Centre for Nuclear Engineering
Newsletter

Aug 2016

Welcome to this edition of the Centre for Nuclear Engineering's (CNE) Newsletter.

The Newsletter contains the latest information on the Centre's activities and achievements.

Issue | 9

Updates

ed.: Jonathan Tate design: Edoardo Giorgi

Changing of the Guard

On 20th June CNE and CDT students and staff past and present gathered in Coco Momos South Kensington to pay their thanks to outgoing Director Prof Bill Lee. Bill, who has been Director of the CNE since 2012 after taking over from the founder Prof Robin Grimes, goes on Sabbatical from 1st July.

After a very enjoyable three-course meal, Bill delivered a short speech pointing out how the CNE had grown and developed over the past four years and affirmed his confidence in the staff and students to take the Centre forward. Dr Mike Bluck, who has been promoted from Deputy-Director to Director of the CNE, then thanked Bill for his hard work and service and proposed a toast, to which the attendees performed with gusto. Dr Luc Vandeperre takes over as Director of the ICO CDT in Nuclear Energy.

Above: Prof Bill Lee's leaving dinner

Below: Dinner thanking students and speakers at the ICO CDT Conference

ICO CDT Student Conference

On Thursday July 7th ICO CDT Cohort 2 students hosted their Nuclear Energy Conference. Representatives from AWE, Atkins, NNL and Radioactive Waste Management were in attendance, complementing a strong turnout from staff and students connected to the CNE and CDT and other universities.

Taking place in the Sir Alexander Fleming Building, the Conference began with a presentation from Cohort 2 Student Nathan Read, who explained the structure and purpose of the CDT and the achievements of his Cohort so far. After a presentation by Cohort 1 CDT students Richard Pearson (Open University) and Will White (Imperial) on their Cohort's research, Prof Gerry Thomas, Chair in Molecular Pathology at Imperial, gave a fascinating lecture on Nuclear Power and Public Health.

After a buffet lunch the lectures continued: Prof Steve Garwood, Professor of Structural Integrity at Imperial, presented on Standards, Innovation and Regulation in Nuclear Components; Dr Trevor Chambers, Head of the Reactor Centre at Silwood Park, on Accelerator-driven Sub-critical Reactors; and Mr Jure Aleksjev, former Advanced Nuclear Engineering MSc student, on Non-destructive Measurement Tools in the Nuclear Industry. The Conference concluded with the speakers and CNE staff hosting a panel discussion. We would like to acknowledge the hard work the students put in organising the Conference: we are sure the skills and experience gained will come in useful for their future careers.

Awards, funding and esteem

Hinckley Point C

EdF Board's recent decision to give the go-ahead to Hinckley Point C, and the UK Government's subsequent decision to postpone its approval to autumn 2016, has encouraged the media to seek opinions from the CNE.

Nuclear materials engineering Lecturer Dr Mark Wenman was quoted in *The Guardian* on Thursday 28th July 2016 as saying that construction would make a significant contribution to securing low-carbon energy generation. His opinion echoed that of Paul Howarth, Chief Executive of NNL, but Hinckley Point C has notable critics such as Green Party MP Caroline Lucas and Greenpeace's Chief Scientist Doug Parr.

Covering a story first published on Imperial's website, on 4th August, *World Nuclear News* also quoted at length CNE academics' opinions. Director Dr Mike Bluck stated nuclear power was an important base-load supporting other intermittent low-carbon technologies, while MSc Advanced Nuclear Engineering Director Dr Ben Britton pointed out that to achieve decarbonisation of the UK's energy mix Hinckley Point C was more feasible than constructing a solar farm equivalent.

CDT Student wins top PG engineering award

Cohort 1 PhD student Sophie Morrison has won an Institute of Engineering (IET) Postgraduate Scholarship for an Outstanding Researcher 2016. The award includes a Scholarship for £10,000, and an invitation to the prestigious IET Achievement Awards Ceremony at the Brewery, London, in November 2016 when Sophie will be presented with her certificate.

