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Annual Report and Accounts 2018/19

United Kingdom Atomic Energy Authority Annual Report and Accounts 2018/19



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2018/19

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Chair's Statement

I am deeply honoured to become the Chairman of the UK Atomic Energy Authority (UKAEA). I am not a plasma physicist or nuclear engineer but trained as a civil engineer and economist. I am a university and business leader with experience in advising governments on policies for science, research and innovation. My capabilities come from working on large infrastructure projects, innovation strategies in technology firms, and developing start-ups from deep science.

As Ian Chapman, our Chief Executive, so clearly states, the world's climate is at a tipping point. The current trajectory of industrial development has destroyed much of the natural environment, polluted the atmosphere and caused many damaging social and economic changes. The world needs a new, safe and clean source of energy. The science of fusion has shown that this is possible. We need to turn this science into technology that can be deployed around the world as soon as we can. That mission is what excited me to join the extraordinary team at the UKAEA. My aim is to use my experience of helping organisations create conditions for their success, developing new ventures from

science and engineering, and work with the exceptional people at the UKAEA to progress towards our goal.

There are many exciting opportunities to be pursued on the journey to fusion power and we have a key role to play in helping the government to realise its Industrial Strategy ambitions. The UKAEA is a centre of excellence in robotics and autonomous control systems for working in challenging environments. Its work in this area is growing rapidly with the potential to improve safety, efficiency, productivity and accuracy in many other industries. Our work on new materials and development of the UK's fusion technology and design capability is also expanding rapidly. There will be many prospects for new applications, new ventures and other commercial opportunities in these areas.

The UKAEA has a highly capable Board and I would like to thank them for their dedication and service over the past year. In particular, we are very grateful to Professor Roger Cashmore, the outgoing Chair, who served in this role for eight years, overseeing a number of major strategic investments and growth in capabilities,

including the UK's flagship fusion device, MAST-U. We also thank Dr Jim Hutchins for his thoughtful guidance and insights, particularly in developing the business case for RACE, the new robotics centre. Jim's term of office on the Board was completed this year and he has continued to provide important expert strategic advice.

Diversity and inclusion are crucial for a vibrant organisation and I am impressed with the actions UKAEA is taking to recruit and to establish a diverse and inclusive workforce.

We have an outstanding Executive team and our talented employees are among the finest scientists, engineers, professional and support staff working in any major research organisation in the world. They are creating the future and the Board will provide all the support we can for them to succeed.

Professor David Gann, CBE
Chair
9 July 2019

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Performance Report Overview

Chief Executive's Statement

The image opposite is undeniably a strange image to choose to begin the UKAEA accounts. However, to me, this image sums up what we do. In the last couple of years, we have seen unprecedented global temperatures and devastating forest fires. Yet, as the image shows, people have a remarkable ability to renormalize what is acceptable. As T.S. Eliot put it, "humankind cannot bear very much reality". Our planet is telling us that we must address climate change. And this is why fusion is more important now than ever before. Fusion offers the promise of carbon-free, clean, inexhaustible, baseload, high energy-density power. We must make it a reality, if not for us, then for our children. My children are in their first decade – they will need carbon-free power.



Eagle Creek forest Fire, September 2017

I feel we may look back and remember 2018/19 as a seminal year as we pursue our mission to deliver fusion power and drive economic growth for the UK. When I became CEO, UKAEA turned over £105M, and two years later we turned over £134M, with a budget of £202M agreed for 2019/20. This growth has only been possible thanks to the brilliance and dedication of our staff. I count myself extremely fortunate to represent some of the best people in the world, and I really mean the world. Of our scientific staff, half were born outside the UK, but all are proud to represent UKAEA. This is the sign of a world class organisation, attracting the brightest and the best, from around the world. This year UKAEA has grown 17% and recruited over 200 new people, with at least 43% of the applicants for jobs with UKAEA from multi-ethnic backgrounds or from outside the UK despite Brexit uncertainty. We are growing, revolutionising, and delivering for our clean energy future and for UK prosperity. We are front and centre of the UK's industrial strategy, delivering two-thirds of the government's commitments within the Nuclear Sector deal and catalysing UK jobs and £100M's of revenue for UK companies in fusion, as well as in adjacent sectors utilising technology developed for fusion.

Three years ago, EU income typically represented 60% of our revenue. This year it was 50% and next year it will be around 40% due to the growth in other areas (the EU income is presently increasing). Whilst we are diversifying and improving our robustness to volatility, JET remains the world's leading fusion device, and operating JET is the most significant part of our operations. I am delighted that in March 2019 we secured an extension to the JET operation contract at least until the end of 2020. This extension is notable, not least since it is worth more than €100M, but more so as a direct bilateral contract between the European Commission and the UK without mention of Brexit. This shows how science transcends borders and transcends politics – the world needs carbon-free energy and the world needs JET.

JET is now back into operation after a long period of upgrades to prepare for tritium operation. We still have work to do to be ready for full power fusion experiments towards the end of 2020, but the buzz has returned to the control room. We have also completed the assembly of MAST Upgrade. In October 2018, the Duke of Cambridge visited to inaugurate MAST-U and initiate the very first low-temperature plasma in our

new machine. MAST Upgrade is unique globally. It will test a novel way to exhaust heat from fusion reactors, which is one of the most important technical challenges for a machine which is confining a fuel at 100 million degrees.

Mid-2016 marked a significant change for UKAEA. While the referendum on EU membership brought uncertainty, we were able to embark on a highly necessary programme for the development of the Culham site. We opened RACE (our robotics centre) and MRF (our materials research facility) and both go from strength to strength, not only providing unique capabilities for fusion, but are supporting neighbouring markets for the benefit of UK industry. Three years later both buildings are full and both have secured further investment for extensions. RACE is now the largest nuclear robotics lab in Europe and has tripled in size. In 2018/19, we broke ground on four new buildings, with more due to begin in 2019/20. We have also been granted approval by government to develop our Culham Science Centre to support UK industry working in fusion and adjacent sectors, aiming to nucleate a world-leading fusion cluster. There are approaching 2,500 people working in 50 companies

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on our site, and we can now look forward to supporting even more adjacent tenants to help us achieve our mission and them achieve theirs.

Last year we secured investment in two new facilities: a Hydrogen-3 Advanced Technology (H3AT) centre and Fusion Technology Facility (FTF). We are going full steam ahead to specify and design these new facilities, both due to open in 2021/22, with interim facilities already operational. This year we have agreed to site part of FTF in Yorkshire, as the first step towards a wider geographic presence of the UKAEA. This will place us nearer to the epicentre of manufacturing expertise in the UK as well as providing access to another pipeline of talent as we continue to expand. Talking of opening the pipeline of talent, we remain deeply committed to improving the diversity and inclusion of the organisation, and I was delighted that we secured a renewal of our Athena SWAN Bronze award this year and we now have a 4-year plan to achieve a Silver award.

Ultimately our mission statement aims at the delivery of fusion power on a commercial basis. We remain a major participant in the EU-wide programme to design an early demonstration tokamak reactor (based on the JET/ITER approach), DEMO. This work over the past five years has produced the world's most detailed fusion reactor study, aiming to be ready for a pre-conceptual design review next year. In parallel, we have begun working towards an alternative, smaller and cheaper reactor design, the Spherical Tokamak for Energy Production (STEP). The UK helped to invent the Spherical Tokamak (ST), and built the first ST, we are a world-leading authority in ST physics. With MAST-U poised to tackle a key question for the future of ST reactors, namely whether we can exhaust the intense heat loads in a compact machine, we are proposing an ambitious programme to deliver fusion electricity from STEP. The Chancellor of the Exchequer announced preliminary support for this programme, with £20M allocated in the October 2018 budget – probably the first time that fusion has ever been mentioned in a House of Commons budget speech!

I am deeply proud of what we have achieved this year. It has not all been smooth sailing, as the organisation grows rapidly we are suffering some growing pains. We have spent the whole reporting period about 10% short of the requisite personnel resources due to a lag between securing new income and recruiting high quality people, so project delivery has not always been perfect. We had hoped that both MAST-U and JET would be operating earlier than now. But our people have pulled out all the stops to get there as soon as possible. On JET, we worked 24/7 for the first time ever as we conditioned the heating systems to get back to operation as quickly as possible. On MAST-U we successfully tracked down an elusive but significant vacuum leak. We overcame these setbacks as a team and together we have brought both machines into commissioning after long shutdowns.

Within the executive team, Martin Cox has partially retired and Catherine Pridham has moved on, whilst Tim Bestwick and Antonia Jenkinson have joined us. Martin and Catherine were incredible members of my leadership team, but in Tim and Antonia we have brilliant new leaders bringing broad experiences yet sharing the passion to deliver clean fusion energy.

I cannot complete my remarks without mentioning Brexit. This year, the UK government have reiterated many times that their policy is to seek an association agreement to the Euratom Research and Training programme. For instance, the Prime Minister said "The UK would like the option to fully associate ourselves with ... Euratom R&D. Of course, such an association would involve an appropriate UK financial contribution, which we would willingly make". Such an association agreement would effectively leave the UK's fusion programme unperturbed. In the meantime, the support and collaboration of our European partners has been unswerving. This year has seen the largest investment from EUROfusion in the UK programme ever, with over €13M secured through competitive programmes for the UK.

The government's commitment to fusion was evidenced by the visit of two Ministers for Universities and Science to Culham this year. Sam Gyimah, MP told staff that "There are a number of sectors where Britain is poised to lead the world. Firstly, in the sector of fusion technology", whilst his successor, Chris Skidmore MP, said "I'm especially glad that the government has committed to double down on our ambition when it comes to nuclear fusion, committing £20 million to begin developing a new UK based Nuclear Fusion reactor, STEP."

At a recent climate change event I was asked, nay implored, by a young girl, "when will we have the fusion power we need?". I replied by quoting Lev Artsimovich, a forefather of fusion research: "Fusion power will be ready when humankind needs it". As I look at this image of humankind oblivious to the fire, I can't help but feel the world needs fusion more than ever. I am proud that UKAEA is focussed squarely on delivering fusion as quickly as possible, whilst upholding the scientific and engineering excellence needed to overcome the technical challenges.

Professor Ian Chapman
Chief Executive and Accounting Officer
9 July 2019



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Purpose

The United Kingdom Atomic Energy Authority's (UKAEA's) principal mission is to lead the commercial development of fusion power and related technology and position the UK as a leader in sustainable nuclear energy. This is encapsulated by five goals:

- Goal 1 - Maintain the UK's position as a world leader in fusion research & development (R&D)**
- Goal 2 - Enable economic growth & new high-tech jobs in UK industry**
- Goal 3 - Grow the UK's nuclear technology capability**
- Goal 4 - Design the first fusion power plants**
- Goal 5 - Develop Harwell and Culham sites as Science and Innovation Centres**

UKAEA has been successfully undertaking nuclear research for 65 years since being established by the UK government in the 1954 Energy Act. It is a Non-Departmental Public Body (NDPB), under the Department for Business, Energy and Industrial Strategy (BEIS).

UKAEA activities are centred around the following operational areas:

- **Culham Centre for Fusion Energy (CCFE)** – the UK's national fusion laboratory, which operates the Joint European Torus (JET), the world's largest fusion facility on behalf of the European Commission, is developing the Mega Amp Spherical Tokamak Upgrade (MAST-U), the UK's new flagship fusion device, and leads the UK's fusion research programme.
- **Remote Applications in Challenging Environments (RACE)** – developing robotics and applied artificial intelligence (AI) technology for fusion and other challenging environments.
- **Materials Research Facility (MRF)** – researching materials for nuclear reactors of the future. MRF is part of the National Nuclear Users Facilities (NNUF) and the Henry Royce Institute for Advanced Materials.
- **Fusion Technology Facility (FTF)** – expanding UKAEA's capability to develop and test components for fusion power plants.
- **Hydrogen-3 Advanced Technology (H3AT)** – expanding UKAEA's tritium capability to create a world leading centre for the fusion fuel cycle.
- **STEP** – a new programme from 2019 to develop fusion reactor designs based on a spherical tokamak as a route to a more compact reactor, with reduced capital cost.
- **Oxfordshire Advance Skills (OAS)** – providing high-quality apprenticeship training for high-technology industries.

Key Challenges

External factors beyond the UKAEA's immediate control continue to influence the risk landscape. The UK's plan to exit the European Union and Euratom agreements has continued to create uncertainty within the fusion community although the Government has made clear its intention to retain the closest possible association. An extension of the JET Operation Contract to the end of 2020 with the European Commission has been signed and is independent of whether the Withdrawal Agreement is signed by the UK or not. This along with UK Government's commitment to keep JET operational until the end of its useful life are all positive indicators of the importance of the JET experiment and continued collaboration with UK researchers, companies, and institutions.

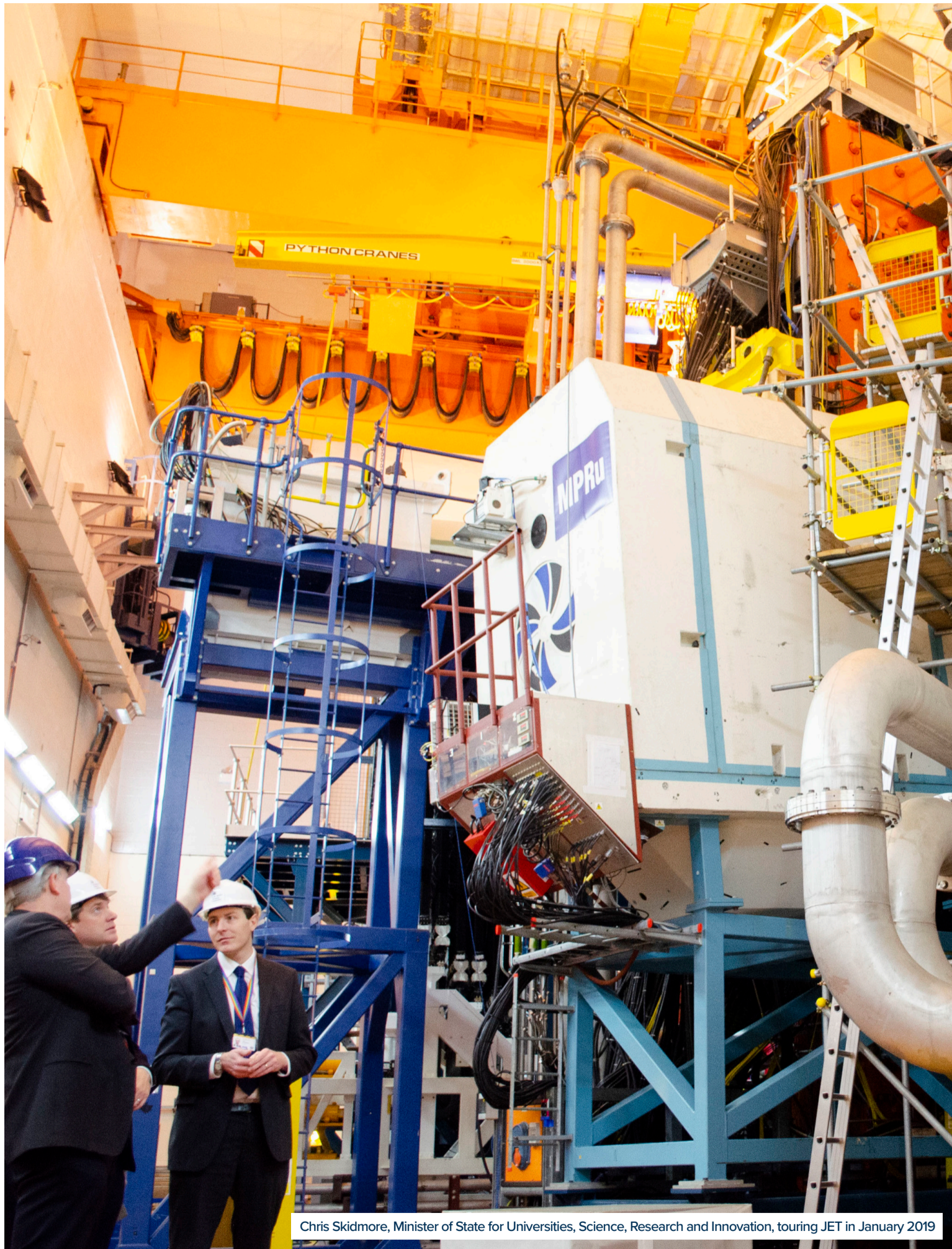
Attracting and maintaining specialist expertise in the organisation as it continues to grow is one of UKAEA's highest risks. Recruitment and retention of people with scarcity skills where there are national shortages and competition in a local area with exceptionally high employment and cost of living remains challenging. The uncertainty created by the EU exit plans is also impacting resourcing strategies. Despite these challenges UKAEA has been successful in significantly growing the organisation over the year with further growth planned in the coming year.

Ageing infrastructure at Culham combined with expansion is putting an increasing strain on the organisation. Investment in new facilities and extensive engineering improvement and enhancement to older facilities such as JET have been undertaken during the year. An asset management project has been set up and further major investments in infrastructure are planned in the coming years.

The UKAEA has secured major government funding including the Industrial Strategy Challenge Fund for the National Fusion Technology Platform and for the first year of STEP. Delivery to schedule on both of these major new programmes is very challenging and the cutting-edge design and engineering work creates inherent technical risks.

UKAEA continues to manage risks and opportunities, proactively utilising mature risk management processes. These are assessed in accordance with the appetite for risk agreed by the Board and, where reasonably practicable, effective mitigations are put in place if threats exist. Further information on the management and governance of risk is provided in the Governance Statement.





Chris Skidmore, Minister of State for Universities, Science, Research and Innovation, touring JET in January 2019

Performance Summary

Recent achievements against the corporate goals include:

- Goal 1** The Duke of Cambridge initiated a plasma on the recently completed MAST-U fusion device and UKAEA's contract to host JET was extended.
- Goal 2** Robotics & AI collaborations have grown to encompass 100 industrial partners and 13 universities. OAS apprentice numbers have grown to nearly 80 from 16 local organisations.
- Goal 3** The Henry Royce Institute funded £2m of new equipment for MRF. Design and procurement for the £86m FTF and H3AT projects progressed in parallel with interim facilities being set up.
- Goal 4** UKAEA was awarded £20m from government to undertake the first year of the new STEP programme in 2019/20.
- Goal 5** Construction of a new office building, autonomous vehicle testing pit lane and sports pavilion were completed at Culham. OAS is under construction ready for September 2019 intake.

The outturn against the corporate performance measures is summarised in table 1. Safety performance was strong during the year with zero RIDDOR reportable injuries or occurrences. UKAEA was awarded the gold award by the Royal Society for the Prevention of Accidents (RoSPA). However, completion of audit actions remains an area for improvement.

The scientific and engineering performance measures were met, with the exception of JET operation where several technical faults resulted in a lengthy shutdown to resolve the problems.

Turnover for RACE and MRF both increased (11% and 56%, respectively) compared with last year, although slightly more support was required than was originally budgeted for these growing new businesses.

There was good performance across all the enabling measures with particular highlights being the success with recruitment and to promote Equality, Inclusivity and Equality (EDI), including submission to retain Athena SWAN Bronze and activities arranged by the inclusion ambassadors.

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Performance Report Overview

Table 1 – Outturn against the corporate performance measures

Performance Measures	Goal	Target	Outturn
Safety & Quality Measures			
Delivery the safety metrics	1-5	Individual targets	Met 7 out of 10 metrics
Complete audit actions on time	1	Individual targets	Missed target for red action, but met targets for amber and green actions
Scientific and Engineering Measures			
Deliver the UK Fusion Programme milestones agreed with Engineering & physical Sciences Research Council (EPSRC)	1, 3, 4	70-100%	Met - 26 out of 31 (84%) milestones achieved on time
Deliver the JET Operations milestone targets agreed with the European Commission	1	70-100%	Missed - 17 out of 31 (55%) milestones achieved on time
Deliver the MAST-U milestones	1, 3, 4	70-100%	Met - 7 out of 9 (78%) milestones achieved on time
Deliver the National Fusion Technology programme milestones	2, 3, 4	70-100%	Met - 9 out of 10 (90%) milestones achieved on time
Technical Growth Measures			
Achieve income target and operating balance (loss) for RACE	1-5	Budget figures	Met the income target, but missed the operating loss.
Achieve the income and profit target for technical consultancy work	1-5	Budget figures	Missed the budget targets
Achieve the income and profit target for technical consultancy work	2, 3	Budget figures	Met the profit target, but missed the income target
Enablers			
Achieve the Culham site development targets	1-5	Individual targets	Met all 3 metrics
Achieve the operating profit targets from commercial property management at Culham	5	Budget figures	Exceeded the upper target
Deliver the capability metrics	1-4	Individual targets	Met 4 out of 5 metrics
Deliver the Equality, Inclusivity and Equality (EDI) measures	1-5	Individual targets	Met all 4 metrics

More detail on specific activities and achievements during the year are provided in the Performance Analysis.

Performance Report Performance Analysis

Tokamak Science Programme

The tokamak science programme explores routes to improving the performance of existing and future tokamaks through conducting experiments, guided and supported by theory and modelling. The programme is structured to concentrate on the following key issues for the successful operation of ITER and future reactors:

- Developing integrated operating scenarios that optimise fusion performance, carrying out world-leading integrated modelling in support of JET and ITER;
- Optimising the performance of the pressure pedestal at the edge of the confined plasma - the interface between the burning core and exhaust region;
- Studying fast particles, heating and current drive to maximise plasma heating and avoid or minimise instabilities;
- Exploring innovative solutions to safely handle heat and particles; and
- Maximising plasma stability and controllability.

In 2020, JET will execute globally unique experiments with both Deuterium (D) and Tritium (T) fuels envisaged in ITER and beyond, which are expected to yield new insights into plasma performance and stability in the presence of fusion reactions and mixed fuel species. In preparation for these experiments, a key objective of JET operations in 2019 will concern the development of high-performance plasmas for implementation in the D-T phase in 2020. Achieving high performance requires satisfying a delicate balance between good confinement of fuel and energy in the plasma centre, whilst allowing impurities (such as helium fusion ash) to be expelled from the core and protecting the wall from excessive heat loads.

UKAEA scientists have key leading roles in the preparation of such high-performance plasmas, holding 9 out of 23 leadership positions. These experiments will be guided by world-leading integrated modelling simulations that include aspects of plasma confinement, heating and exhaust, to interpret the observations from experiments and explore routes to high performance.

The fuel isotope composition of fusion plasmas has a significant impact on performance, especially in the region that acts as the interface between the core and exhaust regions known as the pedestal. The pedestal has been observed in experiments to form when the applied auxiliary heating power exceeds a threshold. A defining characteristic of the pedestal is the presence of a steep gradient in the plasma pressure, which leads to improved fusion performance but can lead to instabilities, called Edge-Localised Modes (ELMs), that expel heat and particles to the wall. Work progressed on the development of predictive models, including Europed, which is being developed with support from EUROfusion to predict the characteristics of pedestals in reactor-scale devices that will require both high performance and small or no ELMs.

The strong auxiliary heating used in current tokamak experiments gives rise to a significant population of energetic particles, through the injection of high energy particle beams, microwaves and radiofrequency waves into the plasma. Understanding how they are transported through the plasma and the instabilities they can excite is required in order to maximise the heating power and fusion performance and reduce power loads to the wall if some of these particles are lost to the wall. A state-of-the-art model, HALO has been developed,

using graphics processors to perform extremely rapid calculations, to predict the redistribution and loss of energetic particles in high-performance JET plasmas. Further extensions to HALO are under development with support from EUROfusion to predict the influence of a wide spectrum of instabilities on plasma heating and wall loads in JET, ITER and future devices.

In 2019, MAST Upgrade will start operations to explore solutions to one of the most significant challenges facing the development of fusion energy, plasma exhaust. The magnetic field that provides good confinement of the core plasma concentrates the heat and particles exhausted from the core into a thin layer, typically mm-cm wide, which intersects the walls of the device. This strong concentration of the exhaust power is predicted to lead to heat fluxes to the wall far in excess of the limits of existing power handling techniques. Experiments on MAST Upgrade will study how to maximise the dissipation of the plasma energy in the exhaust region before it reaches the wall, whilst maintaining good fusion performance. The width of the exhaust plasma is governed by turbulence and other processes, requiring detailed numerical simulations in a 3D computational domain in realistic geometry. The STORM module has been developed in close collaboration with the University of York and benchmarked against data from MAST experiments, which were found to be generally in good agreement. Studies are under way to predict the power loads in MAST Upgrade, and the efficacy of techniques to minimise them through dissipating the plasma energy via radiation, which is critical for ITER, DEMO and STEP power plants.

