URENCO UK Limited

ENSREG Stress Tests Report

REVISION HISTORY

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EXECUTIVE SUMMARY

Following the earthquake and consequent tsunami at Fukushima, Japan on 11th March 2011, the European Commission and the European Nuclear Safety Regulators Group (ENSREG) worked to produce a response to the Commission's request that "comprehensive risk and safety assessments be made for all European nuclear power plants". The resulting process has become known as the "Stress Tests".

The Office for Nuclear Regulation (ONR) issued a request to all UK non-Nuclear Power Plant operators, including UUK, to respond to the "Stress Tests". This required a report to be provided to ONR by 31st December 2011 and UUK provided a response by the due date. Subsequent to this, ONR requested operators prepare a non-protectively marked and non-commercial version suitable for publication on their websites. UUK has therefore created this document to address this request.

It is noted that the ENSREG Stress Tests requirements were formulated for Nuclear Power Plant Sites. There are no Nuclear Power Reactors or spent nuclear fuel at the URENCO UK Limited Capenhurst Site. To place the URENCO UK Limited report in context, it is important to recognise the fundamental differences between a lower hazard non-Nuclear Power Plant Site, such as the URENCO UK Limited Site at Capenhurst, and a higher hazard Nuclear Power Plant Site. Given the nature of the URENCO UK Limited Capenhurst Site, and the relatively low level of hazard posed by the activities undertaken, this document therefore presents a proportionate response to the ENSREG Stress Tests Requirements. The report follows the suggested format for Stress Tests Reports, but is tailored as necessary where aspects are less significant or not applicable to the URENCO UK Limited Capenhurst Site.

UUK considers its response to the ENSREG Stress Test requirements has adequately challenged UUK resilience to cliff-edge effects from the more unlikely events within and beyond design basis and concluded that there are no credible fault scenarios at the UUK Capenhurst Site for which there is not currently adequate provision.

It is also concluded, however, that there are a number of areas to which further consideration should be given to determine whether there is any need to further enhance the site resilience to extreme events. A Forward Action Plan is in development and will be submitted to the Office for Nuclear Regulation ONR following consideration by the UUK Nuclear Safety and Environment Committee during 2012.

This report, its identified considerations and conclusions, is site specific to the outcome of the stress tests for UUK activities in response to the UK Office for Nuclear Regulation (ONR).

1 GENERAL DATA ABOUT THE SITE / PLANT

1.1 Brief Description of the Site Characteristics

Capenhurst site is located approximately 10km north of Chester in Cheshire. The site is approximately 6km south west of the River Mersey and 6km north east of the River Dee. Rivacre Brook runs close by the site.

Two companies, URENCO UK Limited (UUK) and Sellafield Limited, are co-located at Capenhurst site and both hold separate Nuclear Site Licences and Environmental Permits. UUK holds Nuclear Site Licence No: 48D. Sellafield Limited is providing a separate European Nuclear Safety Regulatory Group (ENSREG) Stress Tests Report.

The principal business of UUK is uranium enrichment as part of the nuclear fuel cycle for global supply to civil nuclear reactor plants. UUK is a wholly owned subsidiary of URENCO Enrichment Company (UEC) which in turn is wholly owned by URENCO Limited, which has other operational sites in Germany, the Netherlands and the United States of America. This report, its identified considerations and conclusions, is specific to the outcome of the stress tests for UUK activities in response to the UK Office for Nuclear Regulation (ONR).

There are currently three companies that are treated as tenants on the UUK Site:

- Enrichment Technology UK Limited (ET UK) operates a project management design and test facility. ET UK facilities are included in the URENCO UK Limited ENSREG Stress Tests;
- URENCO ChemPlants Limited (UCP) will operate the future Tails Management Facility, which has not yet been built. The impact of the ENSREG Stress Tests requirements will be accounted for separately by UCP as the design further progresses; and
- National Grid Metering owns, and remotely operates, a Gas Pressure Reduction Station. This forms a part of the UUK submission, but is considered only in general terms as a source of hazard from a gas explosion.

It is noted that the ENSREG Stress Tests requirements were formulated for Nuclear Power Plant (NPP) Sites. There are no NPPs or spent nuclear fuel at the UUK Capenhurst Site. To place the UUK report in context, it is important to recognise the fundamental differences between a lower hazard non-NPP site, such as the UUK Site at Capenhurst, and a higher hazard NPP site.

1.2 Main Characteristics of Each Unit

For the purposes of this report UUK 'Units' comprise three main groups of plant concepts:

- Centrifuge Enrichment Plants;
- Cylinder Storage Rafts and Container Receipt and Despatch (CRD) building;
- Other support facilities.

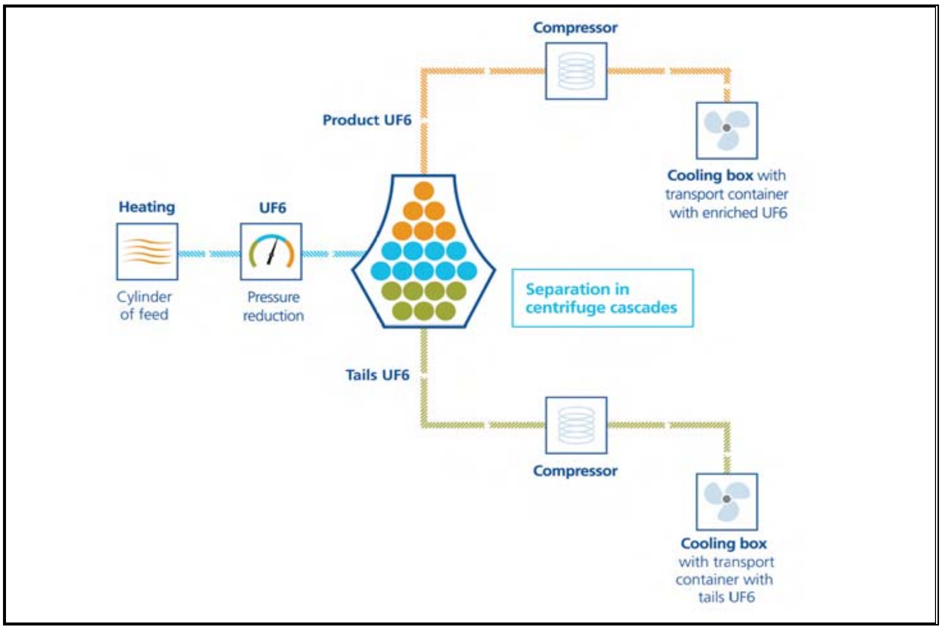
1.2.1 *Centrifuge Enrichment Plants*

UUK operates three centrifuge plants to deliver its core uranium enrichment services. The plants were commissioned in stages between 1982 and 2008.

The process material used at the UUK Capenhurst Site is Uranium Hexafluoride (UF_6), which is transported to and from the Capenhurst Site, and stored on the site, in robust, internationally approved transport cylinders which are ANSI N14.1 compliant. Type 48 cylinders are used for 'Feed' material and Depleted material ('Tails') and Type 30B cylinders are used for Enriched material ('Product').

Only Non-irradiated uranium UF_6 is used in the enrichment process on the UUK Site at present and the enrichment process is similar within all three Plants. Cylinders containing UF_6 are warmed to feed UF_6 gas into the centrifuge cascades via a number of pressure reduction and control valves. The UF_6 flows through the cascade and emerges in two gas streams; a product stream and a tails stream. The streams from several cascades are then combined before being condensed into Type 48 or 30B cylinders which are chilled to a low temperature. This process is presented schematically in the figure below.

