

MANCHESTER  
1824

The University of Manchester  
Dalton Nuclear Institute

10 YEARS

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DALTON

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2005 - 2015

NUCLEAR

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INSTITUTE

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A DECADE OF DRIVING NUCLEAR R&D FORWARD

When John Dalton presented his atomic theory to the Manchester Literary and Philosophical Society in 1803 he had little idea of the impact his work would have on our future society. That, for example, an understanding of the structure of the atom would eventually pave the way for the development of what is now an increasingly important energy source for the UK, which currently produces one fifth of our electricity. Or that a world-leading centre for nuclear research and skills development, bearing his name, would be established more than 200 years later, in the same city where he had made this presentation, with its own state-of-the-art research facility located in West Cumbria, near to his birthplace in Eaglesfield.

Our heritage

# It starts with inspiration

The University of Manchester has a rich heritage in nuclear research. This dates back to John Dalton's links with the Manchester Mechanics Institute and the advances made by other notable nuclear scientists, including Ernest Rutherford, Niels Bohr, James Chadwick and John Cockcroft, in other early institutions that collectively established the groundwork for the University as we know it today. Building on the foundations laid by these early pioneers, nuclear activities were thriving in the north west of England by the mid 20th century. The first nuclear sites were selected in 1946, and subsequently in 1956 the world's very first commercial nuclear reactor at Calder Hall in Cumbria came into service.

Several decades later, the arrival of the new millennium brought with it two key collaborative ventures which paved the way for an idea that soon became known as 'Project Dalton'. First in 1999 the Centre for Radiochemistry Research (CRR) was founded in a University Research Alliance (URA) with British Nuclear Fuels Limited (BNFL); to be followed shortly thereafter by a further URA with BNFL, the Materials Performance Centre (MPC), in 2002.

These achievements and the ongoing commitment of the University to furthering nuclear research and development culminated in the founding of Dalton Nuclear Institute in 2005. It was created to harness the strength of The University of Manchester's nuclear capabilities and its proven interdisciplinary and collaborative approach, which would soon establish the Institute as a major driving force in the field of nuclear research and higher learning.

Since the University's leaders first had the foresight to draw together and provide a focus for nuclear science and technology research more than a decade ago, our work has become more

vital than ever. A renaissance in nuclear power generation has resulted in the need for substantial research and development (R&D) being recognised at the highest levels of government, leading to the publication of the UK's Nuclear Industrial Strategy and R&D roadmap in 2013. This established R&D and skills development as cornerstones of a strategy to fully realise the positive economic impact of the nuclear sector for the UK, with The University of Manchester's Dalton Nuclear Institute, alongside other academic institutions and our partners, playing a substantial part in its delivery.

When the Institute was launched our goal was to provide a strategic focus in order to address nuclear research and skills challenges with a constant eye on future needs. Ten years on, it's time to celebrate what has been achieved so far and reflect on our key successes along the way to becoming the most advanced and best connected academic nuclear research centre in the UK. The following highlights showcase a selection of our accomplishments to date.



Whitworth Building, The University of Manchester



“Prof Richard Clegg and I had initial discussions about bringing together the research from Manchester’s existing centres of excellence to form a nuclear research centre...which eventually became Dalton Nuclear Institute.”

**Prof Paul O’Brien**

“Prof Richard Clegg and I had initial discussions about bringing together the research from Manchester’s existing centres of excellence to form a nuclear research centre, which had the proposed name of the ‘National Centre for Nuclear Science and Technology’ and which eventually became Dalton Nuclear Institute.

“The University of Manchester got ahead of the wave by founding this Institute, which is now well established and stands out as being unique in the UK.

“One of its biggest contributions has been the level of public influence it has achieved, particularly through Prof Andrew Sherry. Around the time of the Fukushima incident Andrew was frequently featured in the media, which helped a great deal in putting Dalton firmly on the map.”

# Laying the foundations

## Early origins

A tremendous amount of planning, hard work and determination was invested into bringing Dalton Nuclear Institute to fruition; the vision and blueprint were developed over three years before it finally became a reality.

Instrumental to this were several key individuals at the University, including: Prof Sir Martin Harris CBE, the then Vice-Chancellor of the Victoria University of Manchester; Prof John Garside CBE, the then Vice-Chancellor of UMIST; Prof Alan Gilbert, the first Vice-Chancellor of the new combined University of Manchester; and Prof John Durell, Interim Dean of the Faculty of Engineering and Physical Sciences during the merger of the two universities. The valuable contributions made by these leaders, as well as others, have helped to make The University of Manchester a world leader in nuclear energy research and skills development.

The idea  
becomes  
reality



MANCHESTER  
1824

The University of Manchester  
Dalton Nuclear Institute

**2005** Dalton Nuclear Institute established

We begin our ten-year story with the launch of Dalton Nuclear Institute in 2005, the culmination of many months of preliminary work, proposals and planning. Our aim from the start was to take a leading role in co-ordinating nuclear science and engineering research across the UK, and to play an active part in international collaborations.

#### Launch in London and Manchester

The Royal Academy of Engineering in London was the venue of our launch in July 2005, followed by a celebration held in Manchester. Here, the objectives were laid out: to become the central hub for all nuclear research and higher learning at The University of Manchester and to act as a bridge to other international world-class research organisations.

