REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-ABWR-0009
Date sent:	5th June 2014
Acknowledgement required by:	26th June 2014
Agreement of Resolution Plan Required by:	4th July 2014
Resolution of Regulatory Observation required by:	*To be determined by the Hitachi-GE Resolution Plan*
TRIM Ref.:	2014/138769
Related RQ / RO No. and TRIM Ref. (if any)**:**	
Observation title:	Analysis of loss of offsite power events
Technical area(s) Fault Studies	**Related technical area(s)** Electrical Human Factors PSA

Regulatory Observation

Summary

Loss of offsite electrical power through either a major failure of the national grid or the grid connection points to the nuclear power plant is commonly referred to as LOOP and is an important contributor to the calculated frequency of plant damage states. ONR has developed a Regulatory Observation for Hitachi-GE to review the resilience of the UK Advanced Boiling Water Reactor (ABWR) to LOOP events and to LOOP events coincident with common cause failures of installed onsite safety classified electrical systems.

Background

Loss of offsite power (LOOP) is an important initiating event that requires consideration in both the deterministic and probabilistic sections of the UK ABWR safety case. The scope of this Regulatory Observation is limited to the deterministic consideration of such events.

National grids and their engineering structures vary throughout the world thus having an impact on the claimed frequency of LOOPs. In the context of this Regulatory Observation, a LOOP is defined as the common cause failure of both the main and alternative sources of electrical grid supplies. The UK's national grid is very reliable and is the preferred source of supply for all UK nuclear power plants (NPPs). However it is not under the control of a NPP licensee and for this reason only modest safety case claims should be made on the failure frequencies related to LOOP. It should also be noted that the national grid will be changing over the next decade due to the increasing introduction of renewable energy sources and the drive, through using smart devices, to further optimise the use of this national infrastructure. Climate change models also predict an increase in the frequency of challenging weather events, such as the storm that led to a LOOP event at the Dungeness B NPP in 2013.

For the above reasons, ONR requires all UK NPPs to be robust against short term, medium term and extended LOOP events. To ensure that ONR's expectation on this matter is integrated into the UK ABWR Pre-Construction Safety Report (PCSR) and supporting references, the following LOOP frequency figures should be used for the generic site:

- Short term LOOP of 2 hours duration $5x10^{-2}$/yr
- Medium term LOOP of 24 hours duration $5x10^{-3}$/yr

- Long term LOOP of 168 hours duration $5x10^{-5}$/yr.

Based on these frequencies, short and medium term LOOP initiating events should be treated as frequent faults in the design basis safety case, and long term LOOP initiating events as infrequent faults, with the appropriate deterministic rules and acceptance criteria applied.

The above are for LOOPs as initiating events in their own right; where a plant fault is assumed to lead to a consequential LOOP (for example, a loss of coolant accident), a short term LOOP can be assumed (unless the cause is a major external event).

In addition to the initiating event of the LOOP, this Regulatory Observation also requires LOOP events to be considered with a common cause failure of the installed emergency diesel generators (EDGs) and with the loss of the back-up building air cooled diverse diesel generators.

Definitions

$LOOP_T$ is the initiating event "loss of offsite power" for duration of T hours where T can be 2 hours, 24 hours with frequencies per year of $5x10^{-2}$ and $5x10^{-3}$ respectively, and 168 hours with a frequency per year of $5x10^{-5}$.

EDG_{CCF} is the common cause failure of the three emergency diesel generators whose duration of failure is assumed to be longer than that of the postulated grid failure.

$BUBDG_{CCF}$ is the common cause failure of the back-up building diesel generators whose duration of failure is assumed to be longer than that of the grid.

No recovery of failed equipment should be assumed within the time specified.

Events to be analysed

This Regulatory Observation requests that the following events are analysed :

1. $LOOP_2$
2. $LOOP_{24}$
3. $LOOP_{168}$
4. $LOOP_2+EDG_{CCF}$
5. $LOOP_{24}+EDG_{CCF}$
6. $LOOP_{168}+EDG_{CCF}$
7. $LOOP_{168}+EDG_{CCF}+BUBDG_{CCF}$

The first two events (short and medium term LOOP) should be analysed as frequent design basis events, with the appropriate deterministic rules and acceptance criteria applied.