Overview of the Enrichment Process



1.2.2 *Cylinder Storage Rafts and CRD*

There are a number of cylinder storage rafts on site. These are used for the storage of feed and tails material and the temporary storage of product material. A number of these storage rafts are equipped with portal cranes for lifting and moving the cylinders. In addition to the main storage rafts there are a number of smaller interim rafts which act as handover points between Operations and Plant Support Services for cylinders transitioning to / from the enrichment plants. There is also a Container Receipt and Despatch facility to store cylinders prior to despatch and to receive cylinders from off-site.

1.2.3 Other Support Facilities

There are a number of facilities that support the three Centrifuge Enrichment Plants. The more significant facilities include maintenance workshops, residue stores, Chemistry Services and a Site Emergency Control Centre. UUK also provides the Fire and Rescue Service for the combined Capenhurst Site.

1.2.4 Main Potential Hazards

There are two main potential hazards as a consequence of UUK operations; release of UF_6 and criticality.

The main hazards associated with a release of UF_6 are predominantly chemotoxic. On release to the environment, UF_6 reacts to form Uranyl Fluoride (UO_2F_2) and gaseous Hydrogen Fluoride (HF). The chemotoxic hazards are therefore primarily from gaseous HF and the heavy metal toxicity of uranium.

UF_6 is also the principal radioactive substance on the UUK Site. Tails, feed and product are all stored on site in internationally approved robust steel transport cylinders. Product will normally be stored on site for short periods only prior to despatch to customers. The majority of operations involve UF_6 at natural enrichment levels or less and so do not present a criticality hazard under any conditions. The final product, low enriched UF_6 (limited to a maximum of 6%, although typically <5%) has a low potential to cause a criticality hazard and is subject to criticality safety controls.

1.3 Fundamental Safety Functions

There are significant differences between the fundamental safety functions and support functions required for higher hazard NPP operations compared with the lower hazards posed by operations at the UUK site. For NPPs, the three fundamental safety functions are:

- Control of reactivity
- Fuel cooling
- Confinement of radioactivity

and the key support functions are:

- Power supply
- Cooling through the ultimate heat sink.

There are no NPPs or spent reactor fuel on the UUK Site. Consequently, only control of reactivity and confinement of radioactivity are applicable to UUK Plant and their operation, as cooling is not an essential safety function. Moreover, power supplies are not essential to maintaining UUK plant safety. The two relevant fundamental safety functions, control of reactivity and confinement of radioactivity, are captured in UUK safety cases as having the following safety functional requirements:

- Prevent criticality
- Prevent a UF_6 release

A fundamental requirement of the Nuclear Site Licence is that each nuclear facility has a safety case which substantiates the nuclear safety of the facility, demonstrates the safety of all operations and identifies the limits and conditions for any operation which are necessary in the interests of safety.

Safety cases prepared for nuclear plants contain rigorous assessments that deterministically justify the adequacy and effectiveness of engineered safety systems. The safety cases also assess the level of residual risk, taking into account the likelihood of any sequence of faults, and any associated release of radioactivity. Company risk targets are set at levels which are broadly acceptable. The overall objective is to demonstrate that the risk presented to people by the facility or operation is tolerable and As Low As Reasonably Practicable (ALARP).

UUK Plant safety cases consider initiating events from both natural and man-made external hazards, including those within the scope of the stress tests. Practicable safety measures are identified depending on the consequences of these events, including those arising from the potential for criticality and UF_6 release.

The assessment of risks at UUK considers those arising during normal operations and fault conditions through a systematic identification and assessment process. The overriding objective for UUK plant safety is the elimination of hazards, by designing in inherent safety. Where this is not practicable, suitable and sufficient safety measures are identified to deliver the safety function following an initiating event in order to mitigate the consequences.

Engineered Structures, Systems and/ or Components are employed to deliver the safety functions wherever practicable together with robust procedural controls. These are chosen from a hierarchy of preferred characteristics such that there is adequate redundancy to accommodate single random failure and to minimize the likelihood of dependent failures. The design of plants/ processes/ operations aims to incorporate appropriate levels of defence in depth including diversity and segregation.

Safety measures are identified for each fault condition. Fault conditions and their consequences are assessed using conservative assumptions. The rigour of the engineering substantiation to demonstrate that the safety measure will provide its safety function is commensurate with the importance of the safety function and safety classification of those components.

The through-life ability of the safety measures to perform their safety function as plants age is reviewed through the Long Term Periodic Review (LTPR) process, which will identify any improvement modifications required.

The ENSREG Stress Tests seek to challenge resilience to cliff-edge effects from the more unlikely events within and beyond design basis. To place the concept of cliff-edge effects following severe combinations of events in context it is worthwhile considering the stress tests in the context of emergency response as required by the Radiation (Emergency Preparedness and Public Information) Regulations (REPPIR), 2001. REPPIR requires a review of the full range of accidents to identify those reasonably foreseeable radiation emergencies having the potential to result in a radiation effective dose greater than 5mSv to a member of the public. The bounding reasonably foreseeable radiation emergency is used as the basis of the detailed emergency plan. This is currently based on a UF_6 release from a damaged cylinder. The likelihood of criticality is ALARP and of such low frequency as to be considered not reasonably foreseeable.

In the unlikely event of a radiation emergency arising from a criticality or larger consequence UF_6 releases from larger single events or combinations of events, emergency response is currently planned for through the concept of extendibility of the detailed emergency plans.

The adequacy of the existing plans are regularly reviewed and subject to periodic testing through exercises, and updated as necessary. However, the existing plans will be specifically considered to ensure that in response to the unlikely event of a criticality, the plans incorporate adequate details to support; the principle of extendibility for off-site response, and control of reactivity through the use of neutron poisons if practicable.

1.3.1 Reactivity Control

There are no NPPs or spent reactor fuel on the UUK Capenhurst Site.

Unlike NPPs, which are designed to operate critical and so require shutdown mechanisms to achieve sub-criticality, the safety aim throughout the enrichment process is to never achieve critical conditions when operating or shutdown. This means that large amounts of heat generating fission products generated within a reactor core will not be present on the UUK Site

The majority of operations on the UUK Site involve UF_6 at natural enrichment levels or less (eg feed and tails cylinders) which do not present a criticality hazard under any conditions at the UUK Site. The final product, low enriched UF_6, does have the potential to cause a criticality hazard and is therefore subject to criticality safety controls.

Criticality safety controls are applied throughout UUK activities whenever generating, handling or storing enriched uranium with U235 concentration levels above natural enrichment. The procedure for criticality control of operations involving enriched uranium at UUK is laid down in Company Instructions. The safety case for such areas includes an assessment of the potential initiating events that could lead to a criticality and identifies the safety measures to minimize the possibility of a criticality. Safety measures are categorized in a criticality safety assessment according to consequence and incorporate both Design Basis Accident Analysis (DBAA) and the Double Contingency Principle to ensure suitable and sufficient safety measures are in place. The criticality safety assessments are prepared, independently peer reviewed and subject to safety committee consideration and endorsement prior to approval and issue. Operations are regularly inspected and assessed for compliance by a criticality inspector who is independent of the Operations function.