Today we have the most advanced academic nuclear research capability in the UK, and provide the knowledge needed to help deliver a sustainable low carbon future through nuclear energy. Our extensive world-class facilities and collaborative links drive innovation across the entire nuclear fuel cycle.

Under the direction of the Institute's founding Managing Director, Richard Clegg, initial projects were brought to life. Dalton Nuclear Institute was the motivating force behind the formation of the Nuclear Technology Education Consortium in 2005. It was particularly rewarding that this initial development focused closely on one of our main aims: training for the nuclear sector.

2005 NTEC launched

# From our first Director to a new concept in training



Prof Francis Livens



"Dalton Nuclear Institute was ahead of its time. It had foresight, and not only put itself at the centre of a growing agenda but probably helped shape it."

Prof Richard Clegg

## £1m funding to transform postgraduate knowledge

A stand-alone grant made it possible to establish the Nuclear Technology Education Consortium (NTEC) and provide flexible postgraduate training for the nuclear sector.

Co-ordinated by The University of Manchester in partnership with 11 UK universities and higher education institutions, the consortium contains over 90% of the country's nuclear postgraduate teaching expertise. The structure and content of the courses it offers grew from extensive consultations with the UK nuclear sector; including industry, regulators, the Nuclear Decommissioning Authority, Cogent Sector Skills Council, the Ministry of Defence and other government departments.

Today NTEC provides a breadth of training which meets the UK's projected skills requirements across varied areas of specialism from decommissioning and clean-up through to reactor technology and environment and safety.

"The Institute was set up back when the general vision surrounding nuclear power was solely focused on decommissioning. It was before the renaissance of nuclear power generation and before talk of an impending nuclear skills crisis had started. Dalton Nuclear Institute was ahead of its time. It had foresight, and not only put itself at the centre of a growing agenda but probably helped shape it.

"My personal highlight from my time here stems right back to around 2002/03. I introduced the idea that after the merger of the Victoria University of Manchester and UMIST, their respective Centre for Radiochemistry Research and Materials Performance Centre could be used as a springboard to build Manchester into a world-leading nuclear university.

"The project was code-named 'Project Dalton' because it coincided with the 200th anniversary of John Dalton presenting his thoughts on atomic structure to the Manchester Literary and Philosophical Society. In these early days 'Project Dalton' kept going through force of personality and perseverance. That same commitment saw it finally come to fruition as the world-leading research institute it is today."

We continued to add to our training portfolio in 2006. An engineering doctorate in nuclear engineering coupled with NTEC's new distance learning capability permitted even more students and professionals to develop their skills and knowledge.

2006 Nuclear EngD launched · NTEC distance learning commenced

## Further developments to boost knowledge

### Launch of the Nuclear EngD programme

The primary focus of our Nuclear EngD programme, launched in 2006, was to develop the outstanding young research engineers of today into future leaders in the nuclear industry. Thanks to an intensive, broad-based training experience delivered in collaboration with nuclear companies, students could focus on real-world industry-based research topics while also developing the wide range of skills that senior industry roles demand.

### NTEC distance learning

After the establishment of NTEC in 2005, we further developed our training so that a postgraduate-level master's degree in Nuclear Science and Technology could be delivered in a distance learning format as well as directly taught. Accredited by the Institution of Engineering and Technology (IET), the Institution of Mechanical Engineers (IMechE), the Energy Institute (EI) and the Institute of Materials, Minerals and Mining (IOM3), the course benefits from international recognition within the nuclear power industry.

# Initial work on establishing a state-of-the-art research facility

2007 Establishing Dalton Cumbrian Facility



The University's Dalton Cumbrian Facility



Students working at the Dalton Cumbrian Facility



Under the leadership of the influential academic figures heading up the Institute at the time, preliminary work on our Dalton Cumbrian Facility (DCF) was undertaken during 2007 to pave the way for a capability that would be unique in the UK and Europe.

## Dalton Cumbrian Facility comes to life

The joint £20m investment with the Nuclear Decommissioning Authority to establish DCF would in a few years' time provide a home for two new research groups, Radiation Science and Nuclear Engineering Decommissioning, and deliver academic access to the National Nuclear Laboratory's Central Laboratory. At this stage, planning permission for the facility had been received and procurement of the building and equipment was about to begin.



"We are a top-table nuclear nation and The University of Manchester's Dalton Nuclear Institute helps to underpin that position."

Prof Paul Howarth

"Dalton Nuclear Institute is now nationally and internationally recognised as a leading centre of excellence in academic nuclear R&D. To see Manchester take the initiative and invest in building the Institute was fantastic.

"What really stands out for me is taking the Duke of York around the Institute. He approached us having heard about it. I took him through the history of nuclear research at Manchester which involved Rutherford, Bragg, Bohr and others. They worked here because Manchester had committed to build capability: people, facilities and programmes. A hundred years later it felt as though Manchester was repeating this through establishing the Dalton Nuclear Institute, in particular its Dalton Cumbrian Facility, because the world-leading research is being done where the industry is based, namely Sellafield. Now we are a top-table nuclear nation and The University of Manchester's Dalton Nuclear Institute helps to underpin that position."

# A royal visit and new doctoral training centre

2009 DTC founded • Royal visitor



Student working in the Geomicrobiology Lab



“Dalton Nuclear Institute is an outstanding example of how the fundamental purposes of a university can be discharged...for the benefit of the individual, the institution and society as a whole.”