On her achievement, Sophie says: "I'm extremely grateful to the IET for this award and to Imperial College and Cambridge for providing me with the opportunity to carry out this research. I'd like to thank BAE Systems who supported me through an apprenticeship and bachelor's degree and the Whitworth Society for their ongoing support. I must also thank my fellow CDT students without whom I would not have achieved this success".

The IET Postgraduate Scholarships promote excellence in engineering research. They provide support for high-quality engineers and encourage them to develop successful academic research careers.

High recognition

Prof Dame Sue Ion recently been elected a Fellow of the Royal Society. Sue is a Visiting Professor at Imperial and teaches on the MSc in Advanced Nuclear Engineering and MRes in Nuclear Energy. Sue has also held important positions in the nuclear field, and is currently the Chair of the Nuclear Innovation Research Advisory Board which advises the UK Government.

Dr Ben Britton has recently won the Engineer Trust's Young Engineer of the Year award. Conferred by the Royal Academy of Engineering, Ben is one of only five recipients and has been awarded a prize of £3,000. The award was made in recognition of his contribution to research on commercially important alloys in harsh environments, including nuclear reactors but also in aero-engines and other energy contexts.

President's Awards

CNE academics have received recognition from Imperial College London's President Prof Alice Gast for their outstanding contribution to the Materials Department and the university as a whole. Prof Robin Grimes, Chief Scientific Advisor to the Foreign and Commonwealth Office, won the President's Award for Excellence in Research Supervision; Dr Luc Vandeperre, Director of the ICO CDT in Nuclear Energy, for Excellence in Pastoral Care; and Prof Mary Ryan, Professor of Materials Science and Nanotechnology, for Excellence in External Engagement and Partnerships

Prof Geoff Hewitt has also been awarded the Imperial College Medal on 4th May. The medal is conferred for meritorious or praiseworthy service to the College or for having otherwise enhanced its reputation, mission or objectives. Geoff, who is Emeritus Professor of Chemical Engineering and sits on the CNE Management Board, is recognised as one of the world's leading authorities on multiphase flow systems.

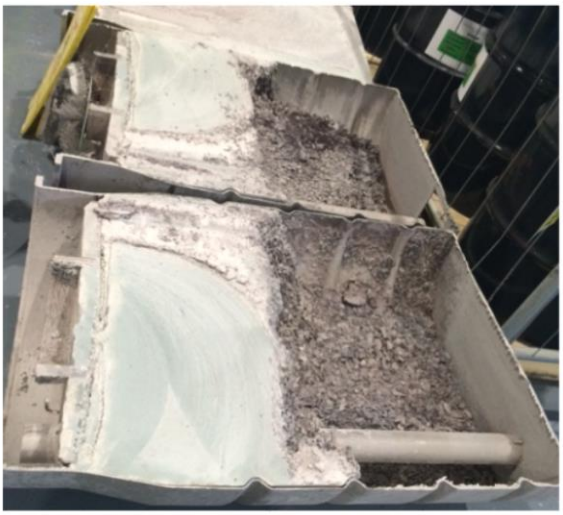
NNL Placement

Over 22nd – 23rd March, MSc Advanced Nuclear Engineering student Yadukrishnan Sasikumar (Yadu) attended a two-day course on 'An Introduction to the Nuclear Industry'. Hosted by the National Nuclear Laboratory (NNL) and the Nuclear Industrial Partnership in Whitehaven, Cumbria, the course was attended by nuclear engineering doctoral and masters' students from universities across the UK, and comprised a series of lectures and a visit to NNL's site in Workington. Yadu offers his thoughts:

As the train screeched its way through Cumbria's, picturesque west coast, it struck me that the journey from London had taken longer than first thought. Eventually I arrived at the residence at Summergrove Halls, sandwiched between the rugged coast on the one side and the beautiful Lake District on the other. According to Dr Ed Butcher, one of NNL's speakers, this location 'has had a long history of housing NNL and Sellafield employees'.

