



Internal minutes of Mature Technology SMR - Stage 1 Industry Engagement

GE Hitachi

Friday 13th April 2018

Present:

ONR

Participants:

[Redacted]

GE Hitachi:

[Redacted]

ONR

Observers:

[Redacted]

EA

Participants:

[Redacted]

Related documents:

ONR Introduction Presentation: TRIM 2018/133849

GEH Presentation (Sent Pre-Meeting): TRIM 2018/169860

GEH Presentation (Delivered on the Day): TRIM 2018/169861

Meeting CR: TRIM 2018/####

Preliminary Stage 2 Engagement Agenda Topics: TRIM 2018/169857

Introduction

ONR introduced the Stage 1 Industry Engagement (see TRIM 2018/133849 for ONR introduction presentation). The meeting agenda was distributed in advance by BEIS (TRIM 2018/81922) and was strictly limited to 4 hours. The key objective was to define an agenda for the upcoming Stage 2 engagement.

ONR clarified at the beginning of the meeting that the regulators will not assess or provide judgements on the information provided. Given the strict 4 hour time limit, there was only some flexibility in the duration of agenda items.

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GE Hitachi BWRX-300 Concept Presentation

[REDACTED] presented the concept for the BWRX-300 to give regulators an overview of the design philosophy and operating conditions. The presentation files can be found at:

- GEH Presentation (Sent Pre-Meeting): TRIM 2018/169860
- GEH Presentation (Delivered on the Day): TRIM 2018/169861

GEH outlined their experience in the US nuclear market including >1700 employees. The decision to proceed with the BWRX-300 was made in the context of [REDACTED]. The licensing basis and DiD aspects were garnered from experience in ABWR and ESBWR.

The [REDACTED] design is [REDACTED], because [REDACTED] to UK expectations. This follows from experience with [REDACTED] on the UK ABWR.

There are [REDACTED] employees in the US and [REDACTED] in Japan working on the BWRX-300. Preliminary strike prices are First of a Kind (FOAK) [REDACTED] with the following nth of a kind (NOAK) plants as low as [REDACTED]. The FOAK could be operational within [REDACTED] years and would be financed [REDACTED].

GEH outlined the evolution of the primary circuit from Dresden 1 to ESBWR. The ESBWR achieves operation with no recirculation pumps, it is therefore naturally circulated and [REDACTED]. The BWRX-300 is very similar in design to the ESBWR but scaled down. Therefore, there are improvements in fabrication with more foundries available for the supply chain.

GEH then outlined the evolution of the containment including the development of [REDACTED]. ESBWR has an elevated suppression pool to increase passive safety.

Slide 13 highlighted the range of testing programs used to inform the design of the ESBWR. Isolation condensers provide decay heat removal in an isolation event, a key safety feature. The heat is transferred to a decay heat tank outside of the containment, combatting the problem of in containment heat-up.

The BWRX-300 is in [REDACTED]. There is a focus on [REDACTED] required. [REDACTED] For example; part of the rationale for electrical output is that [REDACTED].

The BWRX-300 is intended to [REDACTED], therefore minimising the need for [REDACTED] and [REDACTED] the need for the following as standalone safety systems:

- [REDACTED]
- [REDACTED]
- [REDACTED]

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- o [REDACTED] (ESBWR used [REDACTED] in containment. A [REDACTED] is used instead);
- o Safety relief valves (taken care of by [REDACTED]);

The BWRX-300 uses a [REDACTED], spent fuel pond [REDACTED] rather than [REDACTED]. The BWRX-300 will [REDACTED]. Instead, this design involves [REDACTED] in [REDACTED] timeframe ([REDACTED]).

The design has evolved to incorporate the principles of lines of defence and has been aligned as far as possible to meet international and UK expectations. Slide 18 illustrates the [REDACTED] safety support systems [REDACTED].

A key feature of the BWRX is [REDACTED]. Therefore, they claim that [REDACTED].