The stability and highest achievable performance of tokamak plasmas is governed by limits that are well described

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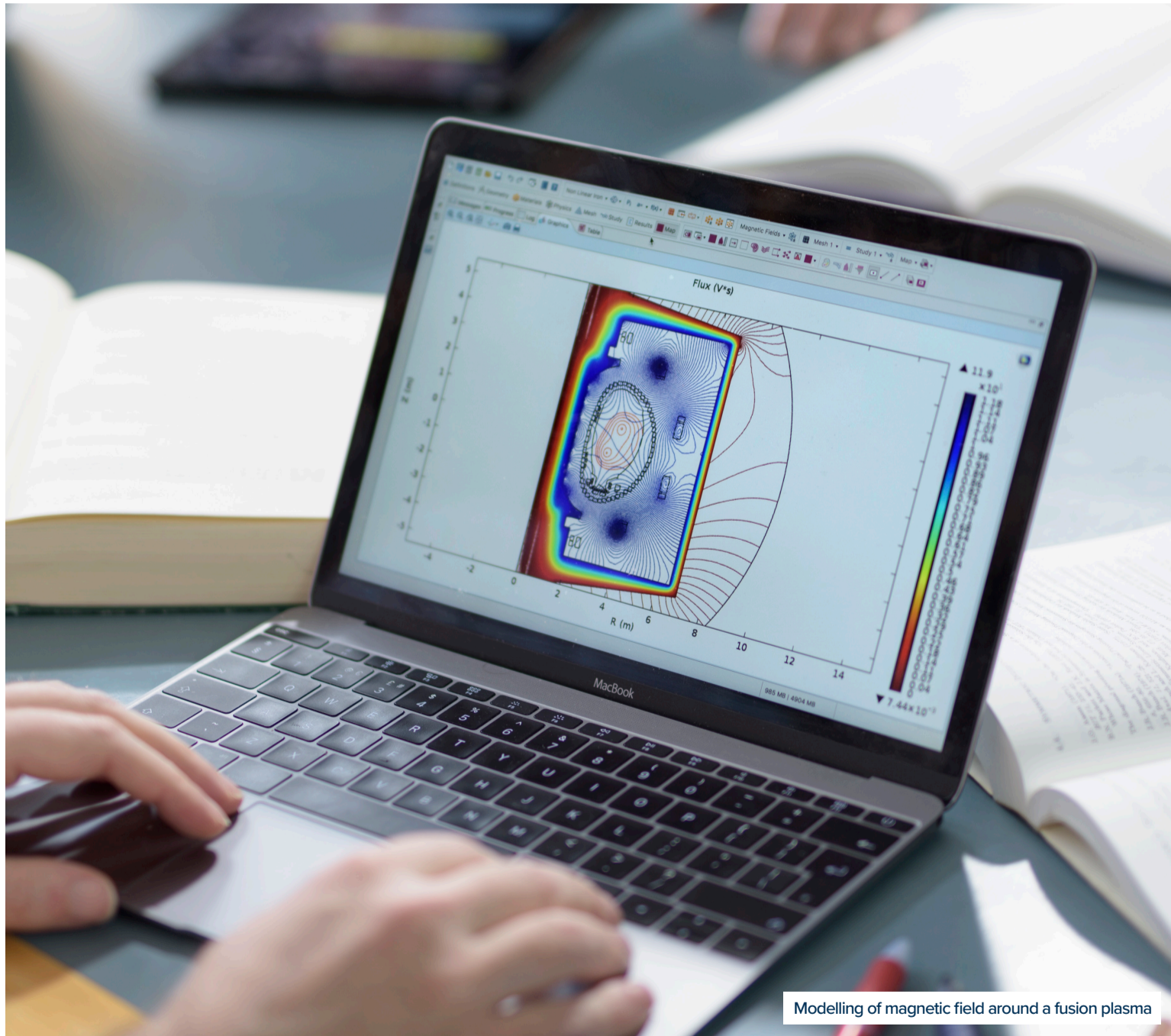
by magnetohydrodynamic models. An important aspect of scenario optimisation is ensuring these limits are avoided, in order to maximise plasma stability and avoid loss of heating power to the wall and degraded performance. Exploration and avoidance of these limits will be carried out on JET and MAST Upgrade through the development of high-performance scenarios. Crossing some “hard” limits can lead to a rapid termination of the plasma, resulting in high thermal and mechanical loads to structures in the device called disruptions. UKAEA

scientists are helping to explore means of mitigating these loads on JET through the use of shattered pellet injection to quench the plasma prior to reaching the wall and more evenly distribute the plasma energy across the wall. These studies are expected to deliver important results for ITER, which is planning to use multiple shattered pellet injectors to mitigate the impact of disruptions.

Looking forward

The Tokamak Science priorities for 2019/20 are:

- Development of high-performance plasmas on JET in preparation for globally unique D-T experiments planned for 2020;
- Starting to explore solutions to plasma exhaust by studying alternative divertor configurations on MAST Upgrade; and
- Development of state-of-the-art models to predict plasma heating and energetic particle losses and pedestal characteristics.



Modelling of magnetic field around a fusion plasma

JET Operations

Preparations for high power campaigns

Following the completion of the final engineering enhancement break within the JET reference programme to 2020, JET resumed operations and achieved a 1.8 MA flat-top plasma on 3 May 2018. Unfortunately, this early success was followed up by a series of unforeseen and significant technical issues which repeatedly interrupted the restart programme with the result that the start of the high-power Deuterium campaign was pushed back to 17th June 2019. This period of operation is essential to evaluate some Key Performance Indicators ahead of the Tritium only (T-T) and deuterium-tritium (D-T) campaigns foreseen in 2020. The major faults included a water leak on the Neutral Beam Heating system, a failure of the cooling system on the primary vacuum pumping system, and a short circuit on the 36kV power supplies infrastructure, each of which required many months to resolve. Whenever such problems have been revealed, key resources were rapidly and effectively mobilised to resolve the fault and evaluate the root causes to avoid future occurrences.

To minimise the impact on the overall programme, machine downtime required to resolve these unforeseen issues was used to bring forward routine maintenance activities (avoiding the need for small interventions ahead of the T-T or D-T campaigns) and to improve the resilience of key support systems in preparation for the D-T campaign, when access will be significantly restricted due to activation levels. An example of the latter was the replacement of all six turbopumps for more reliable, tritium-compatible models.

By the end of the reporting period, all the unforeseen failures have been recovered and all maintenance activities had been completed, enabling restart activities to recommence, with the vessel pumped down and the machine area locked up for operations by 29th March 2019. The exception was some of the Tritium Injection Modules which required refurbishment and will be installed before the start of the DT rehearsal in Autumn 2019.

In October 2018, the EUROfusion General Assembly unanimously agreed to include the proposed “JET work programme in support of ITER for the period 2021-24” in its proposal provided that: (i) the EUROfusion Science & Technology Advisory Committee concludes positively its assessment of the impact of this Programme for ITER; (ii) the rationale for conducting this programme on JET and that the high level deliverables can be met in an optimal way on the proposed timescale; (iii) a funding arrangement is reached for the continued operation of JET in support of the EUROfusion programme between the UK government and the European Commission; and (iv) the ITER organisation gives a positive appreciation of the proposed JET Work Programme. By the end of the reporting period, criteria i), ii) and iv) had been met.

Shattered Pellet Injector

The Shattered Pellet Injector (SPI) is a Disruption Mitigation System developed by Oak Ridge National Laboratory in the USA on behalf of ITER, who consider disruptions as their highest operational risk. Testing the effectiveness of the SPI will be a key part of the forthcoming deuterium campaign on JET and be used to inform the ITER programme.

Installation and commissioning of this system on the JET machine is funded by US-ITER domestic agency under contract with UKAEA. By March 2019, all SPI hardware had been delivered to site, installed and many of the sub-systems commissioned.

Exhaust Detritiation System

The Exhaust Detritiation System (EDS) is part of the Active Gas Handling System and designed to capture tritium from the JET exhaust. It is a key safety system for JET operations with tritium, although is not an essential system for the forthcoming D campaigns.

As reported in the previous annual report, at some time prior to or during the last shutdown, the EDS was exposed to gases containing fluorine and chlorine. The process used to capture the tritium resulted in halogenated hydrocarbons being converted

into acids, which have caused corrosion in the system. A major project was therefore initiated to procure a new system and put in place additional monitoring to prevent any recurrence. Whilst its construction has retired a significant risk related to readiness for the T-T and D-T campaigns, the supply contracts significantly over-ran, with the result that the start of these campaigns on timescales compliant with the latest amendment of the Operating Contract is now under serious threat. By March 2019, the replacement EDS had been fully assembled and passed its Factory Acceptance Tests and is expected to be operational by the end of 2019.

Radioactive waste processing

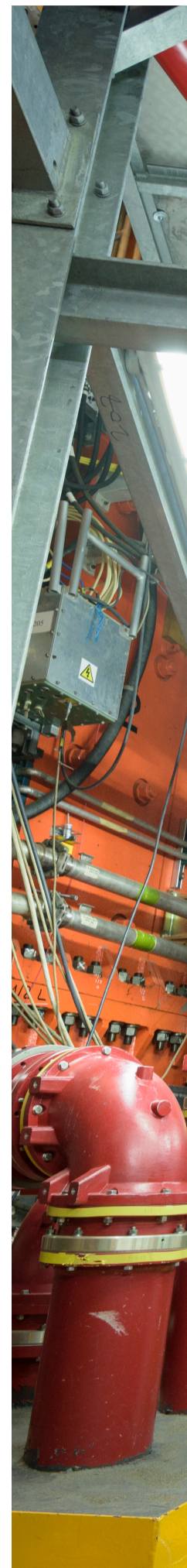
The scope of the JET Operating Contract includes the processing and disposal of radioactive wastes arising out of the operation and interventions on the JET facilities, including dealing with legacy wastes. To support this goal, a Water Detritiation System (WDS) and a Materials Detritiation Facility (MDF) have been built and commissioned. The WDS remains dependent on the availability of the EDS so is not expected to be operational until early 2020. However, the MDF is now fully operational and, within the first few months of operation, has already treated over 10 tonnes of Intermediate Level Waste with a projected saving of over £1.2M waste liability.

This is a major success for the organisation and wider fusion community and sets a new standard in ‘Best Available Techniques’ by recycling the Tritium and removing the risk and uncertainty regarding waste which would otherwise require long term management prior to disposal in the UK’s Geological Disposal Facility.

Looking forward

The JET operation priorities for 2019/20 are:

- JET D campaign including use of the SPI to investigate its risk mitigation capacity for ITER; and
- Commissioning of EDS and other systems required for D-T operations.





Inside the torus hall at JET

MAST Upgrade

The construction of MAST-U was completed in October 2018 and this was commemorated by a visit from the Duke of Cambridge. The first high temperature conditioning bake was performed, followed by glow discharge cleaning in helium. This bake successfully removed a layer of hydrocarbon contamination from the tiles. The Personnel Access Safety System has been commissioned, allowing the machine to proceed into integrated power supplies and neutral beam commissioning. Remedial work on the Toroidal Field assembly was completed and additional diagnostics were added to the Toroidal Field sliding joints assembly. This monitoring will enable operations to be adapted to allow an increase in the duration of the first physics campaign.

During machine cooldown after the first bake an air leak became apparent. Although the leak was large it required extensive tests and the building of special equipment in order to identify the location of the leak. The leak was finally identified as being from a crack in the stainless steel can surrounding one of the poloidal field coils (P5 upper). The machine was subsequently vented, the leak localised and the coil can welded and the leak repaired.

Preparations for machine operations have been progressing, including modelling the plasma start-up and ramp-up and improvements to the plasma control system. A number of new diagnostics systems, many supplied by collaborators, have been designed, manufactured and are ready for installation onto the machine once the final commissioning bake is performed. The US Department of Energy announced a call for participation on international Spherical Tokamaks including MAST-U. There was considerable interest inside the US Fusion community and out of the 15 proposals submitted 10 proposals were selected. The proposals awarded amount to \$12.5M over

3 years with funding starting from July 2018 and will include staff being seconded to work on MAST-U as well as a number of new diagnostics.

With the arrival of new collaborators, a 2nd call for experimental proposals was launched. These proposals were discussed at the 2nd MAST-U research forum, which was held at Culham in February 2019. The forum reviewed the status of the machine and discussed the outcome of the call for participation in the 2019/20 MAST-U campaign. 80 people attended the forum in person with another 30 people taking part remotely. The call for participation resulted in 135 proposals requesting 2500 shots. This represents a factor of 3 more than are available in the first campaign. These proposals have subsequently been combined into experimental programmes and the scientific co-ordinators identified. A revised plan for restart and timeline to first plasma has been developed.

MAST-U Enhancements

The UK government and Euratom are funding £21M of enhancements to improve functionality of the heating and plasma exhaust systems on MAST-U. Several of the major project risks have been retired and some work packages are nearing completion. The overall spend on the project remains slow compared to phased budget, but good progress has been made. Some issues remain with the people resources available to the project and some project risks yet to be retired notably Double Beam Box manufacture costs.

Two reviews took place during the year and were complimentary about the way that the project was being planned and delivered. Some concerns were raised and these are being addressed through a re-forecasting/re-baselining activity and outsourcing workshops to ensure a good balance between 'make and buy'.

The following enhancements are on track for use in the first MAST-U campaign:

- High Frequency Pellet Injector;
- Gas fuelling valves; and
- Diagnostics including additional infra-red cameras, high speed imaging, bolometry and Langmuir probes.

Good progress has been made this year on several other work packages, including the following milestones:

- Cryoplant – liquid helium tank delivered and detailed design review of the liquefier. Liquid nitrogen tank ordered and planning permission gained to reuse an existing plinth;
- Power Supplies – high voltage power supply contract placed;
- Double Beam Box - detailed design review;
- Plasma Control - concept design reviews of real time control systems; and
- Diagnostics - detailed design review of point Thompson Scattering diagnostic.

Looking forward

The MAST-U priorities for 2019/20 are:

- On coil commissioning by late summer 2019;
- First plasma in autumn 2019; and
- First campaign in early 2020.





The Duke of Cambridge initiating a plasma on the new MAST-U facility, October 2018

National Fusion Technology Platform

The Government announced the National Fusion Technology Platform in 2018 with an initial £86 million investment from the Industrial Strategy Challenge Fund to undertake the H3AT and FTF projects. The goal is to support UK industry to win £1 billion of fusion contracts, this is in addition to over £500m of ITER contracts already secured by UK businesses.

Following the programme start in late 2017, recruitment of the scientific and engineering teams has been a key priority during 2018/19 with the majority of posts now filled. Specification and initial design of the major bespoke items has been completed with tenders for systems integrators ongoing at the period end. Contracts for supply of the major equipment items will be issued during 2019/20.

In order to enhance UKAEA's ability to engage with relevant manufacturing and research organisations, the provision of a new building at the Advanced Manufacturing Park in Rotherham is being negotiated. Design of a building to accommodate the Culham based facilities has also started with a planning application scheduled for submission in Summer 2019. As these new buildings will not be available until late 2020 and early 2021, interim facilities have been established at Culham to provide an early capability. Industry engagement has been enhanced by an ongoing series of seed-corn projects the objectives of which are to provide timely knowledge which will enhance the ability of UK companies to bid for fusion related work.

In addition, on behalf of BEIS and the Welsh Government, UKAEA undertook a technical requirements capture and costed options study on the proposed National Thermal Hydraulics Test Facility in North Wales. This work included holding engagement workshops with potential users and

suppliers in Anglesey, Rotherham and Culham in order to ascertain the business demand for such a facility. This facility has synergies with the planned Module Testing Facility (MTF) which allow thermal hydraulic testing in a magnetic field. MTF will be located in Rotherham.

FTF

The purpose of the FTF project is to establish a centre of excellence to provide a complete development life cycle for materials and components covering pre-nuclear material qualification, joining, design and manufacture, lifetime integrity and testing and decommissioning for fusion.

Highlights from the year include:

- Expanding the Materials Technology Laboratory (MTL) as part of the FTF project and commissioning of new test facilities;
- Commencing Phase 2 of the Nanostructured Steels Project, in collaboration with the University of Sheffield, Materials Processing Institute, National Nuclear Laboratory and Sheffield Forgemasters International Ltd.
- Commissioning a range of development projects relevant to value engineering ITER first wall production and presented to F4E. Further development is ongoing;
- Commissioning 11 seed-corn projects with SMEs, universities, industry, government organisations and catapults in fusion relevant technologies including advanced manufacturing, non-destructive testing, hazardous materials detection; and
- Completing the concept design competition for the MTF System Integrator and proceeded to detailed engineering evaluation.

H3AT

The purpose of H3AT is to build a world class capability delivering tritium solutions and IP to support the realisation of fusion as a commercial reality, enabling UK industry to win significant contracts and to train the next generation of UK tritium technologists.

Highlights from the year include:

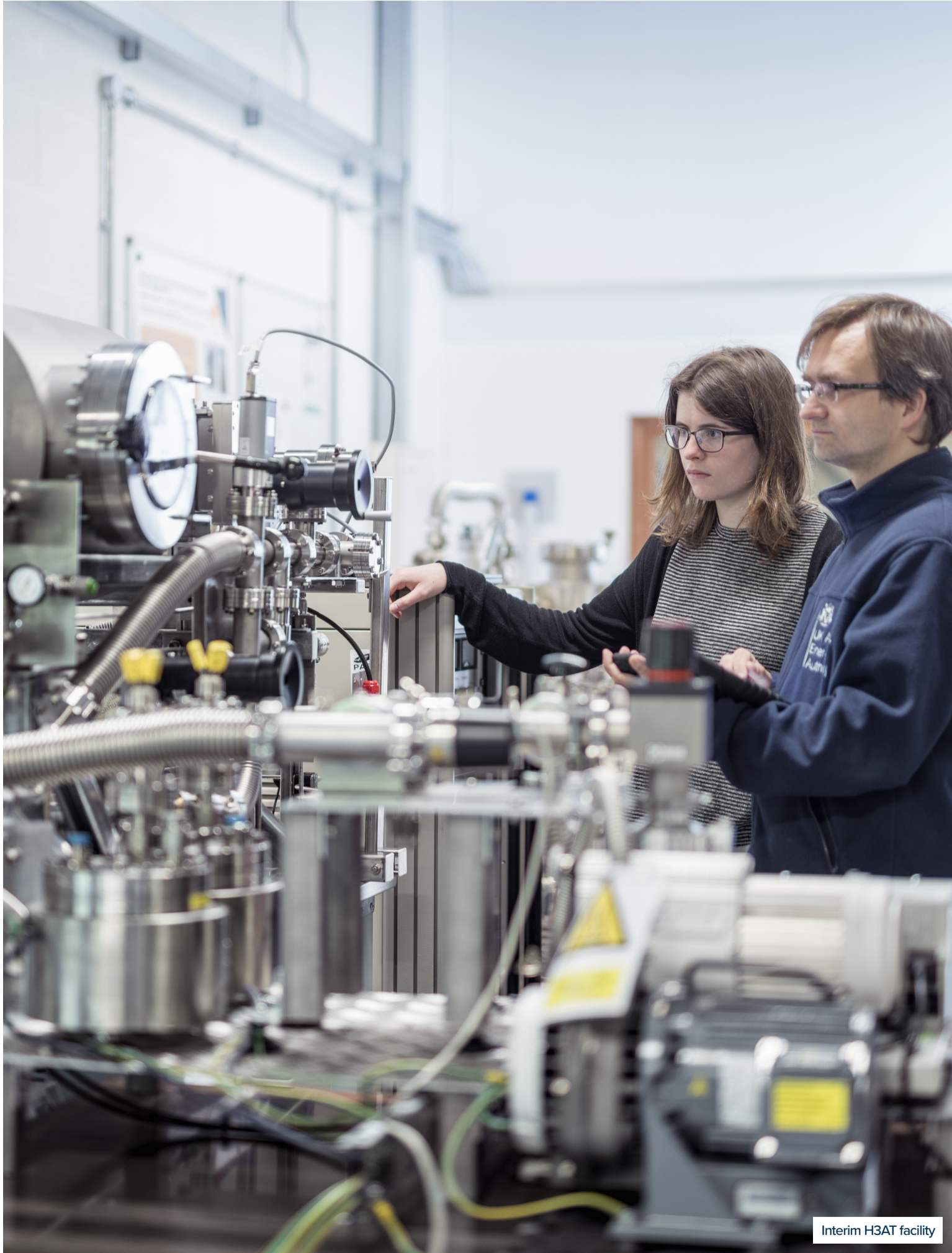
- Establishing an interim H3AT facility at Culham;
- Establishing the H3AT Project Team, including recruitment of a new H3AT Department Manager and 13 new members of staff to work on the project; and
- Winning the ITER Palladium Membrane Reactor contract and increased EUROfusion research in tritium and waste handling.

Looking forward

The National Fusion Technology Platform programme priorities for 2019/20 are:

- Placing procurement contracts for buildings and all major bespoke equipment items including the system integrator & magnet manufacturer for MTF, systems integrator for the H3AT plant, and supply of the various H3AT subsystems;
- Continued recruitment of commissioning and operations teams and the development of commissioning plans for all major systems;
- Establishing high temperature and cryogenic materials testing, characterisation of tensile response of materials by neutron scattering with Science & Technology Facilities Council (STFC); and
- Installation of a mini exhaust detritiation system in the interim H3AT facility.





Interim H3AT facility

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RACE

RACE is consolidating and growing a diversified portfolio of projects and revenue streams from both commercial contracts and grant funded research in the field of robotics and applied AI. The focus remains on remote operations and maintenance for high hazard environments where hands-on intervention is undesirable and on contributing to the delivery of the UK's Industrial Strategy. RACE collaborations are also growing, with more than 40 projects, 100 industrial partners and 13 universities.

In fusion it is now widely recognised that remote maintenance is 'device defining' and 'mission critical', meaning that the maintenance of a fusion power plant cannot be considered as an afterthought: it is a lens through which to evaluate whether a particular architecture is viable. This means that UKAEA's expertise in RACE is relevant to all fusion power plant architectures including non-magnetic confinement solutions and the efforts of the multiple fusion start-ups. A highlight of the year is a RACE mechanical engineer winning second place in the international SOFT 2018 Innovation prize for his work designing an in-bore laser cutting and welding tool. This could prove vital to a future fusion reactor, where pipes will need to be cut and joined during maintenance and perhaps installation.

Beyond fusion, remote maintenance is also a key driver in legacy decommissioning where robotics and AI provide an alternative, potentially safer and cheaper solution that reduces the need for operators to enter hazardous spaces in air-fed suits or use glove boxes.

RAIN, the UK Research and Innovation (UKRI) funded 'Robotics and AI in Nuclear' hub, is now reaching its mid-term review. Highlights include more than 30 post-doctoral researchers grappling with the

challenges of nuclear remote operations and working collaboratively to develop and demonstrate solutions. UKAEA has mapped nuclear facilities at Culham, Sellafield, overflown Chernobyl and are supporting UK industry decommissioning the Fukushima reactors. This programme of 'hot' working will intensify in the remaining two years to show users that robots can be used routinely and to great effect.

UKAEA continues to build on thirty years of JET remote operations which use person-in-the-loop haptic (force feedback) control to conduct all manner of handling tasks within the JET Vacuum Vessel. The next step is to enhance the operator's abilities using new interfaces developed for gaming and AI techniques to better interact with 'hidden' objects. The work suggests that it may soon be possible to replace a person's hands within a glove box so that people can work even more safely from a distance. This has the potential to decrease risks and also improve productivity. Such techniques also apply to non-nuclear tasks such as mining, operations in space or underwater.

Five major procurement contracts have now been placed with industry for the main elements of the European Spallation Source Active Cell Facility. This is a windowless hot cell, which services an international science facility, where end of life, highly active components are cut into smaller pieces for storage prior to safe disposal. The challenge has been to specify customer requirements so that industry has clear goals without limiting innovation with the intention of lowering costs. This work is also directly relevant to intermediate and long-term waste storage and other hot cell operations such as the ITER Hot Cell.