The overriding objective is the elimination of hazards, by designing in inherent safety. The likelihood of criticality is ALARP and of such low frequency as to be considered not reasonably foreseeable. The principal controls and safeguards to prevent and mitigate criticality can be summarized as:

- Overall pessimism in calculations used to determine safe working limits;
- Use of geometrically favourable shapes to prevent criticality wherever reasonably practicable;
- Where safe geometries cannot be guaranteed, engineered controls are utilized wherever practicable supported by procedural controls;

- Robust procedural controls defined through Operating Rules, safe operating conditions and instructions;
- Maintaining safe separation distances between fissile material holdings;
- A Criticality Incident Detection and Alarm System (CIDAS) to raise the alarm and prompt evacuation from the affected area in the unlikely event of a criticality incident;
- Contingency shielding to reduce radiation dose in the unlikely event of a criticality.

For the above reasons criticality is considered to be not reasonably foreseeable, even in the event of extreme flooding. In the unlikely event that a criticality occurred following severe combinations of events, intervening buildings and other shielding would provide dose reduction. If larger or multiple criticality events occurred this would not present a cliff-edge effect and would be addressed via extendibility.

Survival of this safety function for the three main groups of plant was reviewed and concluded that existing controls and responses are adequate.

1.3.2 *Cooling Requirements*

There are no NPPs or spent reactor fuel on the site. Decay heat removal systems are therefore not relevant to UUK operations as the large quantities of heat generating fission products found in reactors and spent fuel stores are not present.

Only conventional heat loads are generated during the enrichment plant processes such as cylinder heating, building climate control, take off station and Liquid Sampling Autoclave (LSA) or Liquid Sampling Rig (LSR) cooling, and centrifuge motor efficiency losses. Once the centrifuge enrichment process has been terminated, cooling is not required.

Cooling water is widely used to maintain optimum efficiency of the enrichment process. Loss of cooling water or failure of the pumping systems would not result in any significant safety issues.

To maintain the centrifuge enrichment facility and its process within the safety boundaries identified in the relevant safety case, no cooling water or any other coolant is required.

The cylinder storage rafts and other support facilities have no cooling requirements for safety purposes.

Cooling of UUK enrichment units is therefore not required to maintain plant safety.

1.3.3 *Confinement of Radioactivity*

In contrast to NPPs, highly radioactive, heat generating fission products are not created, stored or processed in a centrifuge enrichment plant and cannot therefore be released to the environment. The main radioactive materials present on the UUK Site are UF_6 and its breakdown products. UF_6 may be present in solid, liquid or gaseous forms. Uranic contamination is present in some oils, residues and trap and filter media. A UF_6 release will produce HF gas which together with the UF_6 could disperse on and off-site. The main breakdown product, uranyl fluoride, is solid. It is widely recognised that UF_6 presents a greater chemotoxic risk than a radiological risk. However, both risks are minimized when UF_6 is contained.

The potential for a significant UF_6 release is low. The fundamental safety principle when processing UF_6 is to maintain containment at all times during normal operations and to design and operate the plant so as to minimise the potential for a significant release in fault conditions, through isolation and safe removal of process gas. When handling uranium contaminated materials outside containment, area ventilation and contamination control together with monitoring become the means of confinement. The robustness of the containment and defence in depth of other safety measures to prevent or mitigate release beyond confinement depends on the potential consequences of the release for the various plants, locations and forms of UF_6.

The principal controls and safeguards to prevent or mitigate release of radioactivity from confinement can be summarized as:

- Robust design and integrity of cylinders and pipework systems commensurate with the level of potential hazard;
- Sub-atmospheric UF_6 processes wherever reasonably practicable;
- Secondary containment (eg autoclaves) wherever UF_6 is in the liquid state and for super-atmospheric UF_6 systems wherever reasonably practicable;
- Fail safe valve states to isolate and shutdown the enrichment process;
- Use of chemical absorber traps and filters;
- Ventilated areas and systems, including gloveboxes and fume cupboards, where necessary and discharge monitoring;
- Area contamination control and monitoring;
- Strict procedural controls and operating instructions.

It is noted that UF_6 systems have a self sealing / flow restriction capacity by formation of solid plugs of uranyl fluoride on exposure of UF_6 to atmosphere. Also, the building fabric provides a decontamination factor for any releases inside buildings: Even a collapsed building would provide a similar factor. In many instances, therefore, only small amounts of radioactive material would be released.

Natural and manmade hazards within the scope of the stress tests are considered in the safety cases for both on-site and off-site release consequences. Practicable measures are included to reduce the risks to As Low As Reasonably Practicable (ALARP) levels.

Survival of the means of preventing UF_6 release for the three main groups of plant is considered below for the initiating events covered by the stress tests.

Centrifuge Enrichment Plants

During the enrichment process, solid UF_6 in feed cylinders is warmed into the gas phase to continuously feed the cascades through pipework and re-solidified at the chilled (enriched) product and (depleted) tails take off-stations.

The centrifuge plant pipework and cascades contain relatively small amounts of UF_6 but are continuously replenished from the feed stations when the process is operating. Larger quantities only exist as liquid or solid UF_6 in the feed and solid UF_6 in the tails and product cylinders.

As far as reasonably practicable, operations in the centrifuge plants operate with UF_6 at pressures lower than atmospheric. Therefore in the event of damage to the enrichment plant causing a leak, air leaks into the process pipe far more readily than UF_6 leaking out.

If process containment is lost, at sub-atmospheric pressures, a leak would cause the pipework pressure to rise. Pressure trips are provided in various locations to detect a pressure rise and automatically shut down the system should in-leakage be detected. The shutdown turns off cylinder heating and isolates the feed cylinder. Depending on the details of the operations at the time of shutdown, the UF_6 gas will either be trapped in a section of pipework or a cascade.

Systems, components and materials applied in design, construction and operations of a URENCO Centrifuge Enrichment Facility have to meet stringent criteria with respect to leak tightness and corrosion resistance. Any leak or deterioration that might lead eventually to a release of radioactive material will firstly cause production interruption and should therefore be detected by alarms and trips.

The principal controls and safeguards to prevent the release of UF_6 from centrifuge plants can be summarized as:

- Robust design and integrity of containers and pipework systems commensurate with the level of potential hazard;
- Sub-atmospheric UF_6 processes wherever reasonably practicable;
- Secondary containment wherever UF_6 is in the liquid state and for super-atmospheric UF_6 systems wherever reasonably practicable;
- Fail safe valve states to isolate and shutdown the enrichment process;
- Use of chemical absorber traps and filters.

In addition, there are various safety measures detailed in the safety cases to prevent a challenge to the containment.

Procedures are in place for immediate response for dealing with damaged cylinders, following an impact which shears the isolation valve.

Following a major earthquake the plant is designed to shut down. If necessary it should be possible to close the superior valves, where these are still attached to cylinders and otherwise seal cylinders where they are not. Even in the general confusion following a major earthquake, this procedure could be completed within a working day. Flooding or loss of power supplies would not significantly enhance the leak.

Rafts and CRD

On the rafts UF_6 is contained within internationally approved robust steel transport cylinders that can withstand significant drop and impact loads. Valve covers are used wherever reasonably practicable. A number of safety measures are included in the safety cases to minimise the potential for cylinder damage and rupture. These include:

- Engineered slope of rafts to drainage system;
- Drainage System;
- Vehicle restrictions;
- Integrity of crane and safety systems;
- Cylinder integrity;
- Cylinder valve covers;
- Physical protection of assets;
- Locating blocks and saddles;
- Integrity of grab;
- Integrity of lifting equipment / cylinder transporters;
- Integrity of shielding.