There will be [REDACTED] main steam lines [REDACTED]. These will be [REDACTED] through [REDACTED]. They [REDACTED]. Instead, this comes under the [REDACTED].

An [REDACTED] has been added as a [REDACTED] to determine [REDACTED]. GEH intend to implement [REDACTED].

Ownership: slide 21. GEH intends [REDACTED]. It is [REDACTED] and should [REDACTED] maintenance. There is a [REDACTED] to postulate certain events.

Site requirements: GEH intend to [REDACTED].

Manufacture: [REDACTED] will be employed where possible. [REDACTED] equipment ([REDACTED]) is desirable. If there is [REDACTED] based inspections from regulators. GEH are [REDACTED]. Ideally, [REDACTED] placed [REDACTED] this, standardising design and reducing EPC contingencies.

Security: GEH are considering using [REDACTED]. The use of [REDACTED].

Decommissioning: GEH have experience in [REDACTED] with [REDACTED] removal and life extension of operating reactors.

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Solid Waste Streams: GEH would like to use [REDACTED] equipment to allow the use of best available techniques (BAT). In addition GEH intend to [REDACTED]. They will instead [REDACTED].

**GEH Suggested General Topics for Stage 2**

During the technical segment of their presentation. GEH listed the general topics they would like to discuss at stage 2:

- [REDACTED].
  - BWRX-300 design is in early development phase;
  - Level of details that were provided for other GDA reviews is [REDACTED] for the BWRX-300;
  - Is there a way to engage ONR during the BWRX-300 design phase to ensure ease of licensing?
  - Pros/Cons of a site license approach instead of a GDA for the first plant;
  - Passive Safety (ALARP and identifying RGP) Licensing Optimisation.
- An agreed upon licensing plan may be used to optimise the GDA process;
  - Define the minimum document set needed to start a GDA;
  - Define scope for each step of the GDA, and any prioritized early reviews;
  - Definition of licensing basis, and required reviews;
  - How to leverage international cooperation -OECD/NRA (used to be MDEP), IAEA, other reviews and approval regulatory bodies etc.
- Pre GDA or Early GDA Potential 'licenseability review'
  - DiD topic report;
  - Safety classification topic report;
  - Design process topic report;
  - Process for claims / argument / evidence;
  - Topic reports for other selected technical areas. (e.g. Event mitigation features presented in a DiD approach , natural circulation, ATWS, LOCA);
- Other features needing discussion:
  - Reduced staffing [REDACTED] people;
  - [REDACTED] maintenance;
  - Reduced security vulnerabilities.

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**Comparison of ONR and GEH Suggested Topics for Discussion**

During the morning presentation, GEH identified topics for discussion in each of the technical areas of Licensing and Siting, Safety Analysis, Engineering, Security and Environment. These are listed below alongside the topics identified by ONR in the afternoon session.

Licensing and Siting

<u>ONR</u>	<u>GEH</u>
<ul style="list-style-type: none"> <li>• Ownership / Deployment model / Site Selection Size</li> <li>• Centralised workforce/ Reduced Staffing                             <ul style="list-style-type: none"> <li>- (priority between different operator)</li> </ul> </li> <li>• Developer different to operator                             <ul style="list-style-type: none"> <li>- (Knowledge Transfer)</li> <li>- (Intelligent Customer)</li> </ul> </li> <li>• Phase deployment on single site</li> <li>• Module build / outside of the UK                             <ul style="list-style-type: none"> <li>- (Supply Chain Oversight)</li> </ul> </li> <li>• Maturity of design + proposed timing</li> <li>• Site specific assessment vs Generic                             <ul style="list-style-type: none"> <li>- (pros/ cons)</li> </ul> </li> <li>• Design Authority / Intelligent Customer</li> </ul>	<ul style="list-style-type: none"> <li>• Licensing Plan;</li> <li>• Defence-in-Depth;</li> <li>• Safety Classification;</li> <li>• Design Process;</li> <li>• Process for claims / arguments / evidence (requirements management) and where it belongs in the GDA process. Identify prioritized claims/arguments/evidence for early evaluation in step 2.</li> <li>• Topic Reports for other selected technical areas:                             <ul style="list-style-type: none"> <li>- Event and Mitigation features (presented in a Defence-in-Depth approach) natural circulation, ATWS, LOCA, security requirements).</li> </ul> </li> </ul>

Notes: GEH would [REDACTED] and would [REDACTED]. GEH would [REDACTED]. GEH would [REDACTED]. GEH would [REDACTED].