The RACE Pit Lane, which will host Autonomous Vehicle developers, will open soon. Oxbotica, which announced a £14m investment into development of autonomous vehicles in October 2018, is already a tenant in RACE and uses the 10km of private road network at Culham to carry out much of its vehicle testing. Funding for an extension to the RACE building has been secured as RACE has grown faster than originally planned. It is an aspiration to seek funding for other facilities to establish a major robotics & AI hub at Culham.

Looking forward

The RACE priorities for 2019/20 are:

- Continued growth and collaborations with academia and industry;
- Supporting successful operations on JET;
- Procurement for the ESS project; and
- Support for the STEP project as remote operations and maintenance will be a key driver for simplifying fusion plant architecture/availability and reduce through life cost.





Inside of a remote handling mascot slave

Materials Science Programme

Materials Research Programme

The materials used in a fusion power station will need to retain their mechanical and thermal properties for months or years, resisting high fluxes of neutrons and heat. Understanding and developing materials for use in power station components is therefore an important part of fusion R&D. UKAEA has a strong materials science programme, much of the research is undertaken in collaboration with UK universities, EUROfusion partners, and organisations in the rest of the world. The work ranges from use of sophisticated computer codes to calculate how materials respond to doses of neutron behaviour, to experiments on tiles that have been exposed to JET plasmas and on samples that have been subject to irradiation.

Highlights in 2018/19 included:

- With scientists at the Los Alamos National Laboratory in the US, identification of a new “high entropy alloy” that has shown unprecedented resistance to irradiation. If further R&D confirms this early promise, this alloy, will be a strong candidate for components in the high heat flux “divertor” region of a fusion power station.
- It is known that the deterioration of properties when they are irradiated is due to the accumulation of very tiny defects in the material’s lattice, which manifest themselves through macroscopic effects. A mathematical breakthrough has been made that now allows the results of calculations of microstructural evolution to be included in computer models of macroscale components, to assess how radiation leads, for example, to their swelling. This work linking the very tiny with the human scale has

opened up a new area of research that could greatly improve computer calculations of radiation damage.

- Chemical compounds that include beryllium, oxygen and deuterium have been found on tile surfaces in JET, and how they form has been established (work with Oxford University and EUROfusion colleagues). If the operating conditions in ITER also lead to their formation, then they may be a way tritium (replacing the deuterium) would be retained in wall components. It is important to minimise the tritium retention inventory for safety and other reasons.

Materials Research Facility

The MRF has been built to allow UK nuclear materials scientists (working in both fission and fusion) to do experiments on material with radioactivity too high for a university laboratory. It has been funded by NNUF and the Henry Royce Institute initiatives.

Several UK universities use the MRF, as does the National Nuclear Laboratory. The range of uses of MRF expanded in 2018/19 and work included MRF’s first contract for ITER. UKAEA also uses the facility in its material science research, for example the JET tile analysis.

Before radioactive material can be handled in the MRF hot cells, exhaustive commissioning is necessary. This commissioning started in 2018/19 and revealed a design flaw for which remedial action is required. During the year, a new set of shielded rooms was installed to accommodate the ever-increasing range of scientific instruments.

In early 2019, Government approved a second round of NNUF funding, and

money to extend the MRF building. MRF capability is expected to expand greatly in the years to 2023, with new shielded hot cells and laboratories, and more equipment to characterise irradiated materials and measure their mechanical and thermal properties.

Looking forward

The Materials Science & MRF priorities for 2019/20 are:

- Extending materials modelling to higher length scales and incorporating a wider range of phenomena;
- Further analysis of tile surfaces exposed to the plasma in JET;
- Use of new equipment, designed by UKAEA and now implemented with Croatian scientists on their facility, that allows more rapid experiments to investigate how the degradation of materials depends on the temperature at which they are irradiated; and
- Operation of the MRF hot cell to allow the processing of radioactive samples for analysis for universities and other users.





MRF Hot cell manipulators

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Property Development

Founded on its assets and UKAEA's mission to support the government's Industrial Strategy, one of UKAEA's five goals is to develop the Harwell Campus and Culham Science Centre as significant centres for science and innovation, thereby supporting UK economic growth and generating high-tech jobs.



Culham Science Centre is one of the three large internationally significant science and business centres in southern Oxfordshire which underpin the County's economic growth. It is owned and exclusively managed by UKAEA. UKAEA is already well on the way to achieving the further 1,000 jobs targeted in South Oxfordshire's Core Strategy with the site now supporting around 2,500 jobs in over fifty organisations. Looking to the future, Culham Science Centre is earmarked for significant further growth in the emerging Local Plan.

UKAEA's vision for Culham Science Centre is to be a leading global hub for innovation in fusion energy and related technology, engineering and design, supporting regional and national growth. In pursuing this vision, the aims are to provide UKAEA with a suitable environment to meet its mission and to enable significant growth in economic activity and high-tech jobs. Both aims will require investment and property development.

During the year, UKAEA has completed the construction of a pitlane for autonomous vehicles, a new office building and a sports pavilion. A new centre for OAS is under construction and will be completed in time for opening in September 2019. Extensions for the RACE and MRF buildings and new facilities for H3AT and FTF are in design stages. This scale of development has not been experienced since JET was built in the 70's. It signals a step change in UKAEA's contribution to national and international science and technology research, and capability growth. These facilities not only support the future of fusion work but have economic impact. To support the immediate growth in UKAEA staff numbers, existing buildings have also been refurbished with a 32% increase in desk spaces over the last 2 years.

UKAEA continues to maintain a consistently high level of occupancy in tenanted space, partly because of the high-quality working environment which benefits from a range of amenities and facilities. Accordingly, significant growth will require the development of new accommodation for commercial activity as well as for UKAEA's own operations. A delivery option for the first phase of new development has been agreed and the UKAEA has been working with government and potential investors to begin implementation.



The Harwell Campus is now one of the fastest growing science and innovation environments nationally. Employment on the Campus has increased from 4,700, in 2014 to over 6,000, working in 225 organisations, in 2018.

UKAEA is in a joint venture Partnership with UKRI (through STFC) and a private sector partner to develop the campus. UKAEA owns the majority of the freehold land including the Harwell licenced site which is leased to the Nuclear Decommissioning Authority (NDA) for decommissioning which enables further land to be made available for development.

In 2018/19, the Partnership completed a series of construction projects including dedicated buildings for Oxford Nanopore and Cobalt and has initiated a further wave of projects for the coming year. The mixed use projects which completed in the previous year are now all fully let and demand continues to grow. The Partnership has significantly raised the national and international profile of the Campus and is both developing and seeding new technology clusters, notably in 2018-19 the EnergyTec Cluster was launched. Further reinforcing the Campus' significance nationally and internationally, government is investing, through UKRI, in the new Rosalind Franklin Institute, the Faraday Challenge headquarters, the National Space Test Facility and the Extreme Photonics Applications Centre.





Looking forward

The Property development priorities for 2019/20 are:

- Complete construction of the OAS apprentice training facility ready for opening in September 2019;
- Start the construction of the National Fusion Technology Platform complex and start extensions to the RACE and MRF buildings; and
- Develop the Culham masterplan including a strategy to attract synergistic companies;
- Appoint a development partner at Culham; and
- Push for accelerated land release from the NDA programme, to support the rapid commercial development at Harwell.

People

Capability

UKAEA's continued world class reputation and increased contribution to the UK and other science and technology capabilities relies on the ability to attract, retain and develop first-class talent. 2018/19 has seen another year where employee numbers have increased with recruitment of 189 new permanent posts and an additional 36 fixed term appointments. Acute shortage areas such as control & instrumentation technicians, engineers (cryogenic, electrical, systems, process, mechanical, design), technical project managers and nuclear specialists are still being addressed through a variety of recruitment campaigns, including targeted social media, recruitment fairs and hard copy adverts.

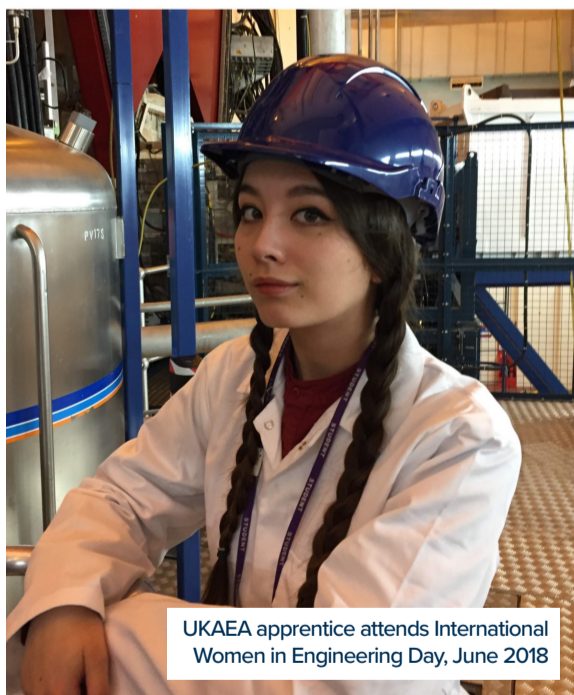
UKAEA continues to improve staff development programmes. This includes a highly valued two-year graduate scheme certified by the Institution of Mechanical Engineers, Institution of Engineering and

Technology (IET) and the Institute of Physics. Graduate intake numbers have risen in 2018 from 18 to over 30 due to start in September 2019. Similarly, accredited continuous professional development schemes encourage employees from all disciplines to become professionally recognised and PhD and MSc opportunities are offered. A mentoring scheme operates to support staff with their career development and targeted professional coaching is also provided. A leadership programme is under development, which will be offered to all levels to enhance and develop leadership capability as the organisation continues to grow.

UKAEA continues to nurture a culture that promotes research, innovation and leading-edge technological excellence and is committed to investing in its people, by striving to create a working environment where people are given challenging and interesting work and frequently required to think innovatively about new problems.

Equality, Diversity and Inclusion

UKAEA is committed to supporting diversity and inclusion and creating an environment that is welcoming, inclusive and supportive to all. UKAEA has been reaccredited with Athena SWAN Bronze Award and an action plan has been developed to attain Silver next time. The Athena SWAN initiative is helping to make gender equality part of UKAEA's overall strategy, and good practice from the Athena SWAN project plan is being used to develop inclusive strategies for all under-represented groups and minorities. Activity is underway to eradicate non-inclusive language and behaviours and to continue to promote a fair and flexible workplace for all, including the launch of Inclusion Ambassadors embedded within Departments and employee support groups such as the LGBT+ Network.



UKAEA apprentice attends International Women in Engineering Day, June 2018

Apprenticeships & OAS

A record number of 21 new apprentices were recruited for the UKAEA Apprenticeship Scheme, the majority starting in September 2018. 2019/20 is set to be another record year and also includes increased numbers of existing employees starting apprentice programmes to gain professional qualifications. UKAEA is well on track to achieve the public sector target of 2.3% of new apprenticeships in the workforce for 2019/20. During the year a number of the apprentices won national awards.

UKAEA also hosts the OAS skills training centre which provides technical apprentice training to businesses across the local area. This new purpose built facility will accommodate up to 350 apprentices per year. OAS will be run by The Advanced Manufacturing Technology Centre (AMTC) who were appointed as the official training provider at the end of 2018.

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OAS welcomed almost 50 new apprentices in September 2018

Stakeholder Engagement

Outreach and Public Engagement

UKAEA hosted a succession of high-profile visits to Culham during 2018/19. These included Prince William, Duke of Cambridge, to mark the completion of MAST Upgrade and two Science Ministers, firstly Sam Gyimah in October 2018 and then his successor Chris Skidmore in January 2019. The latter's visit saw him deliver his first major speech on science policy. In addition, Head of the Civil Service, Sir Mark Sedwill, visited site in March 2019.

Other notable visits included US Under Secretary of Energy for Science, Paul Dabbar, Sir John Kingham, Chair of UK Research and Innovation, Patrick Vallance, Government Chief Scientific Advisor, Tim Stone, chair of NIA, Lord Browne of Madingley, Baroness Bloomfield of Hinton Waldrist, Liberal Democrat MPs Tom Brake and Layla Moran, MEPs Clare Moody and John Howarth, David Willetts (former Conservative MP and Science Minister),

NASA's Chief Scientist, Jim Green, Virgin Galactic future astronauts and South Oxfordshire District Council's cabinet.

Some very welcome news came at the end of March when a new JET operations contract was agreed between the UK and the European Commission - guaranteeing operations until the end of 2020. This excellent result was aided by a prolonged public affairs effort, involving many interactions with UK and European stakeholders over the course of almost three years.

A total of 249 items of printed and online news coverage were logged in 2018. Significant coverage included appearances in two primetime BBC TV documentaries, a BBC World Service radio programme on the prospects for fusion energy, a Reuters video report on MAST Upgrade, feature articles on DEMO, RACE and OAS in The Engineer magazine, and

widespread coverage of UKAEA's contract to design the Thermal Hydraulic Facility in Anglesey and of the Duke of Cambridge's visit to Culham.

UKAEA's 2018/19 education and outreach programme enabled 1,275 students from schools and universities to visit Culham. The Sun Dome school workshop visited 26 primary schools with 1,330 Key Stage 2 pupils having the chance to find out about fusion. In February 2019, UKAEA launched its presence on Dendrite, the on-line educational platform aimed at 11-14 year olds. There was also representation at six different science festivals including New Scientist Live and ATOM (Abingdon Science & Tech festival). The annual Plasma Physics summer school welcomed 41 students from 23 countries who represented 36 different institutions globally.

Universities

UKAEA has 25 UK universities and a number of international fusion technology, computing, university and PhD students. Research Collaboration with UKAEA

UKAEA has relationships with several UK universities including University of Bristol, Cambridge University and others. UKAEA students on



SunDome educational show for K2 students



University Collaborations

UKAEA has collaborative links with over 25 UK universities and with a far greater number of university departments. These links encompass plasma physics, materials science, fusion technology, robotics and advanced computing. UKAEA helps to fund several university academic posts and a large number of PhD studentships. Several universities have Research Council grants for research projects with UKAEA as a collaborator.

UKAEA has established strong and effective relationships with many Centres for Doctoral Training (CDTs), especially the Fusion CDT led by the University of York, and has links to several Fusion and Nuclear Masters courses including Universities of York, Birmingham, Bristol, Cambridge, Manchester and Imperial College. UKAEA staff provide lectures to students on many of these courses.

Every year UKAEA hosts a large number of pre-doctoral students for placement durations ranging from a few months to a year ('Year-in-Industry' projects). Over the last 3 years this has doubled, reaching around 60 in 2018. Over the same period, placements undertaken by women have grown from around 18% to 27%. Following such placements, many students are motivated to study for a PhD in fusion research or to apply to the UKAEA Graduate Scheme.

At present UKAEA typically part-funds around 20 new PhD studentships each year and currently there are over 60 part-funded students actively studying for a PhD. Many of these are based at Culham Science Centre. As in previous years, UKAEA hosted a Summer event showcasing the work of PhD students and a PhD Open Day in December, organised in conjunction with the Fusion CDT,

which was attended by around 60 potential PhD students and representatives of 10 university departments.

Collaboration with UKAEA gives universities an opportunity to leverage EUROfusion funding for Enabling Research, Research on JET and Medium Sized Tokamaks, for Educational Support and for post-doctoral researcher fellowships. They also have access to other facilities at Culham such as MRF, RACE and the ADRIANA facility.



Assurance

Health & Safety

UKAEA was once again awarded the prestigious Gold Medal by RoSPA in recognition of its sustained commitment to accident and ill-health prevention. This award recognises the achievement of all on site delivering on safety.

The UKAEA continues to monitor and measure its safety performance through leading and lagging metrics, identifying areas for improvement based on the results. The accident frequency rate (defined as the ratio of work-related lost time injuries (<1 day) per 100,000 hours worked averaged over the year) is 0.08 (for employees and contractors combined). This low rate compares favourably when benchmarked with other similar organisations.

This year focused on visible leadership on safety and health with a series of successful Safety Leadership events being held, working with an external partner.

The UKAEA recognises how important a positive health and safety culture is and has implemented a programme to grow the culture to one where safety and health is second nature.

Health and wellbeing remain an important focus and as for previous years the UKAEA has promoted several activity-based programmes including a number of 'fun-runs' and other sporting activities that encourage people to take time away from work in order to exercise. Other initiatives were aligned

with national programmes such as 'Men's Health Week' and 'Dry January'.

All radiation exposures are assessed as low as reasonably practicable. The average radiation dose to the monitored/classified workers for 2018 was 0.02mSv, which is less than 1% of both the legal limit (20mSv per year), the site dose constraint (5mSv per year) and average background radioactive dose received by members of the public (2.7mSv). The maximum dose seen was 0.58 mSv (UKAEA employees) and 0.28 mSv (contractors) in both cases less than 15% of the UKAEA site dose constraint.

Environment and Sustainability

Energy and water consumption, as well as waste disposal volumes all vary year on year due to changes in plant operations, and this therefore affects the total greenhouse gas emissions. During operational periods, electricity and water use increase. During periods of plant shutdown, waste production and staff numbers increase. During 2018/19, UKAEA's annual carbon footprint has remained constant compared to the previous year, as JET continued to be in a period of restart.

UKAEA is on track for the introduction of the government's consumer single use plastics scheme in 2020. This will include the elimination or replacement with alternatives for common items such as plastic cutlery, glasses, containers and packaging. To promote further environment engagement an Environmental Forum will be established.

Table 2 – Summary of financial and non-financial sustainability information for 2018/19

Area		2015/16	2016/17	2017/18	2018/19
Greenhouse gas emissions (1,000 tCO ₂ e)		31	25.4	15.4	15.6
Estate Energy	Consumption (mill kWh)	65.8	59.9	36.1	49.8
	Expenditure (£k)	5,669	5,418	4,055	5,686
Estate Waste	Amount (tonnes)	693.5	626.5	503	659.2
	Expenditure (£k)	241	190	345.5	382.8
Estate Water	Consumption ('000 m ³)	79.8	97.5	62.7	98
	Expenditure (£k)	126	165	144	279

Note:

1. More detail is provided in Tables 3-5. The information has been prepared in accordance with guidelines laid down by HM Treasury.

Table 3 –

Non-financial (1,000 tCO ₂ e)
Related expenditure (million £)
Financial (£k)

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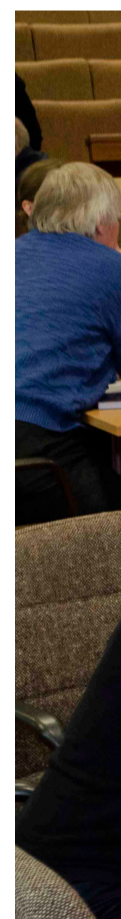


Table 3 – Greenhouse gas emissions

Greenhouse gas emissions		2015/16	2016/17	2017/18	2018/19
Non-financial indicators (1,000 tCO ₂ e)	Total emissions (Scope 1-3)	31.0	25.4	15.4	15.6
	Gross emissions Scope 1 (direct)	3.95	1.67	1.45	1.20
	Gross emissions Scope 2 & 3 (indirect)	271	23.7	13.9	14.4
Related energy consumption (million kWh)	Electricity: Non-Renewable	54.0	52.7	29.8	44.7
	Electricity: Renewable	–	–	–	–
	Gas	11.76	7.24	6.33	5.01
	LPG	–	–	–	–
	Other	–	–	–	–
Financial indicators (£k)	Expenditure on Energy	5,669	5,418	4,055	5,686
	CRC Licence expenditure	465	438	411	566
	Expenditure on accredited offsets	–	–	–	–
	Expenditure on official business travel	394	445	569	677

Note:

2. The greenhouse gas emissions were calculated (from the raw data) using DEFRA/DECC conversion factors: <https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting>
3. Figures which have been partially or entirely estimated or revised are in bold italics. Explanations of each estimate follow:
 - i. Estate Water – Estimated figure for 2018/19 due to change in supplier.
 - ii. CRC Licence Expenditure – The estimated figure for 2017/18 has been updated with actuals.



2018/19
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32.8
98
279

Table 4: Waste Disposal

Waste		2015/16	2016/17	2017/18	2018/19	
Non-financial indicators (tonnes)	Total waste disposed of	693.50	626.48	503.04	659.20	
	Hazardous waste	Total	50.99	32.34	24.48	19.89
		Landfill	14.96	21.11	13.36	56.36
	Non-hazardous waste	Reused/Recycled	422.56	377.23	270.94	409.16
		Composted	37.44	39.32	37.36	33.84
		Incinerated (energy recovery)	97.3	99.5	100.1	99.0
		Incinerated (no energy recovery)	26.14	4.06	0.07	0.03
		Total non-hazardous waste	598.41	541.22	421.83	598.43
	Radioactive	Produced	31.05	39.44	40.94	50.05
		Disposed	44.10	52.92	56.73	40.88
	OSR (see note below)	Produced	10.90	10.18	36.49	9.81
Incinerated (no energy recovery)		–	–	–	–	
Total Radioactive / OSR waste disposed of		44.10	52.92	56.73	40.88	
Financial Indicators (£k)	Total disposal cost	241	190	345.5	386.5	
	Hazardous waste disposal cost		92	15	24	16.5
	Non-hazardous waste disposal costs	Landfill	9	10	2	4
		Reused/recycled	28	25	41	30
		Composted	2	3	1.5	2
		Incinerated (energy recovery)	11	20	21	20
		Incinerated (no energy recovery)	–	–	–	–
	Radioactive	Disposed	99	117	256	314
OSR	Incinerated (no energy recovery)	–	–	–	–	

Note:

- The figure for 'Compost' is food waste sent for anaerobic digestion. Negative financial figures for 'Reused/Recycled' reflect rebates received from scrap metals.
- Out of Scope of Regulations (OSR) waste is material where the activity is low enough to fall below the threshold set by the Environmental Permitting Regulations to be classified as radioactive waste.
- Figures which have been partially or entirely estimated are in bold italics.

Table 5: Finite Resource Consumption

Finite resource consumption		2015/16	2016/17	2017/18	2018/19	
Non-financial indicators ('000m ³)	Water consumption (whole site)	Supplied	79.79	97.52	62.7	97.95
		Abstracted	N/A	N/A	N/A	N/A
		Supply per FTE	0.07	0.09	0.06	0.08
	Average number FTE staff/contractors	1,080	1,046	1,130	1,249	
	A4 paper reams equivalent	5,600	4,300	4,800	5,200	
Financial indicators (£k)	Water supply costs (whole site)	126	165	144	279	
	Paper supply cost	11	8	7	8	

Management

UKAEA operates a range of management systems, including the international standards for Management Systems (ISO 9001), successful ISO 14001 certification, OHSAS 18001, and independent Health Physics ISO17025, testing laboratories.

The international assurance standards are being reviewed and are being updated, requiring us to manage these areas to manage risk.

The quality of our work is a program of continuous improvement.



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Management Systems and Quality

UKAEA operates an integrated management system and is certified to the internationally recognised core ISO Management Standards. The UKAEA successfully maintains combined certification to ISO 9001, 14001 and OHSAS 18001, which is subject to independent audit by AFNOR. In addition, Health Physics Group is accredited to ISO17025, the international standard for testing laboratories.

The internal audit programme provides assurance to management and stakeholders that the required standards are being maintained and where areas requiring improvement are identified these are actively tracked and reported to management.

The quality management system is subject to a programme of continuous improvement

which is supported by the development of a Quality Vision and Strategy focused on meeting the needs of the growing organisation and diversification into new areas of work. Capability and capacity within the Quality team has grown significantly to meet organisational requirements and the launch of a new intranet platform offers an opportunity to further improve the accessibility and function of the management system.

Security

The UKAEA maintains an effective level of security at Culham Science Centre aligning closely with the BEIS Security Strategy. The Security Policy framework provides a balanced set of security requirements and improvements to the physical security arrangements across the site continue to be delivered. Education via campaigns, briefings and training covering a wide range of security threats is ongoing for

staff. In addition, a number of security related exercises have been undertaken demonstrating that arrangements in emergency and business continuity planning are robust.

Information security, data protection and related risks are actively managed and monitored by the Information Assurance Steering Committee. A significant activity was undertaken to ensure that UKAEA was compliant with the General Data Protection Regulation (GDPR) on 25 May 2018. Work is ongoing to improve UKAEA's IT resilience. Having obtained Cyber Essentials, an action plan is being progressively worked through to meet the requirements of the 10 steps to Cyber security.

