

Update on Hunterston B

Stephen Harrison – Head of Operational Facilities Assessment

Stuart Fannin – Hunterston B Site Inspector

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We intend to cover:

1. Introductions
2. Status of Hunterston B reactors
3. ONR's assessment of Reactor 4 return to service case
4. Increase in OA & CEDTL
5. Basis of ONR's decision
6. ONR independence and competency
7. Status of Reactor 3 safety case for return to service
8. Monitoring post re-start
9. Questions?

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Status of Hunterston B reactors (1)

- Reactor 3 (Shutdown in March 18) - more extensive and complex cracking than predicted – R3 likely to have been operated outside (albeit conservative) operational allowance.
- Reactor 3 remains shutdown pending acceptable EDF safety case for return to service.
- Reactor 4 Inspection (Shutdown in October 2018) - similar cracking, but less advanced - within operational allowance.
- ONR's assessment of the Reactor 4 safety case completed and Licence Instrument permitting operation issued on 20th August.



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Status of Hunterston B reactors (2)

Hunterston B R3 (Inspections in March & June 2018)

- Number of channels inspected – 86 (of 308)
- % of channels inspected – 28%
- Estimated number of cracked bricks – 377

Hunterston B R4 (Inspected in October 2018)

- Number of channels inspected – 34 (of 308)
- % of channels inspected – 11%
- Estimated number of cracked bricks – 209

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Status of Hunterston B reactors (3)

- Cracking of graphite bricks was expected, but has happened sooner and faster than predicted.
- "Induced cracking" was not anticipated.
- Inspections have indicated the potential for multiply cracked bricks – although none observed to date.

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ONR's Assessment of Reactor 4 return to service case (1)

- ONR's assessment of the Reactor 4 safety case completed and Licence Instrument permitting operation issued on 20th August.
- Permits operation to 16.025 TWd, approximately 4 months operation at power.
- ONR's team of specialist inspectors completed an extensive assessment of the detailed safety case submitted by EDF.
- In support of assessment ONR's inspectors have engaged extensively in technical discussions with EDF over many months to ensure key issues are adequately addressed.
- ONR's assessment concluded that Reactor 4 is safe to operate for the period covered by the safety case.

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ONR's Assessment of Reactor 4 return to service case (2)

- Assessment focused on whether the reactor core would be able to fulfil its fundamental nuclear safety requirements:
 - Allow unimpeded movement of control rods and fuel;
 - Direct gas flows to ensure adequate cooling of the fuel and core;
 - Provide neutron moderation and thermal inertia.
- Increase in Operational Allowance (OA) and Currently Established Damage Tolerance Level (CEDTL) through:
 - Improvements to Hunterston B building model resulting in reduced seismic input to core;
 - Improvements to damage tolerance analysis methods;
 - More extensive analysis.

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Increase in OA & CEDTL

	Total Number of Full Height Axial Cracks		
	OA	CEDTL	Predicted at 16.025 TWd*
Original safety case - NP/SC 7716	350	700	-
New safety case - NP/SC 7785	700	1331	467

OA Operational Allowance
CEDTL Currently Established Damage Tolerance Level
* 99% Calculated Confidence Level

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Basis of ONR's Decision

- **Objective** – evidence based rigorous assessment of the demonstration of safety in EDFs safety case.
- **Stringent Standards** – (Published) Safety Assessment Principles, Technical Assessment Guides, and international standards and guidance.
- **Assessors** - multi-disciplinary team comprising: graphite, fault studies, civil engineering and external hazards specialist inspectors.
- **Transparency** – Project Assessment Report has been published and detailed Assessment Reports will be published by end of September

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ONRs independence and competency

We utilised:

- Our own specialist, expert graphite inspectors.
- Independent expert advice (e.g. Manchester and Birmingham Universities, Graphite Technical Advisory Committee, HSE Health and Safety Laboratory).
- Our decisions are subject to multiple levels of review including ONR's heads of specialisms, Superintending Inspector, Deputy Chief Nuclear Inspector etc.
- We act independently (i.e. without fear or favour).

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Status of Reactor 3 Safety Case for Return to Service

- EDF has submitted a safety case for re-start of Reactor 3 - aims to justify operation for a period of approximately 6 months.
- ONR has just started assessment of the safety case.
- Key focus of the assessment will be the prediction of core state after 6 months operation and whether there are sufficient margins in the case.
- We will only give permission for the re-start of Reactor 3 if safe to do so.

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Monitoring post re-start

- The operation of Reactor 4 (and Reactor 3 if permitted) will be very closely monitored:
 - **Operating periods** – limited periods of operation, each followed by core inspections overseen by ONR.
 - **Reactor operations** – fuel movements, control rod movement and core parameters will be closely monitored to give early warning of emerging issues.

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Questions?

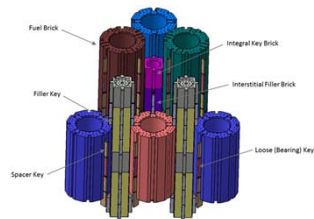
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Additional Slides

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Overview of graphite issue (1)

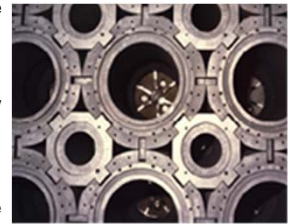
- AGR cores are constructed from graphite bricks keyed together with channels for fuel and control rods



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Overview of graphite Issue (2)

- Irradiation is known to cause shrinkage and cracking of graphite bricks
- Cracking can lead to core distortion with the potential to impede movement of fuel/control rods
- Each reactor safety case must demonstrate that fuel is adequately cooled and that control rods will shut the reactor down (even in a seismic event)



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