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General Nuclear System Ltd.

UK HPR1000 GDA Project

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Preliminary Safety Report
Chapter 25
Conventional safety

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Section Number	Section Title	Page	Content	Category

Table of Contents

25.1 List of Abbreviations and Acronyms

ALARP	As Low As Reasonably Practicable
BOP	Balance of Plant
CDM	Construction (Design and Management) Regulations
CI	Conventional Island
COMAH	Control of Major Accident Hazards
GDA	Generic Design Assessment
HF	Human Factors
HPR1000 (FCG3)	Hua-long Pressurised Reactor under construction at Fangchenggang nuclear power plant unit 3
HSE	Health and Safety Executive
HSG	HSE Guidance Note
IAEA	International Atomic Energy Agency
NI	Nuclear Island
NPP	Nuclear Power Plant
PCSR	Pre-Construction Safety Report
PRC	People's Republic of China
SFAIRP	So Far As Is Reasonably Practicable
UK HPR1000	The UK version of the Hua-long Pressurised Reactor
WENRA	Western European Nuclear Regulators' Association

25.2 Introduction

The control of conventional safety during all stages is a key element of any project. The aim of this chapter as it develops during the Generic Design Assessment (GDA) is to provide information for aspects of the design that might impact on conventional (i.e. non-nuclear) safety during construction, operation and decommissioning of the power station, on Control of Major Accident Hazards (COMAH) regulations and compliance with fire safety and health and safety regulations, including compliance with the general requirements of the Health and Safety at Work etc. Act 1974, the Construction (Design and Management) Regulations 2015 (CDM), and the Regulatory Reform (Fire Safety) Order 2005).

This chapter supports the following high level objective: The design, and intended construction and operation, of the UK HPR1000 will be developed to reduce, so far as is reasonably practicable, the impact on the workers, the public, and the environment.

This chapter will demonstrate the following:

a) Fire Safety will be managed to protect workers and other people who may be affected by our business activities.

b) Conventional Safety will be managed to protect workers and other people who may be affected by our business activities.

However, the design for the UK HPR1000 for the Generic Design Assessment (GDA) has not yet been declared and consequently no detailed UK HPR1000 design information is available at this time. The design will be based on the version of the Hua-long Pressurized Reactor under construction at Fangchenggang nuclear power plant unit 3, as discussed in chapter 1. Therefore this chapter provides a summary of the conventional safety processes and procedures implemented for the HPR1000 (FCG3) design that will form the basis of those to be followed for the UK HPR1000 design.

The regulatory systems in China differ significantly from those in the UK. Due to the magnitude of this difference it is considered inappropriate to present UK HPR1000 claims in this chapter.

This chapter, as it develops in future steps of GDA, will have interfaces with chapter 15 in terms of Human Factors (HF) assessments of activities that are designed in (a proportionate approach will be taken to HF activities, to ensure that the conventional safety risks to personnel are ALARP), chapter 8 and 9 in terms of cable routing, chapter 10, in terms of fire-fighting systems, chapter 16 in terms of design and safety of civil structures and protective barriers and CDM requirements for building design hazard reduction, chapter 19, internal hazards including impact of fire on nuclear safety (and any overlap or conflict with conventional fire) and review of compartment and barrier design, chapter 20, Management of Nuclear Safety and Quality Assurance in terms of processes, chapter 24, Decommissioning, and chapter 26, Environment, including substances that could be toxic to the environment (through fire-fighting provisions and a COMAH interface for example). This chapter provides a summary of conventional safety activities which are not part of the nuclear safety case production process.

The basic objective for the conventional safety design of UK HPR1000 (or industrial safety as this is referred to in Chinese law) is to eliminate or reduce the risk from non-nuclear hazards inside the nuclear power plant site, provide awareness around the organisation of residual hazards and risks, and overall to protect the health and safety of all site personnel.

25.3 Design Evolution HPR1000 (FCG3) (Conventional Safety Focus)

The HPR1000 (FCG3) has been developed and evolved continuously through a series of improvements on NPP technologies with optimisation in order to improve and to enhance conventional safety, as summarized as follow:

a) Non-toxic substances preferentially used, avoid the use of substances harmful to health generally, as far as practicable.

b) Reduce manual operation and potential exposure through adopting increased automated process equipment.

c) Further optimisation of the design of sealing and purification measures to prevent exposure to toxic substances.

d) Install automatic alarm/detection devices in locations where acute occupational poisoning could otherwise occur, where hazardous substances cannot be eliminated.

e) Reduce bulk quantities of dangerous substances, as far as practicable.

f) Eliminate areas where potentially explosive atmospheres may occur, where this is not possible, avoid potential ignition sources and ensure the use of correctly certified electrical equipment class for each zone, and strengthen the control of personnel access.

g) Improved safety design in potentially explosive environments (such as: provision of antistatic PPE for the workers involved, as well as proper electrical earthing etc.).

h) Install automatic alarm/detection devices in locations where potentially explosive atmospheres may occur, where dangerous substances cannot be eliminated.