**Prof Colin Bailey**

“The University of Manchester’s Dalton Nuclear Institute has enabled a significant and positive change to the national and international nuclear landscape. It is also an outstanding example of how the fundamental purposes of a university can be discharged effectively in a critically important sector for the benefit of the individual, the institution and society as a whole.

“The Institute is strategically important to the UK, international partners and industry, in working across three primary areas: the development of a skilled workforce, research and development and socio-economic benefits. It has played a leading role in engaging strategically with nuclear companies in the UK and overseas to help realise the economic benefit of nuclear through skills development, research collaboration and technology transfer.”



Research at the Henry Moseley X-ray Imaging Facility

In 2009 The University of Manchester, in collaboration with the University of Sheffield, led a successful bid to the Engineering and Physical Sciences Research Council (EPSRC) to establish a £7.3m Doctoral Training Centre (DTC) in Nuclear Fission Research, Science and Technology (Nuclear FiRST). Our profile was also growing and attracted a knowledgeable royal visitor.

## The Duke of York comes to Manchester

On 10 March, His Royal Highness the Duke of York visited Dalton Nuclear Institute to hear about the ambitions of The University of Manchester in nuclear research and education and to take a tour of its research laboratories. During the visit the Duke demonstrated an interest in the area through some astute observations and challenging questions.

## A £7.3m Doctoral Training Centre

The Nuclear FiRST DTC was founded to give postgraduate students high quality training that would help them achieve international scientific leadership in nuclear energy. The programme involves world-leading nuclear science and engineering research groups. Its strong links to UK industry means students can choose to work with industry or regulators during their research project.

The programme’s four-year interdisciplinary PhD is a radically different approach to study. The course offers students not only a foundation in academic nuclear research, but a wealth of industry insights, experience, support for secondments to overseas laboratories, and opportunities to present results at international conferences, thus building a valuable network.

The Nuclear FiRST DTC has since been superseded by the Next Generation Nuclear (NGN) CDT, which started in 2014.



# RESEARCH

Our research expertise supports the competitive growth of the UK nuclear industry through innovation. Collaborating with industry and academia, we bring together world-leading experts across disciplines and give them access to some of the most extensive and advanced nuclear research facilities in Europe. The result is an unrivalled depth and breadth of fundamental and applied research focused on today and on the future.

The nuclear landscape continues to evolve. There are several proposed future reactor designs for the UK and worldwide interest in small modular reactors, plus the continuing operations of the present-day UK nuclear fleet and the legacy clean-up work of the Nuclear Decommissioning Authority. Current issues include ever-increasing energy demand, challenging carbon emission targets and the need for a secure supply of safe, cost-effective power. We address the whole spectrum of these challenges through our research across the nuclear fuel cycle.

Future concerns are important to address, as new nuclear power stations will have an essential role in delivering our increasing energy needs. Our New Nuclear Manufacturing (NNUMAN) programme focuses on new build and future reactor design research needs.

## Case study - the NNUMAN programme

*The £8m NNUMAN programme was set up to develop R&D capabilities that support a robust supply chain for civil nuclear power to meet UK and global energy needs well into the future.*

*Managed by The University of Manchester's Dalton Nuclear Institute, and supported by the Nuclear AMRC at the University of Sheffield, the NNUMAN programme delivers the scientific underpinning of advanced manufacturing for the next generation of power stations. Research is focused on the development of innovative manufacturing methods to increase cost efficiency and reduce production times, delivering competitive advantage to the UK supply chain in pursuit of both global and local business opportunities.*

*There are four key areas where research can help manufacturers evolve their processes or adopt new techniques that lower costs and/or enhance the safety, longevity and performance of their products. Briefly, these are: new ways of joining components, advanced machining and surfacing, near-net shape and engineered structures and product performance.*

*The next generation of nuclear manufacturing scientists and engineers are enjoying the benefit of high-level academic and technical support, world-class facilities and strong links to industry.*

# Adding to our strengths through collaboration

In 2009 our work was growing and evolving with a new Director at the helm. Not only did we become part of the new management team of the National Nuclear Laboratory (NNL), but we also collaborated with the University of Sheffield to form the Nuclear Advanced Manufacturing Research Centre, and partnered with Rolls-Royce to create the Rolls-Royce University Technology Centre at Manchester.



National Nuclear Laboratory's Central Laboratory

Machining equipment at Nuclear AMRC



2009 SBM consortium · Nuclear AMRC collaboration

## Our role as part of a new management consortium

Along with Serco and Battelle Memorial Institute, The University of Manchester's Dalton Nuclear Institute became part of NNL's new 'SBM' management consortium in 2009.

Now government-owned and operated, NNL is a nuclear services technology provider which focuses on waste management and decommissioning, fuel cycle solutions and reactor operations support. Dalton Nuclear Institute works alongside NNL as partners in important initiatives such as the UK's Nuclear Fuel Centre of Excellence (NFCE), National Nuclear User Facility (NNUF) and Innovus, a UK technology business development programme. Our combined capability expands across expertise, facilities and research.

## Nuclear AMRC collaboration announced

In 2009 a collaboration between the Universities of Sheffield and Manchester, forming the Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC), was officially announced. Nuclear AMRC was established to develop new manufacturing techniques and technologies to meet the demands of the new generation of nuclear power stations. Founding members included AREVA, Westinghouse, Rolls-Royce, Sheffield Forgemasters and Tata Steel Europe.