The cranes on rafts are not seismically qualified and as such, in undertaking the safety assessments it is pessimistically assumed that these cranes would collapse. A pessimistic number of cylinders are assumed to be affected. Given that the cylinders are robust and are designed to withstand significant impacts, it is judged that there will be a spectrum of damage to the cylinders ranging from dents/ scratches to a small loss of containment which may self-seal due to the formation of UO_2F_2 as UF_6 reacts in the air. Contingency plans are in place to deal with such an eventuality.

The consequences of a release could increase if terminating the leak took longer than expected, otherwise it is difficult to conceive any worsening of the events as a result of a larger seismic event or in combination with other initiating events such as flooding or loss of power.

Other Support Facilities

There are only a few buildings that have negative depression areas to provide containment of radioactivity. These include the UF_6 laboratory and fume cupboards in chemistry services, as well as the degassing room and fume cupboards in the maintenance workshops. However, the holdings are such that releases and doses to the public would be low under such circumstances.

1.3.4 Power Supply Requirements

The Electrical Distribution System provides no support to nuclear safety functions as all processes on-site are designed to shutdown in a safe manner following loss of power.

The Electrical Distribution System on the Capenhurst Site provides power to the site for all UUK, Sellafield Limited and ETUK operations. Electrical power distribution to the significant buildings, plants, operations and processes is via a set of electrical towers, underground cables, gridyards, substations, transformers, and switch rooms, to form a power Distribution System including Earthing and Lightning Protection.

UUK has multi-redundant electrical supplies to site, to help ensure continued operation. However, in the event of total loss of all these electrical supplies operations will cease safely with or without operator intervention.

The availability of power supplies and back ups can, however, impact emergency response activities. These aspects are addressed in Section 6.

There have been many tens of power dips on the UUK Capenhurst Site, most of which occurred during severe weather conditions and can be caused by transient faults throughout the region (30-40 mile radius). This is not an issue for plant safety as it does not rely on power supplies to maintain safety.

Capenhurst is a 'List 'O'' customer under the Electricity Supply Emergency Code (ESEC). As such the site would still receive supplies on a 24/7 basis should the local area (or country) suffer rota disconnections in the event of a major power disruption. To comply with the ESEC the site would however have to reduce demand broadly in line with the rota disconnection level or as low as possible without compromising the asset.

Should a region or country wide power failure occur (Black Start) the site would not necessarily be a priority user for restoration of supply and any supplies offered may be less than total site demand. The Electrical Distribution Team would manage restoration of supplies and comply with the instructions of the Distribution Network Operator.

Diesel generators are available to provide an alternative electrical supply. In the event of an on-site emergency these diesel generators may be required to provide power for emergency alarm enunciators and emergency lighting etc. These diesel alternators are identified as Minor Structures, Systems and Components in the relevant safety justifications, thereby ensuring adequate periodic maintenance and testing.

1.4 Significant Differences between Units

There are differences between the centrifuge plants, some of which are identified in the sections above and detailed in the safety cases. The key differences between the centrifuge plants include:

- Two of the centrifuge plants are fully housed in seismically qualified buildings. The other comprises parts that are housed in seismically qualified buildings where those parts operate at super-atmospheric pressures or handle liquid UF_6;
- Two of the centrifuge plants have a combined workforce, whereas the other has its own.

All the rafts are essentially the same, being large open storage concrete platforms with a crane for handling cylinders stored in rows. There are differences in the numbers, types and height of stacking of the cylinders.

The other support facilities are unique as summarised in the above sections. All are described in detail in their respective safety cases.

1.5 Scope and Main Results of Probabilistic Safey Assessment (PSA)

The general approach in most extant safety cases is to quantitatively assess those faults that have not been screened out on very low consequence grounds to determine the need for any further improvements to meet ALARP requirements.

Following a UUK Site wide review, a number of external hazards are discounted from detailed assessment on the grounds that they are either very low likelihood events or are not considered credible at the UUK Site. External hazards that require consideration within the PSA are:

- Seismic Hazard;
- Extreme wind;
- Extreme precipitation;
- Flooding;
- Snow/ice accumulation;
- Extreme temperature;
- Lightning strike;
- Climate change.

Natural hazards are subject to DBAA and ALARP review only. If the DBAA criteria cannot be met for new plants then consideration is given to undertaking PSA.

Initiating events with a frequency less than 1 in 10 million years and with a radiation dose less than 0.1mSv to workers and 0.01mSv to the public are excluded from consideration in the PSA.

The HSE Safety Assessment Principles (SAPs) expect the scope and depth of the PSA to vary depending on the magnitude of the radiological hazard and the risks, the novelty of the design, the complexity of the facility, and the nature of the decision that the safety case is supporting. As part of continuous improvement, each extant safety case is being updated in a proportionate and appropriate manner at its next LTPR to address the requirements of UUK's latest Safety methodologies as explained in the UUK Safety Assessment Handbook (SAH). Once this exercise is complete a proportionate and appropriate site wide PSA will be considered for the UUK Site.

2 EARTHQUAKES

2.1 Design Basis Earthquake against which the Plant is Designed

The Capenhurst Site is one of the less seismically active regions of the UK with a best estimate peak free field horizontal ground acceleration (pga) of 0.19g corresponding to a 1 in 10,000 years seismic event frequency. Existing safety cases have considered the need for seismic qualification of plant and buildings depending on the consequences of failure for a range of earthquake magnitudes beyond 0.19g and provisions made where appropriate. The latest UUK safety case approach is captured in the UUK SAH. Each extant safety case is being updated at its next LTPR as part of a staged improvement programme. The latest UUK SAH methodology is summarised followed by the basis used in the extant safety case where this is different.

2.1.1 Latest UUK Methodology

New plant is assessed to determine the unmitigated dose consequence to the public (from all pathways) following a Design Basis Earthquake (DBE) with a frequency of 1 in 10,000 years. For natural hazard DBAA, a worst case approach is to be adopted. The radiological assessments will make conservative assumptions in respect of radiological inventory, release mechanisms and dose uptake.

Where the unmitigated dose to a member of the public is less than 1mSv, no special seismic provisions are required beyond the general requirement to satisfy the ALARP principle.

In addition to satisfying the ALARP principle, where the expected unmitigated dose to a member of the public is greater than 1mSv but less than 5mSv, then the plant is to be engineered to withstand the event to the extent that the expected dose to a member of the public off site is less than 1mSv following an event with a frequency of 1 in 1000 years.

In addition to satisfying the ALARP principle, where the expected unmitigated dose to a member of the public is greater than 5mSv, then the plant is to be engineered to withstand the event to the extent that the expected dose to a member of the public off site is less than 5mSv following an event with a frequency of 1 in 10,000 years.

For new build plant requiring withstand to a 1 in 10,000 years seismic event, UUK will continue the established current practice in the UK of adopting the Principia Mechanica Ltd. (PML) spectral shape, conservatively anchored to a pga of 0.25g and two thirds of this value in the vertical direction. For new build plant requiring a 1 in 1000 years design, the PML spectral shape shall be used with a pga of 0.1g, and two thirds of this value in the vertical direction.

