

NGN_{CDT}

Centre for Doctoral Training
Nuclear Energy

Update for Nuclear Academics Meeting
September 9th 2015
Sheffield



www.imperial.ac.uk/nuclearcdt

Bill Lee and Francis Livens
CDT Directors

CDT MSc Teaching Programme 2014/15



Core Subjects

- Introduction to Nuclear Energy
- Nuclear Chemical Engineering
- Nuclear Thermal Hydraulics
- Reactor Physics
- Nuclear Materials for Reactor Systems
- Nuclear Waste Management and Decommissioning
- Modelling for Nuclear Engineers
- Nuclear Safety Management

Short Courses

- Nuclear Energy Policy
- Radiation Protection
- Fast Reactors and Nuclear Hydrogen Production
- Nuclear Fusion
- Nuclear Engineer in Industry
- Nuclear Island Constructionarium

Teaching 67%, Research Project 33%.

CDT MRes Year One Training Programme 2015/16



— Core Subjects – 42%

- Introduction to Nuclear Energy
- Reactor Physics
- Nuclear Materials 1: Materials for Reactor Systems
- Nuclear Materials 2: Nuclear Waste Management and Decommissioning
- Modelling for Nuclear Engineers
- Nuclear Safety Management
- Nuclear Energy Policy
- Nuclear Engineer in Industry

— Research Component – 58%

- Nuclear Energy Research Project

Nuclear Energy

Imperial . Cambridge . Open

CDT → MRes + PhD

CDT(4 years) = MRes(1 year at Imperial) + PhD (3 years at either
Imperial, Cambridge or Open)

Building UK Civil Nuclear Skills for Global Markets

£4M funding from EPSRC (led by Imperial College)