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Security fence surrounding the Culham Science Centre

Financial Review

Operating Performance

UKAEA grew significantly in 2018/19, income increased £14.2m and fixed asset additions by £16.0m. This growth was driven by initiatives in support of the Government Industrial Strategy, from the BEIS sponsoring department in respect to site infrastructure and growth of research and development programmes, particularly in RACE.

Costs have moved in line with growth, the main driver of the reported operating loss being the revaluation of land held at Harwell some of which has transferred into the HSIC Joint Venture. This operating loss is offset by increased profits flowing from the HSIC Joint Venture and higher tax credits.

UKAEA's operating performance in 2018/19 is summarised in the table below:

Finite resource consumption	2018/19 £k	2017/18 £k	Variance year on year £k	Comment on variance where significant
Income	118,019	103,826	14,193	Increase mainly in the Fusion operating segment. Year on Year growth of 14% due to Government Industrial Strategy investments and growth of RACE.
Expenditure	133,971	110,970	23,001	Growth of 21%, increase in staff and external expenses, 13% related to the increase of activities and 9% to costs that have subsequently been capitalised to fixed asset additions. Average headcount over the year has increased from 1,130 to 1,249.
Revaluation	9,559	868	8,691	Revaluation of investment property land.
Costs capitalised	(15,489)	(6,695)	(8,794)	Reflecting the increase in infrastructure investment in UKAEA.
Operating (loss)/profit	(10,022)	(1,317)	(8,705)	Operating loss mainly due to the impact of land revaluation adjustments at Harwell (2019: £9,559k compared with 2018 £868k).
Retained profit (loss) for the year after financing but before taxation	(5,314)	10,942	(16,256)	Primarily due to UKAEA's £4,582k share of profits in the HSIC Joint Venture (2018: £12,168k), and the revaluation adjustments referred to above.
Profit for the year after taxation	321	13,660	(13,339)	The factors above have been partially offset by higher tax credits of £5,635k (2018: £2,718k). The deferred tax credit has increased by £3,191k between years owing to the impact of property revaluations on the deferred tax provision, and also a £1,115k increase in the deferred tax asset recognised.

Site restoration provision

During the year, UKAEA has reviewed and updated the Lifetime Plan that underpins the site restoration provision recognised in UKAEA's Accounts. This has led to a £108,506k increase in the discounted provision, and the related receivable with BEIS. Further details are at Note 20.1.

Professor Ian Chapman

Chief Executive and Accounting Officer

9 July 2019

Performance Report Performance Analysis



Researchers in the Fusion Technology Facilities

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Accountability Report

Corporate Governance Report

Directors' Report

The Directors of the Board, and where appropriate the period for which they served during the year, are set out below.

Chair

Professor Roger Cashmore, CMG, FRS (to 31 July 2018)

Professor David Gann, CBE (from 1 August 2018)

Executive Directors

Professor Ian Chapman, Chief Executive Officer (CEO)

Antonia Jenkinson, Chief Financial Officer and Director of Corporate Affairs (Board member from 6 June 2019)

Non-Executive Directors

Norman Harrison

Shrinivas Honap (from 1 April 2018)

Dr Jim Hutchins (to 28 February 2019)

Sue Scane (from 1 April 2018)

Professor Sir Adrian Smith FRS (from 1 April 2018)

Chris Theobald

Biographical details of the active Directors are included on pages 35 to 36. The responsibilities of the Directors are included on pages 38 to 39.

The Executive Team

Professor Ian Chapman, Chief Executive Officer (CEO)

Antonia Jenkinson, Chief Financial Officer and Director of Corporate Affairs (from 11 February 2019)

David Martin, Chief Operating Officer

Catherine Pridham, Chief Financial Officer and Director of Corporate Affairs (to 11 February 2019)

The Executive Team listed above are members of the wider UKAEA Executive Committee which comprises UKAEA senior managers.

Biographical details of the active Executive team members above are included on page 37. Their remuneration has been included in the Remuneration Report.



1 Professor

Appointed on 1 August Innovation at Imperial Between 2 College's V playing a c new White major new and invest Secretary Advisory B member of largest pro advisor to firm. He ha technology Gammon, developed and mento up business

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Chairman and Non-Executives



1 Professor David Gann, CBE

Appointed as chair of the UKAEA Board on 1 August 2018. David is Professor of Innovation and Technology Management at Imperial College Business School. Between 2013-2019, he was Imperial College's Vice President – Innovation, playing a central role in developing the new White City campus and in securing major new corporate collaboration and investment. He is a member of the Secretary of State for Health's Technology Advisory Board, a non-executive board member of Directa Plus plc the world's largest producer of pristine graphene, and advisor to NEC, the Japanese electronics firm. He has advised several global technology companies including Citigroup, Gammon, IBM, McLaren and Tata Group, developed Crossrail's Innovation Strategy and mentored numerous technology start-up businesses.

He was Chairman of the Smart London Board (2012-2017), responsible for London's digital strategy, reporting to the Mayor of London and previously Group Innovation Executive, Laing O'Rourke plc (2007-2011).

He is the author of 8 books on innovation, entrepreneurship and technology management, which have been published in 8 languages. He is a Fellow of the Institution of Civil Engineers, an Honorary Fellow of the Royal College of Art and a Fellow of the City & Guilds Institute.



2 Norman Harrison

Appointed to the UKAEA board in March 2016. He is currently the Deputy Chair of the Advisory Council to RWM Ltd and the Deputy Chair of the Board of Governors at Manchester Metropolitan University. He also runs his own consultancy business.

He has 35 years' experience in the power and nuclear power sector. He has a long track record of successfully running nuclear power stations including Heysham 1 and Sizewell B. He delivered a major change programme at Dounreay and was CEO of UKAEA from 2006 to 2010 and led on the privatisation programme for UKAEA.

Norman is a Chartered Chemist and holds Fellowships with Nuclear Institute, Royal Society of Chemistry and Royal Society of Arts.



3 Shrinivas Honap

Appointed to the UKAEA Board on 1 April 2018, Shrinivas took over the position as Chair of the UKAEA Audit and Risk Committee, which oversaw the production of this document. Previously he has held senior roles at Vodafone and Capita and as a non-executive within the NHS. He brings a wealth of experience focused particularly on major system development, customer management, regulation and finance.

He currently holds non-executive roles on the following organisations: British Transport Police Authority; Registers of Scotland; Lay Member of the Speakers Committee on IPSA; Driver and Vehicle Standards Authority; and Office of the Public Guardian. He is also Chair of the Audit Committee for the latter two organisations. He is also panel Member of CMA and Board member and Chair of Audit at Office Legal Complaints.



4



4 Sue Scane

Appointed to the UKAEA Board on 1 April 2018. Sue was the Director for Environment & Economy at Oxfordshire County Council until her retirement, having previously been their Assistant Chief Executive & Chief Finance Officer. She is a qualified Accountant and has worked in Local or Central Government throughout her career.

She also serves on the Boards of the Oxford Diocese and of Didcot First.

5



5 Professor Sir Adrian Smith, FRS

Appointed to the UKAEA Board on 1 April 2018. Adrian Smith joined The Alan Turing Institute in September 2018. His previous role was Vice-Chancellor of the University of London where he was in post from 2012. He was Director General, Knowledge and Innovation in BIS (now BEIS) between 2008-2012.

He has worked with the UK Higher Education Funding and Research Councils and was appointed Deputy Chair of the UK Statistics Authority from September 2012. In 2014, he was appointed Chair of the Board of the Diamond Synchrotron at Harwell.

He is a past President of the Royal Statistical Society and was elected a Fellow of the Royal Society in 2001 in recognition of his contribution to statistics. In 2003-04, he undertook an inquiry into Post-14 Mathematics Education for the UK Secretary of State for Education and Skills and in 2017, on behalf of Her Majesty's Treasury and the Department for Education, published a 16-18 Maths Review.

In 2006 he completed a report for the UK Home Secretary on the issue of public trust in Crime Statistics. He received a knighthood in the 2011 New Year Honours list.

Former Non-Executive Directors:

Professor Sir Keith Burnett – served as non-executive director 1 November 2010 to 31 January 2018

Peter Jones, FCCA – served as non-executive director 1 November 2010 to 31 January 2018

Professor Roger Cashmore, CMG, FRS – served as chair 30 July 2010 to 31 July 2018

Dr Jim Hutchins – served as non-executive director 1 March 2016 to 28 February 2019.

6



6 Chris Theobald

Appointed to the UKAEA Board on 1 March 2016. He is a senior executive from the nuclear, energy and defence markets. During the last 15 years he has held leadership roles including MD of Serco's nuclear consulting business and Divisional MD at a joint venture between BAE Systems and Finmeccanica. Previously he held senior roles in BAE Systems Avionics and GEC-Marconi. He led the £140m sale of Serco's nuclear consulting business to AMEC in 2012. He served as a board director for the UK Low Level Waste Repository at Drigg, Cumbria and was a founding member of the board for the National Skills Academy for Nuclear. He was recently Vice- President UK/Europe for BWXT Inc (formerly Babcock and Wilcox) leading business development in the civil nuclear market.

Chris has a degree in Aeronautical Engineering and is a Member of the Royal College for Defence Studies.

1



1 Professor Sir Keith Burnett

Appointed to the UKAEA Board on 1 October 2010. He became a non-executive director in 2014. He has held various roles in fusion research, publishing papers and giving presentations.

He has won several awards, including the Society for Applied Mathematics Rosalind Franklin Award for European Nuclear Physics in 2014, the Young Scientist Medal in 2015 and the Cavendish Medal for a physicist.

He was made a Member of the Royal Society in 2015 and a Professor of Nuclear Physics in 2016.

Executive Team



1 Professor Ian Chapman

Appointed Chief Executive Officer and Accounting Officer for the UKAEA on 1 October 2016. He joined UKAEA in 2004, becoming Head of Tokamak Science in 2014. He has held a number of international roles in fusion, published over 120 journal papers and given 40 invited lead-author presentations at international conferences.

He has won a number of international awards, including the American Physical Society Thomas Stix Award in 2017, the Rosalind Franklin Award Lecture in 2015, the European Physical Society Early Career Prize in 2014, the Institute of Physics Paterson Medal in 2013, the IUPAP Plasma Physics Young Scientist Prize in 2012 and the Cavendish Medal for Best early-career UK physicist awarded by SET for Britain in 2011.

He was made a Fellow of the Institute of Physics in 2013 and became a visiting Professor at Durham University in 2015.



2 Antonia Jenkinson

Appointed Chief Financial Officer & Director of Corporate Affairs on 11 February 2019, and a member of the UKAEA Board on 6 June 2019. Antonia was previously CFO of Roc Technologies Ltd where she completed the acquisition of Esteem Systems Ltd; CFO/COO of the Satellite Applications Catapult where she helped grow the company from start-up; and CFO of the Wyevale retail group where she refinanced the £270m multi-site business after debt and credit issues in 2008.

Alongside her executive roles, Antonia has been a Non-Executive Director and Chair of the Audit Committees of Garden Centre Property Development Trading plc, Ocean Safety Ltd and currently Vysiion Limited. She won the Sunday Times NED Award for a private equity backed business in 2015.

Antonia is a fellow of the Chartered Institute for Securities & Investment.



3 David Martin

Appointed Chief Operating Officer in March 2016. He is a Chartered Mechanical Engineer and Fellow of the Institution of Mechanical Engineers who joined Culham after completing an apprenticeship at Harwell in 1979. Following a role in the build and operation of the Neutral Beam Testbed on JET, he joined the Engineering Group in Neutral Beams before establishing the Engineering Analysis Section. He became Engineering Group Leader and then Department Manager in 2008. In 2011 he was appointed Head of Physics and Engineering Development Division. He has held other senior engineering posts such as Engineer in Charge and Deputy Chief Engineer. In 2013 he was appointed Operations Director.

David is committed to staff development and has initiated many of the training schemes presently being run at UKAEA – including the apprentice and graduate programmes – helping to achieve accreditation by IET, IMechE and the Power Academy. He established OAS to give access to high quality technician training to local businesses.

He is a fellow of the IET.

Statement of Accounting Officer's Responsibility

Section 4(3) of the Atomic Energy Authority Act 1954 requires the United Kingdom Atomic Energy Authority to prepare a statement of accounts for each financial year in the form and on the basis set out by HM Treasury. The financial statements are prepared on an accruals basis and must give a true and fair view of the state of affairs of the Authority and of its Consolidated Statements of Comprehensive Income, Financial Position, Changes in Taxpayers' Equity and Cash Flows for the financial year.

In preparing those financial statements, the Accounting Officer is required to comply with the requirements of the Government Financial Reporting Manual and in particular to:

- observe any additional guidance issued by HM Treasury, including the relevant accounting and disclosure requirements, and apply suitable accounting policies on a consistent basis;
- make judgements and estimates on a reasonable basis;
- state whether applicable accounting standards as set out in the Government Financial Reporting Manual have been followed, and disclose and explain any material departures in the financial statements; and
- prepare the financial statements on a going concern basis.

The Accounting Officer of the Department for Business, Energy and Industrial Strategy (BEIS) has appointed the Chief Executive as Accounting Officer of the United Kingdom Atomic Energy Authority. The responsibilities of an Accounting Officer, including responsibility for the propriety and regularity of the public finances for which the Accounting Officer is answerable, for keeping proper records and for safeguarding the Authority's assets, are set out in Managing Public Money published by HM Treasury.

The Accounting Officer confirms that:

- the Annual Report and Accounts as a whole are fair, balanced and understandable; and
- as Accounting Officer he takes personal responsibility for the Annual Report and Accounts and the judgements required for determining that they are fair, balanced and understandable.

External Audit

The Accounting Officer and Directors also confirm that:

- there is no relevant audit information of which the auditors are unaware;
- all relevant steps have been taken to ensure that they are aware of relevant audit information; and
- all steps have been taken to establish that the auditors are aware of the information.

Details of the remuneration of the Group's auditors are set out in Note 7.

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Governance Statement

Scope of Responsibility

As Accounting Officer, I have responsibility for maintaining a sound system of governance and internal control that supports the achievement of the United Kingdom Atomic Energy Authority's policies, aims and objectives, whilst safeguarding the public funds and assets for which I am personally responsible, in accordance with the responsibilities assigned to me in Managing Public Money. I am assisted in this across the Authority (UKAEA) Group as a whole by the Chief Financial Officer and Director of Corporate Affairs.

Purpose of the Governance Statement

The Governance Statement, for which I am personally responsible, sets out how I have discharged my responsibility to manage and control UKAEA's resources during the year. It also sets out the governance framework and control structure of UKAEA, its stewardship and corporate governance, and the framework for and effectiveness of the risk management process in place.

The Authority's Governance Framework and Structure

The Board

The United Kingdom Atomic Energy Authority is controlled through its Board of Directors, who are appointed by the Secretary of State of BEIS. The Board's main role is to establish UKAEA's vision, mission and values, set strategy and structure, and exercise accountability to UKAEA's stakeholders.

The Board, which met six times during the year, has a schedule of matters reserved for its approval. This includes: establishing the overall strategic direction of UKAEA within the policy and resources framework agreed with the responsible Government Minister; reviewing UKAEA's corporate objectives and goals; approving the annual accounts, budget and corporate plan; reviewing and approving proposals to start new activities or to discontinue existing activities; ensuring that high standards of corporate governance are observed at all times; and reviewing the safety, environmental and security performance of UKAEA.

The Board delegates responsibility for day-to-day and business management control to the Chief Executive who is assisted by key senior managers comprising the Executive Committee. The Executive Committee meets monthly. Specific responsibilities delegated to the Executive Committee include: development of UKAEA performance measures; implementation of the strategies and policies as determined by the Board; monitoring of the operating and financial results against plans and budgets; developing and implementing risk management systems and reviewing progress on major projects.

The roles of the Chair and Chief Executive

The division of responsibilities between the Chair of the Board and the Chief Executive is clearly defined and has been approved by the Board. The Chair leads the Board in the determination of its strategy and in monitoring the achievement of its objectives. On 1 August 2018, Professor David Gann was appointed the Chair of UKAEA upon the retirement of Professor Roger Cashmore.

The Chief Executive has direct charge of UKAEA on a day-to-day basis and is accountable to the Board for the financial and operational performance of UKAEA and its subsidiaries. The Chief Executive is also UKAEA's Accounting Officer and is responsible to Parliament through the Committee of Public Accounts and other Select Committees for the stewardship of resources. His responsibilities are set out in a letter from the BEIS Permanent Secretary and the accompanying Accounting Officer Memorandum. The Accounting Officer has a personal responsibility for the propriety and regularity of the public finances for which he is answerable; for the keeping of proper accounts; for prudent and economical administration; for the avoidance of waste and extravagance; and for the efficient and effective use of all available resources. He is also responsible for taking formal action by issuing an Accounting Officer Direction, if the UKAEA Board is contemplating a course that would infringe these requirements. No Directions were issued during the year.

Directors and Directors' independence

For the year to 28th February 2019, the Board comprised the Chair, one Executive Director and six independent Non-Executive Directors. In March 2019 one Non-Executive Director retired, and a replacement will be appointed later in the year. The Chief Financial Officer and Director of Corporate Affairs joined the Board in June 2019. The composition of the UKAEA Board is in line with other bodies that report to BEIS. A list of Board members and their biographical details is included in the Directors' Report.

The Non-Executive Directors constructively challenge and help develop proposals on strategy, and bring strong and independent judgement, knowledge and experience to the Board's deliberations. The independent Directors are of sufficient calibre and number that their views carry significant weight in the Board's decision making.

The Board considers all its Non-Executive Directors to be independent in character and judgement.
No Non-Executive Director:

- has been an employee of UKAEA within the last five years;
- has, or has had within the last three years, a material business relationship with UKAEA or its former or current subsidiaries;
- receives remuneration from the Authority other than a Director's fee and expenses incurred in carrying out their duties;
- has close family ties with any of UKAEA's advisers, Directors or senior employees;
- holds cross-directorships or has significant links with other Directors through involvement in other companies or bodies; or
- has served on the Board for more than nine years.

Corporate Governance

UKAEA's corporate governance arrangements are kept under review to ensure that they are compliant with best practice. It made a formal assessment during the year of its compliance against the code of good practice for Government and concluded that UKAEA met the requirements of the code. In addition, the Board keeps its own performance under review and conducted a performance self-assessment based on a template developed by the National Audit Office (NAO) and Non-Executive Directors' Group. The results indicated predominantly good performance with no areas for improvement identified.

The Board reviews the performance of its sub-committees on an annual basis, using a self-assessment process. The review of the Audit Committee indicated good performance in all areas of the committee's remit. The review of the Remuneration Committee indicated good performance in all areas except for senior succession planning where members wanted more assurance in particular given UKAEA's expanding business and some difficulties in recruitment.

In addition to the Board sub-committees, external advice is a key element of the Corporate Governance process. The Culham Programme Advisory Committee, which has an external chair and membership, all of whom have backgrounds in fusion and industry, provides expert external scrutiny of UKAEA programmes and strategy, and reports directly to the Board. The key role of the committee is to review the UKAEA corporate strategies and scientific programme and provide guidance and advice to the Executive on the implementation and planning for these, as well as independent assurance to the Board that the whole UKAEA programme is soundly-based and achievable.

UKAEA's subsidiary, AEA Insurance Ltd, has appropriate governance arrangements in place. These are formally reviewed and updated as necessary by its Board of Directors, which includes UKAEA's Director of Finance. A compliance and company secretarial summary is tabled for review at each Board meeting. A risk register and provisions for an annual internal audit of controls and risks are also in place.

The UKAEA Group has 50% control of a joint venture, Harwell Science and Innovation Campus Public Sector Limited Partnership (HSIC PubSP), the public-sector partner in Harwell Science and Innovation Campus Ltd Partnership (HSIC), which is responsible for the development of the Harwell Campus. Both HSIC PubSP and HSIC have appropriate and fully documented governance arrangements in place, covering such matters as membership of and decisions made by their Boards of Directors, appointment and removal of Directors, funding and confidentiality. The Chief Financial Officer and Director of Corporate Affairs is on the Board of HSIC PubSP and the Business Development and Innovation Director is on the Boards of both HSIC PubSP and HSIC.

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Accountability Report Corporate Governance Report

Board Committees

Attendance

The number of full Board meetings and committee meetings attended by each Director during the year was as follows:

	Board	Remuneration Committee	Audit Committee	Board Assurance Committee
Roger Cashmore	2 (2)	1 (1)	2 (2)	
David Gann	4 (4)	2 (3)	2 (3)	
Ian Chapman	6 (6)	–	–	
Norman Harrison	6 (6)	4 (4)	5 (5)	
Shrinivas Honap	6 (6)	4 (4)	5 (5)	
Jim Hutchins	5 (5)	3 (3)	4 (4)	
Sue Scane	6 (6)	4 (4)	5 (5)	
Adrian Smith	6 (6)	3 (4)	5 (5)	
Chris Theobald	6 (6)	4 (4)	5 (5)	4 (4)

Figures in brackets indicate the maximum number of meetings in the period in which the individual was a Board member.

Remuneration Committee

The Remuneration Committee met four times during the year. All its members are independent Non-Executive Directors. Where necessary, non-committee members are invited to attend.

The Committee's principal responsibility is to make recommendations to BEIS on the level of Directors' remuneration. In addition, the Committee regularly reviews UKAEA's executive remuneration policy in relation to its competitors and industry norms and contract periods. The Committee also advises on any Human Resources policy issue or any proposed change to remuneration arrangements or terms and conditions of UKAEA staff generally which would require the agreement of Government.

As the members of the UKAEA Board are appointed by BEIS, UKAEA does not maintain a nominations committee.

Audit Committee

The Audit Committee met five times during the year. All its members are independent Non-Executive Directors.

For the year to 31st March 2019, the Committee had at least one member possessing what the Smith Report and HMT's Audit Committee Handbook describe as recent and relevant financial experience; Shrinivas Honap is a qualified Chartered Accountant and holds a number of roles as Chair of Audit across government having previously been an executive at Vodafone and Capita Plc.

The Directors' biographical details included in the Directors' Report show that the other members of the Committee brought to it a wide range of experience from positions at the highest level in the UK scientific and business community. Shrinivas Honap was appointed as Non-Executive Director and Chair of the Audit Committee from 1 April 2018.

Under its terms of reference, the Committee is responsible for:

- monitoring the effectiveness of the external audit process and overseeing the terms of engagement and remuneration of the external auditor and their work;
- endorsing UKAEA's policy on the provision of non-audit services by the external auditor (none were provided in 2018/19);
- reviewing annually the system of internal control and the processes for monitoring and evaluating the risks facing UKAEA;
- agreeing, monitoring and reviewing the effectiveness of the internal audit programme and the implementation of recommendations arising from it;
- reviewing the actions and judgements of management in relation to annual and other financial statements before submission to the UKAEA Board; and
- reviewing UKAEA's procedures for detecting and preventing fraud and its whistleblowing policy.

Key areas considered by the Audit Committee during the year were:

- workplan of internal audit, the results of such audit work and management's progress to resolve issues and risks identified and key areas of focus for Internal Audit;
- the 3 year internal audit and management systems audit programmes and mapping of these audits to the Corporate Risk Register;
- fraud landscape, UKAEA counter-fraud action plan and the implementation of the new Government Functional Standard 013 – Counter fraud, bribery and corruption;
- update and review of the lifetime plan which underpins the site restoration provision;
- review of information security policy and procedures; and
- UKAEA's statutory accounts, including compliance with HMT guidance and the application of accounting policies and assumptions.

Board Assurance Committee

The Board Assurance Committee met four times during the year. The committee is chaired by a non-executive Director and membership includes operational leaders, the Head of Assurance and externals with significant operational safety experience. The principal responsibility is to assure the Board that appropriate processes and monitoring are in place to effectively manage UKAEA's risks relating to security, safety, health, environment, quality and good scientific reputation.

In addition to regular update reports on QSHE, Security, Information Assurance and Legislation, other areas considered by the Board Audit Committee during the year included:

- Growing UKAEA's safety Culture
- Scientific quality;
- Business continuity management;
- Preparations for tritium operations;
- Facilities asset management; and
- The Integrated Delivery Process (IDP) project.

The Risk and Internal Control Framework

As Accounting Officer, I have responsibility for reviewing the effectiveness of the systems of risk management; information security and internal control. My review of the effectiveness of these systems is informed by the work of senior managers within UKAEA who have responsibility for the development and maintenance of the internal control framework, an internal audit function and comments made by the external auditors in their management letter and other reports.

