3 Generic Site Envelope for Seismic Effects

Parameters		Generic Site Envelope	Unit
Seismic	DBE	0.3	g
	Shear wave velocity	150~350(1)	m/s
	Response spectra	EUR spectra	---

Note:

(1) In Reference [3], 150 m/s ~ 350 m/s from Heathrow Terminal 5 is adopted as the value of Generic Site Envelope. In the meanwhile, the EUR recommends a range between 250 m/s and 1100 m/s for soft to medium sites. In UK HPR1000 design, 150 m/s ~ 1100 m/s is adopted as the bounding value of shear wave velocity, which is presented in T-3.6-1.

3.5.1.4 Man Made

The man made conditions of the generic site envelope cover accidental aircraft crash and EMI. The background aircraft crash rates are shown in T-3.5-4. When the background aircraft crash rate is multiplied by the effective target area, it provides a value for the accidental aircraft crash rate, which is shown in T-3.6-1. The site is protected from EMI through the electrical design as well as the I&C design. The protection measures of missiles are considered in GDA phase, while missiles caused by other industrial facilities need to be further studied in the nuclear site licensing phase.

T-3.5-4 Generic Site Envelope for Accidental Aircraft Crash

Parameters		Generic Site Envelope	Unit
Background aircraft crash rate	Light aircraft	1.76	$km^{-2}\cdot yr^{-1}\cdot 10^{-5}$
	Helicopters	0.97	

Parameters		Generic Site Envelope	Unit
	Small transport aircraft	0.06	
	Large transport aircraft	0.08	
	Military combat aircraft	0.28	
	Total	3.19	

3.5.2 Site Information

3.5.2.1 Grid Connections

When connected, the regional power grid has enough capacity (including the capacity of transmission lines and grid stability) to adapt to the power produced by the nuclear unit.

The UK HPR1000 unit is designed to be connected to the external grid through a main connection and a standby connection.

The main generator of the UK HPR1000 has a terminal voltage of 24 kV, which can be stepped up to an applicable voltage level, typically 400 kV, through a unit transformer to connect to the grid. The rated frequency of the UK HPR1000 unit is 50 Hz which is consistent with the UK grid, Reference [8].

The ranges of voltage and frequency comply with the requirements of the UK grid code, Reference [8]. If there is any deviation, it is necessary to coordinate with the transmission system operator and ensure that the nuclear safety functions are not impacted.

3.5.2.2 Heat Sink

The Ultimate Heat Sink (UHS) of the UK HPR1000 is designed to supply sufficient cooling water, which shall be available for reactor operation and the mitigation for most accidents.

The UHS has two transferring media (the seawater and the air atmosphere). The main UHS in most conditions is the seawater. The Essential Service Water System (SEC [ESWS]), which is an open system, takes cooling water from the sea and is used under normal operating conditions, design basis conditions and some design extension conditions if it remains available. The SEC comprises of three independent trains, adapting to the Component Cooling Water System (RRI [CCWS]). Train A and B are of the same configuration, and each train has two redundant sets of equipment. Train C has only one set. The detailed information on the UHS is described in Sub-chapter 10.4.9.

In addition, there are two seismically qualified mechanical draft cooling towers for each unit, which use the air atmosphere as the heat sink. The ECS [ECS], by means of the mechanical draft cooling towers, removes the core residual heat and the spent fuel

decay heat from the spent fuel pool in case of failure of the RRI [CCWS] and the SEC [ESWS]. The detailed information on the ECS [ECS] is described in Sub-chapter 7.10.

3.5.2.3 Density and Distribution of Local Population

Data for the density and distribution of the local population needs to be provided for the protection of individuals and populations from radiological risk. Most UK sites specified in Reference [1] are classified as semi-urban sites. The population distribution for a specific site will be confirmed once appropriate site specific studies have been performed. Emergency arrangements have already been prepared in all the sites listed in Reference [1], since nuclear installations existed on or near them in the past. The emergency arrangements will be re-examined against population in the nuclear site licensing phase.

3.5.2.4 Soil

The soil conditions of the generic site envelope cover bearing capacity, as shown in T-3.5-5.

T-3.5-5 Generic Site Envelope for Soil

Parameters		Generic Site Envelope	Unit
Soil	Bearing capacity (Static)	1 to 1.5(1)	MPa

Note:

(1) This value is set for soil beneath the nuclear island buildings under the common raft foundation.

3.6 Parameter Values for the UK HPR1000 Design

This sub-chapter presents the parameter values for the UK HPR1000 design. They are generally derived from selecting bounding values between the values of the Reference Design and the generic site envelope. The relationship between them is shown in F-3.2-1, and the values for the UK HPR1000 design are listed in T-3.6-1. The detailed information of these design values are described in Reference [9].