The course began on 22nd March 2016 with a short quiz on nuclear energy. We then moved into the lectures, which covered radiation effects, fuel enrichment and manufacture, and the issues affecting industry's decision over reactor designs and choices. Between lectures, I found the insight and anecdotes of Dr Dominic Rhodes especially interesting. As well as being the academic representative and university co-ordinator at NNL, Dominic also helps obtain uranium samples and is a leading expert in reactor operations and maintenance.

Later in the first day, we visited NNL's Workington site. During the visit we learned more about various methods of rig testing, operator training, design development and 3D modelling and simulation techniques which are currently used by industry. We were also treated to a demonstration of automated robotic arms, similar to those used in car manufacturing, which were developed to handle cladding waste and spent fuel in highly radioactive environments. The first day concluded with NNL researchers hosting a lively Q&A session. So eager were the attendees that the discussions continued through dinner, although it did end up digressing at the bar when we debated the merits of Lego vs. K'Nex!



Above: Dominic Rhodes at the NNL Workington Laboratory

Below: Waste immobilisation through cement encapsulation at Workington

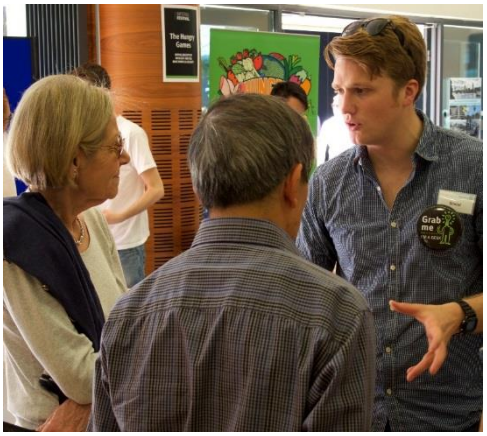
The second and last day began with a lecture entitled 'Waste Management and Geological Disposal'; such issues were expanded upon in the next lecture on 'Public and Stakeholder Perceptions of the Nuclear Industry'. In this latter talk, Dr Adam Qaisar revealed, much to my surprise, how markedly different our perceptions, and those of scientists in general, were to the public's. After lunch we had another lecture on various category 3-5 nuclear accidents, and touched briefly on the 1957 Windscale fire (present-day Sellafield) where we saw exclusive pictures of the Windscale pile core.

The course ended with a brief presentation on NNL facilities, which are open to academics interested in sample testing of active and non-active materials. The National Nuclear User Facility houses one of the world's three Focused Ion Beam (FIB) electronic microscopes, which can handle radioactive materials. There are facilities available also for using X-ray tomography, microscale machining, and Transmission Electron Microscope. If you wish to find out more, please contact Dr Dominic Rhodes at dominic.rhodes@nnl.co.uk or Dr Adam Qaisar at adam.qaisar@nnl.co.uk

As an aspiring PhD student, the course benefitted me as I could network with potential industry supervisors and doctoral students. I definitely recommend the course to other students in the CNE, as it provides an opportunity to make useful industrial contacts and keep updated on current research.

Imperial Festival 2016

Over the sunny weekend 7th-8th May 2016, CNE staff and students participated at the Imperial Festival 2016.



Left: Visitors testing out the Geiger counter and creating stunning visual effects with the uranium glass

Right: PhD student Dimitri Pletser explaining to visitors

Co-ordinated by CNE Manager Emma Warriss, our stand and exhibits attracted significant attention from visitors of all ages. With the theme of the stand being the release and effects of radiation, children enjoyed the opportunity to use a Geiger counter to record radiation from everyday objects, such as bananas and brazil nuts, and use a UV touch on uranium glass and beads in order to see them illuminate a bright green (and rather pretty!) colour. For older visitors, the CNE stand hosted a quiz where participants had to rank in ascending order radiation doses (mSv) absorbed by the human body undertaking common activities, like eating a banana, taking a transatlantic flight or having a chest X-ray. Visitors could also inspect real-life items from a nuclear power plant, such as fuel rods and waste pellets.