Training 62 PhD students in 5 cohorts

<http://www.imperial.ac.uk/nuclearcdt>

EPSRC

Engineering and Physical Sciences
Research Council

Imperial College
London

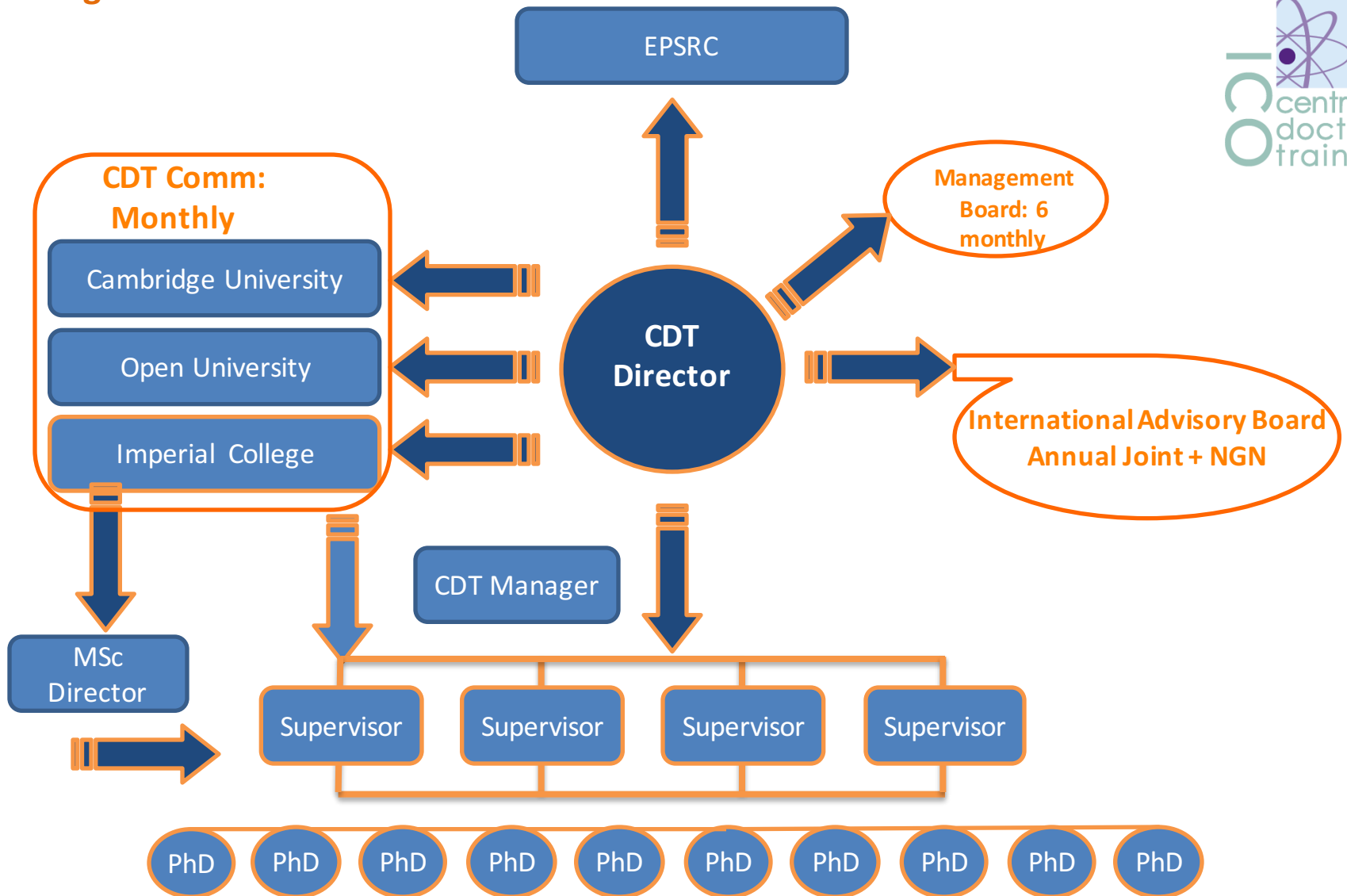


UNIVERSITY OF
CAMBRIDGE



The Open
University

Management Structure



Members drawn from key global players such as Areva and EdF (France), Idaho National Lab and MIT (USA), KAIST (Korea) and Hitachi-GE (Japan).

Strategic, global, input.

Meets: Annually jointly with Manchester led Next Generation Nuclear CDT

First meeting: March 24th 2015 at Imperial preceded by dinner previous evening

Outside Attendees: Mujid Kazimi (MIT USA), John Loughhead (DECC CSA), Fumio Murata (Hitachi, EU office), Terry Todd (INL USA), Luc Van den Durpel (Areva France), Man-Sung Yim (KAIST Korea).

Actions: Discuss possibility of CDT student symposium attached to global conference. CDT academics to meet at next Winter school for SWOT analysis etc. Joint fission/fusion CDT event. Possible joint CDT strategy from NGN/ICO. Next IAB meeting (Easter 2016 in Manchester) to be 2 days including talks by international visitors.

2014 Entry Cohort 1: 9 Students plus 17 associated MSc and 10 associated PhDs

1. **Immobilisation Process for High Dose Spent Absorbent from Fukushima**
 - **Bhaswati Guha** (Bill Lee – ICL, Hitachi-GE, Japan)
2. **The Effect of Hydrogen on the Mechanical Properties in Steel**
 - **William White** (Ben Britton – ICL, AWE)
3. **Atomic Scale Simulation of Fuel-Cladding Interaction**
 - **Alexandros Kenich** (Robin Grimes – ICL, Westinghouse, USA)
4. **Multi-objective Optimization of PWR Reload Cores by Tabu Search**
 - **Mark Mawdsley** (Geoff Parks – Cambridge University)
5. **Use of Thorium-fuelled LWRs to Manage the UK's Plutonium Stockpile**
 - **Sophie Morrison** (Eugene Schwagareus – Cambridge University)
6. **Development of a Multi-objective Optimization Capability for Heterogeneous LWR Fuel Assemblies**
 - **Alan Charles** (Geoff Parks – Cambridge University)
7. **Process Heat Applications of Fusion Energy**
 - **Richard Pearson** (Bill Nuttall/Bartek Glowacki – The Open University)
8. **Residual Stresses in Next Generation Nuclear Power Plant**
 - **Johannes Brokx** (John Bouchard – The Open University)
9. **Future Nuclear Fission Energy Systems and Hydrogen Production**
 - **Andrew Wilson** (Bill Nuttall/Bartek Glowacki – The Open University)

Cohort Building / Extra Curriculum Activities

Winter School

Manchester 6-8 January 2015



Joint Winter School organised by Manchester CDT Next Generation Nuclear and ICO CDT to create a forum for discussion and interaction for all Nuclear CDT students and staff in the UK

NGN_{CDT}

Nuclear Energy Policy Course

Cambridge 13-15 January 2015

Explores energy policy issues facing the future of nuclear energy . Emphasis given to considerations affecting nuclear new build. The main context considered was the UK within the European Union although many lessons will be relevant to other energy markets.