Risk Management

The Head of Assurance co-ordinates deployment of the risk management arrangements, ensuring consistency of approach and periodically reporting risk to the Executive Committee and Board. Ownership of divisional or functional risk registers is assigned to relevant senior managers, and individual risks are owned by the most appropriate individual. The Corporate Risk Review Group, which meets quarterly, provides oversight of corporate and major project risks, it reviews the status of the risk register and the progress of mitigations identified by the risk owners.

The Board formally reviews key risks biannually in conjunction with UKAEA's risk appetite statement. The risk landscape is used to inform the business strategy and the audit programmes to aid management in the delivery of business objectives. Performance of major projects including current status, risk and financial metrics, is reviewed on a monthly basis by the Executive.

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Accountability Report Corporate Governance Report

Key risks can be grouped into the following areas:

Strategic

- maintenance of UKAEA's reputation as a world leader in fusion research;
- UK's plan to exit the EU and Euratom agreements;
- future funding (including the impact of changes in the Euro: Sterling exchange rate); and
- strategic planning for the organisation in development of existing and future programmes in cutting-edge design and engineering work to enable future growth.

Operational

- recruitment and retention of employees with key skills and capabilities required for the success of the organisation;
- operation of JET to maximise the scientific output before eventual decommissioning;
- achievement of the first physics campaign for MAST-U following successful commissioning into operations;
- promotion of a proactive safety culture throughout the organisation;
- improvements required in cyber security in terms of detection & prevention; and
- strengthening business continuity planning.

Internal Audit

UKAEA has an internal audit function which operates in accordance with Public Sector Internal Audit Standards and an Audit Charter approved by the Audit Committee. The work of Internal Audit is determined by analysis of the risks to which UKAEA is exposed. The annual internal audit programme is based on this analysis and additionally includes a 3-year rolling programme to test key financial controls. It includes reviews which test and challenge the effectiveness of the management of risks and information

The Head of Internal Audit provides me, as Accounting Officer, with regular reports on internal audit activity in UKAEA. These reports include an independent opinion on the adequacy and effectiveness of UKAEA's system of risk management and internal control. Internal audits undertaken during the year took into account an assessment of where the greatest control risks were, and this approach resulted in the following classifications:

Classification	Substantial Assurance	Moderate Assurance	Limited Assurance	Unsatisfactory
Number of reports	–	7	3	–

The following table summarises progress during the year on completing recommendations and actions arising from Internal Audit reviews:

Audit actions	2017-18	2018-19	Total
Carried forward from previous years	21	–	21
Raised in year	–	43	43
Completed in 2018/19	(19)	(34)	(53)
Actions overdue at 31st March 2019	2	2	4
Total actions outstanding but not overdue at 31st March 2019	–	7	7
Total carried forward to next year	2	9	11

There has been an improvement in the total overdue audit recommendations from last year, these outstanding relate to:

- Payroll integration with external payroll supplier
- An improvement to automate the interface from UKAEA to its payroll supplier is ongoing. Through this automation, the risk of manual error will be eliminated. External delays with technical delivery have extended the project completion to first half of next financial year.
- Management and control of agency supplied Trade and Craft workers
- UKAEA identified a lack of key governance controls over resourcing and expenditure in this specific area of its workforce. To address this, improvements have been put in place particularly in respect to time recording, internal procedures and invoice controls. These processes will be fully embedded by the end of the financial year.
- Plant and Equipment recording and maintenance.
- Although there are areas of appropriate diligence by UKAEA staff in recording, caring for, and supporting complex research plant through its lifecycle, this is not sufficiently comprehensive across the whole business. An improvement programme has been approved by the Executive and includes implementing new processes and tools for Asset Management.

Head of Internal Audit Statement

On the basis of the audit work undertaken for the year and taking into account all available evidence, in my opinion, I can provide moderate assurance that there is a generally sound system of internal control, governance and risk management within UKAEA. The control weaknesses that were identified in the Cyber Security Audit and the Eurofusion Audit which resulted in a Limited Assurance opinion are in the process of being addressed; with remaining actions continuing to be resolved. The issues relating to the recent Business Continuity review existed at year end and have action plans in place to address them in 2019.

Information Security

The UKAEA Chief Financial Officer and Director of Corporate Affairs is nominated as the Senior Information Risk Owner (SIRO), with special responsibilities for information risks.

Information risks are overseen by an Information Assurance Steering Committee (chaired by the SIRO), which feeds significant risks into the Corporate Risk Review Group. During the year GDPR awareness training was undertaken by all relevant employees, further information assurance training was rolled out to staff, and the internal communications campaign continued, with key themes of cyber and information security. Following the cyber essentials certification in 2017, the UKAEA is progressing towards being aligned with the Government's 10 Steps to Cyber Security Framework. To help with this, an external cyber security audit was undertaken which resulted in some improvement recommendations around IT governance; these are in progress. Continued funding was received from BEIS to invest in IT infrastructure and IT/information business continuity; this work will continue over the next few years. One of the projects funded is to implement Azure Information Protection, which will provide automatic document classification and encryption where required.

There have been no reportable data breaches or data loss incidents during the year.

Whistleblowing policy

UKAEA has a detailed whistleblowing policy which is available to all employees through the Intranet. It is regularly reviewed and refreshed, and is written in a way that encourages employees to report concerns, and makes it clear who the key contacts are. No concerns have been reported during the financial year.

Other Matters

Decommissioning Provision Review

UKAEA and the Nuclear Decommissioning Authority have completed a review of the Lifetime Plan which underpins the Decommissioning Provision, the impact of which is included within the Financial Statements (see note 20.1). This has followed the principles set out in "The Aqua Book", a good practice guide published by the UK Government for assurance of financial analysis.

Accounting Reporting changes

The financial statements include the impact of financial reporting changes to financial instruments and revenue accounting. The notes include prior year comparatives where applicable for clarity.

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Professor
Chief Exec
9 July 201

Accountability Report Corporate Governance Report

Alexander Tax Review

I confirm that the UKAEA is compliant with the requirements of the Alexander Review (2012). We have one Senior Staff member on secondment and have confirmed that they are paid via the payroll of their seconding organisation. All other Senior Staff and Non-Executive Members are paid via UKAEA payroll. In all cases, this results in appropriate tax contributions being deducted at source.

During the year under review, UKAEA reviewed the tax arrangements of its off-payroll appointments. All contractors within scope of this exercise have been required to provide evidence of tax compliance. All off-payroll appointments were tax compliant as at 31st March 2019.

MacPherson Review of Quality Assurance

UKAEA conducted a review of analytical modelling as advocated by the Macpherson review (2013) and can confirm that it conducts no analytical modelling within the scope of the review.

JET Operating Contract Renewal

On its renewal, the JET Operating Contract was amended to include grant conditions related to the attainment of key milestones enabling the delivery of the European research programme. In the event that these milestones are not met, the European Commission can reduce its operational funding by a maximum of Euros 30m across the contract period (to December 2020), with this being instead met by UK Government.

Going Concern

The financial statements have been prepared on a going concern basis. UKAEA income and investment is growing through support of the Government's Industrial Strategy and the global fusion programme. A significant proportion of UKAEA revenue is from the European Commission to finance the operation of JET, representing approximately 48% of UKAEA total revenue. An operating contract, independent of Brexit outcomes, is in place until the end of December 2020. In principle, this can be extended to 2024 following an agreement on the scientific basis and EU budgets – in line with the cycle of renewal for the European research programmes.

The balance of UKAEA portfolio is broadening, with both UK & European funding. The European funding is in scope of the guarantee given by the UK Government in July 2018, providing certainty of funding over the course of EU Exit, guaranteeing the continuation of funding for the lifetime of UK projects that have been awarded competitively by the European Commission.

Our sponsor department, BEIS, have also demonstrated their ongoing support for the fusion programme by their £86m investment in the new Hydrogen-3 Advanced Technology (H3AT) and the Fusion Technology Facilities (FTF) which is taking place between 2017 and 2021. In 2019/20 UKAEA is receiving £20m to establish a national programme (the STEP Programme) that will explore the options, challenges and solutions for accelerating fusion delivery, seeking to identify a pathway to supply net energy by the early 2040's. UKAEA is also receiving ongoing investment into RACE and MRF – to build capability and facilities for future exploitation.

The Board, Executive and I therefore believe that the commitment from international parties and the UK Government to fusion research is sufficient to support continuing operations for the foreseeable future.

UKAEA's Statement of Financial Position includes liabilities of over £468m for site restoration and restructuring costs. Matching reimbursement receivables are recognised for most of these liabilities on the basis of assurances from BEIS that it continues to accept responsibility in principle for these costs and provides for them in the BEIS departmental resource accounts. These assurances are re-confirmed annually and there is therefore no effect on UKAEA's ability to operate as a going concern.

I have reviewed all evidence provided to support the annual Governance Statement. My conclusion is that UKAEA's overall governance and internal control structures are generally sound and fit for purpose.

Professor Ian Chapman
Chief Executive and Accounting Officer
9 July 2019

Accountability Report

Remuneration and Staff Report

Remuneration Policy

The remuneration of Directors is set by the Secretary of State for BEIS with the approval of HM Treasury in accordance with the Atomic Energy Authority Act 1954. The UKAEA Remuneration Committee makes recommendations to BEIS on the overall remuneration package for Executive Directors. The Non-Executive Directors who form the Committee are not involved in decisions relating to their own remuneration.

In reaching its recommendations, the Committee has regard to the following considerations:

- the need to recruit, retain and motivate suitably able and qualified people to exercise their different responsibilities; and
- the funding available to UKAEA.

The Committee takes account of the evidence it receives about wider economic considerations and the affordability of its recommendations.

Service contracts

Executive Directors are appointed by the Secretary of State for BEIS. This is normally for a three year term that may be renewed upon expiry in accordance with the guidelines issued by the Commissioner for Public Appointments.

Remuneration and pension entitlements

The individual components of the remuneration packages are:

Salary and fees

The CEO as Executive Director receives a basic salary which is reviewed annually by UKAEA's Remuneration Committee. The Chair and Non-Executive Directors receive fees for their services. Members of the Executive Team also receive a basic salary which is reviewed annually by the Remuneration Committee. The Remuneration Committee makes recommendations to BEIS as appropriate.

Benefits

Some members of the Executive Team receive a car allowance.

Executive Directors, and members of the Executive Team, are also reimbursed for reasonable expenses incurred in line with the policy for UKAEA's employees. These reimbursements are not included in the table below.

Performance related bonuses

The performance bonuses for Executive Directors are calculated in accordance with performance against agreed objectives, confirmed by BEIS on the basis of recommendations from the Remuneration Committee. The total bonus is made up of two components: the performance of UKAEA against specific quantified targets, and the performance of the individual against specific targets. Members of the Executive Team receive bonuses based on formulae that are agreed each year by the Remuneration Committee, and which are subject to approval by BEIS where applicable. The performance-related bonuses for 2018/19 shown in the table below have been calculated on the basis of assessment by the Remuneration Committee of performance against the relevant specific targets. Payment of the CEO's bonus is subject to approval by BEIS.

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Accountability Report Remuneration and Staff Report

Individual Directors' remuneration for the year is shown in the table below, with salaries disclosed on an accruals basis.

This part of the report is subject to audit.

2018/19	Salary/ Fees £k	Benefits^(e) to nearest £100	Annual bonus £k	Pension benefit^(g) £k	2018/19 Total £k
Chair					
Roger Cashmore (to 31 July 2018) ^(a)	5-10	–	–	–	5-10
David Gann (from 1 August 2018) ^(a)	15-20	1,200	–	–	15-20
Non-Executive Directors					
Norman Harrison	10-15	200	–	–	15-20
Shrinivas Honap	10-15	1,200	–	–	15-20
Jim Hutchins (to 28 February 2019) ^(b)	10-15	400	–	–	10-15
Sue Scane	10-15	100	–	–	15-20
Adrian Smith	10-15	–	–	–	10-15
Chris Theobald	10-15	1,300	–	–	15-20
Executive Directors					
Ian Chapman	165-170	–	20-25	–	190-195
Members of the Executive Committee					
Antonia Jenkinson (from 11 February 2019) ^(c)	15-20	–	–	4	20-25
David Martin	125-130	6,100	10-15	7	150-155
Catherine Pridham (to 11 February 2019) ^(c)	110-115	5,600	10-15	26	155-160
2017/18					
Chair					
Roger Cashmore	20-25	–	–	–	20-25
Non-Executive Directors					
Keith Burnett ^(b)	10-15	–	–	–	10-15
Norman Harrison	10-15	–	–	–	10-15
Jim Hutchins	10-15	600	–	–	15-20
Peter Jones ^(b)	10-15	1,000	–	–	10-15
Chris Theobald	10-15	2,200	–	–	15-20
Executive Directors					
Ian Chapman	160-165	–	20-25	111	295-300
Members of the Executive Committee					
Martin Cox (to 31 March 2018) ^(d)	110-115	5,000	5-10	(13)	110-115
David Martin	125-130	6,100	5-10	(9)	130-135
Catherine Pridham	120-125	6,100	10-15	24	160-165

Notes:

- Roger Cashmore retired as Chair on 31 July 2018. David Gann was appointed Chair from 1 August 2018. The full year remuneration for the Chair was £25k.
- The full year fees were £15k.
- The full year salaries for Catherine Pridham and Antonia Jenkinson were in the ranges £120-125k and £130-135k respectively.
- Martin Cox became an adviser to the CEO in 2018/19 and was no longer a member of the Executive team. His remuneration for 2018/19 was in the range £55-60k. He also received benefits of £2,700 (to nearest £100).
- Expenses disclosed for the Chair and Non-Executive Directors in 2019 and in the comparatives for 2018 relate to travel for Board and other meetings at Culham and include the tax liability on these expenses which was met by UKAEA. These expenses vary depending on the distance of the individual's home from Culham.
- Annual bonuses disclosed in the Accounts are subject to approval by BEIS where applicable. The actual 2017/18 bonuses awarded did not differ materially from those reported in the comparative for 2017/18.
- The value of pensions benefits accrued during the year is calculated as (the real increase in pension multiplied by 20) plus (the real increase in any lump sum) less (the contributions made by the individual). The real increases exclude increases due to inflation or any increase or decrease due to a transfer of pension rights. In some cases the pensions benefit is negative in real terms where pay increases and additional service have not offset the effect of inflation. The presentation of negative pension benefit has been changed for 2018/19. Where there is a negative benefit, nil benefit is shown in the remuneration tables. The comparatives have been left unchanged.

Remuneration ratios

These figures are subject to audit.

	2018/19 £	2017/18 £
Highest Paid Director's Total Remuneration	194,766	187,381
Median Total Remuneration	42,458	42,300
Ratio	4.59	4.43

Reporting bodies are required to disclose the relationship between the remuneration of the highest paid director in their organisation and the median remuneration of the organisation's workforce.

No employee received remuneration in excess of the highest-paid Director in either 2018/19 or 2017/18.

Total remuneration includes salary, performance-related pay and benefits in kind. It does not include pensions benefit, employer pension contributions and the cash equivalent transfer value of pensions.

The range of staff remuneration included in the calculation above was £11,721 to £194,766 (2017/18: £11,665 to £187,381).

Pension entitlements (subject to audit)

Executive Directors and members of the Executive Committee are members of the United Kingdom Atomic Energy Authority Combined Pension Scheme that pays an annual pension based on pensionable final earnings together with a lump sum at normal retirement age. Benefits are also payable in the event of death or ill health retirement. UKAEA also operates an unfunded pension arrangement for three former Chief Executives to take account of pensionable pay above the earnings cap introduced by the Finance Act 1989.

Further details of the pension schemes and unfunded pensions can be found later in the Remuneration and Staff Report.

The pension entitlements shown in the table below are those that would be paid annually on retirement based on service to 31 March 2019 and include the value of added years paid for by Directors.

	Accrued pension as at 31/3/19 £k	Lump sum as at 31/3/19 £k	Real increase in accrued pension ^(a) £k	Real increase in lump sum ^(a) £k
Executive Directors				
Ian Chapman	20-25	65-70	(2.5-5)	(7.5-10)
Members of the Executive Committee				
Antonia Jenkinson	0-5	0-5	0-2.5	0-2.5
David Martin	60-65	180-185	0-2.5	0-2.5
Catherine Pridham ^(b)	10-15	40-45	0-2.5	2.5-5

Notes:

(a) The real increase has been calculated after subtracting inflation.

(b) Figures for Catherine Pridham are up to 11 February 2019 when she left UKAEA.

Accountability Report Remuneration and Staff Report

The following table (which is subject to audit) sets out the Cash Equivalent Transfer Value (CETV) of the Executive Directors' and Executive Team members' accrued pension entitlements which have been calculated by the Scheme managers in accordance with the Occupational Pension Schemes (Transfer Values) Regulations 1996 as amended, having taken actuarial advice. The transfer values do not represent sums paid or payable to the Directors or Executive Committee members but represent a potential liability of the pension scheme or UKAEA.

	CETV at 31 March 2018 £k	Real increase in CETV ^(a) £k	CETV at 31 March 2019 £k
Executive Directors			
Ian Chapman	298	(43)	326
Members of the Executive Committee			
Antonia Jenkinson	–	3	4
David Martin	1,346	8	1,484
Catherine Pridham ^(b)	244	23	308

Notes:

- (a) The real increase has been calculated after subtracting inflation
 (b) Figures for Catherine Pridham are up to 11 February 2019 when she left UKAEA.

Members of the pension scheme have the option to pay Additional Voluntary Contributions; neither the contributions nor the resulting benefits are included in the above tables.

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Staff Report

This section is subject to audit.

Staff costs

Staff costs comprise:

	2019 £k	2018 £k
Permanently employed staff		
Salaries, bonuses and allowances	42,558	36,479
Social security costs	4,899	4,227
Pension costs	6,900	5,946
	54,357	46,652
Other staff	17,708	17,463
	72,065	64,115

Staff numbers

The average number of full time equivalent staff during the year was as follows:

	2019	2018
Directly employed	922	787
Other staff	327	343
	1,249	1,130

Other staff are hired staff. The majority of these are used to carry out specialist work in UKAEA's scientific facilities.

Staff composition as at 31 March 2019

All figures in the tables below relate to actual staff numbers at the year end rather than to average full time equivalents.

Board and senior staff

	Male	Female	Total
Board members ^(a)	6	1	7
Executive Team	2	1	3
Executive Committee	8	4	12
Senior staff	11	2	13

(a) An additional female Board member was appointed to the Board from 6th June 2019.

All Employees

	2019	2018
Male	783 (76.8%)	681 (77.9%)
Female	237 (23.2%)	193 (22.1%)

Sickness absence

The average sickness absence per employee for UKAEA during the 2018/19 year was 6.4 days per person, compared with 6.7 days in 2017/18. This is considerably lower than the public sector average of 8.4 days per employee for all public services workers as disclosed in the latest Chartered Institute of Personnel and Development Health and Wellbeing at work report.

UKAEA Pension Schemes

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Accountability Report Remuneration and Staff Report

UKAEA has three defined benefit schemes: the Combined Pension Scheme (CPS), the Principal Non-Industrial Superannuation Scheme (PNISS) and the Protected Persons Superannuation Scheme (PPSS). These schemes have members from other employers as well as UKAEA. No information in these financial statements relates to other employers participating in the CPS, PNISS or PPSS. The Group has overall responsibility for the management of the schemes under a Framework Agreement with BEIS. No contingent liability is expected to arise from this responsibility.

In common with other public sector schemes, the CPS, the PNISS and the PPSS do not have many of the attributes of normal pension schemes. All contributions are paid to and benefits paid by HM Government via the Consolidated Fund. Any surplus of contributions made in excess of benefits paid out in any year is surrendered to the Consolidated Fund and any liabilities are met from the Consolidated Fund via the annual Parliamentary vote. The Government does not maintain a separate fund and actuarial valuations are based on a theoretical calculation as to how a typical UK pension scheme would have invested the historical surplus of contributions over payments.

In accordance with the FReM, the schemes are accounted for as defined contribution schemes.

Employer contributions are calculated in accordance with HM Treasury methodology "Superannuation Contributions Adjusted for Past Experience" and are based on the expected cost of members' benefits as they accrue. The total contributions paid by the Group during the year were £6,875k (2018: £5,924k).

(b) Defined contribution schemes

UKAEA manages two defined contribution schemes, the Additional Voluntary Contribution (AVC) scheme and the Shift Pay Pension Savings Plan (SPPP) scheme, both of which are fully insured schemes administered by Prudential Assurance Company Ltd to whom contributions are paid.

The AVC scheme includes members from UKAEA and from other employers who are members of CPS or PPSS and who have opted to pay additional voluntary contributions. No employer contributions are made to this scheme.

The members of the SPPP scheme include shift working employees of UKAEA and other employers who are members of CPS or PPSS. The costs of the SPPP scheme, which are directly linked to shift pay earnings, are charged to the statement of comprehensive income at the time the shift pay is paid. The total contributions paid by UKAEA during the year were £23k.

(c) Unfunded retirement benefits

Three former UKAEA chief executives have unfunded retirement benefits which are not included in the UKAEA pension schemes.

The movement in the liability for these benefits is shown below:

	Group and Authority	
	2019	2018
	£k	£k
At 1 April 2018	2,251	2,323
Change in discount rate	(57)	47
Interest on liability	56	64
Benefits payable	(81)	(79)
Actuarial (gain) loss	(63)	(104)
At 31 March 2019	2,106	2,251

The interest on liability is included in the statement of comprehensive income and the actuarial loss is included in taxpayers' equity. The closing liability, discounted at the appropriate pensions liability discount rate, is included in other provisions for liabilities and charges in the statement of financial position (further details of provisions are given in Note 20).

Staff Policy

UKAEA's equal opportunities policy requires that all job applicants enjoy equal opportunity for employment on the basis of ability, qualifications, experience and suitability for the work. We deliver in-house training on diversity and equality, unconscious bias and specific recruitment training. Both courses cover equality, diversity and inclusion, ensuring that line managers are aware of their responsibilities towards, and the benefits of, these topics.

UKAEA's equal opportunities policy provides a framework for ensuring that equality is considered throughout the employment of staff. For those who become disabled during their employment, we provide occupational health facilities which provide direct support to the employee and also advise line managers on modifications and restrictions which are required. In addition to the training mentioned above, HR Business Partners provide coaching on flexible working and unconscious bias to ensure that employees with disabilities are given equal opportunity in training, career development and promotion. UKAEA is also registered on the Disability Confident Scheme.

UKAEA is currently developing an Equality, Diversity and Inclusion strategy, with sponsorship at Board and Executive level, and has recruited an Equality, Diversity and Inclusion Partner to provide specialist knowledge and direction to the organisation.

UKAEA is currently developing an Equality, Diversity and Inclusion strategy, with sponsorship at Board and Executive level.

Expenditure on consultancy

There was no expenditure on consultancy in either the current or the previous year.

Off-payroll appointments

(a) Off-payroll engagements as of 31 March 2019, for more than £245 per day that last for longer than six months

Number of existing engagements as of 31 March 2019	62
Of which:	
Number that have existed for less than one year at time of reporting	14
Number that have existed for between one and two years at time of reporting	24
Number that have existed for between two and three years at time of reporting	7
Number that have existed for between three and four years at time of reporting	–
Number that have existed for more than four years at time of reporting	17

(b) New off-payroll appointments, or those that reached six months in duration, between 1 April 2018 and 31 March 2019, for more than £245 per day and that last for longer than six months

Number of new engagements, or those that reached six months in duration, between 1 April 2018 and 31 March 2019	30
Of which:	
Number assessed as within the scope of IR35	29
Number assessed as not within the scope of IR35	1
Of which:	
Number engaged directly (via Personal Service company) and on UKAEA payroll	–
Number of engagements reassessed for consistency/assurance purposes during the year	1
Number of engagements that saw a change to IR35 status following the consistency review	–

(c) Off-payroll engagements of board members, and/or senior officials with significant financial responsibility, between 1 April 2018 and 31 March 2019

Number of off-payroll engagements of board members, and/or senior officials with significant financial responsibility, during the financial year	1
Total number of individuals on payroll and off-payroll that have been deemed “board members, and/or senior officials with significant financial responsibility” during the financial year	17

The off-payroll engagement above related to the short term engagement of Jim Hutchins, former Non-Executive Director up to 31 March 2019, to provide expert advice to UKAEA pending the appointment of a replacement Non-Executive Director.