Safety analysis

<u>ONR</u>	<u>GEH</u>
<ul style="list-style-type: none"> <li>• [REDACTED] LB LOCA                             <ul style="list-style-type: none"> <li>- Engagement with structural integrity</li> </ul> </li> <li>• Novel Aspects with respect to ABWR.</li> <li>• Expectations for fault analysis                             <ul style="list-style-type: none"> <li>- DBD, PSA, SAA</li> <li>- Cat + Class</li> <li>- DiD</li> </ul> </li> <li>• Simplifications with respect to ESBWR                             <ul style="list-style-type: none"> <li>- ALARP Considerations</li> </ul> </li> <li>• Diverse means of shutdown (frequent faults)                             <ul style="list-style-type: none"> <li>- ATWS</li> </ul> </li> <li>• Containment operations</li> </ul>	<ul style="list-style-type: none"> <li>• Deterministic safety analysis;</li> <li>• Probabilistic safety analysis;</li> <li>• Event and Mitigation features (presented in a Defence-in-Depth approach);</li> <li>• Natural circulation;</li> <li>• ATWS;</li> <li>• LOCA.</li> </ul>

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<ul style="list-style-type: none"> <li>• Passive systems                     <ul style="list-style-type: none"> <li>- <i>Reliability Assessments</i></li> </ul> </li> <li>• Multi units (Risk targets)</li> </ul>	
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Notes: There was discussion over whether [REDACTED]. It was noted to GEH that it would perhaps be easier to explain to ONR the differences from the ABWR rather than ESBWR. Regarding UK expectations for fault analysis, GEH are currently writing a document called ‘Safety analysis framework’. GEH are also writing a separate report on ‘Defence in Depth’.

Engineering

<u>ONR</u>	<u>GEH</u>
<ul style="list-style-type: none"> <li>• Containment Philosophy                     <ul style="list-style-type: none"> <li>- Pressure relief</li> <li>- Isolation</li> <li>- External Hazards</li> </ul> </li> <li>• Basis for simplifications of design from ABWR/ESBWR</li> <li>• Defence in Depth</li> <li>• Passive v Active protection                     <ul style="list-style-type: none"> <li>- Resilience</li> <li>- Dependence on Support Systems</li> </ul> </li> <li>• Construction Methods + Modularisation</li> <li>• Supply chain management</li> <li>• Novel Materials (In containment or vessel?)</li> <li>• Plant control protection philosophy</li> <li>• Nuclear Baseline for Staffing ([REDACTED])</li> </ul>	<ul style="list-style-type: none"> <li>• Features and function (plant description);</li> <li>• Control and Instrumentation;</li> <li>• Electrical distribution system;</li> <li>• [REDACTED];</li> <li>• Other features.</li> </ul>

Notes: The electrical distribution system was noted by ONR to be [REDACTED]. The [REDACTED] are claimed by GEH as [REDACTED] this is not necessarily novel to ONR.