The design and plant modification processes deployed also address a review of conventional/industrial health and safety and conventional fire safety.

The design of HPR1000 (FCG3) considers the following conventional risks: fire, explosion, high temperature and high pressure, chemical hazards, dust hazards, noise, electrical hazards, power frequency electromagnetic field, mechanical injury, object strike, fall from height, drowning, confined space etc.

The basic objective of the conventional safety design of HPR1000 (FCG3) is to reduce the risk of various hazardous factors inside the nuclear power plant site, and protect safety and health of site personnel. The conventional safety design principles of HPR1000 (FCG3) are as follows:

a) Safety is the priority, and hazard prevention is the main objective.

b) The design of systems and equipment are in line with the intrinsic safety principle as far as possible.

c) The avoidance of risks from corrosion through the selection of suitable materials and application of robust surface protective systems, eg painting and coating.

d) The design fully considers human factors and adopts safety system engineering and ergonomic principles to enhance system reliability, reduce and avoid errors, and ensure the safety of workers and other people who may be affected by our business activities.

e) The design pays close attention to in-service inspection accessibility, as well as regular test and maintenance feasibility.

f) Regarding safety, the design confirms to classification requirements, implements quality assurance measures, and ensures building and equipment reliability.

Operating experience is being recorded from the ongoing construction project, and will be reflected in the UK HPR1000 design evolution.

25.4 Regulations, Codes & Standards Applicable to HPR1000 (FCG3)

25.4.1 Summary of Chinese Conventional Safety Regulatory Framework

The ‘Work Safety Law’ of the People's Republic of China (PRC) and the ‘Law of the People's Republic of China on Prevention and Control of Occupational Diseases’, are the two supreme or highest level Laws related to health and safety in China. This includes the requirement to manage risk from the conventional safety hazards. A further tier of legislation is provided through the Regulations issued by the State Administration of Production Safety Supervision and Management. Finally, there are the National Standards (divided into mandatory standard and recommended standard). For different regions of China, local standards may also be enforced.

Requirements for conventional safety management of nuclear power plant projects in China defined in the Work Safety Law establishes the need for a safety management organisation, configures the number and arrangement of staff, establishes the need for a management system, according to national requirements.

Appendix 1 provides a list of the most relevant Chinese laws, regulations and standards for this chapter, and details of fire provisions are described in sub-chapter 25.5.2.1. Work is underway to map EU/UK regulations and ensure a gap analysis occurs to ensure potential differences are understood early and are addressed.

25.4.2 Specific Regulations Applying to HPR1000 (FCG3) Conventional Fire Safety

25.4.2.1 Implementing of the Principle of ‘defence in depth’ for Fire Protection

The principle of ‘defence in depth’ shall be implemented for fire protection design of nuclear power plants (NPP), including three levels: fire prevention, fire separation and fire control, in which, Level 2 is achieved by way of physical or geographical separation through the inherent fire resistance of separation materials themselves (walls, panels and doors) and propagation characteristics of fire and temperature to confine fire to a given area range within a certain period, so as to limit the spread of fire.

a) Fire prevention

Fire prevention is to take a complete set of precautionary measures to prevent the occurrence of fire or decrease the possibility of occurrence. These measures include selection of non-combustible or fire-retardant materials and control of ignition sources. During design of processes and equipment, requirement related to fire safety in design specifications of the processes and equipment themselves shall be followed, while fire protection design requirements shall also be met for relevant processes and equipment in ETC-F 2010. Fire hazard sources shall be identified in the design process and appropriate pertinent fire protection measures shall be taken when necessary.

b) Fire separation

The principle of physical or geographical separation is adopted to divide the plant into several fire zones, to limit the spread of fire and confine fire and smoke impact within a given range in the event of a fire.

c) Fire control

Fire detection system and fixed fire protection system shall be designed to achieve early detection and extinguishing of fire, so that fire is under control.