For existing plant, the new build plant criteria provide a benchmark subject to ALARP considerations which may include consideration of the conservatism in the 1 in 1000 years seismic hazard.

In developing these criteria, UUK has taken due account of data, advice and guidance from experts from both the nuclear and chemical industries. The data have also been reviewed against the data compiled for Article 37 of the Euratom Treaty.

Engineering principles of the HSE SAPs require that a small change in DBAA parameters should not lead to a disproportionate increase in radiological consequences. This can be demonstrated by considering the potential consequences from a more severe event. It is important to demonstrate that no new or unexpected fault conditions are initiated beyond the DBE level, that would render the analysis unsuitable for simple extrapolation to the beyond DBE regime. Cliff-edge effects should be addressed by demonstrating a full understanding of the failure modes of the structure or plant for increased seismic demand, in particular the brittle or ductile nature of the failure. Brittle failure modes are generally to be avoided at the DBE as part of good seismic design practice. The above off-site requirements are summarized in Table 1.

Table 1: Summary of Seismic Radiological Criteria for New Plant

Unmitigated Dose Public off-site (mSv)	Frequency	Pga
< 1	No specific provision beyond ALARP	-
≥1 to 5	$1x10^{-3}$/y (1 in 1000 years)	0.10g
≥ 5	$1x10^{-4}$/y (1 in 10,000 years)	0.25g

2.1.1.1 Centrifuge Plants

Original design bases and update reviews for each of the centrifuge plants have assessed their seismic withstand capability against a 1 in a 10,000 years event assuming a range of pga up to 0.25g. The analysis included consideration of factors of safety against plant yield failure and includes sensitivity studies.

It is expected that following a 1 in 10,000 years earthquake, buildings of the type of construction of the centrifuge plants are likely to experience slight to moderate damage, eg small cracks in walls; fall of masonry blocks. Thus, structural failure of the facility would not be expected following such an event, although the structural steel envelope may be damaged.

One of the centrifuge plants has a different roof construction to the others and recent work has identified the need to evaluate this further as part of its LTPR process. Given the original design criteria and work programme to evaluate the options for building structural improvements as part of its imminent LTPR, the design basis for this centrifuge plant is considered adequate.

The centrifuge plant safety cases also consider the potential for damage to the UF_6 containment pipework and cylinders within the buildings following seismic events. This ranges from no structural pipework failure or damage to the very robust cylinders or autoclaves, to a range of damage to pipework outside the autoclaves.

The feed stations and liquid sampling autoclaves (or rigs) are seismically qualified in one of the centrifuge plants to resist a 0.28g pga seismic event and possibly beyond. In the other two centrifuge plants the liquid sampling autoclaves (or rigs) were originally only seismically qualified in the lowered, not raised position. This was judged acceptable given the small proportion of time spent in the raised position and the judgement that the robust autoclave would remain intact if failure of the lifting mechanism occurred. This will be re-examined as part of the LTPR process.

Outside the autoclaves, fractures could occur in the UF_6 and instrument air pipework. Electrical supplies are likely to be lost but spring loaded valves ensure that the valves fail to a safe state according to the configuration of the plant prior to shutdown. Significant damage to product tails or feed cylinders and traps is very unlikely. Sub-atmospheric processes help to minimise the potential for significant leaks even in the event of significant pipework breaches. Damage to the plant from seismic activity resulting in a significant release of UF_6 to the environment has been estimated to be very remote. With the exception of the centrifuge plant that has a different roof construction, which is to be re-evaluated as part of its LTPR, the design bases for the other centrifuge plants are considered to be adequate.

2.1.1.2 Rafts and CRD

The cranes on rafts are not seismically qualified and as such, it is pessimistically assumed that these cranes would collapse. A pessimistic number of cylinders are assumed to be affected. Given that the cylinders are robust and are designed to withstand significant impacts, it is judged that there will be a spectrum of damage to the cylinders ranging from dents/ scratches to a small loss of containment which may self-seal due to the formation of UO_2F_2 as UF_6 reacts in the air. Contingency plans are in place to deal with such an eventuality.

Using the above assumptions, the consequences to the public from a collapse of cranes for individual facilities due to a seismic event is <1mSv. Therefore, there is no requirement to provide special seismic provisions beyond the general requirement to satisfy the ALARP principle. It should be noted that UUK is in the process of procuring new cranes for its Rafts where necessary. These will be seismically qualified and are currently programmed to be installed in 2013.

2.1.1.3 Others

Various building design bases are used. The consequences of building collapse and significant damage are below the need to seismically qualify buildings or equipment. The design basis is therefore considered adequate.

2.1.2 Provisions to Protect the Plant against the Design Basis Earthquake

2.1.2.1 Centrifuge Plant

Unlike reactors which have to be forced to shutdown from an operational state and serviced to maintain safety even when shutdown, the enrichment process is best visualized as being held open by services such that if they are removed its aim is to shutdown without any service requirements to maintain that state.

In a seismic event, or any event that causes a loss of containment or loss of power, the enrichment process is capable of automatically shutting itself down into a safe state. This is achieved by a number of safety measures that fail safe and function in the absence of any operator intervention or service requirement, eg feed heater trips to prevent further UF_6 gas generation. Depending on the operating state prior to shutdown, the valves would trap UF_6 gas in the process line pipework or cascades, close off further feed supply and allow temperature/ pressure driven discharge of UF_6 gas to cold and available take-off stations, chemical absorber traps or contingency dump traps. Passive structures such as the cylinders, closed sections of pipework, autoclave and seismically qualified building structures provide various post seismic roles to maintain effective containment of the radioactivity within them.

Emergency response and other contingencies will be coordinated in accordance with the Capenhurst Emergency Plan and associated Emergency Handbook and emergency system/ operating instructions. Combinations of more extreme events would require further consideration in terms of impact on resources that might delay or prevent emergency actions.

The latest enrichment plants at UUK employ a seismic detection system to trigger termination of the enrichment process upon detection of relatively minor earthquakes. This system is not required to be operational for safety purposes as the area of the process it protects operates well below atmospheric pressure. The seismic detection system purely reduces the risk of the sensitive enrichment equipment being damaged by an earthquake and is therefore only required for investment protection.

2.1.2.2 Rafts and CRD

The cranes on the rafts and in the Container CRD building are not seismically qualified. Therefore in order to reduce risks to ALARP, when not in use, the cranes are not parked above cylinders containing UF_6 where practicable and not parked adjacent to any sensitive buildings. Obviously, should the cranes collapse in a seismic event when they are not located above cylinders containing UF_6 then the consequences will not be significant. In the event of damage to cylinders, the on-site Fire and Rescue Service has methods and devices that are used to seal breached cylinders. Given that the pressure in the cylinders is not super-atmospheric, the leak sealing process is relatively simple. In addition, very small leaks are likely to self-seal due to the formation of UO_2F_2 as UF_6 reacts in the air. It should be noted that UUK is in the process of procuring new cranes for its Rafts where necessary. These will be seismically qualified and are currently programmed to be installed in 2013.

2.1.2.3 Others

No specific provisions are required based on the estimated consequences.

2.1.3 Compliance of the Plant with its Current Licensing Basis

Noting the comments in Section 2.1.2, UUK safety cases and compliance processes are in place to ensure that any safety measures required to achieve safe shutdown or protect against the indirect effects of an earthquake are adequately maintained.