The University of Manchester provides extensive proof of concept manufacturing, component testing and analytical research facilities in a world-class environment dedicated to breaking new ground in manufacturing processes and systems – the Manufacturing Technology Research Laboratory. The laboratory's unique combination of equipment addresses materials-based issues from micro to macro scale, with £8m having been invested in its expansion following the announcement of the Nuclear AMRC collaboration.



“The University is about generating new knowledge through research and new skills through education. Academic and industrial partnerships should continue to strengthen the delivery of both for the good of society.”

**Prof Andrew Sherry**

“The University of Manchester has created an internationally-renowned centre of academic excellence in the UK for nuclear science and engineering. This has helped to shape the UK landscape in nuclear research and skills, influencing the development and the delivery of the UK’s Nuclear Industrial Strategy.

“Looking ahead, the University is about generating new knowledge through research and new skills through education. Academic and industrial partnerships with Manchester’s Dalton Nuclear Institute should continue to strengthen the delivery of both for the good of society. With its leading nuclear capability, Dalton Nuclear Institute is in a position to positively influence the wider UK landscape by showing leadership in building strong collaborations within the UK and on the international stage.”



Titan G2 ChemiSTEM electron microscope

**2010** Rolls-Royce UTC established

### Rolls-Royce University Technology Centre (UTC)

The Rolls-Royce UTC was designed to underpin the science and engineering requirements of Rolls-Royce in nuclear, and help develop the next generation of nuclear scientists and engineers needed by industry.

Facilitating a skills exchange between the University and Rolls-Royce, the UTC provides industry with high-quality research expertise at the cutting edge of technology and offers the University’s academic partners real-world challenges for their research. This currently focuses on material properties, modelling of processes in the nuclear plant, as well as safety and reliability with applications in both civil nuclear power and submarines.

From L-R: Prof Colin Bailey, Rolls-Royce’s Colin Smith, Prof Dame Nancy Rothwell and Prof Tim Abram at the Rolls-Royce UTC launch



# Two important launches, high praise

In 2011 we continued to gather speed. The new Centre for Nuclear Energy Technology helped place the region at the forefront of reactor fuels and nuclear fuels technology, while the ground-breaking Research Centre for Radwaste & Decommissioning opened up further collaboration opportunities. We also learned that Dalton Nuclear Institute would be recognised with a Queen's Anniversary Prize, an outstanding honour for all our academic and support staff, researchers and students.

The Queen's Anniversary Prize certificate



2011 C-NET established · RCRD launched · Queen's Anniversary Prize announced

## Launch of the Centre for Nuclear Energy Technology (C-NET)

Benefitting from a joint investment between The University of Manchester and the former Northwest Regional Development Agency (NWDA), C-NET was established in 2009 as a centre of excellence for the nuclear energy sector in the north west. With a focus on new nuclear manufacturing and the longer-term development of future reactors, C-NET helps expand knowledge, skills and capabilities in science and engineering to address the future needs of the industry.

As Prof Andrew Sherry said at the time of the launch: "We now have the largest single university-focused expertise and some very exciting new research facilities. The fact that we have a number of industrial partners linked in to the nuclear programme at Manchester shows that the programmes being developed here, the people here, and the facilities here really are the best in the UK."

## Launch of Research Centre for Radwaste and Decommissioning (RCRD)

Launched in November 2011, RCRD's work focuses on the geosphere/biosphere, engineering and materials aspects of nuclear waste disposal and nuclear decommissioning as the UK seeks safe, long-term solutions for handling our complex nuclear legacy.

From research into safe storage and disposal to studying the effects of decommissioning existing nuclear power stations and other installations containing radioactive contamination, academics and their collaborators continue to embark on numerous significant projects in this field, including leading the NERC Biogeochemical Gradients and Radionuclide Transport (BIGRAD) programme.

## Queen's Anniversary Prize announced

In November 2011 The University of Manchester's Dalton Nuclear Institute was announced as a winner of a Queen's Anniversary Prize for Higher and Further Education, the UK's most prestigious form of national recognition open to a UK academic or vocational institution. The Institute was recognised for its "internationally renowned research and skills training for the nuclear industry", acknowledging the support it provides to government, regulators and industry, and its training and outreach activities for undergraduate and postgraduate students, professionals and schools. The winning entries ranged from individual departments or research groups to major international development projects, community schemes and cutting-edge research. It was even more memorable for us to receive this award during the year of the Diamond Jubilee.



# SKILLS

From comprehensive academic courses to tailored industrial education, our programmes are designed to educate the next generation of nuclear scientists and engineers and meet the needs of industry. These programmes encompass undergraduate teaching, postgraduate research and continuing professional development (CPD) and include courses that are internationally recognised and unique in concept and format.