25.4.2.2 Fire Legislation Relevant for HPR1000 (FCG3)

Laws, regulations, national standards, codes and technical standards that have been followed for fire protection design for HPR1000 (FCG3):

a) Laws and regulations

1) Fire Prevention Law of the People's Republic of China, issued in 2008 and implemented in 2009.

2) Regulations on Supervision and Management of Safety in Nuclear Power Plant, KGF [2006] No. 1191.

3) Code on Safety of Nuclear Power Plant Design (HAF102-2004).

b) Safety guidelines and technical standards

1) Fire Protection in Nuclear Power Plants, HAD102/11-1996.

2) Code on the Fire Protection of Nuclear Power Plant Operation, HAD103/10-2004.

c) Fire protection design for NI buildings

For the fire protection design the French ETC-F 2010 code is used as the design standard, which is aligned to International Atomic Energy Agency (IAEA) and Western European Nuclear Regulators' Association (WENRA) expectations and utilises harmonised standards. All the principles of fire protection design come from this code.

The main codes used are as follows:

1) ETC-F - EPR Technical Code for Fire Protection, 2010.

2) Code for Design of Cables of Electric Engineering, GB50217-2007.

3) Standard for Lighting Design of Buildings, GB50034-2013.

4) Design Code for Protection of Structures against Lightning, GB50057-2010.

5) Electrical Installations Design Code for Explosive Atmospheres and Fire Hazard, GB50058-2014.

d) Fire protection design for Conventional Island and Balance of Plant

For the fire protection design of Conventional Island (CI) and other non-safety related Balance of Plant (BOP) buildings, Chinese domestic regulations and codes are followed. For CI, the main code for fire protection design is GB50745-2012 a specific Code for design of fire protection for CI in nuclear power plants. The clauses in these standards are all specific, and require compliance with these requirements. These standards have considered all aspects of fire protection design. For the UK HPR1000 project, a gap analysis will be undertaken in the next step to identify any gaps between Chinese standards and UK standards to ensure the UK HPR1000 design can fulfil the requirement of UK legislation, as part of the Fire Risk Assessment process.

For the CI, areas with flammable materials such the steam turbine, fuel storage/pump house, transformer, cabling and layout are all specifically addressed. Requirements for safe evacuation, classification of fire risk of buildings, fire detection, fire-fighting, power supplies, HVAC, are all addressed.

The main codes used are as follows:

1) Code for Design of Fire Protection for Conventional Island in Nuclear Power Plants, GB50745-2012.

2) Code for Design of Cables of Electric Engineering, GB50217-2007.

3) Standard for Lighting Design of Buildings, GB50034-2013.

4) Design Code for Protection of Structures against Lightning, GB50057-2010.

5) Electrical Installations Design Code for Explosive Atmospheres and Fire Hazard, GB50058-2014.

6) Code for Design of Automatic Fire Alarm System, GB50116-2013.

7) Code for Installation and Acceptance of Fire Alarm System, GB50166-2007.

8) Code of Design on Building Fire Protection and Prevention, GB50016-2014.

For other non-safety related buildings, the main code used in fire protection design is the Chinese code for fire protection design of buildings (GB50016-2014). Again, fire hazards are classified, fire resistance requirements are stated for civil structures and design elements, fire-fighting measures are defined and specific considerations for evacuation are specified.

25.5 Overview of HPR1000 (FCG3) facility design principles

25.5.1 HPR1000 (FCG3) Classification of Hazards

For the HPR1000 (FCG3) design, the Chinese ‘Standard for Classification and Code for the Hazardous and Harmful Factors in Process’ (GB/T 13861-2009) has been used. To manage other conventional safety risks across the nuclear power plant, the major facility design conventional hazard preclusion measures are addressed in sub-chapter 25.5.3.

25.5.2 General Working Conditions

A comfort zone for personnel can be defined by appropriate ranges of temperature and humidity. These factors interact and must be addressed jointly. There will be suitable provision in the design to ensure a comfortable normal working environment, and alternative safe control locations provided for use in the event of normal control locations becoming inhabitable due to a fault. The design shall provide adequate lighting and working space.

As an overall concept for UK HPR1000 the design principles will encourage the use of engineering controls to minimise the use of personal protective equipment.

There are more detailed but potentially significant requirements at later stages in the design, such as the need to avoid slips and trips during use and maintenance through good design, and ensure construction design minimises the need for manual handling.