Each facility has a Plant Maintenance Schedule (PMS), which specifies the Examination, Inspection, Maintenance and Testing (EIMT) activities required to implement the safety case, and is required in order to comply with the requirements of Licence Condition 28 of the Nuclear Site Licence.

The PMS is documented following a systematic assessment of the safety case. The EIMT activities identified are considered to be those necessary to demonstrate that Plant Items continue to operate satisfactorily. They cover all Plant Items that could affect nuclear safety, including those necessary to ensure that the facility remains within its identified safe operating envelope under normal and all postulated credible fault conditions. The timely completion of all identified EIMT activities is required in support of effective implementation of the safety case.

Any alteration to buildings, plant SSCs, operations, processes or safety cases including any replacement, refurbishment or repairs to existing buildings, Plants or processes and alterations to the design of Plants during the period of construction (which is outside the existing safety case) is controlled via UUK's modification procedure (Control of Safety & Environmental Implications) in support of demonstrating compliance with Nuclear Site Licence Conditions 19 to 22 (inclusive) and 35 and with UUK's Environmental Permits.

As a part of continuous improvement, changes in legislation, guidance and standards are considered to determine their potential impact on extant safety case assumptions and methodologies. Civil structural and seismic reviews are undertaken as part of the validation of the safety case assumptions to support continued operations in compliance with the LTPR programme.

2.2 Evaluation of Safety Margins

2.2.1 Range of Earthquake Leading to Severe Fuel Damage

Not applicable to UUK plant and operations

2.2.2 Range of Earthquake Leading to loss of Containment Integrity

The Capenhurst location is one of the less seismically active regions in the UK with a "best estimate" peak ground acceleration for a 1 in 10,000 years seismic event frequency of approximately 0.19g.

2.2.2.1 Centrifuge Plants

No structural failure has a significant probability of occurrence at 0.19g. However, a weld failure on the UF_6 feed system has a seismic risk of 10^{-6}/year.

Seismic failure of the secondary containment feed and liquid sampling autoclaves would be well beyond 0.25g pga and there are indications that there is adequate withstand up to 0.35g pga.

2.2.2.2 Rafts and CRD

The cranes on the rafts and in the CRD building are not seismically qualified. It is assumed within the safety case that the cranes on the rafts and in the CRD building will collapse following a 1 in 10,000 years earthquake. It should be noted that UUK is in the process of procuring new cranes for its Rafts where necessary. These will be seismically qualified and are currently programmed to be installed in 2013.

2.2.2.3 Other Support Facilities

Estimation of pga is unnecessary as facilities are assumed to collapse and/ or experience significant damage. Bounding assumptions are used when assuming loss of integrity.

2.2.3 Earthquake and Flooding Exceeding the Design Basis

The earthquake intensity experienced at Fukushima is not considered credible at Capenhurst. Smaller earthquakes are credible and have been addressed as far as is reasonably practicable in plant design and operations safety cases. The combination of distance from the sea and height above sea-level (+35.5 m) provides confidence that a tsunami or significant flooding, which may affect safety, is not a credible initiating event at UUK.

Consideration was given to a number of potential means for an earthquake to cause local flooding on the site. This included collapse of Cheshire salt mines and fracking giving rise to local earthquakes and flooding expectations from rivers, on-site ponds and local water works. It was judged that none of these had sufficient potential to give rise to flooding that could in any way impact operational safety. The only possible impact was as a hindrance to emergency response but of minor significance.

2.2.4 Potential need to Increase Robustness of the Plant against Earthquakes

In general those areas of the plant that could lead to consequences requiring seismic qualification have been qualified. The remaining potential consequences are low enough to be considered ALARP without the need for any further practicable improvements.

One exception is the roof design for one of the centrifuge plants which has a different construction to the other two plants. Work undertaken to examine seismic withstand of the the building identified the need to further improve withstand of the roof structure which is to be evaluated further as part of the plants LTPR process.

A revisit to the means for retaining subcriticality post seismic events is also noted for consideration at the next LTPRs for each Plant.

3 FLOODING

3.1 Design Basis

3.1.1 Flooding against which the Plant is Designed

The design basis for flooding and any other natural hazard considered credible for the UUK site is essentially the same as that for a seismic event being based on an assessment of the unmitigated dose consequence to the public (from all pathways) following a DBA with a frequency of 1 in 10,000 years. As for seismic assessments, a worst case approach is to be adopted which is demonstrably conservative whilst avoiding excessive pessimism

The UK Environment Agency (EA) website offers a map-based analysis of flood likelihood for the whole of the UK. The flood maps for the UUK Capenhurst Site are shown below:

The whole of the UUK Capenhurst Site is in an area which falls outside the extent of the extreme flood, at the time of the EA assessment of the likelihood of flooding. Generally this means that the chance of flooding each year from rivers or the sea is 0.1% (1 in 1000 years) or less. The Flood Map shows the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences.

No safety significant cliff-edge effects would be expected for less likely flooding of increased severity for the following reasons. The above figures show that the nearest flood region comes within about 1 km of the eastern perimeter of the UUK Capenhurst Site. It should be noted that the railway embankment running parallel to the eastern site perimeter forms a barrier between the UUK Site and this region of potential flooding.

At a distance of approximately 4 km to the west of the site is the flood area arising from the River Dee and Shotwick Brook. The highest undefended flood level reported is +13.7 m.

The minimum height of the Capenhurst Site in metres Above Ordnance Datum (AOD) ie height above datum sea level is +35.5 m AOD.

Any water ingress to plants would be spread across the floor and a localised build up would be difficult to imagine. It is judged not credible that water levels to allow significant ingress to pipework or cylinders could occur.

The most likely effect of flooding within an enrichment plant is loss of electrical supplies. The plant is designed to fail to a safe state upon loss of electrical supply and, as noted above, would not require cooling. Criticality safety assessments already assume water reflection, therefore flooding has no effect upon the calculated safety margins.

It s noted that Local Authority flood prediction plans acknowledge the following:

- The Rivacre Brook has a 1 in 100 years potential to flood. The only potential impact for the site may affect Capenhurst Lane near the small roundabout. There are alternative access routes to site if Capenhurst Lane is affected
- Sutton Hall Water Treatment works reservoir. If the storage is compromised it could impact on the adjacent national gridyard. It is anticipated that any consequential flooding would not affect the site. However, if the power supply from the gridyard was lost there would be no safety significant consequence for the site.

Existing measures such as drains are therefore considered adequate. The likelihood and most likely consequences of credible flooding on the UUK Capenhurst Site do not warrant any further measures.

3.1.2 Provisions to Protect the Plant against the Design Basis Flood

The site Sewage and Drainage Systems provide support to nuclear safety functions in preventing flooding on the Capenhurst Site and providing discharge routes for liquids.

Water entering the drains from buildings and plants is transferred to the Site Sewage Farm (operated by Sellafield Limited). Surface water from the site is collected by the surface water drainage system and is discharged to Rivacre Brook.

3.1.3 Plant Compliance with its Current Licensing Basis

Noting the comments in 3.1.1, UUK safety cases and compliance processes are in place to ensure that any safety measures required to achieve safe shutdown or protect against the indirect effects of flooding are adequately maintained. See Section 2.1.3.

3.2 Evaluation of Safety Margins

3.2.1 Estimation of Safety Margin against Flooding

Not applicable. There are no NPP or spent fuel on the site.