## Case study - Nuclear Technology Education Consortium (NTEC) Masters Degree

*Much of our training is facilitated by the Nuclear Technology Education Consortium (NTEC), a hub of postgraduate learning for the nuclear sector. With a curriculum formulated through consultation with industry, it's the means by which students and professionals alike can discover the latest thinking and develop useful skills.*

*This NTEC course meets the UK's projected nuclear skills requirements in reactor technology, decommissioning and clean-up, and is designed to create the next generation of nuclear engineers and scientists. The course is aimed at postgraduate students and industry professionals.*

*Taught by leading academics and industrial specialists, the course is flexible, offers additional qualifications and continuing professional development (CPD) and is designed in tandem with industry to ensure that students develop skills that are immediately transferable to the real world.*

*NTEC comprises the Universities of Birmingham, Central Lancashire, Lancaster, Leeds, Liverpool, Manchester and Sheffield, City University London, Imperial College London and the Nuclear Department of the Defence Academy. Together they represent more than 90% of the nuclear postgraduate teaching expertise based in the UK's universities and research institutes.*

*Reflecting the needs of today's students, who may be looking for full-time, part-time or distance learning, NTEC offers courses in a variety of formats.*

*Directly-taught subjects are presented in 'short course' format suitable for engineers and managers in full-time employment.*

*Additionally ten modules are available in distance learning format. Each module contains the same syllabus and outcomes as its directly-taught counterpart, and is delivered once a year at a fixed time via a 'virtual classroom'.*

# Further launches and celebrations

With a ceremony to mark our Queen's Anniversary Prize, plus the start of the New Nuclear Manufacturing (NNUMAN) programme and a ground-breaking £1.2m centre to develop nuclear decontamination technologies, 2012 proved to be a year of recognition as well as achievement.



2012 Queen's Anniversary Prize ceremony and celebrations · NNUMAN launched · Decontamination centre set up

## Queen's Anniversary Prize ceremony

Her Majesty The Queen presented academics from The University of Manchester with the Queen's Anniversary Prize in recognition of the quality of Dalton Nuclear Institute's work in the nuclear field at a ceremony held at Buckingham Palace. The prizes, awarded every two years, celebrate outstanding work which is making a real and practical impact for the benefit of human progress.

Prof Dame Nancy Rothwell, President and Vice-Chancellor of The University of Manchester, and Prof Andrew Sherry, then Director of the University's Dalton Nuclear Institute, accepted the award. Prof Sherry said: "The prize comes at a time when the UK is developing its nuclear research agenda and, as a world-leading institution, The University of Manchester is committed to playing its part to help shape and deliver this agenda to benefit the UK."

## NNUMAN programme launched

A joint project led by The University of Manchester with support from the University of Sheffield, the £8m New Nuclear Manufacturing (NNUMAN) programme was awarded £4m by the Engineering and Physical Sciences Research Centre (EPSRC) to research innovative high-productivity manufacturing techniques for the future of the UK's nuclear power supply.

Addressing a House of Lords concern about insufficient research and development into nuclear energy, the programme acts as a research engine for manufacturing in order to drive progress and step-change technologies. It prototypes structural component developments via the Nuclear AMRC and nuclear fuel innovations through the Nuclear Fuel Centre of Excellence in partnership with NNL, facilitating a route to market.

Through this multi-disciplinary programme, the next generation of nuclear manufacturing scientists and engineers benefit from the highest level of academic and technical support, world-class facilities and strong links to industry.

## New centre to develop nuclear decontamination technologies

To support Sellafield Ltd's Decontamination and Effluent Treatment Centres of Expertise the University established a £1.2m centre in November 2012 for research into decontamination technologies and the treatment of nuclear waste.

The Decontamination and Effluent Treatment Centre focuses its research and development on decommissioning activities and aims to create new technologies, enhance understanding of existing ones and develop effective and sustainable decontamination approaches. It builds on research programmes at the University's Centre for Radiochemistry Research (CRR) and the Research Centre for Radwaste and Decommissioning (RCRD).

Prof Francis Livens, from the University's School of Chemistry, said at its launch: "This centre is an opportunity for the University to enhance its nuclear research and to strengthen its links with a vital part of the nuclear industry."

## Celebrating the Queen's Anniversary Prize at the House of Commons

Following the award of our Queen's Anniversary Prize earlier in the year, and a celebratory event held at The University of Manchester in May, a collection of industry leaders, government officials and academics attended a celebration at the House of Commons in June 2012 hosted by The Rt Hon the Lord Jenkin of Roding.



Prof Dame Nancy Rothwell and Prof Andrew Sherry meeting The Queen and The Duke of Edinburgh

# New programmes, new facilities and £multi-million projects



Innovus event

Winning pupils from St Benedicts School at the Innovus launch



2013 Innovus launched

The year featured a string of innovations, from a programme that commercialises great ideas to the appointment of our first Co-Director. 2013 also saw the official opening of our world-class Dalton Cumbrian Facility, while some major funding awards enabled an even greater focus on developing a range of new technologies.

## Innovus - connecting bright ideas with market need

Innovus, launched in Cumbria in February 2013, is a business development programme which takes ideas in the field of technology and turns them into a commercial success. The programme connects 'bright ideas' with 'real needs' in the marketplace and, as importantly, provides support through the lifecycle. Thanks to Innovus, innovators can enjoy connections to market demand, access to world-class facilities, funding, technical skills and business support through key delivery partners, The University of Manchester and the National Nuclear Laboratory.

At the launch Kevin Warren, Director of Operations and Sustainability at The University of Manchester's Dalton Cumbrian Facility said: "Innovus has evolved from a shared belief at the University and NNL that Cumbria has a unique research and development capability and the opportunity to harness technology as a driver for significant economic growth. I was particularly pleased with the number of school and university students at the launch, as they will be the innovators of the future and will be able to access more high-tech opportunities in Cumbria as a result of Innovus."