25.5.3 Hazard Identification and Mitigation Principles

a) High-temperature, high-pressure, flammable, highly flammable, extremely flammable, oxidising, and explosive hazards

— Avoid areas where operators are regularly present when routing high-temperature high-pressure pipes.

— Design for safe operations and maintenance.

— Provide heat insulation design, corresponding shielding and physical isolation for high-temperature pipes.

- Provide suitable and sufficient ventilation.
- Install visual and audible alarm devices and fire-fighting measures to avoid accumulation of inflammable and explosive gases.
- Design to reduce the need for entry of personnel in high-temperature areas.

b) Chemical hazard

Related systems inside the Nuclear Island use chemicals, such as nitric acid, boric acid, sodium hydroxide, lithium hydroxide and hydrogen peroxide. Ammonium hydroxide, and hydrazine are used in the Conventional Island. Eliminate, reduce or replace principles are applied:

- Preferential use of non-toxic (non-harmful) substances instead of toxic, using advanced production processes and technology, and non-harmful raw materials, in order to eliminate chemical hazards.
- The thresholds/calculations for COMAH will be considered and steps taken to design-out or reduce COMAH classified chemicals wherever possible.
- For the process and equipment which will use or produce harmful chemical substances (including outage process equipment), adopt mechanisation and automation, in order to avoid direct manual operation and reduce the potential of exposure to chemicals.
- Emergency ventilation and leakage alarm devices are interlocked with an emergency exhaust system. Equipment and protective systems for use in hazardous area must be ensured the use of correctly certified electrical equipment class.
- Design for safe operations and maintenance.
- To prevent toxic materials spilling and leaking, the equipment and pipelines adopt effective sealing, are combined with ventilation and purification measures. For example, all the acid and alkali solution tanks are sealed containers, located to reduce heat loading. There is a piece of integrated absorption equipment (acid mist absorber) at the exhaust port of the solution tank.
- Design in hygiene and emergency facilities.
- Avoid use of toxic materials, where harmful substances are unavoidable, internal structures and surfaces such as walls, ceiling and floors of workplaces which need to use toxic compounds use materials and coatings to provide corrosion resistance, and are non-absorbent.

c) Electrical hazards

- Design for safe operations and maintenance, and develop Permit To Work / Permit

For Work processes and build practical isolation solutions.

— Implement high voltage protection measures to ensure separation of high voltage equipment from operating areas and personnel.

— Implement safe working maintenance practices for high voltage equipment.

— Use reliable insulation for electric parts, implement isolation, use fire retardant products for switch cabinets, use anti-spark protection in potentially flammable atmospheres, and employ reliable earth leakage protection.

— Lightning protection measures for buildings (this will be explored further in future GDA steps in chapter 9).

— Anti-static protection measures to prevent static accumulation.

— Choose correctly certified electrical equipment class for use in hazardous area and high-temperature resistant equipment.

d) Mechanical hazards

— Design for safe operations and maintenance, and develop Permit To Work / Permit For Work processes and build practical isolation solutions.

— Choose mechanical equipment with high reliability.

— Ensure operators are protected from revolving/moving parts, and ensure appropriate interlocks and alarms are designed.

— Set fixed barriers and warning signs.

e) Working at Height

— Design for safe construction, operations and maintenance.

— Consider the need to work at height in the design stage.

— Eliminate where practicable, including addressing design of stairs, operating platforms, holes/wells/tanks.

— Provision of edge protection where there is a foreseeable risk of falls.

— Design for safe operations and maintenance, including need for moveable platforms or other devices.

— Design of roof mounted services that require access (for maintenance and so on), with provision for safe access (such as barriers).

— Avoid specification of fragile roof lights and roofing assemblies.

— Early installation of permanent means of access, and prefabricated staircases with hand rails.

- Provide tie-ons for individual fall protection (as a last resort).
- All areas of operation and routine maintenance, including valves, roofs, lighting etc should be capable of being assessed from a position of safety, using 'no-climb' systems or staircase systems and fixed access platforms wherever practicable, avoiding need for temporary access arrangements.
- Prevention of falling objects should also be addressed in the design, where practicable.

f) Vibration and noise

- Design for safe construction, operations and maintenance.
- Reduce potential sources of noise by choosing appropriate equipment.
- Monitoring vibration through design.
- Deploy and isolate equipment at different noise levels addressing noise levels for work areas as a priority.
- Identify the high noise working area at the design stage and provide control requirements for the personnel working time of the working area.
- Give due regard to expected noise levels in all areas of the plant and take steps to specify noise reduction requirements at an early stage of design and in procurement.

g) Dust hazard and particulate exposure

Processes giving rise to large quantities of dust (such as dry cutting, blasting and so on during construction need to be eliminated as far as is reasonably practicable.