Events 3, 4 and 5 (long term LOOP, and short/medium term LOOP events with common cause failure of the three emergency diesel generators) should be analysed as infrequent design basis events, again with the appropriate deterministic rules and acceptance criteria applied.

For all the design basis events (i.e. events 1 to 5), it is assumed that the appropriate acceptance criteria will be met through the adequate performance of appropriately classified engineered structures, systems or components (SSCs). These SSCs need to be clearly identified.

Events 6 and 7 should be analysed as beyond design basis events. The deterministic rules and acceptance criteria can be relaxed from the more onerous requirements for design basis events. However, any SSCs

designed and claimed to act in response to these events still need to be clearly identified and appropriately classified.

Regulatory Observation Actions

RO-ABWR-0009.A1 - Analysis of design basis events

Hitachi-GE is required to demonstrate that the UK ABWR has an adequate design basis safety case for the following LOOP events:

- Short term LOOP as a frequent design basis event ($LOOP_2$)
- Medium term LOOP as a frequent design basis event ($LOOP_{24}$)
- Long term LOOP as an infrequent design basis event ($LOOP_{168}$)
- Short term LOOP with the common cause failure of the three emergency diesel generators as an infrequent design basis event ($LOOP_2$+EDG_{CCF})
- Medium term LOOP with the common cause failure of the three emergency diesel generators as an infrequent design basis event ($LOOP_{24}$+EDG_{CCF})

All five events need to be captured on the UK ABWR fault schedule.

For the frequent faults, diverse means need to be demonstrated to bring the UK ABWR to a sustainable safe state, with single failures and the worst permissible maintenance states considered. It will be clear which SSCs need to be claimed (including support systems) and that they can achieve the necessary mission time. Additional transient analysis may be required to demonstrate that the claimed SSCs can achieve the sustainable state with the appropriate design basis acceptance criteria met.

Separate safety demonstrations may be required for the two categories of frequent faults, or it may be possible to consider the two scenarios with a single bounding fault.

For the infrequent faults, only one method of reaching a sustainable safe state needs to be demonstrated, but still with single failures and the worst permissible maintenance states considered. It will be clear which SSCs need to be claimed (including support systems) and that they can achieve the necessary mission time. Additional transient analysis may be required to demonstrate that the claimed SSCs can achieve the sustainable state with the appropriate design basis acceptance criteria met (which may be different to those applied for frequent faults).

Existing transient analysis and safety case arguments, potentially considering more onerous beyond design basis scenarios without any AC power available (grid or on-site diesel power), may provide confidence that these scenarios are within the design capability of the UK ABWR. However, it is important to account for the different rules about single failures and maintenance assumptions which apply in design basis safety cases.

The methodology for addressing this Action and a comparison of with how these events are considered in the Japanese reference NPP shall be described in Rev A of the PCSR.

A topic report (or similar document) describing the design basis safety case for these faults, including fully populated fault schedule entries and any supporting transient analysis shall be completed and fully integrated into the subsequent revision of the PCSR.

Resolution required by: To be determined by the Hitachi-GE Resolution Plan

RO-ABWR-0009.A2 – Analysis of beyond design basis events

Hitachi-GE is required to analyse as beyond design basis events the following:

- Long term LOOP with the common cause failure of the three emergency diesel generators ($LOOP_{168}$+EDG_{CCF})
- Long term LOOP with the common cause failure of the three emergency diesel generators and the common cause failure of the back-up building diesel generators ($LOOP_{168}$+EDG_{CCF}+$BUBDG_{CCF}$)

The deterministic rules and acceptance criteria can be relaxed (compared to the more onerous requirements for design basis events). Existing transient analysis may already be appropriate or new analysis specifically for the UK ABWR may be required.

Any SSCs designed and claimed to act in response to these events need to be clearly identified and appropriately classified.

The methodology for addressing this Action and a comparison of with how these events are considered in the Japanese reference NPP shall be described in Rev A of the PCSR.

A topic report (or similar document) describing the design basis safety case for these faults, including fully populated fault schedule entries and any supporting transient analysis shall be completed and fully integrated into the subsequent revision of the PCSR.

Resolution required by: To be determined by the Hitachi-GE Resolution Plan

REQUESTING PARTY TO COMPLETE	
Actual Acknowledgement date:	
RP stated Resolution Plan agreement date:	