2013 KTPs and R&D projects funded · DCF officially opened



Prof John Perkins and Prof Paul Howarth at the DCF launch event

### £Multi-million boost for nuclear research

Business Secretary Vince Cable's announcement of some major new funding awards was exceptional news for The University of Manchester's Dalton Nuclear Institute and the UK's nuclear industry as a whole.

The Institute was awarded three Knowledge Transfer Partnerships (KTPs) worth £500k and four large-scale R&D projects with a total value of £6m. The funding is now supporting the development of new technologies for the construction, operation and decommissioning of nuclear power plant.

At the announcement, Prof Andrew Sherry, then Director of Dalton Nuclear Institute said: "We're looking forward to working collaboratively with our nuclear industry partners and SMEs on the development of innovative technologies which will have a real impact for the UK in current operations of the existing reactor fleet, decommissioning and waste management."

### Launch of the Dalton Cumbrian Facility

The Rt Hon the Lord Hutton of Furness officially announced the opening of The University of Manchester's Dalton Cumbrian Facility (DCF) on 6 September 2013.

DCF, a state-of-the-art user facility for nuclear research and development, was established with an initial £20m joint investment by the University and the Nuclear Decommissioning Authority (NDA). The facility, now an integral part of the UK's National Nuclear User Facility (NNUF) alongside the National Nuclear Laboratory (NNL) and the Culham Centre for Fusion Energy (CCFE), complements and significantly expands the research and education capability of the UK's nuclear R&D sector. Overall it delivers world-leading nuclear research and the transfer of knowledge to industry.

DCF's research environment features detailed computer modelling capability and large-scale experimental laboratories, including extensive irradiation facilities and associated analytical and inspection equipment. DCF has pioneered unique academic access to NNL's extensive R&D and engineering facilities at their Central Laboratory - vital to full lifecycle development and the deployment of innovative technologies.



"This is the biggest co-ordinated nuclear academic R&D centre in the UK."

Prof Melissa Denecke

"Possibly the biggest contribution that Dalton Nuclear Institute has made over the last ten years has been to establish a high profile in industry, with governments and collaborators around the world. That and the Institute's size make it stand out: this is the biggest co-ordinated nuclear academic R&D centre in the UK.

"The achievements of our experts help to leverage crucial funding. It's funding of that nature which underpins my personal highlight, which is the opening of the Dalton Cumbrian Facility in 2013.

"It's a fascinating sector to be part of, and one that will continue to grow in importance both in the UK and on the global stage."



# IMPACT

In terms of influence and reach, we're uniquely placed to have a positive and beneficial impact on the wider world. We frequently engage with audiences and multiple stakeholder groups in the nuclear energy sector, both in the UK and worldwide. In our various collaborations we're a hub for R&D facilities and advice.

Our experts act as consultants, providing fundamental and applied research for companies across the full fuel cycle. We also work with industry to train and educate its workforce and take part in strategic partnerships with government, industry and other universities.

The public will always be a vital stakeholder in the nuclear energy programme. We invest in schools and community outreach, attending events, such as The Big Bang UK Young Scientists and Engineers Fair and providing inspiring educational activities.

## Case study - Public Understanding of Nuclear Energy (PUNE)

*In July 2014 a subgroup of the Nuclear Industry Council, chaired by Prof Andrew Sherry, then Director of The University of Manchester's Dalton Nuclear Institute, published 'In the Public Eye: Nuclear Energy*

*and Society' to explain the importance of public engagement and understanding of nuclear energy as a major source of power in the future.*

*The report found that there is broad political support for nuclear power as part of an energy mix that will underpin our future low carbon economy. The industry itself is thriving and multi-faceted, from proposed new nuclear power stations to delivering fuel cycle services. R&D is recognised as key to better securing all parts of the sector, and the UK has high calibre scientific and technical expertise to help ensure that nuclear energy remains a competitive source of low carbon energy.*

*Beyond this, however, there is evidence that while the public feel relatively well-informed about renewable energy, they are not so well placed when it comes to nuclear power. Just over 25% state that the risks outweigh the benefits, and safety and impact on health are frequent concerns.*

*It's clearly essential that we engage the public in the transformation of the UK energy system. This is echoed by the UK's Nuclear Industrial Strategy, which includes an action for the Nuclear Industry Council to "work with universities, research institutes and others on programmes that improve understanding of radiation and how it is used in society and managed within the nuclear industry."*

*The Nuclear Industry Council recognises that many organisations are already contributing to the public's understanding of nuclear via various outreach initiatives and events. As a key academic institution contributing to the industry, our experts are perhaps best equipped to explain nuclear science and technology to a range of audiences and so our long-term commitment to public education is vital. We should continue our joint efforts with the nuclear industry, government and skills bodies to ensure that the public feel informed and reassured about nuclear energy through open, transparent and two-way dialogue.*

For more information on our impact and engagement activities visit our website: [www.dalton.manchester.ac.uk/impact](http://www.dalton.manchester.ac.uk/impact)

# One year, three major accomplishments

2014 IOM3 Gold Award · Nuclear-PDP commenced · NFCE launched

During 2014 we enjoyed highlights on three fronts. We began planning the infrastructure of a new centre of excellence, we launched Europe's first full management-focused course for nuclear technology and engineering, and we were honoured by IOM3 for our research and innovation.