(d) AEA Insurance Limited (see also Note 13.1): Off-payroll engagements of board members, and/or senior officials with significant financial responsibility, between 1 April 2018 and 31 March 2019.

Number of financial re Total numb and/or sen

Engagemen Isle of Man directors a

From 2014

Trade Unio

Table 1 – P

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Table 2: P

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51-99%
100%

Table 3: P

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Table 4: P

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£10,000 -
£25,000
£50,000
£100,000
Total num

Accountability Report Remuneration and Staff Report

Number of off-payroll engagements of board members, and/or senior officials with significant financial responsibility, during the financial year	3
Total number of individuals on payroll and off-payroll that have been deemed “board members, and/or senior officials with significant financial responsibility” during the financial year.	3

Engagements from 2002 and 2005 respectively: AEAIL is a captive insurance company registered in the Isle of Man and subject to their tax and NI legislation. AEAIL does not employ anyone. Two AEAIL directors are off-payroll by default and are paid a small fee by AEAIL.

From 2014 to 2019: The third off-payroll director is a director of UKAEA and on UKAEA payroll.

Trade Union Facility Time

Table 1 – Relevant Union Officials

Number of employees who were relevant union officials during the relevant period	Full-time equivalent employee number
14	14

Table 2: Percentage of time spent on facility time

Percentage of working time spent on facility time by employees who were relevant union officials	Number of employees
0%	8
1-50%	6
51-99%	–
100%	–

Table 3: Percentage of pay bill spent on facility time

	Figures £
Total cost of facility time	7,457
Total pay bill	54,356,699
Percentage of the total pay bill spent on facility time, calculated as: (total cost of facility time ÷ total pay bill) x 100	0.014%

Table 4: Paid trade union activities

Time spent on paid trade union activities as a percentage of total paid facility time hours calculated as: (total hours spent on paid trade union activities by relevant union officials during the relevant period ÷ total paid facility time hours) x 100	Nil
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Exit packages paid to employees (audited)

Exit package cost band	Number of compulsory redundancies		Number of other departures agreed		Total number of exit packages by cost band	
	2018/19	2017/18	2018/19	2017/18	2018/19	2017/18
<£10,000	–	–	1	–	1	–
£10,000 - £25,000	–	–	–	–	–	–
£25,000 - £50,000	1	–	–	–	1	–
£50,000 - £100,000	–	–	–	–	–	–
£100,000 - £150,000	–	–	–	–	–	–
Total number of exit packages	1	–	1	–	2	–

The departures disclosed above relate to early releases which are within the terms set out in UKAEA's Conditions of Employment Manual, or have been subject to separate and appropriate approval processes. Where applicable, the additional costs of early releases are met by UKAEA and not by UKAEA's CPS. Ill-health retirement costs are met by the CPS and these retirements are not included in the table.

Fees and Charges (audited)

UKAEA does not receive fees and charges for public services, as defined by HM Treasury in Managing Public Money. There are therefore no related disclosures.

Losses and Special Payments (audited)

There were no reportable losses and special payments during the financial year.

Remote Contingent Liabilities (audited)

UKAEA has no remote contingent liabilities to report.

Brexit

On 29 March 2017, the UK Government submitted its notification to leave the EU in accordance with Article 50. The triggering of Article 50 started a two-year negotiation process between the UK and the EU. On 11 April 2019, the government confirmed agreement with the EU on an extension until 31 October 2019 at the latest, with the option to leave earlier as soon as a deal has been ratified.

Any subsequent changes in legislation, regulation and funding arrangements are subject to the outcome of the negotiations

Professor Ian Chapman
Chief Executive and Accounting Officer
9 July 2019



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RACE technical review meeting

Accountability Report Parliamentary Accountability and Audit Report

The Certificate and Report of the Comptroller and Auditor General to the Houses of Parliament

Opinion on financial statements

I certify that I have audited the financial statements of the United Kingdom Atomic Energy Authority for the year ended 31 March 2019 under the Atomic Energy Authority Act 1954. The financial statements comprise: the Group and Authority Statements of Comprehensive Net Expenditure, Financial Position, Cash Flows, Changes in Taxpayer's Equity; and the related notes, including the significant accounting policies. These financial statements have been prepared under the accounting policies set out within them. I have also audited the information in the Accountability Report that is described in that report as having been audited.

In my opinion:

- The financial statements give a true and fair view of the state of Groups and of the United Kingdom Atomic Energy Authority's affairs as at 31 March 2019 and of Group's and Authority's net income for the year then ended; and
- The financial statements have been properly prepared in accordance with the Atomic Energy Authority Act 1954 and Secretary of State directions issued thereunder.

Opinion on regularity

In my opinion, in all material respects the income and expenditure recorded in the financial statements have been applied to the purposes intended by Parliament and the financial transactions recorded in the financial statements conform to the authorities which govern them.

Basis of opinions

I conducted my audit in accordance with International Standards on Auditing (ISAs) (UK) and Practice Note 10 'Audit of Financial Statements of Public Sector Entities in the United Kingdom'. My responsibilities under those standards are further described in the Auditor's responsibilities for the audit of the financial statements section of my certificate. Those standards require me and my staff to comply with the Financial Reporting Council's Revised Ethical Standard 2016. I am independent of the United Kingdom Atomic Energy Authority in accordance with the ethical requirements that are relevant to my audit and the financial statements in the UK. My staff and I have fulfilled our other ethical responsibilities in accordance with these requirements. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

Responsibilities of the Board and Accounting Officer for the financial statements

As explained more fully in the Statement of Accounting Officer's Responsibility, the Board and the Accounting Officer are responsible for the preparation of the financial statements and for being satisfied that they give a true and fair view.

Auditor's responsibilities for the audit of the financial statements

My responsibility is to audit, certify and report on the financial statements in accordance with the Atomic Energy Authority Act 1954.

An audit involves obtaining evidence about the amounts and disclosures in the financial statements sufficient to give reasonable assurance that the financial statements are free from material misstatement, whether caused by fraud or error. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs (UK) will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with ISAs (UK), I exercise professional judgment and maintain professional scepticism throughout the audit. I also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of Group's and Authority's internal control.

- Evaluate the disclosures
- Evaluate the consolidated
- Obtain an understanding of Group's performance

I communicate the audit findings

In addition, the statements of

Other Information

The Board of the annual statements in form of accounts and, in doing so, audit or other information

Opinion on

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- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the consolidated financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the Group to express an opinion on the consolidated financial statements. I am responsible for the direction, supervision and performance of the group audit. I remain solely responsible for my audit opinion.

I communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

In addition, I am required to obtain evidence sufficient to give reasonable assurance that the income and expenditure reported in the financial statements have been applied to the purposes intended by Parliament and the financial transactions conform to the authorities which govern them.

Other Information

The Board and the Accounting Officer are responsible for the other information. The other information comprises information included in the annual report, but does not include the parts of the Accountability Report described in that report as having been audited, the financial statements and my auditor's report thereon. My opinion on the financial statements does not cover the other information and I do not express any form of assurance conclusion thereon. In connection with my audit of the financial statements, my responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or my knowledge obtained in the audit or otherwise appears to be materially misstated. If, based on the work I have performed, I conclude that there is a material misstatement of this other information, I am required to report that fact. I have nothing to report in this regard.

Opinion on other matters

In my opinion:

- The parts of the Accountability Report to be audited have been properly prepared in accordance with Secretary of State directions made under the Atomic Energy Authority Act 1954;
- In the light of the knowledge and understanding of the Group and Authority and its environment obtained in the course of the audit, I have not identified any material misstatements in the Performance Report or the Accountability Report; and
- The information given in the Performance Report and Accountability Report for the financial year for which the financial statements are prepared is consistent with the financial statements.

Matters on which I report by exception

I have nothing to report in respect of the following matters which I report to you if, in my opinion:

- Adequate accounting records have not been kept or returns adequate for my audit have not been received from branches not visited by my staff; or
- The financial statements and the parts of the Accountability Report to be audited are not in agreement with the accounting records and returns; or
- I have not received all of the information and explanations I require for my audit; or
- The Governance Statement does not reflect compliance with HM Treasury's guidance.

Report

I have no observations to make on these financial statements.

Gareth Davies
Comptroller and Auditor General
National Audit Office
157-197 Buckingham Palace Road
Victoria, London, SW1W 9SP

Date: 12 July 2019

Consolidated Statement of Comprehensive Income

for the year ended 31 March 2019

	Note	Group		Authority	
		2019 £k	2018 £k	2019 £k	2018 £k
Income					
Revenue	5	116,766	101,627	113,497	100,503
Other Income		4,392	3,240	5,229	4,246
Less: share of revenue of joint venture		(3,139)	(1,041)	–	–
		118,019	103,826	118,726	104,749
Expenditure					
Raw materials and consumables		23,547	21,994	23,547	21,994
Other external expenses		35,322	22,813	35,322	22,813
Staff costs	6	72,065	64,115	72,065	64,115
Depreciation, amortisation and impairment		1,942	1,712	1,942	1,712
Other expense		1,679	1,444	1,288	2,030
Costs charged to provisions		(584)	(1,108)	(584)	(1,108)
		133,971	110,970	133,580	111,556
Revaluation adjustment		9,559	868	9,559	868
Costs capitalised		(15,489)	(6,695)	(15,489)	(6,695)
		128,041	105,143	127,650	105,729
		(10,022)	(1,317)	(8,924)	(980)
Operating (loss)/profit					
Finance income	8	146	123	88	74
Finance expense	8	(16)	(29)	(16)	(29)
Loss on disposal of assets		(4)	(3)	(4)	(3)
Share of profit/(loss) of joint venture after tax	13	4,582	12,168	–	–
Profit/(loss) before tax	9	(5,314)	10,942	(8,856)	(938)
Current tax credit – RDEC	10	3,591	3,865	3,591	3,865
Deferred tax (debit)/credit	10	2,044	(1,147)	2,044	(1,147)
Profit/(loss) for the year		321	13,660	(3,221)	1,780
Other comprehensive income					
Net gain/(loss) on revaluations		9,805	6,207	(416)	2,742
Actuarial gains/(losses) on defined benefit pension plans		120	57	120	57
Income tax (debit)/credit relating to components of other comprehensive income		227	(339)	227	(339)
Other comprehensive income for the year		10,152	5,925	(69)	2,460
Total comprehensive income for the year		10,473	19,585	(3,290)	4,240

The notes on pages 62 to 86 are an integral part of these financial statements.

Consolidated Statement of Financial Position as at 31 March 2019

Authority 2018 £k	Note	Group		Authority	
		2019 £k	2018 £k	2019 £k	2018 £k
		Non-current assets			
100,503	11	59,064	45,502	59,064	45,502
4,246	12	50,520	60,030	50,520	60,030
–	13	49,689	32,986	18,623	16,723
104,749	15	458,704	355,366	458,704	355,366
		617,977	493,884	586,911	477,621
		Current assets			
21,994		11	11	11	11
22,813	15	30,799	31,772	30,956	32,623
64,115	13	6,811	6,769	–	–
1,712	16	57,393	37,116	56,162	35,194
2,030		95,014	75,668	87,129	67,828
(1,108)					
111,556		712,991	569,552	674,040	545,449
868		Current Liabilities			
(6,695)	17	52,654	37,512	52,646	37,505
105,729	20	6,978	7,024	6,728	6,004
		59,632	44,536	59,374	43,509
(980)		653,359	525,016	614,666	501,940
74		Non-current liabilities			
(29)	17	1,322	278	1,322	278
(3)	18	7,927	5,544	7,927	5,544
–	19	8,052	10,322	8,052	10,322
(938)	20	471,159	367,372	468,088	366,155
3,865		488,460	383,516	485,389	382,299
(1,147)		164,899	141,500	129,277	119,641
1,780					
		Taxpayers' equity			
2,742		13,658	13,658	13,658	13,658
57		12,986	13,671	12,986	13,671
(339)		31,120	–	31,120	–
2,460		107,135	114,171	71,513	92,312
4,240		164,899	141,500	129,277	119,641

The notes on pages 62 to 86 are an integral part of these financial statements.

The Financial Statements on pages 58 to 86 were approved by the Board on 9 July 2019 and were signed on its behalf by:

Professor Ian Chapman
Chief Executive and Accounting Officer
9 July 2019

Consolidated Statement of Cash Flows

for the year ended 31 March 2019

	Note	Group		Authority	
		2019 £k	2018 £k	2019 £k	2018 £k
Cash flows from operating activities					
Profit for the year		321	13,660	(3,221)	1,780
Adjustments for non-cash transactions:					
– Depreciation, amortisation and impairment		1,943	1,712	1,943	1,712
– Deferred income released	18	(264)	(277)	(264)	(277)
– Change in fair value of investment property	12	9,558	868	9,558	868
– Loss on disposal of property, plant and equipment		4	3	4	3
– Net finance income recognised		(130)	(94)	(72)	(45)
– Income tax debit/(credit)	10	(5,635)	(2,718)	(5,635)	(2,718)
– Share of loss/(profit) of joint venture		(4,582)	(12,168)	–	–
Changes in working capital:					
– (Increase)/decrease in trade and other receivables		5,515	(1,057)	6,209	(1,310)
– (Increase)/decrease in inventories		–	–	–	–
– (Increase)/decrease in current financial assets		(42)	427	–	–
– Increase/(decrease) in trade and other payables		18,779	(18,548)	18,778	(18,548)
– Use of and change in provisions, net of the movement on reimbursement receivables		(621)	134	(1,705)	900
Net cash inflow/(outflow) from operating activities		24,846	(18,058)	25,595	(17,635)
Cash flows from investing activities					
Purchase of property, plant and equipment	11	(15,973)	(6,871)	(15,973)	(6,871)
Investment in joint venture	13	(1,900)	(3,200)	(1,900)	(3,200)
Net cash inflow/(outflow) from investing activities		(17,873)	(10,071)	(17,873)	(10,071)
Cash flows from financing activities					
Grant from sponsoring department		13,158	7,954	13,158	7,954
Interest received		146	123	88	74
Net cash inflow/(outflow) from financing activities		13,304	8,077	13,246	8,028
Net increase/(decrease) in cash and cash equivalents in the period		20,277	(20,052)	20,968	(19,678)
Cash and cash equivalents at the beginning of the period		37,116	57,168	35,194	54,872
Cash and cash equivalents at the end of the period		57,393	37,116	56,162	35,194

The notes on pages 62 to 86 are an integral part of these financial statements.

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Consolidated Statement of Changes in Taxpayers' Equity for the year ended 31 March 2019

Authority

2018 £k	Group	General reserve £k	Revaluation reserve £k	Capital grants reserve (Note a) £k	Retained earnings £k	Total £k
1,780	Balance at 1 April 2017	13,658	11,606	-	88,697	113,961
	Changes in Taxpayers' Equity 2017/18					
1,712	Capital Grant from sponsoring department	-	-	-	7,954	7,954
(277)	Total comprehensive income for the year	-	2,403	-	17,182	19,585
868	Depreciation transfer	-	(338)	-	338	-
3	Balance at 31 March 2018	13,658	13,671	-	114,171	141,500
(45)	Restatement of Opening Balance due to IFRS 15 at 31 March 2018	-	-	-	(232)	(232)
(2,718)	Changes in Taxpayers' Equity 2018/19					
-	Movement to Capital Grant Reserve ^(a)	-	-	19,038	(19,038)	-
(1,310)	Capital Grant from sponsoring department	-	-	13,158	-	13,158
-	Total comprehensive income for the year	-	(190)	-	10,663	10,473
(18,548)	Depreciation transfer	-	(457)	(1,076)	1,533	-
900	Revaluation transfer	-	(38)	-	38	-
(17,635)	Balance at 31 March 2019	13,658	12,986	31,120	107,135	164,899

Note (a) - UKAEA has made a presentational change to the accounts to show the net of capital grants received from BEIS and the associated depreciation in a separate capital grants reserve, rather than as part of Retained Earnings. There is no impact on overall reserves from this change.

	Authority	General reserve £k	Revaluation reserve £k	Capital grants reserve (Note a) £k	Retained earnings £k	Total £k
(6,871)	Balance at 1 April 2017	13,658	11,606	-	82,183	107,447
(3,200)	Changes in Taxpayers' Equity 2017/18					
(10,071)	Capital Grant from sponsoring department	-	-	-	7,954	7,954
	Total comprehensive income for the year	-	2,403	-	1,837	4,240
	Depreciation transfer	-	(338)	-	338	-
	Balance at 31 March 2018	13,658	13,671	-	92,312	119,641
	Restatement of Opening Balance due to IFRS 15 at 31 March 2018	-	-	-	(232)	(232)
	Changes in Taxpayers' Equity 2018/19					
	Movement to Capital Grant Reserve	-	-	19,038	(19,038)	-
	Capital Grant from sponsoring department	-	-	13,158	-	13,158
	Total comprehensive income for the year	-	(190)	-	(3,100)	(3,290)
	Depreciation transfer	-	(457)	(1,076)	1,533	-
	Revaluation transfer	-	(38)	-	38	-
	Balance at 31 March 2019	13,658	12,986	31,120	71,513	129,277

See Note (a) above.

The notes on pages 62 to 86 are an integral part of these financial statements.

Notes to the Financial Statements

1 General information

UKAEA is an NDPB and was established by the Atomic Energy Authority Act 1954. The address of UKAEA's registered office is Culham Science Centre, Abingdon, Oxfordshire, OX14 3DB. Its sponsoring government department is the Department for Business, Energy and Industrial Strategy. UKAEA and its subsidiaries are referred to as "the Group".

2 Basis of preparation

The financial statements comply with the provisions of the Atomic Energy Authority Act 1954 and the requirements of HM Treasury. The latter requires the financial statements to be prepared in accordance with the Government Financial Reporting Manual (FRoM) issued by HM Treasury as updated annually. The accounting policies contained in the FRoM apply International Financial Reporting Standards (IFRS) as adapted or interpreted for the public sector. Where the FRoM permits a choice of accounting policy, the accounting policy which is judged to be most appropriate to the particular circumstances of the Group for the purpose of giving a true and fair view has been selected.

The financial statements have been prepared on a going concern basis.

The Board, Executive team and Accounting Officer believe that the commitment from international parties and the UK Government to fusion research, combined with the acceptance by BEIS of responsibility for costs associated with UKAEA site restoration and restructuring liabilities, is sufficient to support continuing operations for the foreseeable future.

The financial statements are presented in pounds sterling, which is UKAEA's functional currency, and have been prepared under the historical cost convention, except for land and buildings, investment properties, assets held-for-sale and derivative financial instruments which are stated at fair value.

The preparation of financial statements in conformity with IFRS requires judgements, estimates and assumptions to be made that affect the application of accounting policies and the reported amounts of income, expenses, assets and liabilities. Estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates are recognised in the period in which the estimates are revised and in any future periods affected. Information about significant areas of estimation uncertainty and critical judgements in applying accounting policies that have the most significant effect on the amounts recognised in the consolidated financial statements is included in the notes to the financial statements.

3 Significant accounting policies

The principal accounting policies applied by UKAEA and its subsidiary AEA Insurance Ltd (AEAIL) in the preparation of these financial statements are set out below. These policies have been applied consistently in dealing with all items that are considered material to the financial statements.

3.1 Provisions

Provisions are recognised when: the Group has a present legal or constructive obligation as a result of past events; it is probable that an outflow of resources will be required to settle the obligation; and the amount has been reliably estimated.

UKAEA's site restoration provision is the most significant area of estimation uncertainty in the financial statements. Full details are in Note 20.

Where there are a number of similar obligations, the likelihood that an outflow will be required in settlement is determined by considering the class of obligations as a whole. A provision is recognised even if the likelihood of an outflow with respect to any one item included in the same class of obligations may be small.

Provisions are measured at the present value of the expenditures expected to be required to settle the obligation using real rates of interest. The change in the provision due to passage of time and changes in discount rate is recognised as finance expense or finance income as appropriate.

Where assurances have been received from another party that they will reimburse some or all of the expenditure required to settle a provision, and the requirements for recognition of IAS 37.53 are met (i.e. it is virtually certain that reimbursement will be received if the obligation is settled) a reimbursement asset will be recognised to the extent of the amount expected to be reimbursed. The reimbursement asset is shown separately from the related provision in the statement of financial position.

3.2 Consolidated

(a) Subsidiaries

Subsidiaries are entities controlled by the Group. The Group's policies of consolidation are set out in Note 20. The consolidated financial statements are prepared on the same basis as the individual financial statements, when necessary adjusted to ensure consistency.

(b) Joint ventures

Joint ventures are entities in which the Group has joint control. The Group's policies of consolidation are set out in Note 20. The consolidated financial statements are prepared on the same basis as the individual financial statements, when necessary adjusted to ensure consistency.

(c) Transactions

Intra-group transactions and balances are eliminated on consolidation.

3.3 Revenue

Revenue is recognised when the Group has transferred control of the goods or services to the customer. Where applicable, revenue is recognised at the fair value of the consideration received or receivable. Revenue is given in the following table:

(a) Services

Revenue from services is recognised when the Group has transferred control of the goods or services to the customer. Revenue is given in the following table:

(b) Rental

Rental income is recognised on a straight-line basis over the term of the lease. Revenue is given in the following table:

(c) Grant-in-aid

Grant-in-aid is recognised when the Group has transferred control of the goods or services to the customer. Revenue is given in the following table:

(d) Other

Other revenue is recognised when the Group has transferred control of the goods or services to the customer. Revenue is given in the following table:

(e) Finance

Finance income is recognised when the Group has transferred control of the goods or services to the customer. Revenue is given in the following table:

(f) Capital

Capital grants are recognised when the Group has transferred control of the goods or services to the customer. Revenue is given in the following table:

3.2 Consolidation

(a) Subsidiaries

Subsidiaries are entities controlled by the Group. Control exists when the Group has the power to govern the financial and operating policies of an entity so as to obtain benefits from activities and actually exercises this power. In assessing control, potential voting rights that are currently exercisable are taken into account. The financial statements of subsidiaries are included in the consolidated financial statements from the date that control commences until the date that control ceases. The accounting policies of subsidiaries are changed when necessary to align them with the policies adopted by the Group.

(b) Joint ventures

Joint ventures are those entities over which the Group exercises joint control through a contractual arrangement. The results, assets and liabilities of joint ventures are incorporated in the consolidated financial statements using the equity method of accounting. Investments in joint ventures are initially carried in the statement of financial position at cost and subsequently adjusted by post-acquisition changes in the Group's share of the net assets of the joint venture, less any impairment in the value of individual investments. Losses of joint ventures in excess of the Group's interest in those joint ventures are not recognised, except where the Group has made a commitment to make good those losses.

(c) Transactions eliminated on consolidation

Intra-group transactions, balances and unrealised gains and losses on transactions between Group companies are eliminated on consolidation.

3.3 Revenue recognition

Revenue is recognised when a performance obligation has been delivered which reflects the point of control over a product or the transfer of a service to the customer and specific criteria having been met as described below.

Where applicable revenue from contracts with customers is recognised in line with IFRS 15 from 1 April 2018.

Revenue is shown net of value added tax, returns, rebates and discounts. A full disclosure of the effects of the implementation of IFRS 15 is given in Note 5.2.

(a) Service contracts

Revenue from cost recovery contracts for managing the UK's fusion research programme, the European Union's JET facility and in support of the wider European fusion research programmes is recognised to the extent of costs incurred in the period that are expected to be recoverable from customers.

Revenue from customer contracts is recognised under IFRS 15. Contract milestones have been identified as the performance obligations for revenue recognition and are at a point in time. Revenue on contracts that do not separately identify milestones are recognised on completion. Most customer contracts with UKAEA allow for invoices to be raised once contract milestones have been completed. Revenue is measured based on the consideration set out in the customer contract. Revenue recognition before the implementation of IFRS 15 was based on a percentage-of-completion method.

(b) Rental income

Rental income from investment properties is recognised in the statement of comprehensive income on a straight-line basis over the term of the lease. Lease incentives granted are recognised as an integral part of the total rental income over the term of the lease.

(c) Grant-in-aid

Grant-in-aid relating to revenue expenditure is recognised in the statement of comprehensive income in the same period as the related expenditure that it is intended to fund.