The waste processing building is equipped with a cement curing line, which is used to solidify radioactive spent resin etc.

- Design for safe construction, operations and maintenance.
- Employ automatic processes as much as possible to avoid personnel contact with dusts (and address related explosion risks).
- Conduct closed operations in areas where the dust hazard exists.
- Provide appropriate ventilation to reduce dust concentration.

h) Drowning

- Design for safe construction, operations and maintenance.
- Design in protective barriers and railings, paying attention to stairways, cranes/fuel handling.
- Ensure protection of the presence of all drowning risk areas.

- Reduce the need for and control personnel in and out to areas with deep water.

i) Vehicle injury

- Design for safe construction, operations and maintenance. Site traffic routes need to allow for one-way systems and vehicular traffic segregated from site personnel.
- Plan for conventional safety in entry and exit control for site in construction and operation by separating vehicles and people.
- Reduce vehicle access generally, and reduce the need for on-site transport containers of all kinds for operational phase.
- Traffic routes should be designed to avoid reversing, to avoid blind corners, and to avoid potential clash with plant, including overhead power lines.

j) Confined space

Confined spaces in the nuclear power plant include closed containers, buried pipes, basements, underground warehouses, sub-drains, tunnels, sumps and galleries.

- Design for safe construction, operations and maintenance e.g. avoid the use of solvent-based paints and thinners, or isocyanates, particularly for use in confined areas.
- Design to eliminate confined spaces (addressing all issues of potential asphyxia).
- Where unavoidable, provide locking devices and entry controls.
- Install fixed ventilation and detection facilities.
- Develop permit control systems.

This process will be reviewed for the UK HPR1000, and any gaps due to different requirements will be addressed. A comprehensive list of safety measures appropriate for each hazard and commensurate to the severity of the risk associated to that hazard will be derived at later stages of the GDA and Construction Design/Nuclear Site Licensing processes. The specific safety measures that for a given type of hazard imposed by specific regulations or suggested as best practice by existing industry guidance will be progressed through the UK HPR1000 project.

25.6 Obligations under UK law

25.6.1 UK Legislation

The HPR1000 (FCG3) design has evolved under the Chinese regulatory system, which is acknowledged to be possibly different from that of the UK in requirements and relevant good practices, including Codes of Practice. The differences will be mapped out over future GDA steps and beyond, as the UK HPR1000 design for construction is developed in more detail. An initial list of UK legislation will form the basis of the analysis, and this is listed in Appendix 2. Specific aspects of key legislation will be explored in the next sub-chapters. A gap analysis of UK legislation will be carried out during the GDA process to identify all applicable legislation, and provide a robust conventional safety management system.

25.6.2 Conventional Design Risk Reduction

Under the Health and Safety at Work Act 1974 and the Energy Act 2013, there is a fundamental responsibility on duty holders to reduce risk So Far As Is Reasonably Practicable (SFAIRP). This commences in the GDA phase with a duty on the Joint Requesting Parties to demonstrate that risks have been reduced ALARP for the GDA scope of the project.

Conventional safety aspects will vary over the lifetime of the NPP, including: design, construction, operation, maintenance, modification and decommissioning. Construction, Design Management Regulations 2015 will be a key piece of UK regulation to address and provide a framework for the review against the gap analysis described above.

In future steps, the Principle Designer and the Principal Contractor etc. will be confirmed. The provisions of the notification of a project under CDM will not need to be initiated at the PSR stage. The duties include: to plan, manage, monitor and co-ordinate the pre-construction phase to ensure the following:

- Plan for the Project to be carried out without risk to health or safety.
- Planning and implementing fire safety provisions.
- Assist the future Client (to be defined in future) in preparation and provision of Pre-Contract Information.
- Foreseeable risks are identified, eliminated and controlled.
- Ensure the co-operation of all parties.
- Ensure Designers comply with their duties.
- Liaise with Principle Contractor to ensure all necessary information provided.
- Prompt preparation and revision of the health and safety file.

Further the Principle Designer will have the responsibility to:

- Eliminate risk.
- Apply general principles of prevention.
- Reduce and control if not able to eliminate.
- Provide information.
- Provide and disseminate residual risk information.
- Sufficient to allow other duty holders to comply in future.