## Awarded the Gold Medal by IOM3

The University of Manchester's Dalton Nuclear Institute was awarded the Gold Medal by the Institute of Materials, Minerals and Mining (IOM3) in July 2014. It was in recognition of our lead in the development of academic research and innovation in the field of advanced materials and manufacturing for the nuclear sector and our specific contribution to nuclear plant life extension, decommissioning and waste management projects.

Prof Andrew Sherry receives the Gold Medal for Dalton Nuclear Institute



A tour of the NFCE equipment at The University of Manchester



Sir Mark Walport speaking at the NFCE launch event

## Launch of Nuclear-PDP

October 2014 saw the launch of Europe's first full management-focused course for nuclear technology and engineering, specifically designed to meet the changes and challenges of a growing nuclear economy. The initial cohort for the Nuclear Technology Management Professional Development Programme (Nuclear-PDP) was made up of 15 industry professionals from Amec Foster Wheeler, Costain, EDF Energy and the National Nuclear Laboratory. This part-time programme allows study to be fitted in around participants' work life via distance learning, face-to-face lectures, tutorials and laboratory sessions delivered by academics and nuclear industry practitioners. The course's Steering Group is made up of industrial representatives from across the nuclear sector, with modules including 'Decommissioning Nuclear Facilities' and 'Nuclear Power Plant Management'.

Nuclear-PDP draws on our extensive links with the nuclear industry and the Nuclear Technology Education Consortium, coupled with our wide range of nuclear facilities, to provide unparalleled flexibility in meeting industry's needs for continuing professional development.

## Nuclear Fuel Centre of Excellence (NFCE) launch

Following the 2013 announcement by Energy and Business Minister Michael Fallon of a joint £8m award to The University of Manchester and the National Nuclear Laboratory (NNL) to establish a Nuclear Fuel Centre of Excellence (NFCE), Sir Mark Walport, Chief Scientific Adviser to HM Government, officially launched the new centre at an event in October 2014.

NFCE is a unique academic research capability dedicated to a technology that is key to the UK's future energy security. Providing the equipment and expertise to develop advanced nuclear fuels with enhanced safety and economic benefits for new reactor systems, the centre will play a leading role in the optimisation of current fuel designs. Crucially, it will also provide an important skills pipeline from academia to the commercial nuclear sector.

Together with partners NNL, we are working to grow the infrastructure for the NFCE to support a new Generation III+ fleet, small modular reactors and ultimately Generation IV fast reactor systems. As importantly, the NFCE's facilities will mean that students can experience working with real fuel destined for nuclear power plant.

# Collaborations

The partnerships and connections we've made over the last ten years have been fundamental to what we've achieved. Included here are many of our main collaborators, from government to other universities to industry partners.

Canada  
USA

## Industrial and Governmental

Amec Foster Wheeler  
AREVA  
Australian Nuclear Science and  
Technology Organisation (ANSTO)  
Battelle Memorial Institute  
BIS  
CEA  
China Nuclear Power Technology Research Institute  
Culham Centre for Fusion Energy (CCFE)  
DECC  
EDF  
Electric Power Research Institute (EPRI)  
European Union  
Hitachi-GE  
International Nuclear Academy  
Korea Atomic Energy Research Institute (KAERI)  
Magnox  
MOD  
National Nuclear Laboratory (NNL)  
Nuclear AMRC  
Nuclear Decommissioning Authority (NDA)  
Radioactive Waste Management Ltd (RWM)  
Rolls-Royce  
Sellafield Ltd  
Swedish Nuclear Fuel and Waste Management Company (SKB)  
TWI (The Welding Institute)  
US DoE National Labs  
Welsh Government  
Westinghouse/Springfields Fuels Ltd

Norway  
UK  
France  
Sweden  
Germany

## Research and Skills Development

Advanced Metallic Systems CDT  
British Geological Survey (BGS)  
Champion  
Defence Academy  
Diamond Light Source  
EPSRC Geowaste  
Innovate UK  
International Atomic Energy Agency (IAEA)  
National Skills Academy for Nuclear (NSAN)  
NERC BIGRAD Consortium  
NERC LO-RISE Consortium  
Next Generation Nuclear CDT  
NNUMAN  
NTEC MSc  
Nuclear EngD  
Nuclear FiRST DTC  
Nuclear-PDP  
NUGENIA  
PACIFIC  
Research Councils UK  
Resource Efficiency KTN  
Scottish Universities Environmental Research Council  
US DoE NEUP

## Academic

Birmingham University  
Bristol University  
Cambridge University  
Chalmers University of Technology  
City College London  
City University London  
Cranfield University  
Delft University of Technology  
Edinburgh University  
Glasgow University  
Huddersfield University  
Imperial College London  
Instituttt for energiteknikk  
Karlsruhe Institute of Technology  
Lancaster University  
Leeds University  
Liverpool University  
Loughborough University  
Newcastle University  
Open University  
Oxford University  
Queens University Canada  
Sheffield University  
Southampton University  
Strathclyde University  
Surrey University  
Tsinghua University  
UHI Millennium Institute  
University College London  
University of Central Lancashire  
University of Michigan  
University of Notre Dame (Indiana)  
University of Western Australia  
Warwick University  
York University

China  
India  
South Korea  
Japan

Australia



"As the UK's major nuclear projects gather momentum, the Institute will be seen as an essential part of the nuclear landscape."