This departure from the specified treatment in the FReM has been agreed with HM Treasury.

Capital grants from UKAEA's sponsoring department are recognised as financing and credited to reserves in line with the FReM.

3.4 Research expenditure

Expenditure on research activities, undertaken with the prospect of gaining new scientific or technical knowledge and understanding, is recognised in the statement of comprehensive income when incurred.

3.5 Employee benefits

(a) Short-term employee benefits

Short-term employee benefits are recognised in the year in which the related service is provided. A liability is recognised for the amount expected to be paid under short-term bonus arrangements if the Group has a present legal or constructive obligation to pay this amount as a result of past service provided by employees and the obligation can be estimated reliably.

(b) Termination benefits

Termination benefits are payable when employment is terminated by the Group before the normal retirement date, or whenever an employee accepts voluntary redundancy in exchange for these benefits. The Group recognises termination benefits when it is demonstrably committed to either: terminating the employment of current employees according to a detailed formal plan without possibility of withdrawal; or providing termination benefits as a result of an offer made to encourage voluntary redundancy. Benefits falling due more than 12 months after the reporting date are discounted to their present value.

(c) Retirement benefits

Obligations for contributions to defined contribution schemes are recognised as an expense when they are due. The Group has no further payment obligations once the contributions have been paid.

The Group operates three defined benefit schemes for the benefit of its employees. Two of these are closed to new members. The schemes are unfunded multi-employer defined benefit schemes. In accordance with the FReM, these schemes are accounted for as defined contribution schemes in these financial statements and the obligations recognised are limited to the contributions due.

The Group also has a separate liability in respect of unfunded retirement benefits relating to three individuals. The liability recognised in the statement of financial position is the present value of the defined benefit obligation at the reporting date, together with adjustments for unrecognised past-service costs. The defined benefit obligation is calculated annually by independent actuaries using the projected unit credit method. The present value of the defined benefit obligation is determined by discounting the estimated future cash outflows using a real rate of interest set by HM Treasury. Actuarial gains and losses arising from experience adjustments and changes in actuarial assumptions are charged or credited to equity in the period in which they arise.

3.6 Segment reporting

Operating segments are reported in a manner consistent with the internal reporting provided to the chief operating decision-maker. The chief operating decision-maker, who is responsible for allocating resources and assessing performance of the operating segments, has been identified as the UKAEA Board.

3.7 Foreign currency translation

Transactions in foreign currencies are translated to the functional currency of the Group using the exchange rates at the dates of the transactions. Monetary assets and liabilities denominated in foreign currencies at the reporting date are retranslated to the functional currency using the exchange rates at that date. Foreign exchange gains and losses resulting from the settlement of transactions and from the translation of monetary assets and liabilities are recognised in the statement of comprehensive income except when deferred in taxpayers' equity as qualifying cash flow hedges.

3.8 Property, plant and equipment

Land and buildings are occupied by the Group and are shown at fair value, based on periodic, but at least quinquennial, valuations by external independent valuers, less subsequent depreciation for buildings. In the intervening years, these valuations may be updated by the Group with the assistance of independent advice as required. A valuation of all the properties was carried out in February 2019.

Fair value is based on market values for existing use as there are no alternative uses for the land and buildings. Where this basis is not applicable because of the specialised nature of the asset, valuations are carried out on a depreciated replacement cost basis.

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Notes to the Financial Statements

Increases in the carrying amount arising on revaluation of land and buildings are credited to the revaluation reserve. Decreases that offset previous increases of the same asset are charged against the revaluation reserve; all other decreases are charged to the statement of comprehensive income. Each year the difference between depreciation based on the revalued carrying amount of the asset charged to the income statement and depreciation based on the asset's original cost is transferred from the revaluation reserve to retained earnings.

In accordance with the FReM, other classes of property, plant and equipment with short useful lives or low book values are stated at historical cost less depreciation as a proxy for current valuations. Subsequent costs are included in the asset's carrying amount or recognised as a separate asset, as appropriate, only when it is probable that future economic benefits associated with the item will flow to the Group and the cost of the item can be measured reliably. All other repairs and maintenance are charged to the statement of comprehensive income during the financial period in which they are incurred.

Land is not depreciated. Assets under construction are not depreciated until they are in use. Depreciation on other assets is calculated using the straight-line method to allocate their cost or revalued amounts to their residual values over their estimated useful lives, as follows:

–	Buildings	up to 40 years
–	Plant, machinery and equipment	up to 10 years

The assets' residual values and useful lives are reviewed, and adjusted if appropriate, at each reporting date.

Property, plant and equipment may have component parts with different useful lives. In accordance with the provisions of IAS 16 - Property, Plant and Equipment, each part of any newly recognised item of property, plant and equipment with a cost that is significant in relation to the total cost of the item is depreciated separately.

An asset's carrying amount is written down immediately to its recoverable amount if the asset's carrying amount is greater than its estimated recoverable amount (Note 3.11).

Gains and losses on disposals are determined by comparing the proceeds with the carrying amount and any amounts to be released from deferred income on disposal and are recognised in the statement of comprehensive income. When revalued assets are sold, any amounts included in the revaluation reserve are transferred to retained earnings.

3.9 Investment property

Investment property, comprising freehold land and buildings, is held either for rental yields or capital appreciation and is not occupied by the Group. Investment property is carried at fair value, representing open market value determined annually by external independent valuers.

Fair value is based on active market prices, adjusted, if necessary, for any difference in the nature, location or condition of the specific asset. In the absence of current prices in an active market, the valuations are prepared by considering the aggregate of the estimated cash flows expected to be received from renting out the property. Valuations reflect the allocation of maintenance and insurance responsibilities between the Group and the lessee and the remaining economic life of the property.

Changes in fair values are recognised in the statement of comprehensive income.

3.10 Intangible assets

Intangible assets comprise acquired computer software licences and are stated at cost, net of amortisation and any provision for impairment. The cost of intangible assets, less estimated residual value, is amortised on a straight line basis over their estimated useful lives of up to five years.

3.11 Impairment of non-financial assets

Assets that are subject to depreciation or amortisation are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognised for the amount by which the asset's carrying amount exceeds its recoverable amount. The recoverable amount is the higher of an asset's fair value less costs to sell and value in use. For the purposes of assessing impairment, assets are grouped at the lowest levels for which there are separately identifiable cash flows. Non-financial assets that suffered impairment are reviewed for possible reversal of the impairment at each reporting date.

3.12 Inventories

Inventories are stated at the lower of cost and net realisable value. Cost is determined using the first-in, first-out method. The cost of work in progress comprises raw materials, direct labour, other direct costs and related production overheads. Net realisable value is the estimated selling price in the ordinary course of business, less applicable selling expenses.

3.13 Cash and cash equivalents

Cash and cash equivalents includes cash in hand, deposits held at call with banks and other short-term highly liquid investments with original maturities of three months or less.

3.14 Current and deferred income tax

The tax charge or credit for the period comprises current and deferred tax. Tax is recognised in the income statement, except to the extent that it relates to items recognised directly in equity. In this case, the tax is also recognised in equity.

Current tax is the expected tax payable or receivable on the taxable income for the year, using tax rates enacted or substantially enacted at the reporting date, and any adjustment to tax payable in respect of previous years.

RDEC credits payable by HM Revenue and Customs are treated as tax credits in line with the provisions of IAS12, and disclosed separately in the income statement.

Deferred tax is recognised, using the liability method, on temporary differences arising between the tax bases of assets and liabilities and their carrying amounts in the consolidated financial statements. Deferred tax is determined using tax rates (and laws) that have been enacted or substantially enacted by the reporting date and are expected to apply when the related deferred tax asset is realised or the deferred tax liability is settled.

Deferred tax assets are recognised only to the extent that it is probable that future taxable profit will be available against which the temporary differences can be utilised.

3.15 Financial instruments

From 1 April 2018, UKAEA has applied IFRS 9, whereby financial assets are classified in the following measurement categories: amortised cost, fair value through Other Comprehensive Income (FVOCI) and Fair Value through Profit and Loss (FVTPL). UKAEA's financial assets comprise trade and other receivables, investments and cash and cash equivalents, and are held at amortised cost.

Financial assets are included in current assets, except for maturities greater than 12 months after the reporting date which are classified as non-current assets.

UKAEA's credit risk is low (see Note 4.3) and the impact of the adoption of IFRS 9 on the financial statements is not material.

Under IFRS 9, financial liabilities are classified as held at amortised cost or at Fair Value through Profit and Loss. They are included in current liabilities, except for maturities greater than 12 months after the reporting date which are classified as non-current liabilities. The majority of UKAEA's financial liabilities relate to trade and other payables which are held at amortised cost.

AEAIL has also applied IFRS 9. The impact on the company is not considered to be material.

3.16 Operating leases

Payments made under operating leases are recognised in the statement of comprehensive income on a straight-line basis over the term of the lease. Lease incentives are recognised as an integral part of the total lease expense over the term of the lease.

3.17 New and amended accounting standards

Certain new standards, amendments and interpretations to existing standards have been published but are not effective on UKAEA's accounting period.

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Notes to the Financial Statements

The following new standards, amendments and interpretations to existing standards are not yet effective or are not yet effective in HMT's 2018/19 FReM and have not been early adopted by the Authority:

IFRS 16 – Leases (IAS 17 replacement – Leases) – effective date 1 January 2019, with adoption mandated in the FReM from 1 April 2020.

UKAEA does not meet the criteria for early adoption set out in the 2019/20 FReM.

IFRS 17 – Insurance Contracts (IFRS 4 replacement – Insurance Contracts) – effective date 1 January 2021.

The Board anticipate that the adoption of these standards and interpretations in future periods will have no material impact on the financial statements of the Authority. There is also no material impact on AEAIL.

4 Financial risk management

Due to the nature of its activities, the Group is not exposed to the same degree of financial risk faced by other business entities. Financial instruments play a much more limited role in creating or changing risk and generally financial assets and liabilities are generated from day-to-day operational activities and not held to change the risks facing the Group in undertaking its activities. While the Group has significant financial liabilities relating to decommissioning and restructuring, most of the risks attached to these liabilities do not rest with the Group as they are broadly matched by reimbursement assets.

4.1 Foreign exchange risk

Foreign exchange risk arises when future commercial transactions or recognised assets or liabilities are denominated in a currency that is not the Group's functional currency. The Group operates internationally and is exposed to foreign exchange risk arising from various currency exposures, primarily with respect to the Euro.

4.2 Interest rate risk

As the Group has no borrowings or significant interest-bearing assets, the Group's income and operating cash flows are substantially independent of changes in market interest rates. Cash balances on deposit are held in highly rated fixed term deposits and the exposure to interest rate risk is minimal and appropriately managed.

4.3 Credit risk

The Group's income is received primarily from public sector bodies in the UK and Europe and the exposure to credit risk is therefore considered to be low.

4.4 Liquidity risk

The Group is primarily financed by income from other public sector bodies, in the UK and in Europe. Uncertainties about the timing and amount of some of this income, particularly income from Europe, expose the Group to liquidity risk. The Group has a facility to request temporary working capital funding from the Department for Business, Energy and Industrial Strategy should the need arise.

5 Segment information

As the majority of the Group's activities do not represent the provision of public services, segment information in accordance with IFRS 8 is included in these financial statements.

5.1 Reportable segments

The Group has two reportable segments, as described below, which are the Group's main business areas reported to the Authority Board. The business areas offer different services and are managed separately because they require different strategies and have different funding streams.

The following summary describes the operations in each of the Group's reportable segments:

- (a) Fusion research – research into using fusion to create a new source of energy that is safe and environmentally benign
- (b) Property management – management and development of the Culham and Harwell campuses for future scientific use

Other segments include grant-in-aid funding and insurance. None of these segments meets any of the criteria for determining reportable segments in 2019 or 2018. The results of these segments are included in the "other" column in the segmental analyses on the following page.

The segment information for the reportable segments for the years ended 31 March 2019 and 31 March 2018 is as follows:

	Fusion research £k	Property management £k	Other £k	Total £k
Year ended 31 March 2019				
External segment revenue	102,714	7,618	6,434	116,766
Less: Share of revenue of joint venture	–	(3,139)	–	(3,139)
Other income	4,021	1	370	4,392
Expenditure	(107,542)	(3,970)	(6,970)	(118,482)
Investment property revaluation	–	(9,559)	–	(9,559)
Operating profit/(loss)	(807)	(9,049)	(166)	(10,022)
Finance income	88	–	58	146
Finance expense	–	–	(16)	(16)
Loss on disposal of fixed assets	–	(4)	–	(4)
Share of profit/(loss) of joint venture	–	4,582	–	4,582
Profit/(loss) before income tax	(719)	(4,471)	(124)	(5,314)
Year ended 31 March 2018				
External segment revenue	91,866	4,708	5,053	101,627
Less: Share of revenue of joint venture	–	(1,041)	–	(1,041)
Other income	3,023	4	213	3,240
Expenditure	(93,879)	(3,701)	(6,695)	(104,275)
Investment property revaluation	–	(868)	–	(868)
Operating profit/(loss)	1,010	(898)	(1,429)	(1,317)
Finance income	74	–	49	123
Finance expense	–	–	(29)	(29)
Loss on disposal of fixed assets	–	–	(3)	(3)
Share of profit/(loss) of joint venture	–	12,168	–	12,168
Profit/(loss) before income tax	1,084	11,270	(1,412)	10,942

Revenue from external parties is measured in a manner consistent with that in the statement of comprehensive income.

Reconciliation between Reportable Segments and Statement of Comprehensive Income

	2019 £k	2018 £k
Revenues		
Total revenue for reportable segments	110,332	96,574
Other revenue	6,434	5,053
Consolidated revenue per Statement of Comprehensive Income	116,766	101,627
Profit or loss		
Total (loss) / profit for reportable segments	(5,190)	12,354
Other profit or loss	(124)	(1,412)
Consolidated (loss) / profit before income tax per Statement of Comprehensive Income	(5,314)	10,942

Notes to the Financial Statements

Geographical segments

In presenting information on the basis of geographical segments, segment revenue is based on the geographical location of customers.

Total £k		2019 £k	2018 £k
	Group Revenue		
116,766	United Kingdom	53,783	45,063
(3,139)	Europe	61,976	55,762
4,392	Rest of the World	1,007	802
118,482		116,766	101,627
(9,559)			
(10,022)	Revenue from major customers		
146		2019 £k	2018 £k
(16)	European Commission	51,787	45,521
(4)			
4,582			
(5,314)			

Income from the European Commission is attributable to the fusion research segment, the main component is the JET Operating Contract. Following the renewal of this contract, there are operating criteria which may result in the income coming from UK Government as well as European Commission in future.

5.2 Disaggregation of revenue IFRS15 (Revenue from Contracts with Customers)

UKAEA derives its customer revenue from the transfer of goods and services at a point in time. This revenue is categorised within the fusion segment, total £7,230k.

Contract milestones have been identified as performance obligations under IFRS 15 and are fulfilled within twelve months.

Timing of revenue recognition

Contract milestones have been identified as the performance obligations for revenue recognition at a point in time.

Revenue on contracts which do not have separately identifiable milestones is recognised at a point in time, on completion.

Most customer contracts provide for invoices to be raised and paid once contract milestones have been completed.

UKAEA has followed HM Treasury guidelines by using the practical expedient of identifying the outstanding performance obligations associated with contracts still open at the beginning of the reporting period and applying the retrospective transitional approach with the cumulative effect of restatement under IFRS 15 recognised as an adjustment to the opening balance of Taxpayers' Equity.

Summary impact of adopting IFRS 15

Impact of transition to IFRS 15 on Changes in Taxpayers' Equity

2018 £k		As reported 2019 £k	Adjustments £k	Without the adoption of IFRS 15 £k
	1 April 2018			
96,574	Retained Earnings	113,939	232	114,171
5,053				
101,627				

As a result of the change in accounting policy due to the implementation of IFRS 15 (Revenue from contracts with customers) the opening retained earnings at 1 April 2018 have been reduced by £232k. This is due to the timing of revenue recognition and the associated direct costs now being deferred to the year end 31 March 2019.

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(1,412)
10,942

Impact of transition to IFRS 15 on Comprehensive Income

	As reported 2019 £k	Adjustments £k	Without the adoption of IFRS 15 £k
31 March 2019			
Income	118,019	117	117,902
Expenditure	(128,041)	(2)	(128,039)
Operating Loss	(10,022)	115	(10,137)

IFRS 15 income recognition in line with performance obligations has meant that income is recognised later than previously stated. The 2019 impact is a net increase in revenue due to a larger proportion of revenue transferring from 2018 to 2019 than 2019 into later years.

The expenditure adjustment is the net movement of direct costs relating to the performance obligations.

Impact of transition to IFRS 15 on Statement of Financial Position

	As reported 2019 £k	Adjustments £k	Without the adoption of IFRS 15 £k
Prepayments and accrued income	12,762	(977)	13,739
Contract Assets	918	918	–
Movement in Assets	13,680	(59)	13,739
Payments received on account	33,171	(141)	33,312
Contract liabilities	197	197	–
Movement in liabilities	33,368	56	33,312
Taxpayers' equity	164,899	115	165,014

Impact of transition to IFRS 15 on Statement of Cash Flows

	As reported 2019 £k	Adjustments £k	Without the adoption of IFRS 15 £k
Profit for the year	321	115	206
Decrease in trade/other receivables	5,515	(59)	5,456
Increase in trade/other payables	18,779	(56)	18,723

Prepayments and accrued income have decreased as revenue is now recognised at a point in time, on the satisfaction of performance obligations and when invoices are raised. Direct recoverable costs incurred on customer contracts before the satisfaction of performance obligations are included in contract assets. Payments on account for customer contracts have been replaced by contract liabilities. Customer contract payments on account are now classified as customer liabilities. Net cashflow impact is nil.

Contract balances

The following table provides information about receivables, contract assets and contract liabilities from contracts with customers

	2019 £k	2018 £k
Trade receivables - Note 15	2,115	1,322
Contract assets - Note 15	918	610
Contract liabilities - Note 17	(197)	(231)

Contract assets primarily relate to the direct costs incurred on unsatisfied performance obligations and performance obligations satisfied but not yet invoiced.

Contract liabilities primarily relate to invoicing and consideration received in advance.

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Significant changes in the contract assets and contract liabilities balances during the year are as follows:

	2019 £k Contract Assets	2019 £k Contract Liabilities
Contract Assets /Liabilities at the beginning of the period	610	(231)
Contract assets for performance obligations satisfied but not yet invoiced	334	—
Contract liability for payments received in advance of the satisfaction of performance obligations	—	(197)
Changes in the measure of progress	(26)	231
Contract Assets / Liabilities at year end	918	(197)

6 Staff costs and operating profit

6.1 Staff costs

Staff costs comprise:

	2019 £k	2018 £k
Permanently employed staff:		
Salaries, bonuses and allowances	42,558	36,479
Social security costs	4,899	4,227
Pension costs – defined contribution plans (see below)	6,900	5,946
	54,357	46,652
Other staff	17,708	17,463
	72,065	64,115

Full details of UKAEA's pension schemes are given in the Remuneration Report. The total contributions paid by the Group to the CPS during the year were £6,875k (2018: £5,924k). The total contributions paid by UKAEA during the year to the SPPP were £23k (2018: £20k)

6.2 Operating profit

Operating profit has been arrived at after charging/(crediting):

	2019 £k	2018 £k
Change in fair value of investment property	9,559	868
Net foreign exchange losses/(gains)	82	(39)
Operating lease rentals – plant, machinery and vehicles	148	255
Non-cash items:		
– Depreciation, amortisation and impairment	1,942	1,712

7 Auditor's remuneration

The total remuneration of the Group's auditor, the National Audit Office, for services provided to the Group was:

	2019 £k	2018 £k
Audit fees		
UKAEA	70	60

The increase in audit fees was primarily due to additional audit work on UKAEA's decommissioning provision, which has been reassessed this year (Note 20.1).

Audit of subsidiary and joint venture

The audit fee paid to the auditors of AEAIL was £9k (2018: £8k). The audit fee paid to the auditors of HSIC PubSP, in which UKAEA has a share of one half, was £13k (2018: £14k). The audit fee paid to the auditors of HSIC LP, in which UKAEA has a share of one quarter via HSIC PubSP, was £50k (2018: £51k).

Notes to the Financial Statements

8 Finance income and expense

2018
£k

6,479
4,227
5,946
6,652
17,463
54,115

	Group		Authority	
	2019 £k	2018 £k	2019 £k	2018 £k
Income				
Interest on term bank deposits	146	123	88	74
Expense				
Revaluation of provisions:				
– Unwinding of discount	(4,516)	(1,034)	(4,516)	(1,034)
– Adjustments to reimbursement receivables	4,444	999	4,444	999
Interest on unfunded retirement benefits	56	64	56	64
	16	29	16	29

Full details of provisions and the discount rates used are provided in Note 20.

9 Analysis of net income

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	Group	
	2019 Total £k	2018 Total £k
Income		
Income from activities	109,536	96,020
Contracts with customers	7,230	5,607
Other income	4,392	3,240
Interest receivable	146	123
Share of revenue of joint venture	(3,139)	(1,041)
Share of profit/(loss) of joint venture	4,582	12,168
	122,747	116,117
Expenditure		
Raw materials and consumables	23,547	21,994
Other external expense	35,322	22,813
Staff costs	72,065	64,115
Other expense	1,679	1,444
Cost charged to provisions	(584)	(1,108)
Costs capitalised	(15,489)	(6,695)
Revaluation adjustment	9,559	868
Non-cash items:		
– Depreciation and impairment	1,942	1,712
– Finance expense	16	29
– Loss on fixed asset disposal	4	3
	128,061	105,175
Net income after interest and before tax	(5,314)	10,942

10 Income tax (expense)/credit

	Group and Authority	
	2019 £k	2018 £k
Current tax		
Current tax credit (RDEC)	3,730	3,545
Adjustments relating to previous years	(139)	320
	3,591	3,865
Deferred tax		
Origination and reversal of temporary differences	929	121
Recognition of deferred tax asset (Note 19)	1,115	(1,268)
	2,044	(1,147)
	5,635	2,718

UKAEA has adopted the Research and Development Expenditure Credit ("RDEC"), which replaced the previous R&D tax relief regime and became mandatory from 1 April 2016. The RDEC is beneficial for UKAEA and offsets any non-trading profits from property and other activities.

The current tax on the Group's profit before tax differs from the theoretical amount that would arise using the weighted average tax rate applicable to profits of the consolidated entities as follows:

	2019 £k	2018 £k
Profit/(loss) for the year	321	13,660
Income tax expense/(credit)	(5,635)	(2,718)
Profit/(loss) excluding income tax	(5,314)	10,942
Tax calculated at the standard UK corporation tax rate of 19% (2018: 19%)	(1,010)	2,079
Tax effects of:		
– Reversal of timing differences	(137)	(324)
– Expenses not deductible	1,387	(119)
– R&D expenditure credit under s104A CTA 2009	875	831
– Brought forward losses set against trading profits	(1,053)	(2,203)
– Non-trading profits offset by RDEC credit	(260)	(319)
– Net RDEC claim 2018/19	(3,730)	–
– Net RDEC claim 2017/18	–	(3,545)
– Tax losses for which no deferred income tax asset was recognised	198	55
– Adjustments for previous periods	139	(320)
Current tax expense/(credit) for the year	(3,591)	(3,865)

The income tax charged/(credited) to equity during the year is as follows:

	2019 £k	2018 £k
Fair value gains on property, plant and equipment	(227)	339

11 Property

Group and Authority

Cost of

At 31 March

Additions

Disposals

Revaluations

Transfers

Transfer to

At 31 March

Additions

Disposals

Revaluations

Transfers

Transfer to

At 31 March

Depreciation

At 31 March

Depreciation

Disposals

Transfer to

Impairment

At 31 March

Depreciation

Disposals

Transfer to

At 31 March

Net book value

At 31 March

At 31 March

All property

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This relates

Notes to the Financial Statements

11 Property, plant and equipment

Group and Authority	Land £k	Buildings £k	Plant and equipment £k	Assets under construction £k	Total £k
Cost or valuation					
At 31 March 2017	11,854	19,601	6,744	7,004	45,203
Additions	–	–	211	6,660	6,871
Disposals	–	–	(12)	–	(12)
Revaluation	197	2,656	–	–	2,853
Transfers within property plant and equipment	–	222	2,070	(2,292)	–
Transfer to investment property	–	(193)	–	–	(193)
At 31 March 2018	12,051	22,286	9,013	11,372	54,722
Additions	–	–	485	15,488	15,973
Disposals	–	–	(90)	–	(90)
Revaluation	(643)	227	–	–	(416)
Transfers within PPE	–	–	830	(830)	–
Transfer to investment property	–	(86)	–	–	(86)
At 31 March 2019	11,408	22,427	10,238	26,030	70,103
Depreciation and impairment					
At 31 March 2017	–	4,186	3,355	–	7,541
Depreciation charge	–	854	828	–	1,682
Disposals	–	–	(9)	–	(9)
Transfer to investment property	–	(42)	–	–	(42)
Impairment depreciation	–	48	–	–	48
At 31 March 2018	–	5,046	4,174	–	9,220
Depreciation charge	–	919	1,024	–	1,943
Disposals	–	–	(86)	–	(86)
Transfer to investment property	–	(38)	–	–	(38)
At 31 March 2019	–	5,927	5,112	–	11,039
Net book value					
At 31 March 2018	12,051	17,240	4,839	11,372	45,502
At 31 March 2019	11,408	16,500	5,126	26,030	59,064

All property, plant and equipment is owned by the Group.