We would like to record our thanks to CNE members whose efforts made the stand a success: Dr Mike Bluck, Dr Catrin Davies, Dr Michael Rushton, Dr and receive information on Joy Farnaby, Emma Warriss, Jonathan Tate, Dimitri Pletser, Conor Galvin, Claudia Gasparrini and Antonio Palazzi. The fifth anniversary of Imperial College's ambition to share and inspire the public with its research, Imperial Festival 2016 was the biggest and most varied yet.

Wylfa Newydd Visit

On 26th July former CNE Director and Chair in Ceramic Engineering Prof Bill Lee and Senior Lecturer Dr James Lawrence travelled to Anglesey, Wales, to visit the Wylfa Newydd Nuclear Power station site. Along with other leading nuclear academics, such as Prof Francis Livens of Manchester University, Prof Sian Hope at Bangor University and Dr Paul Norman at Birmingham University, Bill and James toured the site and received technical updates on the progress being made.

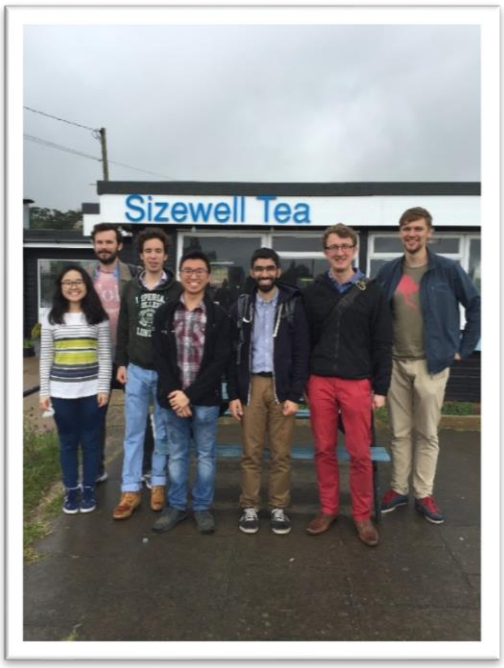
'What really struck me was the scale of it' Bill commented. 'It is a 1,000 acre site, and £1.6 billion has already been spent on preparatory work. They will move the same volume of material to level the site that was taken out of the Channel Tunnel.'

Prof Bill Lee (third from right) and Dr James Lawrence (far left) with colleagues outside the Wylffa site.

Constructed by Horizon Nuclear Power, a subsidiary of Hitachi-GE, Wylfa Newydd Nuclear Power Station is expected to commence operations in the early-mid-2020s. Using two Generation III+ UK Advanced Boiling Water Reactors (UK ABWRs), once operational the station will create over 10,000 jobs and generate 2,700 megawatts of electricity: enough secure, low-carbon energy to power around five million homes for decades to come.

Sizewell B Tour

Accompanied by course director Dr Ben Britton, MSc Advanced Nuclear Engineering students visited Sizewell B Nuclear Power Plant on 2nd August 2016. Built and commissioned between 1987 and 1995 and located on the Suffolk coast, Sizewell B is the UK's only commercial Pressurised Water Reactor (PWR). Student Adomas Lukensas offers his thoughts on the one-day visit:



Above: Dr Ben Britton (second from right) and MSc students (Adomas Lukensas far right)

Below: The unmistakeable big white dome at Sizewell B, as seen from the beach!

The day began very early, as we departed for our destination at 08:30am outside the Royal School of Mines. After a somewhat subdued several-hour journey, at around midday we caught sight of Sizewell B's striking white dome: at that point it dawned on me just how huge the site actually was.

After climbing off of the minibus, we headed for the Visitors' Centre where we were welcomed by EdF Energy, the company that operates the plant. After a security check, Centre staff then gave us mandatory safety instructions, including provision of hard hats, bright jackets and ear defenders, which were required in order to enter certain areas of the site. Afterwards, we were ready for the tour!