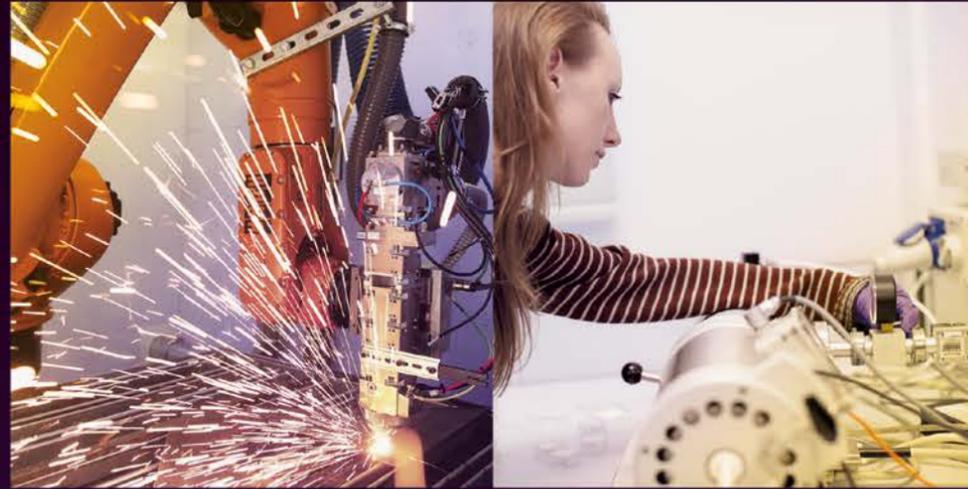
Prof Francis Livens

"The Dalton Nuclear Institute covers the whole nuclear fuel cycle, has the ability to work across discipline boundaries and collaborates inside and outside Manchester. Over the last ten years it has put together a coherent whole from the research groups and centres which already existed, and taken a strategic view on further development, in order to provide an integrated approach to nuclear fuel.

"Speaking personally, it has given me the chance to work with all sorts of interesting people, including some really interesting collaborations beyond physical science and engineering. Looking ahead, as the UK's major nuclear projects – whether new build, decommissioning or geological disposal – gain momentum, the Institute will be seen as an essential part of the nuclear landscape.

"If you want a challenging and exciting career, nuclear is the place to be. It is more vibrant than at any time in the last 30 years, and I am jealous of the opportunities there are for you."

Prof Francis Livens was appointed Interim Director of Dalton Nuclear Institute from January 2015 following the departure of Prof Andrew Sherry at the end of 2014.



# FACILITIES

The University of Manchester has established a comprehensive range of specialist laboratories and facilities to drive fundamental and industry-focused nuclear research across the full fuel cycle.

The **Dalton Cumbrian Facility (DCF)** is a state-of-the-art nuclear research complex where academia and industry from all over the world can collaborate on research in the fields of Radiation Science and Nuclear Engineering Decommissioning.

An £8m laboratory expansion has created a new world-class research facility in our **Manufacturing Technology Research Laboratory**. It is dedicated to providing scientific research that underpins improvements to manufacturing processes and systems.

Through the **Nuclear Fuel Centre of Excellence** we are building an advanced R&D capability within existing facilities. It will support the UK in becoming a world leader in fuel technology and grow UK talent with specialisms in the nuclear fuel field.

## Our research facilities include:

Dalton Cumbrian Facility  
 Active Graphite Laboratories  
 Advanced Microstructural Characterisation Equipment  
 Analytical Laboratory  
 Corrosion Facilities  
 Electron Optics  
 Henry Moseley X-ray Imaging Facility  
 High Temperature Laboratory

Manufacturing Technology Research Laboratory  
 Mechanical Testing Facilities  
 Nuclear Fuel Technology Research Laboratories  
 Nuclear Physics Facilities  
 Radiochemistry Laboratory  
 Radionuclide Biogeochemistry Suite  
 Thermal Hydraulics Research Laboratory  
 Tomography Centre

# A future of exploration

## Looking forward

For ten years we have been working collaboratively to lead the way in the full cycle of nuclear research, higher learning and engagement to secure nuclear energy for future generations. This review has highlighted not only our efforts and successes, but those of numerous partners, collaborators and individuals who have contributed over the past decade. Our thanks to all of you.

As we move through the second decade of the 21st century we're in the early stages of an energy revolution. Nuclear power is enjoying a period of revival worldwide as countries around the globe strive to meet the increasing energy needs of their growing economies while decreasing their greenhouse gas emissions. With the need for an immense and dependable flow of electrical energy every moment of the day, the UK nuclear industry has a guaranteed and exciting future. Remarkable research is being undertaken on new generations of reactors which will be safer, operate for longer and generate less waste than older designs. Significant progress is also being made in the treating and disposing of nuclear waste products. As a key contributor to this thriving sector we will continue to build on the work we've achieved so far. There are many ways that you could be involved and share the continuing journey with us.

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**10** YEARS  
2005-2015  
**DALTON**  
NUCLEAR  
**INSTITUTE**

2005 - 2015

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