There was £4,962k capital expenditure contracted for at the reporting date but not recognised in the financial statements (2018: £1,493k).

This related mainly to assets in course of construction.

12 Investment property

	Group and Authority	
	2019 £k	2018 £k
At 1 April	60,030	60,840
Change in fair value	(9,558)	(868)
Net transfer from property, plant and equipment	48	76
Impairment	-	(18)
At 31 March	50,520	60,030

Investment properties were valued at fair value at 28 February 2019 by independent valuers. The valuations were undertaken by Carter Jonas in accordance with the Valuation Standards of the Royal Institute of Chartered Surveyors, IFRS and guidelines in HM Treasury's FReM. The Group has adopted this valuation at the reporting date on the grounds that there were no material changes between the valuation date and the reporting date.

Most of the reduction in fair value was at Harwell and was due to revaluations of some of UKAEA's land holdings, and also the drawdown of land by the Harwell Joint Venture (Note 13.2).

Investment properties are held for their investment potential. Rental income from tenants outside the Group is negotiated at arm's length. The following amounts have been recognised in the income statement:

	Group and Authority	
	2019 £k	2018 £k
Rental income	2,400	2,000
Direct operating expenses:		
– Investment properties that generated rental income	1,712	1,427
– Investment properties that did not generate rental income	364	304

13 Financial assets

	Group		Authority	
	2019 £k	2018 £k	2019 £k	2018 £k
Non-current				
Movements during the year				
At 1 April	32,986	14,152	16,723	13,523
Investment in joint venture	1,900	3,200	1,900	3,200
Revaluation	14,803	15,634	-	-
	49,689	32,986	18,623	16,723
Total non-current assets				
Investment in subsidiary undertakings	-	-	3,000	3,000
Investment in joint venture	49,689	32,986	15,623	13,723
	49,689	32,986	18,623	16,723
Current				
Term bank deposits	6,811	6,769	-	-
At 31 March	6,811	6,769	-	-

13.1 Invest

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Notes to the Financial Statements

13.1 Investment in subsidiary undertakings

Name	Country of incorporation	Ownership interest %	
		2019	2018
AEA Insurance Limited	Isle of Man	100	100

All subsidiary undertakings are included in the consolidation. The proportion of voting rights in the subsidiary undertakings held directly by the Group does not differ from the proportion of shares held.

13.2 Investment in joint venture

The Group has 50% control of a joint venture, Harwell Science and Innovation Campus Public Sector Limited Partnership (HSIC PubSP), the public sector partner in Harwell Oxford, which is responsible for the development of the Harwell Oxford Campus. The interest in the joint venture is accounted for using the equity method in the Group financial statements.

	Group	
	2019 £k	2018 £k
At 1 April	32,986	14,152
Investment in joint venture	1,900	3,200
Share of profit/(loss) net of tax	4,582	12,168
Revaluation	10,221	3,466
	49,689	32,986
Analysed as follows:		
Cost or valuation	31,882	19,761
Share of retained profits/(losses)	17,807	13,225
	49,689	32,986

The £4,582k share of profit of the joint venture (2018: profit of £12,168k) represents UKAEA's share of the operating profit of Harwell Oxford via HSIC PubSP, and was largely due to revaluation adjustments. The increase in investment compared with the previous year was mainly due to a higher share of non-current assets in the joint venture, and related to Harwell Oxford investment properties and assets under construction.

The following amounts represent the Group's share of the income, results, assets and liabilities of the joint venture. They are included in the Statement of Comprehensive Net Income and Statement of Financial Position:

	2019 £k	2018 £k
Profit/(loss) net of tax		
Income	5,492	12,557
Expenses	(910)	(389)
	4,582	12,168
Assets		
Current assets	25,372	11,316
Non-current assets	49,862	35,448
	75,234	46,764
Liabilities		
Current liabilities	1,329	2,420
Non-current liabilities	24,216	11,358
	25,545	13,778
Net assets	49,689	32,986

There are no contingent liabilities relating to the Group's interest in the joint venture, and no significant contingent liabilities of the venture itself.

13.3 Term bank deposits

Term bank deposits are held with major UK banks. The average interest rate on the deposits held at 31 March 2019 was 0.97% (2018: 0.56%). The credit risk associated with these investments is considered to be low because of the size and status of the banks involved.

14 Financial instruments

From 1 April 2018, UKAEA has applied IFRS 9 (see Note 3.15). Term deposits (Note 13.3) are solely payments of principal and interest and are therefore held at amortised cost. With the exception of UKAEA's interest in its subsidiary and joint venture (Notes 13.1 and 13.2), which are exempted from the application of IFRS 9, all other financial assets of the Group were held at amortised cost at both 31 March 2019 and 31 March 2018. All financial liabilities of the Group were held at amortised cost at both 31 March 2019 and 31 March 2018.

The majority of financial instruments relate to contracts to buy non-financial items in line with the UKAEA's expected purchase and usage requirements and UKAEA is therefore exposed to little credit, liquidity or market risk.

Notes to the Financial Statements

15 Trade and other receivables

2018 £k	Group		Authority	
	2019 £k	2018 £k	2019 £k	2018 £k
12,557 (389) 12,168	Amounts falling due after more than one year			
	Reimbursement receivables (Note 20):			
	420,258	313,054	420,258	313,054
	38,446	42,312	38,446	42,312
	458,704	355,366	458,704	355,366
11,316 35,448 46,764	Amounts falling due within one year			
	3,879	3,143	3,879	3,143
	Reimbursement receivables (Note 20):			
	1,529	226	1,529	226
	3,261	3,437	3,261	3,437
2,420 11,358 13,778	12,761	15,770	12,738	15,756
	918	-	918	-
32,986	1,280	2,097	1,280	2,097
	7,136	7,120	7,136	7,120
	35	(21)	215	844
	30,799	31,772	30,956	32,623

There are no impaired assets in any of the classes of trade and other receivables. UKAEA has calculated an Expected Credit Loss for its trade receivables in accordance with the requirements of IFRS 9. This is £24k.

The reimbursement receivables have been discounted at the rates applicable to the provisions to which they relate. Further details of these rates are disclosed in Note 20.

16 Cash and cash equivalents

	Group		Authority	
	2019 £k	2018 £k	2019 £k	2018 £k
At 1 April	37,116	57,168	35,194	54,872
Net change in cash and cash equivalent balances	20,277	(20,052)	20,968	(19,678)
At 31 March	57,393	37,116	56,162	35,194
The following balances were held at 31 March:				
Commercial banks and cash in hand	57,393	37,116	56,162	35,194
	57,393	37,116	56,162	35,194

17 Trade and other payables

	Group		Authority	
	2019 £k	2018 £k	2019 £k	2018 £k
Amounts falling due within one year				
Trade payables	1,613	2,385	1,613	2,385
Accrued costs	15,155	9,440	15,146	9,433
Payments received on account	33,171	23,841	33,171	23,841
Contract liabilities (Note 5.2)	197	-	197	-
Social security and other taxes	1,464	1,088	1,464	1,088
Other payables	1,054	758	1,055	758
	52,654	37,512	52,646	37,505
Amounts falling due after more than one year				
Payments received on account	1,322	278	1,322	278

18 Deferred income

The majority of UKAEA's deferred income relates to capital grants for the purchase of equipment for the Materials Research Facility and grants for the RACE building and new facilities for RACE.

	Group and Authority	
	2019 £k	2018 £k
At 1 April	5,544	5,767
Deferred income received	2,647	54
Released to income statement	(264)	(277)
At 31 March	7,927	5,544

Notes to the Financial Statements

19 Deferred income tax

Group and Authority	Investment property £k	Land and buildings £k	Total £k
Deferred tax liability			
At 31 March 2017	7,526	4,389	11,915
Income statement debit/(credit):	(122)	–	(122)
- Revaluation			
Charged directly to equity:	–	339	339
- Revaluation			
At 31 March 2018	7,404	4,728	12,132
Movements during 2018/19:			
Income statement debit/(credit):	(929)	–	(929)
- Revaluation			
Charged directly to equity:			
- Revaluation	–	(227)	(227)
At 31 March 2019	6,475	4,501	10,976
Deferred tax asset			
At 31 March 2018			1,810
Increase/(decrease) in deferred tax asset			1,114
At 31 March 2019			2,924
Net deferred tax liability			
At 31 March 2018			10,322
At 31 March 2019			8,052

19.1 Deferred tax liability

The UK corporation tax rate has been 19% since 1 April 2017. A reduction to 17% with effect from 1 April 2020 was enacted on 6 September 2016. The closing deferred tax liability has been calculated at 17% as the liability is not expected to unwind before 1 April 2020.

Movements in the deferred tax provision relating to investment property are charged or credited to the income statement. Movements in the provision relating to land and buildings are charged or credited to the revaluation reserve.

19.2 Deferred tax asset

Deferred income tax losses are recognised for tax depreciation and tax loss carry-forwards to the extent that the realisation of the related tax benefit through future taxable profits is probable. The adoption of the RDEC means that previous trading losses are brought into the annual corporation tax computation. UKAEA now therefore expects to utilise its remaining carried forward losses in 2019/20 and 2020/21. A deferred income tax asset of £1,828k has therefore been recognised in the Accounts, calculated at the tax rates expected to be in force in those years.

In addition, UKAEA has recognised a deferred income tax asset of £1,096k in respect of RDEC set-off amounts that can be carried forward against future taxable income. Under the RDEC rules, these can only be utilised after existing trading losses have been exhausted. It is now expected that UKAEA will utilise these in 2021/22.

The total deferred tax asset of £2,924k has been netted off UKAEA's deferred tax liability in the Accounts as it fulfils the conditions for offsetting in IAS12.

20 Provisions for liabilities and charges

Group	Site restoration £k	Restructuring £k	Other £k	Total £k
At 1 April 2017	305,106	53,393	9,791	368,290
Changes in price levels	8,355	1,497	127	9,979
Unwinding of discount	(5,813)	128	(49)	(5,734)
Discount charge	5,735	–	–	5,735
Provided in the year	–	–	2,355	2,355
Provisions not required written back	–	(308)	(791)	(1,099)
Provisions utilised in the year	(102)	(3,684)	(1,344)	(5,130)
At 31 March 2018	313,281	51,026	10,089	374,396
Changes in price levels ⁽¹⁾	–	1,116	60	1,176
Unwinding of discount	(4,477)	47	(45)	(4,475)
Discount charge	(32,786)	–	–	(32,786)
Provided in the year ⁽¹⁾	145,964	–	562	146,526
Provisions not required written back	–	(1,991)	–	(1,991)
Provisions utilised in the year	(195)	(3,608)	(906)	(4,709)
At 31 March 2019	421,787	46,590	9,760	478,137

Note:

1. Site Restoration Provision is expressed in 2018/19 money values, as part of the recent review.

At 31 March 2018				
Non-current	313,055	47,362	6,955	367,372
Current	226	3,664	3,134	7,024
	313,281	51,026	10,089	374,396
At 31 March 2019				
Non-current	420,258	43,017	7,884	471,159
Current	1,529	3,573	1,876	6,978
	421,787	46,590	9,760	478,137

20.1 Site re

The decommissioning costs for the storage, processing and disposal of

Calculations are based on the best estimate of the costs of decommissioning out the work required to meet current legislation and other legal liabilities. A provision is made for attributable costs.

The detailed information is in 2007/8 and subsequent years. During this period, the provision has increased, including provisions for the decommissioning of the site.

The best estimate of the costs of decommissioning is based on the rates advised by the decommissioning contractor.

Short term

Medium term

Long term

Very long term

Cash flows

The unwinding of the discount on cash flows is based on the best estimate of the discount rates for the year, based on the best estimate of the discount rates, discounted to the present value.

The analysis is based on the best estimate of the costs of decommissioning.

Not later than

Later than

Later than

Later than

Later than

A later closure

Notes to the Financial Statements

20.1 Site restoration

The decommissioning provision represents the estimated costs of decommissioning the JET facility at UKAEA's Culham site, including the storage, processing and eventual disposal of radioactive wastes.

Calculation of the liabilities is based on the technical assessments of the processes and methods likely to be used in the future to carry out the work. Estimates are derived from the latest technical knowledge and commercial information available, taking into account current legislation, regulations and Government policy. Summary figures are built up by aggregating detailed estimates for individual liabilities. Allowance is also made for infrastructure costs, which are an appropriate share of site running costs and other overhead costs attributable to plant and buildings. The calculation is reassessed annually.

The detailed Lifetime Plan for decommissioning, funded by the Nuclear Decommissioning Authority (NDA), was originally drawn up in 2007/8 and this is the basis, together with high level assessment of changes, of the site restoration provision at the 31 March 2018. During this financial year, the NDA have carried out a detailed update to the Lifetime Plan, which included a refresh of assumptions including pricing, the site restoration provision at the 31 March 2019 represents this updated plan.

The best estimate of the cost of dealing with the liabilities at 31 March 2019 is discounted to the reporting date at inflation and discount rates advised by HM Treasury. The rates are set out below.

	Time Period	Nominal discount rate	Implied inflation rate	Real terms discount rate	Equivalent rate in 2017/18
Short term	Up to and including 5 years	0.76%	2.10%	-1.33%	-2.42%
Medium term	Between 6 and 10 years	1.14%	2.10%	-0.95%	-1.85%
Long term	Between 11 and 40 years	1.99%	2.10%	-0.10%	-1.56%
Very long term	41 or more years	1.99%	2.10%	-0.10%	-1.56%

Cash flows which occur during the first year are assumed to be at present value and are not discounted or inflated.

The unwinding of discount in the year to March 2019 is the change in the provision from unwinding the previous year's estimated forward cash flows at the same rate as was used the previous year but bringing all the cash flows forward by one year. The discount charge for the year to 31 March 2019 represents the effect of changes in the discount rates as advised by HM Treasury in comparison to prior year rates, this is the difference between the current year's cash flows discounted at the current year's rates and the same cash flows discounted at the previous year's rates.

The analysis of expected timing of discounted cash flows is as follows:

	Group and Authority	
	2019 £k	2018 £k
Not later than one year	1,529	226
Later than one year and not later than five years	126,391	86,202
Later than five years and not later than ten years	223,661	149,235
Later than ten years and not later than twenty years	70,206	58,258
Later than twenty years and not later than fifty years	–	19,360
	421,787	313,281

A later closure date for JET will mean the timing of cash flows moving into later years.

Total
£k

368,290

9,979

(5,734)

5,735

2,355

(1,099)

(5,130)

374,396

1,176

(4,475)

(32,786)

146,526

(1,991)

(4,709)

478,137

367,372

7,024

374,396

471,159

6,978

478,137

The increase of £108,506k in the provision compared with 2017/18 is mainly due to changed requirements for waste preparation and packaging, additional project management and other staffing costs, an updated analysis of project contingency and the effects of discount rates.

The real terms discount rate is sensitive to changes in inflation and nominal discount rates, as illustrated below;

Group and Authority 2019(£k)					
	Current rates	With a 0.5% increase in inflation	With a 0.5% decrease in inflation	With a 0.5% decrease in nominal discount rates	With a 0.5% increase in nominal discount rates
Not later than one year	1,529	1,529	1,529	1,529	1,529
Later than one year and not later than five years	126,391	128,414	124,358	128,450	124,343
Later than five years and not later than ten years	223,661	231,540	216,061	231,653	216,029
Later than ten years and not later than twenty years	70,206	73,981	66,542	74,004	66,557
	421,787	435,464	408,490	435,636	408,458

The best estimate of the undiscounted cost of dealing with the liabilities is £402,189k (2018: £273,499k). The best estimate of the discounted cost is £421,787k (2018: £313,281k). This figure includes a contingency, as illustrated below;

	P50 - 50% chance of actual costs being higher or lower £k	P80 - 80% chance of actual costs being lower £k
Undiscounted costs	402,189	453,804
Discounted costs	421,787	475,917

The best estimate (P50) value is supported by a statistical analysis of cost and estimation uncertainties, along with other discrete risks. The final value was reached by agreement between the UKAEA and the Nuclear Decommissioning Authority. The discounted cost of contingency is applied proportionally.

A letter issued by the then Secretary of State for Energy in 1986 stated that the Government was prepared to continue to accept responsibility in principle for those costs which UKAEA incurs in treating and disposing of nuclear wastes and in decommissioning plant arising from:

- (i) programmes carried out by UKAEA and its predecessors prior to 1 April 1986; and
- (ii) programme agreement work undertaken for BEIS and its predecessors after 1 April 1986.

These assurances were reconfirmed by BEIS in May 2019. On the basis of these assurances a matching receivable is included in the statement of financial position.

UKAEA has assessed the impact of the date of JET closure, which is a key variable, on the best estimate recognised in the 2018/19 Annual Accounts. A later JET closure date by 2 years, would decrease the discounted cost to £418,951k, due to a greater proportion of the spend profile being subject to the long term discount rate provided by HM Treasury.

Notes to the Financial Statements

20.2 Restructuring

The restructuring provisions represent termination benefits payable under early retirement arrangements to employees who had retired early, or had accepted early retirement, before 31 March 2019. These benefits continue at least until the date at which the employee would have reached normal retirement age, and in many cases part of the benefit is payable for life. The restructuring provisions are discounted to the reporting date at the discount rate for pension liabilities advised by HMT, which is 0.29% in 2018/19 (2018: 0.10%). The undiscounted cost of the group provisions is £47,639k (2018: £51,442k) and the benefits are estimated to be payable over a period up to 35 years.

The analysis of the expected timing of discounted cash flows is as follows:

	Group and Authority	
	2019 £k	2018 £k
Not later than one year	3,573	3,664
Later than one year and not later than five years	13,598	13,990
Later than five years	29,419	33,372
	46,590	51,026

Part of the expenditure required to settle the restructuring liabilities will be reimbursed by other parties as follows:

- (i) Lump sums paid to employees on early retirement are refundable to the Group from the appropriate pension scheme at or after the date on which the individual concerned would have reached normal retirement age.
- (ii) Assurances covering restructuring provisions made before 1 April 2004 have been received from BEIS, and reconfirmed in May 2019, and expenditure related to these provisions is reimbursed by BEIS.

On the basis of these reimbursement arrangements, receivables have been included in the statement of financial position.

20.3 Other provisions

Provision of £1,883k has been made relating to the disposal of operational waste arising from UKAEA's previous contract to operate JET, which ended in December 2014. The provision was discounted at the Treasury rates for general provisions referred to in note 20.1 above. The undiscounted cost of the provision is £1,874k. In addition, UKAEA has made provision of £561k for the eventual decommissioning of the MRF at its Culham site. The remaining provisions mainly comprise unfunded retirement benefit obligations and claims relating to industrial-related injuries.

21 Operating leases

21.1 The Group as lessee

Non-cancellable operating lease rentals are payable as follows:

	2019 £k	2018 £k
Not later than one year	125	102
Later than one year and not later than five years	75	94
Later than five years	–	–
	200	196

UKAEA leases vehicles and office equipment under operating leases. AEAIL does not have operating leases.

21.2 The Group as lessor

UKAEA leases its investment property with lease terms of between 0.5 and 25 years. The leases contain market review clauses in the event that the lessee exercises the option to renew. The lessee does not have an option to purchase the property at the expiry of the lease period. AEAIL is not a lessor.

The future minimum lease payments under non-cancellable leases are as follows:

	2019 £k	2018 £k
Not later than one year	1,644	1,696
Later than one year and not later than five years	3,084	1,720
Later than five years	302	190
	5,030	3,606

Rental income received during the year is disclosed in Note 12.

22 Related party transactions

UKAEA is an NDPB sponsored by BEIS which is regarded as a related party.

During the year, UKAEA had various material transactions with BEIS and with other entities for which BEIS is regarded as the responsible department, in particular UKRI (EPSRC). UKRI (STFC) is UKAEA's partner in the Harwell Science and Innovation Campus Public Sector Limited Partnership (Note 13). Other material transactions took place with the Civil Nuclear Constabulary and the NDA, organisations within the BEIS Group.

No Board member, key manager or other related party has undertaken any material transactions with the Group during the year, except for remuneration as disclosed in the Remuneration and Staff Report.

23 Statutory borrowing limit

During 2018/19, the statutory borrowing limit set by Section 3 of the Atomic Energy Authority Act 1986 as amended by The United Kingdom Atomic Energy Authority (Limit on Borrowing) Order 1991 remained at £200m. There were no borrowings by UKAEA during the current or previous year.

24 Events after the reporting period date

In accordance with the requirements of IAS10 - Events After the Reporting Period, post Statement of Financial Position events are considered up to the date on which the Accounts are authorised for issue. This is interpreted as the same date as the date of the Certificate Report of the Comptroller and Auditor General.

AVC

AEAIL

AI

BEIS

CRC

CETV

CEO

CDT

CPS

CCFE

DEMO

DT

EDI

EDS

ELMs

EPSRC

FReM

FTE

FTF

H3AT

HMT

HSIC Pub

IAS

IET

IFRS

ITER

Glossary

AVC	Additional Voluntary Contribution	JET	Joint European Torus
AEAIL	AEA Insurance Ltd	MDF	Material Detritiation Facility
AI	Artificial Intelligence	MRF	Material Research Facility
BEIS	Department for Business, Energy and Industrial Strategy	MAST-U	Mega Amp Spherical Tokamak Upgrade
CRC	Carbon Reduction Commitment Energy Efficiency Scheme	MTL	Materials Test Laboratory
CETV	Cash Equivalent Transfer Value	MTF	Module Test Facility
CEO	Chief Executive Officer	NAO	National Audit Office
CDT	Centre for Doctoral Training	NNUF	National Nuclear Users Facility
CPS	Combined Pension Scheme	NDPB	Non-Departmental Public Body
CCFE	Culham Centre for Fusion Energy	NDA	Nuclear Decommissioning Authority
DEMO	Demonstration fusion power station	OAS	Oxfordshire Advanced Skills
DT	Deuterium-Tritium campaigns	OSR	Radioactive and Out of Scope of Regulations
EDI	Equality, Diversity & Inclusion	PPSS	Protected Persons Superannuation Scheme
EDS	Exhaust Detritiation System	PNISS	Principal Non-Industrial Superannuation Scheme
ELMs	Edge Localised Modes	RACE	Remote Applications in Challenging Environments facility
EPSRC	Engineering and Physical Sciences Research Council	R&D	Research & Development
FReM	Government Financial Reporting Manual	RDEC	R&D Expenditure Credit
FTE	Full Time Equivalent	RoSPA	Royal Society for the Prevention of Accidents
FTF	Fusion Technology Facilities	STFC	Science & Technology Facilities Council
H3AT	Hydrogen-3 Advance Technology – tritium facility	SIRO	Senior Information Risk Officer
HMT	Her Majesty's Treasury	SPPP	Shift Pay Pension Savings Plan
HSIC PubSP/LP	Public/private sector partnership for the Harwell joint venture	ST	Spherical Tokamak
IAS	International Accounting Standards	STEP	Spherical Tokamak for Energy Production
IET	Institution of Engineering and Technology	WDS	Water Detritiation System
IFRS	International Financial Reporting Standards	UKAEA	UK Atomic Energy Authority
ITER	Next generation international experimental fusion reactor	UKRI	UK Research and Innovation

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