UK Irradiated Materials Archive

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UKNAM meeting – Bristol – September 2016

UK Irradiated Materials Archive

Background

- Mid 2014: Initiative within Bristol-Oxford NRC to retain ex-Magnox RPV steel surveillance specimens
  - Specimens of known pedigree with up to 40 years of service exposure
  - Materials well suited for use in future university-based research programmes
- Initial meetings expanded this concept
  - Initial informal interest group expanded to include other stakeholders
    - NNL & NDA – specimen owners and custodians
    - NNUF (inc. CCFE Materials Research Facility)
    - Other universities
  - Widened scope to consider other UK irradiated materials of good pedigree
  - Discussions with USA Materials Archive initiative
- Formal Terms of Reference agreed early 2016

IMAG Terms of Reference

- **OBJECTIVES**
  - The objective of the Irradiated Materials Archive Group is to underpin research into nuclear materials in the UK academic community by facilitating access to active materials and associated data from UK and international energy programmes. Materials of interest include, but are not limited to: pressure vessel steels, graphite, fuel claddings.
- **ACCOUNTABILITY**
  - IMAG is a sub-group of NNUF (the National Nuclear User Facility), will provide advice on the status of the nuclear materials archive to the NNUF; the NNUF is represented on the Nuclear Innovation and Research Advisory Board (NIRAB).

IMAG Terms of Reference

DELIVERABLES

1. to establish an inventory of irradiated nuclear structural materials around the UK, including:
   ownership; location; composition and heat treatments; irradiation history; test data.
2. to facilitate making the inventory available to UK nuclear researchers.
3. to advise on the creation of an accessible physical archive of well characterized materials (of irradiated and unirradiated reference samples).
4. to participate in the development of agreed access procedures for materials in the archive between research users, specimen owners, storage facility operators and licensing authorities.
5. to provide advice on issues relating to transport of active materials to and from the archive, and to facilitate such transport.
6. to identify additional irradiated materials collections in the UK and, if appropriate, to bring them into the catalogue, and if appropriate, the physical archive.
7. to advise on which materials currently kept are, or will be, of interest to the UK and international research community.
8. to liaise with similar initiatives outside the UK, working towards:
   compatibility of inventories; sharing of inventories; international availability of materials.
9. to disseminate information about the activities of IMAG to the broader community.

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Current committee (meeting 2-3 times per year):

IMAG Co-chair	Peter Flewitt	University of Bristol
IMAG Co-chair	Steve Roberts	University of Oxford
NNUF Co-chair	Chris Grovenor	University of Oxford
NNUF Co-chair	Malcolm Joyce	University of Lancaster
NIRO representative	Andrew Brown	
NDA representative	Beth Ripper	
CCFE representative	Martin O'Brien	
NNL representative	Des Wright	
Universities representative	Simon Pimblott	University of Manchester
EPSRC representative	Kate Bowman	

Attendance at IMAG meetings is open to any interested party, on request to the IMAG executive. The executive may invite people with relevant expertise, or representing relevant entities, to attend meetings.

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Magnox steel vessels – nominal compositions

- Design and construction standard
  - Non-nuclear BS1500 Class 1
- RPV materials
  - Plain carbon-manganese steel plates and forgings
  - Manual metal arc (MMA) or automatic submerged arc (SAW) welds

	Composition /wt%					
	C	Mn	Si	S	P	Cu
Plate	0.09-0.17	1.04-1.32	0.10-0.60	0.02-0.04	0.01-0.04	0.03-0.15
Forging	0.18	1.30	0.36	0.024	0.024	0.10
MMA	0.086	0.91	0.91	0.022	0.025	0.08
SAW	0.088	1.49	1.49	0.037	0.031	0.23

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Magnox specimens

- Specimen listing has been evaluated
  - Composition
  - Charpy and tensile specimens with linked test data
  - More than 8000 specimens
    - Plate material
    - Forged material
    - Manual metal arc welds
  - Irradiation temperatures **170 - 360°C**
  - Doses **unirradiated** plus **irradiated**, **range 10** to **400 x10^{-5}** dpa

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Magnox specimens

- Specimens are distributed in cans within overpacks
- Currently stored at Sellafield
- Well-documented
- For research purposes probable division:
  - "1st division" specimens
    - kept / tested below 50°C after irradiation
    - ~500 specimens
  - "2nd division" specimens
    - kept / tested below 100°C after irradiation
    - ~150 specimens

