Resistivity Measurement of Graphite Fuel Channel Bricks in Advanced Gas-Cooled Reactors

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Material testing

The physical properties of the graphite bricks in AGR cores are needed as part of the assessment of structural integrity

- Graphite at the bore surface becomes porous
- Trepanned specimens - weight loss
- A non-destructive mapping of porosity would be better
Inspection Access

Hoist and control

Charge face

Support chains and umbilical

Empty fuel channel

Reactor core

Inspection tool
Prototype Eddy Current Inspection Tool - PECIT
Estimating resistivity

Normalized coil reactance vs. Normalized coil resistance diagram showing air, core graphite, and calibration brick graphite points with lift off and $\pm \rho$ indications.
Unbalanced operation

Usually eddy current testing is balanced (nulled) with the probe on the material under test.

• Operating point is used to determine resistivity, so we cannot balance.
• So we reset the balance (set all offsets to zero)
Eddy current system

• MS5800 operated with Magnifi 2

Upgraded August 2104 to:

• Ectane operated with Magnifi 3
  ❖ Coil drive not independent for different coils
  ❖ Amplifier gain only has one setting for all input channels
PECIT deployment Hartlepool R1 2014
PECIT deployment Hartlepool R1 2014
PECIT deployment Hartlepool R1 2014
PECIT deployments

Heysham 1: 2012, 2013

Hinkley Point B: 2012, 2014

Hartlepool: 2013, 2014

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PECIT scan data full channel
PECIT scan - two bricks
Resistivity specimens
4kHz Impedance plane relative to air point

virgin

+ρ

air

20°C

30°C

40°C

50°C

60°C

70°C
Vector to Air vs Resistivity: 4kHz

Resistivity /µΩm

Magnitude of vector to air

20°C
30°C
40°C
50°C
60°C
70°C
Resistivity mapping

• Manual extraction of resistivity point-by-point from eddy current data

• Application developed by Quintessa that processes the eddy-current C-scans and transforms directly to resistivity map.
What can we do with the information?

• We have produced a system for giving a complete map of the resistivity of the fuel-channel surface.
• Can be used to reduce need for trepanning
• Can be used to understand apparent anomalies in trepanned data

• More reliable predictions of reactor integrity
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Thank you for your attention