3.2.2 Potential need to Increase Robustness of the Plant against Flooding.

No further measures have been identified.

4 EXTREME WEATHER CONDITIONS

4.1 Design Basis

In the latest UUK SAH the design basis for extreme whether and any other natural hazard considered credible for the UUK Site is essentially the same as that for a seismic event being based on an assessment of the unmitigated dose consequence to the public (from all pathways) following a DBA with a frequency of 1 in 10,000 years. As for seismic assessments, a worst case approach is to be adopted which is demonstrably conservative whilst avoiding excessive pessimism

The extreme weather design bases for existing safety cases vary in the approach applied. A more consistent approach will evolve as safety cases are updated against the latest UUK SAH as part of the ongoing LTPR process.

4.1.1 Reassessment of Weather Conditions used as Design Basis

Although the design bases vary in approach they are generally considered adequate pending a more consistent approach in future.

4.2 Evaluation of Safety Margins

The extreme weather design bases for existing safety cases vary in the approach applied but are generally considered adequate. A more consistent approach will evolve as safety cases are updated against the latest UUK SAH as part of the ongoing LTPR process.

4.2.1 Estimation of safety margin against extreme weather

There are no obvious scenarios that would result in significantly worse consequences for more extreme weather conditions.

4.2.2 Potential need to Increase Robustness against Extreme Weather

Given the general building and equipment design standards and low radiological risk posed by extreme whether conditions experienced at the UUK Site the current site structures and equipment are judged to be adequate.

5 LOSS OF ELECTRICAL POWER AND LOSS OF ULTIMATE HEAT SINK

There are no NPPs or spent reactor fuel on the site. Decay heat removal systems are therefore not relevant to UUK operations as the large quantities of heat generating fission products found in reactors and spent fuel stores are not present.

The Electrical Distribution System provides no support to nuclear safety functions as all processes on-site are designed to shutdown in a safe manner following loss of power.

6 SEVERE ACCIDENT MANAGEMENT

UUK and Sellafield Limited (Capenhurst) have a joint on-site emergency plan (the Capenhurst Emergency Plan) that has been approved by ONR which ensures that suitably qualified and experienced people and suitable facilities and equipment are available at all times to respond to any abnormal events. The objective is to contain quickly and effectively any event so that both on-site and off-site effects are controlled and minimized. Regular exercises are held to demonstrate the adequacy of the arrangements defined in the plan to the satisfaction of ONR.

6.1 Organisation and Arrangements of the Licensee to Manage Accidents

6.1.1 Organisation of the licensee to Manage the Accident

Staffing and management in normal operation

UUK and Sellafield Limited (Capenhurst) have a joint on-site emergency plan that has been approved by ONR which ensures that suitably qualified and experienced people and suitable facilities and equipment are available at all times to respond to any abnormal events. An off-site emergency plan has also been developed in conjunction with Cheshire West and Chester Council area for any potential off-site consequences.

Plans for strengthening the site organisation for accident management

The on and off-site emergency plans are subject to regular review and update. At present, both the on and off-site emergency plans are currently being reviewed and updated to take account of Capenhurst Site Integration Project, which is seeking to reunify the UUK and Sellafield Limited nuclear licensed sites to form a single licensed site operated by UUK.

UUK is planning to undertake a further review of the site emergency arrangements to identify any further reasonably practicable enhancements and to identify any cliff-edge effects within the Emergency Arrangements. This review is broader than the scope identified as part of the ENSREG stress tests. Any enhancements arising from this review will be considered for implementation on an ALARP basis noting the relatively low hazard level on site.

Measures taken to ensure optimum intervention personnel

All emergency response roles are clearly defined within the on and off-site Emergency Plans and are allocated only to appropriately trained personnel. Regular observed training exercises are undertaken with the observers providing feedback to the team on collective and individual performance.

The Site Emergency Control Centre, and associated facilties and emergency equipment, is maintained, checked and tested on a regular basis.

Use of off site technical support for accident management

External agencies are involved when the off-site emergency plan is initiated and the Strategic Co-ordination Centre is established. Agencies include the Health Protection

Agency, Emergency Services, the Food Standards Agency, the Environment Agency, the Office for Nuclear Regulation, the Cabinet Office, and the Department of Energy and Climate Change.

Procedure, Training and Exercises

The Capenhurst Emergency Plan describes the principles of the Site Emergency Arrangements and provides a brief summary of the actions taken by those external organisations with a major role in the event of an emergency.

The Plan is designed to ensure that a consistent approach is taken in dealing with emergencies and that best use is made of the human and material resources. Although provided primarily for responding to radiological and chemotoxic incidents the arrangements can be applied, as necessary, in other circumstances where the Site infrastructure, workforce, contractors, public, plant, equipment or environment are threatened.

Level 1 exercises are conducted on an annual basis to test the adequacy of the on-site emergency arrangements. Level 2 exercises, involving the use of the off-site emergency plan and facilities, are conducted on a three-yearly basis. Level 1 and Level 2 exercises are observed by the ONR. These are in addition to shift exercises.

The site has a range of procedures to deal with such eventualities as severe weather and threats to business continuity.

6.1.2 Possibility to use Existing Equipment

Provisions to use mobile devices (availability of such devices, time to bring them on site and put them in operation)

The provision of mobile emergency response equipment is detailed in the Capenhurst Emergency Plan and associated Emergency Handbook and such items are regularly maintained and tested.

Provision for the management of supplies (fuel for diesel generators, water etc)

Back-up generators are available on site for use until main power supplies can be resumed. There are no safety significant implications from loss of power supplies.

Management of radioactive releases, provision to limit them

In the event of a radiological release, the site emergency arrangements include the deployment of an emergency monitoring team to measure HF/ uranium levels, which are then reported back to the Site Emergency Control Centre (SECC). Information gathered will be used by the emergency response teams in the SECC and the off-site co-ordination centres, if established, to decide on the appropriate measures to be taken to limit the impact on the workforce and local population.

In the event of a criticality accident, a site monitoring system provides an indication of radiation levels across the site, which is automatically reported back to the SECC. In addition, the site emergency monitoring team can be deployed to measure radiation levels, feeding information back to the SECC.

Communication and Information Systems (internal and external)

In the event of an accident or natural disaster there is a need to be able to promulgate an alert and to pass information across, into and out of the site. The site uses a number of systems in order to achieve this.

Warning alarms are sounded across the site depending on the nature of the event eg fire alarm, muster alarm, criticality alarm and the off-site siren. Information can be conveyed using the site Public Address system. Both UUK and Sellafield Ltd have telephone systems and other communication media linking the SECC and the operational response teams.

As required by Regulation 16 of REPPIR, UUK provides members of the public living and working near the site with prior information on chemotoxic and radiation incidents, their potential consequences, emergency arrangements and action to be taken etc. The site issues a calendar each year which includes the prior information detailed above as well as dates and times of the testing of the off-site siren for the forthcoming year. The information provides advice to persons living and working in the area on measures they should take on hearing the off-site siren.

6.1.3 Evaluation of factors that may Impinge Accident Management and Respective Contingencies

Extensive destruction of infrastructure or flooding around the installation that hinders access to the site

In the event of extensive damage to local infrastructure, disruption to local communication routes can be assumed, resulting in restricted access for emergency response personnel, relief staff and Cheshire Fire and Rescue Service. There is no expectation, however, that following a seismic event, access to the Capenhurst Site will be necessary to prevent a severe off-site release.