Security

<u>ONR</u>	<u>GEH</u>
<ul style="list-style-type: none"> <li>• Vital area identification                     <ul style="list-style-type: none"> <li>- Key SSCs</li> <li>- Understanding and Application DBT</li> <li>- Security of Nuclear Fuel</li> </ul> </li> <li>• Cyber Security &amp; IA ([REDACTED])                     <ul style="list-style-type: none"> <li>- Identification of Risks</li> <li>- SNI</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Minimizing vulnerabilities;</li> <li>• Defence-in-depth approach;</li> <li>• SySAPs review;</li> <li>• Overview of security features.</li> </ul>

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<ul style="list-style-type: none"> <li>• Supply Chain (NISR)             <ul style="list-style-type: none"> <li>- Introduction of Defects</li> <li>- Security and Integrity</li> </ul> </li> <li>• Threat to Adjacent Site (NISR)             <ul style="list-style-type: none"> <li>- Parallel operation and construction.</li> </ul> </li> </ul>	
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Notes: ONR to present an overview of ‘expectations’ including security features, DiD principles (deter, delay and detect) and supply chain assurance.

Environment

<u>ONR</u>	<u>GEH</u>
<ul style="list-style-type: none"> <li>• Overview of RadWaste Systems             <ul style="list-style-type: none"> <li>- Design maturity/innovation</li> <li>- BAT in design process</li> <li>- Source term understanding</li> <li>- Systematic ID of routes to environment</li> </ul> </li> <li>• Optimisation             <ul style="list-style-type: none"> <li>- Embedding vs groundwater risk</li> <li>- Zero liquid discharges vs Solid waste</li> <li>- Gaseous discharges (is scaling appropriate)</li> <li>- Decommissioning waste</li> <li>- Fuel cycle &amp; waste i.e. yearly outage</li> </ul> </li> <li>• Relationship between ABWR, ESBWR, BWRX-300             <ul style="list-style-type: none"> <li>- Waste reduction aspects</li> </ul> </li> <li>• Deployment Model             <ul style="list-style-type: none"> <li>- Implication of multiple units for waste and discharges</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Liquid and gas releases during normal operation;</li> <li>• Other siting requirements –land and water use.</li> </ul>

Notes: EA noted that Liquid and gas release is covered under ‘optimisation’. The detail of design does not necessarily need to be finalised. In GDA, the decision making process is more important for assessment purposes. ‘Principles’ rather than details are the focus of GDA.

**OFFICIAL****Themes Identified from ONR and GEH Suggested Topics**

Using these preliminary topics, covering the technical areas (of Licensing and Siting, Safety Analysis, Engineering, Security and Environment), the following themes emerged. These were used to directly inform the stage 2 agenda.

- 1) Deployment Model – **GEH Lead**
  - Site Selection
  - Phased Deployment
  - Developer vs Operator
  - KT & IC
  - Multi-unit considerations (inc. threat & waste streams)
- 2) Resource Model - **GEH Lead**
  - [REDACTED]
  - Nuclear Baseline (inc. construction phase)
- 3) Maturity of design & timelines - **GEH Lead**
- 4) Updated GDA Process + SLC + EA Permitting – **ONR / EA Lead**
  - Site specific v generic design assessment
  - Pros and cons
- 5) Novel aspects of BWRX-300 design - **GEH Lead**
  - [REDACTED]
- 6) Defence in Depth - **GEH Lead**
  - Including examples of events
- 7) Passive vs Active Safety Systems - **GEH Lead**
  - VAI
  - Plant Control / protection philosophy
- 8) Supply Chain Oversight – **GEH / ONR Lead**
  - NISR
- 9) Vital Area Identification (Risk Identification) – **ONR / EA Lead**
  - Secure by Design
  - ONR to present acceptance Criteria
- 10) CS & IA – **ONR Lead**
  - Expectations
- 11) Overview of Radwaste Systems - **GEH Lead**
  - BAT in design
- 12) Optimisation of Waste Streams and Systems – **GEH / EA Lead**
  - Nuclear Fuel Cycle
- 13) Design Process and Requirements Management – **GEH / ONR Lead**
  - GEH to present on their design process: claims, arguments and evidence.
  - ONR to present the role of requirements for claims, arguments and evidence in the GDA process.

**Agenda for Stage 2**

The agenda for stage 2 was developed from the themes listed above and can be found at TRIM 2018/169857.

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