As the project progresses, there will also be application of conventional hazard identification for UK HPR1000 through a systematic process of design review across the NPP in order to reduce risk ALARP through a process of hazard reduction and management of residual risks through a graded approach:

- Eliminate (hazards where practicable).
- Reduce (hazards where it is not practicable to eliminate them).
- Inform (provide information on residual risks in a systematic way).
- Control (manage those residual risks).

25.6.3 Summary of any COMAH-Type Hazards

Nuclear reactors can have substantial inventories of chemicals that mean they can in some cases become a 'largest hazard' or 'Upper Tier' site under COMAH 2015 regulations, meaning they present a potentially significant chemical hazard in addition to a radiological one. Some of this information is relevant to specific chapters e.g. chapter 21, Reactor Chemistry. As with other types of PWRs worldwide, the HPR1000 (FCG3) needs to use certain chemicals and fuels in order to operate the plant safely and efficiently. Sites with large inventories of dangerous (including flammable) chemicals have to demonstrate that the chemicals do not pose an unacceptable risk, and can initiate the need for additional non-radiological emergency planning provisions which are specific to these materials. 'Upper Tier' sites need to undertake demonstration that the chemicals do not pose an unacceptable risk, which includes producing a safety case in advance of emergency planning steps.

The intent is to provide appropriate information at the GDA stage to demonstrate risks are ALARP. Information will be made available in future GDA steps to show that the chemicals are safely stored and used. Categories of dangerous substances that will be assessed include: health hazards, physical hazards, environmental and other hazards. Assessment is underway of substances in use on site to confirm whether an UK HPR1000 single unit site would present a hazard under the scope of COMAH. Assessment is expected to confirm that there are no further dangerous substances that may be generated on the UK HPR1000 due to the loss of control of a process involving any assessed dangerous substance.

Chemicals will be safely stored at the UK HPR1000 plant in controlled locations on the Nuclear Island (NI), CI and BOP as the plant is constructed. To calculate the maximum total inventory of each individual substance, it is assumed that each tank could potentially be 100% full of a single chemical.

Chinese Regulation GB18218-2009 requires assessment of chemical storage on site in a specific manner, against a defined set of chemicals. It is not known at this time whether there is a gap between the two methodologies. The gap analysis will map the requirements of the Control of Major Accident Hazards UK Regulations (COMAH) against the provisions under Chinese Law and Regulations.

Assessment is currently underway of the complete chemical inventory for HPR1000 (FCG3) across the site, in line with the UK COMAH schedules in order to ascertain whether a UK HPR1000 site is likely to be listed as an upper tier site under COMAH. It is expected that this will be brought forward in a supporting reference report to the GDA in a future step. The related environmental impacts addressed through COMAH are described in chapter 26.

25.7 Conventional Fire Protection Design for UK HPR1000

Chapter 25.4.2 described the existing fire design principles applied to the HPR1000 (FCG3). There may be a difference with UK requirements and relevant good practice. Full compliance with the design codes and UK requirements may also be challenged by nuclear safety considerations. This will be assessed further in the gap analyses.

As well as considering the possible impact of fires on the UK HPR1000 safety functions through the safety case in chapter 19, attention will be given to consider the residual conventional risk of harm to staff, the public and the environment arising from fires that may occur inside and outside NI, CI, and BOP. Specific strategies will be developed to ensure that hazards relevant both to conventional and nuclear safety (including fire, and pressure parts failure for example) will be produced at later stages of the GDA process.

The specific function of conventional fire safety provisions will be to ensure adequate means of escape in the event of a fire in the NPP and to provide adequate fire-fighting means for fighting any fire that may occur at the NPP site to full extinction. Under the principle that the UK HPR1000 design will comply with legal requirements for fire safety in the UK, conventional fire safety provisions will be designed to satisfy fire safety legislation as well as to follow relevant good practice in order to reduce residual risk ALARP. Additional safeguards for the protection of commercial assets may be considered in future by the Licensee/Operator, as long as they have no adverse impact on safety. Impacts where there are any conflicts of interest between conventional fire safety, nuclear safety, security, environmental protection will need to be addressed.

A gap analysis will be undertaken to identify the difference between the requirements of UK legislation, regulations, codes, standards and guidance documentation and the original codes employed for the existing HPR1000 (FCG3) design for conventional fire safety.