Cohort Building Visits



CONSORT Reactor Centre Visit Silwood Park 16 December 2014

A joint visit for all MSc and CDT students

Institute for Nuclear Research Romania May 18-21 2015



The Institute for Nuclear Research Pitesti was founded in 1971 as a unit of strategic importance, having as field of activity the scientific research, design, technological development and scientific and technical responsibility for the development of nuclear energy in Romania.

The Halden Reactor Norway May 26-28 2015



The Halden Reactor is a 25MW nuclear reactor located in Halden, Norway and dedicated for research. The reactor became operative in 1958, and is operated by the Institute for Energy Technology.



ICO Student Conference in London

15th July 2015

- Student led and organised
- Attended by ~60 academics, government reps and industry partners
- Speakers from across the UK nuclear spectrum
- Hailed a great success by attendees



CDT Research Projects Cohort 2: 2015-2019

Topic	Projects 2015-2019	Institution/Support
Reactor Design, Safety Case Support & Technology Policy	Chris Best: Safety case for BWR cores operating in self-sustainable Th-U233 fuel cycle.	Cambridge/Hitachi
Reactor Thermal Hydraulics	Nathaniel Read: Modelling Thermo Mechanical Reactivity Feedback in Fast Reactors	Cambridge/Hitachi
Reactor Physics, Radiation Shielding and Criticality		
Reactor Materials Manufacture, Performance, Structural Integrity & Ageing	Peilong Dong: Additive manufacturing of metallic components	Imperial/EDF Energy
	Thomas Whiting: Experimental set-up of an irradiation programme for reactor pressure vessel steels at ANSTO	Imperial/RR/ANSTO
	Michael Taylor*: Near Surface Residual Stresses from Manufacturing	OU
Fuel Behaviour and Fuel Cladding Systems	Dhan-Sham Rana: Development of layered zirconium carbide materials for accident tolerant nuclear fuels using element specific spectroscopy	Cambridge/Westinghouse
	Lloyd Jones: Peridynamics Modelling of Oxide Failure on Nuclear Fuel Cladding	Imperial/NNL
Development of Advanced Characterisation Techniques	Giles Rought-Witta: Chemical and Radiolytic ageing of UO ₂ and PuO ₂	Cambridge/AWE
Remote Monitoring in Hazardous Environments		
Nuclear Waste Management		
Geological Disposal, Geomechanics, Geotechnics & Radionuclide Transport	Said El Chamaa: New Routes to Multi-metallic Nano- and Bulk- Materials Containing f-block Elements	Imperial College/NNL
	Elizabeth Yates: An Investigation of He Mobility and Bubble Formation in FCC Metals	Imperial/AWE
Nuclear Security, Safety and Non-proliferation		

EPSRC Centre for Doctoral Training in Nuclear Energy- Next Generation Nuclear

- Partners: Lancaster, Leeds, Liverpool, Manchester and Sheffield Universities

- Students

Cohort 1 (start Sept 2014)- 13 students

Cohort 2 (start Sept 2015)- 22 students

Cohort 3 (start Sept 2016)- 22 students

- Scope

Theme	Lancaster	Leeds	Liverpool	Manchester	Sheffield
Existing operations	Yes	Yes	Yes	Yes	Yes
New nuclear build	Yes		Yes	Yes	Yes
Plant life extension			Yes	Yes	
The fuel cycle	Yes	Yes		Yes	Yes
Advanced reactor technology		Yes		Yes	Yes
Decommissioning & cleanup	Yes	Yes		Yes	Yes
Waste management	Yes	Yes		Yes	Yes
Geological disposal	Yes		Yes	Yes	Yes
Nuclear safety & regulation	Yes	Yes	Yes	Yes	
Safeguards & security	Yes		Yes	Yes	Yes
Public Acceptability			Yes	Yes	Yes

Table 1. NGN research themes, and consortium capability



- Working with other CDTs

Joint Winter School with ICO CDT Jan 2015 and Jan 2016

Joint International Advisory Board with ICO CDT

Joint fission/fusion event with both fission CDTs and the fusion CDT December 2015