Alternative access routes to the site are available and considered in the Capenhurst Emergency Plan.

Loss of Communications facilities\systems

UUK has a robust communications system featuring diversity and redundancy. The eventuality of loss of the usual communication facilities is considered within the UUK Site Contingency Plans which have been developed for business continuity.

Impairment of Work Performance due to high local dose rates, radioactive contamination and destruction of some facilities on site

Monitoring personnel can provide information on the local dose rates using mobile radiation survey instruments allowing response teams to ensure their doses are minimised. Electronic Personal Dosimeters are also used to monitor doses and support management of exposures to ensure dose limits are not exceeded.

For teams with the appropriate PPE and RPE and undressing/ decontamination processes in place, radioactive contamination would not prevent appropriate remedial work being undertaken.

Under conditions of high local dose rates, radioactive contamination and destruction of some facilities, UUK would be relying on the on-site Command and Control structures to manage the event making an accurate assessment of the situation and best use of available resource. Loss of buildings and infrastructure is addressed within the Capenhurst Emergency Plan and the UUK Site Contingency Plans.

Impact on the accessibility and habitability of the main and secondary control rooms, measures to be taken to avoid or manage this situation

The UUK Site has arrangements in place for use of alternative Control Centres. Other facilities are located off-site and further potential alternatives are also available.

Impact on the different premises used by the crisis teams or for which access would be necessary for management of the accident

The UUK Site has arrangements in place for use of alternative Control Centres. Other facilities are located off-site and further potential alternatives are also available.

Feasibility and effectiveness of accident management measures under the conditions of external hazards (earthquakes, floods)

The accident management measures are intended to be flexible. Identified personnel have appropriate levels of authority to utilise any resources available.

Unavailability of power supply

There are no UUK activities or operations that are dependent on power supplies for safety provisions. Reinstatement of power supply is addressed in the site procedures. Diesel generators are available to provide an alternative electrical supply. In the event of an on-site emergency these diesel generators may be required to provide power for emergency alarm enunciators and emergency lighting etc.

Potential failure of instrumentation

Arrangements exist for alternative environmental monitoring capability and manual sampling where required.

Potential effects from the other neighbouring installations at site.

On and off-site emergency plans exist for the combined Capenhurst Site. In the event of a combined site emergency being declared, resources from both licensees would come together to effect a resolution. The emergency response takes consideration of existing interactions with licensees and tenanted facilities.

6.1.4 Measures which can be envisaged to enhance accident management capabilities

None identified at present, but a further review process is being undertaken following the Fukushima event to examine the UUK Site's resilience.

6.1.5 Maintaining the containment integrity after occurrence of significant fuel damage (up to core meltdown) in the reactor core

Not applicable.

6.1.6 Elimination of fuel damage/ meltdown in high pressure

Not applicable

6.1.7 Management of hydrogen risks inside the containment

Design provisions, including consideration of adequacy in view of hydrogen production rate and amount

Not applicable. There is no credible mechanism for rapid production of hydrogen.

Operational provisions

Not applicable. There is no credible mechanism for rapid production of hydrogen.

6.1.8 Prevention of overpressure of the containment

Design provisions, including means to restrict radioactive releases if prevention of overpressure requires steam/ gas relief from containment

Within the context of UUK Capenhurst Site operations, this is addressed in Section 1.3.

Operational and organisational provisions

None required

6.1.9 Prevention of re-criticality

Design provisions

Within the context of UUK Capenhurst Site operations, this is addressed in Section 1.3 and Section 2.2.4.

Operational provisions

Within the context of UUK Capenhurst Site operations, this is addressed in Section 1.3 and Section 2.2.4.

6.1.10 Prevention of base-mat melt through

Potential design arrangements for retention of the corium in the pressure vessel

Not applicable to the UUK Site.

Potential arrangements to cool the corium inside the containment after reactor pressure vessel rupture

Not applicable to the UUK Site.

Cliff-edge effects related to time delay between reactor shutdown and core meltdown

Not applicable to the UUK Site.

6.1.11 Need for and supply of electrical AC and DC power and compressed air to equipment used for protecting containment integrity

Design provisions

This is addressed in Section 1.3.

Operational provisions

This is addressed in Section 1.3.

6.1.12 Measuring and control instrumentation needed for protecting containment integrity

This is addressed in Section 1.3.

6.1.13 Measures which can be envisaged to enhance capability to maintain containment integrity after occurrence of severe fuel damage

Not applicable.

6.2 Accident Management Measures to Restrict the Radioactive Releases

6.2.1 Radioactive releases after loss of containment integrity

Design provisions

Equipment and facilities are available throughout UUK to enable repairs to Plants and cylinders if required.

Operational provisions

Written Operating and Maintenance Instructions are prepared to ensure that facilities are operated and maintained in a safe manner.

The maintenance schedule ensures that the equipment is well maintained.

Consequences are minimised by containing water run off and provision of covering to minimise release.

The Safety Case and modification processes ensure that the design and operation are carefully considered. In addition an emergency scheme exists to provide a prompt and appropriate response to any emergency.

6.2.2 Accident management after uncovering of the top of fuel in the fuel pool

This section is not relevant to the UUK Site as there are no fuel ponds on the Capenhurst Site.

Hydrogen management

Not applicable

Providing adequate shielding against radiation

Not applicable

Restricting releases after severe damage of spent fuel in the fuel storage pools

Not applicable

Instrumentation needed to monitor the spent fuel state and to manage the accident

Not applicable

Availability and habitability of the control room

Not applicable

6.2.3 Measures which can be envisaged to enhance capability to restrict radioactive releases

No further measures have been identified.

Table 2: Summary List of UUK Plant Concepts

ID	Description	Comments
1	Centrifuge Enrichment Plant	
2	Centrifuge Enrichment Plant	
3	Centrifuge Enrichment Plant	Includes Centrifuge Hot Test Rig.
4 to 7	UF_6 Storage Raft	Storage of UF_6 cylinders.
8	Drum Monitoring Facility and Radioactive Store.	
9	Compliance Department Technicians' Laboratory	
10	Chemistry Services	New purpose-built facility.
11	Centrifuge Assembly including the X-Ray Facilities	Currently leased to ET UK.
12	Enrichment Technology Company Design & Qualification Test Facility	Currently leased to ET UK.
13	Container Receipt and Dispatch	Storage of UF_6 cylinders.
14	Storage of contaminated redundant equipment, contaminated process residues and radioactive sources.	Includes the temporary storage of vacuum pumps in ISO containers on the ISO Container Park.
15	Site Laundry	Handles potentially contaminated clothing.
16	Plant Ancillaries Workshop and Vacuum Pump Disassembly Facility	

Table 3: Summary of Issues for Further Consideration by UUK

UUK has identified a number of considerations arising from its ENSREG Stress Tests. The specific findings that ONR will monitor progress on are detailed in the following table.

UUK Findings
Review the existing emergency plans to ensure that, in relation to the response to a criticality accident, the plans incorporate further details to support; the principle of extendibility for off-site response, and control of reactivity through the use of neutron poisons if practicable.
Consider the impact on resources required to respond to combinations of more extreme events that might delay or prevent emergency actions. This review should examine the effect of concurrent criticality on ability to effect safe rescue of injured personnel and the validity of assumptions on capability to mitigate a severe accident propagating.