The first step will be to identify the complete set of relevant fire protection codes, legislation, standards and best practice guidance in use in the in England and Wales. As a minimum this will include consideration of the Regulatory Reform Order 2005 and the Standards and Codes of Practice most commonly used in the design of non-nuclear premises, namely: BS9999 and Approved Document B. The latter two documents are not mandatory for application in nuclear licensed sites in the UK, but are recognized to be indicative of relevant good practice by UK nuclear operators and, therefore, are considered highly relevant for the gap analysis. Consideration will also be given to any requirements arising from UK environmental safety guidance documentation related to control of run-off of fire-fighting water or chemical control. Appendix 2 presents a list of standards that will be reviewed. In addition, National Fire Protection Association Standards and other standards will be examined in the future. For development, management and application of fire safety design standards to be developed for the future construction site, reference will also be made to relevant guidance such as HSG 168, 'Fire safety in construction - Guidance for clients, designers and those managing and carrying out construction work involving significant fire risks'.

HF interface will also be required with conventional safety, where human capabilities and the interface with equipment design and layout influence conventional safety risks. For example, the fire safety strategy will require consideration of alarm response, fire-fighting and evacuation. A proportionate approach will be taken to HF activities in support of conventional safety.

The aim for UK HPR1000 will be to comply with UK guidance and standards of fire safety, mainly contained within BS9999 for building design and comply with other relevant industry good practice mentioned, as far as is reasonably practicable. Any differences between the original HPR1000 (FCG3) provisions with respect to UK requirements and relevant good practice will be listed and further assessed with reference to:

a) Identify departures in the UK HPR1000 design from UK established Building codes and fire safety expectations due to nuclear safety requirements and other design features.

b) Assess the impact of the differences or departures on conventional fire safety objectives, including compliance with legislation and.

c) Provide an equivalent level of fire safety for any of the departures through a process of optioneering, prioritisation and selection using suitable and sufficient ALARP justification processes. This will include analysis and ALARP assessment of potential design modifications required to address the UK HPR1000 design to meet the UK requirements.

This assessment will then be used to identify any modifications considered essential to support CGN's GDA submission for the UK HPR1000 design or for consideration in future when detailed design considerations requiring Licensee input for the specific site need to be made. Where appropriate these modifications will be incorporated in the UK HPR1000 design in a controlled manner as outlined in chapter 20. It is expected that the main vehicle for demonstrating the adequacy of provisions for fire safety for the UK HPR1000 will be a dedicated topic report on fire safety, which will constitute an integral part of the GDA PCSR master submission list. This will be submitted at later stages of the GDA process.

Appendix A

Examples of Key Chinese Legislation and Guidance Relevant to PSR

A list of the main Chinese legal requirements for conventional safety and addressed in the HPR1000 (FCG3) design is set out below:

[1] Work Safety Law of the People's Republic of China, 2014.

[2] Law of the People's Republic of China on Prevention and Control of Occupational Diseases, 2016.

[3] Regulations on Labour Protection in Workplaces Where Toxic Substances Are Used, 2002.

[4] GB, National Standard of PRC, The classification for casualty accidents of enterprise staff and workers, GB6441, 1986 edition, May 1986.

[5] GB, National Standard of PRC, Hygienic standards for the design of industrial enterprises, GBZ 1, 2010 edition, January 2010.

[6] GB, National Standard of PRC, Occupational exposure limits for hazardous agents in the workplace Part 1：Chemical hazardous agents, GBZ 2.1, 2007 edition, April 2007.

[7] GB, National Standard of PRC, Occupational exposure limits for hazardous agents in the workplace Part2: Physical agents, GBZ 2.2, 2007 edition, April 2007.

[8] GB, National Standard of PRC, Identification of major hazard installations for dangerous chemicals, GB 18218, 2009 edition, March 2009.

Appendix B

List of Relevant UK Legislation to Conventional Safety for PSR

This section establishes a provisional list of priority legislation (in alphabetical order) to address for the design of the UK HPR1000 at the GDA stage and beyond, and the requirements of these will be mapped against Chinese legislation, codes and standards etc.:

[1] BUILDING AND BUILDINGS, The Building Regulations, 2010 No.2214, 2010.

[2] HEALTH AND SAFETY, The Confined Spaces Regulations, 1997 No. 1713, 1997.

[3] HEALTH AND SAFETY, The Construction (Design and Management) Regulations, 2015 No. 51, 2015.