T-3.6-1 Parameter Values for the UK HPR1000 Design

Parameter		Parameter Values for the UK HPR1000 Design	Unit
Air Temperature	Maximum	48.5	℃
	Minimum	-22	

Parameter		Parameter Values for the UK HPR1000 Design		Unit
Humidity	Maximum	100		%
	Minimum	8		
Enthalpy	Instantaneous extreme high enthalpy	90.5(1)		kJ/kg
Wind (10-meter height from ground)	Extreme wind speed (3-second gust)	80		m/s
Tornado	Speed	89		m/s
	Pressure drop	6.3		kPa
	Tornadic missile speed	34 (Automobile, 5 m×2 m×1.3 m, 1810 kg)		m/s
		34 (Schedule 40 pipe, 0.168 m×4.58 m, 130 kg)		
		7 (Solid steel sphere, 0.0254 m)		
Rainfall(2)	1h	216		mm
	24h	302		
Snow	Snow load	1.5		kPa
Seawater Temperature	Maximum(3)	33.5		℃
	Minimum	-2		
Ice	Clear ice thickness	117		mm
	Clear ice density	9		kN/m^3
Lightning	Current	300		kA
Drought(4)	---	---		---
Hydrological	Flooding	---		m
Space Weather	Horizontal Magnetic Field Strength of GIC	6080		nT
Soil	Bearing capacity	≥1(5)		MPa
Man Made	Accidental aircraft crash rate	Light aircraft	6.25	10^{-7}/yr
		Helicopters	3.13	
		Small transport aircraft	0.21	
		Large transport aircraft	0.28	
		Military combat aircraft	0.99	
		Total	10.86	

Parameter		Parameter Values for the UK HPR1000 Design	Unit
	EMI	EMI comes from lightning and industrial activities	---
	Missiles[(6)]	---	---
Seismic	DBE	0.3	g
	Shear wave velocity	150 to 1100	m/s
	Response spectra	EUR spectra	---

Note:

(1) The instantaneous extreme high enthalpy is relevant to the air temperature values, so 90.5kJ/kg is adopted in the design of UK HPR1000 though the value used in the Reference Design is 103kJ/kg.

(2) The rainfall values used in the Reference Design are 326mm (1 hour) and 1320mm (24 hours), which are much larger than the UK generic site values. Therefore, the rainfall values are determined based on the generic site envelope with full consideration of the meteorological conditions of the UK sites.

(3) The maximum seawater temperature (33.5℃) of the generic site envelope is lower than the temperature adopted in the Reference Design (38℃), which is from the southern part of China. In order to better reflect the characteristics of the UK generic sites, 33.5℃ is adopted as the design value of the UK HPR1000.

(4) Drought parameter is qualitative not quantitative in the GDA phase.

(5) This value is set for soil beneath the nuclear island buildings under the common raft foundation.

(6) Missiles due to industry activities are deemed to be bounded by tornadic missiles in the GDA phase.

T-3.6-1 lists the parameter values for safety design and assessment of the UK HPR1000 in the GDA phase. Note that several characteristics cannot be defined until the nuclear site licensing phase. These will be analysed in the specific site investigation.

3.7 Concluding Remarks

This chapter derives the generic site envelope of the UK HPR1000 in GDA via a systematic approach, and presents the parameter values for the UK HPR1000 design, which cover the generic site envelope.

3.8 References

[1] Department of Energy and Climate Change, National Policy Statement for Nuclear Power Generation (EN-6), Vol 1&2, July 2011.

[2] CGN, UK HPR1000 Design Reference Report, NE15BW-X-GL-0000-000047, Revision I, September 2021.

[3] CGN, UK HPR1000 Generic Site Report, GHX00100091DOZJ03GN, Revision B, September 2020.

[4] ONR, Nuclear Safety Technical Assessment Guide, External Hazards, NS-TAST-GD-013, Revision 8, October 2018.

[5] ONR, New nuclear reactors: Generic Design Assessment Guidance to Requesting Parties for the UK HPR1000, ONR-GDA-GD-001, Revision 4, October 2019.

[6] Met Office Hadley Centre, UK Climate Projections, Land Projections Report, 2018.

[7] CGN, Generic Design Parameters for Civil Engineering, GHXNIX10016DWJG42GN, Revision H, July 2021.

[8] National Grid Electricity System Operator Limited, The Grid Code, Revision 33, 2019.

[9] CGN, Generic Site Related Design Values, GHX00100007DOZJ03GN, Revision D, January 2021.