One of the first sights we saw was a giant granite sign where the words 'Nuclear safety is our overriding priority' were inscribed. Our tour guides, Lynette Tucker and Debbie Telkman, explained that EdF Energy wished to assure visitors and reminded employees that safety was taken extremely seriously.

After the sign, we entered a huge blue building where the reactor is located. As we walked around, our hosts talked at length about the auxiliary systems built around the reactor in order to ensure safe and consistent operation. We then moved into the diesel generator room, where we listened about implemented safeguards: the talk made us realise that the plant designers must have considered practically every possible incident when constructing emergency safeguards that function no what matter what.

When we saw the main water cooling circuit, I appreciated to an even greater extent the effort and engineering that when into the design of the plant. The hosts told us that around two million litres of water are pumped per minute in and out of the North Sea to ensure sufficient reactor cooling. However, the biggest surprise there was not the scale or engineering that went into the system itself, but the effort in designing and building a system that also ensured the local fish population is unaffected. This, to my mind, really underscored the sustainability of nuclear energy.

In my opinion, the tour reached its pinnacle when we entered the turbine hall. I must admit to feeling overwhelmed by the size of the building and slightly disorientated by the noise coming out of the two steam turbines, which generated up to 3 per cent of the total electricity consumed in Britain. As we walked around it was great to see the turbines, generators and cables in real life rather than just in textbooks.

Our tour finished with a Q&A session hosted by EdF Energy's nuclear safety expert Colin Tucker, who did admirably in answering the questions asked by our cohort, some of which were quite complex! After a brief visit to the beach (please see photo to the left), we returned to the minibus and departed at around 17:00 back to the Royal School of Mines.

CNE Latest Research Outputs

Coupling RELAP5-3D and STAR-CCM+ for Simulations of Steady and Transient Single Phase Flows

Palazza A, Bluck MJ, Lo S and Slijepcevic S
Proceedings of the International Congress on Advancements in Nuclear Power Plants (Apr 2016)

*

The Effect of Prior Cold Work on the Chloride Stress Corrosion Cracking of 304L Austenitic Stainless Steel Under Atmospheric Conditions

Scatigno GG, Ryan MP, Guiliani F and Wenman MR
Materials Science and Engineering: A (2016)

*

Melting Behaviour of $(Th,U)O_2$ and $(Th,Pu)O_2$ Mixed Oxides

Ghosh PS, Kuganathan N, Galvin COT, Arya A,Dey GK, Dutta BK and Grimes RW
Journal of Nuclear Materials (2016)

*

In-situ Digital Image Correlation for Fracture Analysis of Oxides formed in Zirconium Alloys

Platt P, Lunt E, Polatidis E, Wenman MR and Preuss M
Corrosion Science (2016)

*

Synthesis and DFT Investigation of New Bismuth-containing MAX Phases

Horlait D, Middleburgh SC, Chroneos A and Lee WE
Scientific Reports (2016)

*

Synthesis and Characterisation of Alumina Forming Nanolaminated Boride: MoAlB

Kota S, Zapata-Solvas E, Ly A, Elkassabany O, Huon A, Lee WE, Hultman L, May SJ and Barsoum MW

Scientific Reports (2016)

*

Synthesis and Oxidation Testing of MAX Phases in the Cr-Ti-Al-C Quaternary System

Horlait D, Grasso S, Chroneos A and Lee WE

Journal of the American Ceramics Society (2016)

Contact Details

Dr Mike Bluck
Director
020 7594 7156
m.bluck@imperial.ac.uk

Dr T Ben Britton
Course Director MSc Adv. Nuclear Engineering
020 7594 2634
b.britton@imperial.ac.uk

Dr Jonathan Tate
Administrator
020 594 6802
j.tate@imperial.ac.uk

Miss Emma Warriss
Manager
020 7594 9916
e.warriss@imperial.ac.uk