[4] HEALTH AND SAFETY, The Control of Major Accident Hazards Regulations, 2015 No. 483, 2015.

[5] HEALTH AND SAFETY, The Control of Substances Hazardous to Health Regulations, 2002 No. 2677, 2002.

[6] HEALTH AND SAFETY, The Dangerous Substances and Explosive Atmospheres Regulations, 2002 No.2776, 2002.

[7] CONSUMER PROTECTION HEALTH AND SAFETY, The Electrical Equipment (Safety) Regulations, 2016 No. 1101, 2016.

[8] HEALTH AND SAFETY, The Electricity at Work Regulations, 1989 No. 635, 1989.

[9] HEALTH AND SAFETY, The Explosives Regulations, 2014 No. 1638, 2014.

[10] HEALTH AND SAFETY, The Gas Safety (Installation and Use) Regulations, 1998 No.2451, 1998.

[11] HEALTH AND SAFETY, The Health and Safety (Safety Signs and Signals) Regulations, 1996 No. 341, 1996.

[12] Health and Safety at Work etc. Act, 1974.

[13] HEALTH AND SAFETY, The Lifting Operations and Lifting Equipment Regulations, 1998 No. 2307, 1998.

[14] CONSUMER PROTECTION, HEALTH AND SAFETY, The Lifts Regulations, 2016 No. 1093, 2016.

[15] HEALTH AND SAFETY, The Management of Health and Safety at Work Regulations, 2006 No. 438, 2006.

[16] HEALTH AND SAFETY, The Manual Handling Operations Regulations, 1992

No. 2793, 1992.

[17] HEALTH AND SAFETY, The Personal Protective Equipment at Work Regulations, 1992 No. 2966, 1992.

[18] CONSUMER PROTECTION, HEALTH AND SAFETY, The Personal Protective Equipment Regulations, 2002 No.1144， 2002.

[19] HEALTH AND SAFETY, The Pressure Equipment Regulations, 1999 No. 2001, 1999.

[20] HEALTH AND SAFETY, The Pressure Systems Safety Regulations, 2000 No. 128, 2000.

[21] REGULATORY REFORM, The Regulatory Reform (Fire Safety) Order, 2005 No. 1541, 2005.

[22] HEALTH AND SAFETY, The Supply of Machinery (Safety) Regulations, 2008 No. 1597, 2008.

[23] HEALTH AND SAFETY, The Work at Height Regulations, 2005 No. 735, 2005.

[24] HEALTH AND SAFETY, The Work in Compressed Air Regulations 1996 No. 1656, 1996.

[25] Energy Act, CHAPTER 32, 2013.

A review against the requirements of Ionising Radiations Regulations 1999 will be focused through chapter 22, Radiation Protection.

Additional Documentation Which Will Form Inputs to for Fire UK Gap Analysis

[1] Approved Document ‘B’ Fire Safety to the Building Regulations, 2010 edition, December 2010.

[2] British Standard， Fire tests on building materials and structures, BS476 (all parts).

[3] British Standard， Emergency lighting － Part 1: Code of practice for the emergency lighting of premises, BS5266-1，2016 edition，May 2016.

[4] British Standard， Eurocode3. Design of steel structures. General rules. Supplementary rules for cold-formed members and sheeting, BS EN 1993-1-3, 2006 edition, November 2006.

[5] British Standard， Application of fire safety engineering principles to the design of buildings. Code of practice. BS7974, 2001 edition, December 2001.

[6] British Standard， Code of Practice for Fire Safety in the design, management and use of buildings, BS9999, 2017 edition, January 2017.

[7] British Standard， Fixed fire-fighting systems － Automatic sprinkler systems － Design, installation and maintenance, BSEN12845, 2015 edition, November 2015.

[8] British Standard， Timber-based fire door assemblies. Code of practice. BS8214, 2016 edition, December 2016.

[9] British Standard， Fire-resistance tests － Elements of building construction － Part 1: General requirements, BS ISO 834-1, 1999 edition, September 1999.

[10] British Standard， Euro code 1: Action of Structures. General actions. Actions on structures exposed to fire. BSEN1991-1-2: 2002 edition, November 2002.

[11] Health & Safety Executive, Fire Safety in Construction Work, HSG 168, Second edition, 2010.

[12] Communities and Local Government fire risk assessment guidance for achieving compliance with the requirements of the Regulatory Reform (Fire Safety) Order 2005. Factories and Warehouses, Offices and Shops.

This is an initial list only and is provided for illustration.