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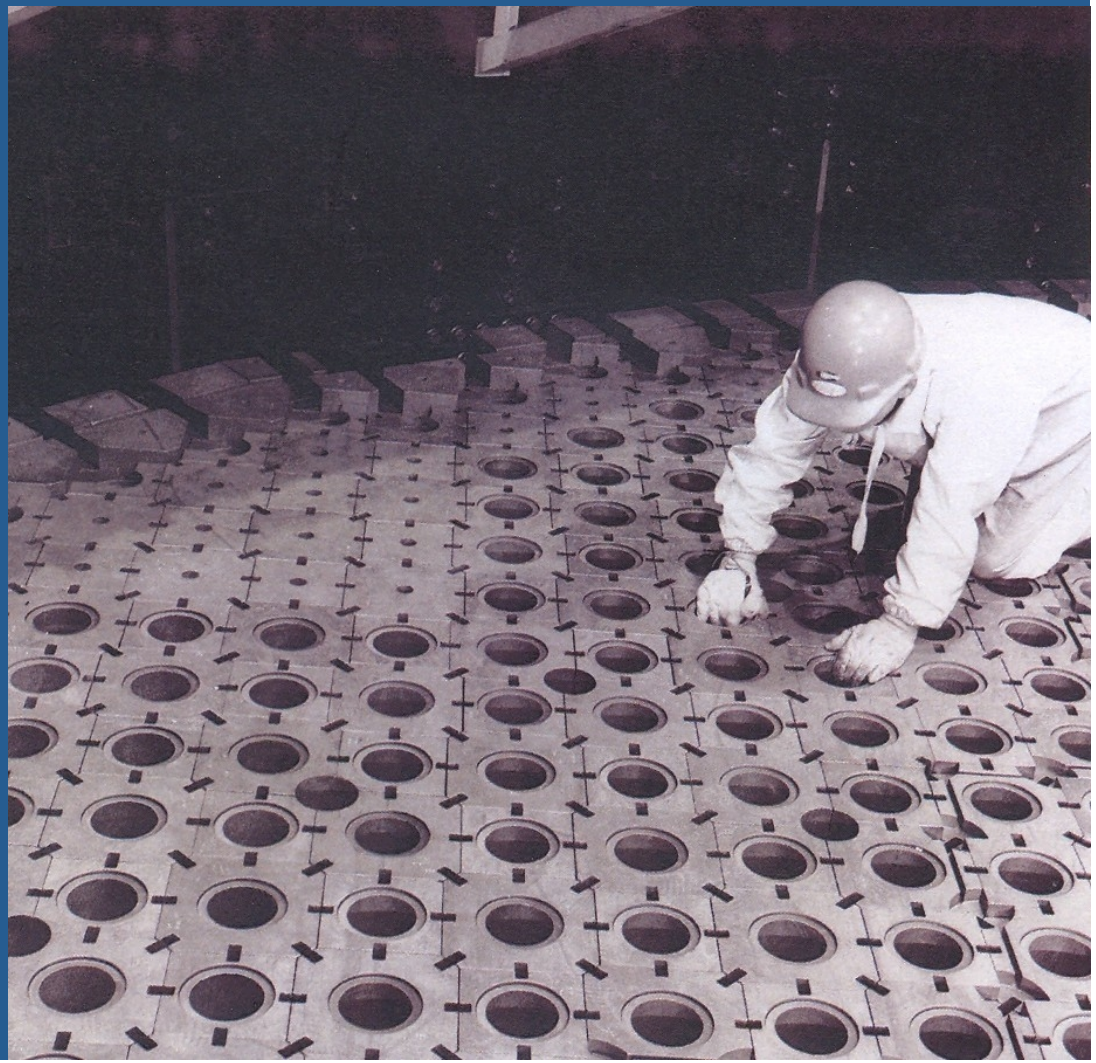
Graphite reactor core

- In addition there are graphite reactor core samples
- Pile Grade A graphite reactor core bricks



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Graphite core

- Measurement scheme made provision for property changes
  - Graphite samples inserted in special reactor core channels were withdrawn for testing at approved intervals
  - Irradiated samples trepanned from individual core bricks
  - A large number of unirradiated samples of graphite representative of the individual reactor cores
  - Measure of properties
    - Physical
    - Chemical
    - Mechanical
  - Up to 40 years of service exposure

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Accessing existing samples

- Access & transfer: on a case-by-case basis
  - Currently via a commercial agreement between the academic institution and the Site Licence Company (not NDA)
  - NDA to authorise transfer from a technical / legal / insurance perspective
- Timescales: 4-6 months is a realistic minimum
  - Currently there is a backlog, so capacity issues may lengthen this
- Costs: Will vary with number, type, location, activity, NIA65 category (nuclear matter / excepted matter / not subject to NIA65) etc.
  - Very rough estimate: "sample(s) retrieval from can" ~£15-20k
- Procedure:
  - Accessible sample list: being worked on by NDA; possibly early/mid 2017
  - No "access forms" at present: use direct email communication

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Next steps

- Following NDA establishing procedures, make specimen lists available
- NNUF funding proposal made for physical irradiated materials archive facility
  - Budget £8M
  - Location TBD
    - Possibly licensed site main store + low-active site transfer facility
  - Proposal was very highly ranked by NNUF and awaits funding decision

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Further information

- Contacts
  - steve.roberts@materials.ox.ac.uk
  - peter.flewitt@bristol.ac.uk
- Website
  - NNUF website: **www.nnuf.ac.uk**