<u>Nathan Phillips</u>

In this issue we are interviewing Nathan Phillips, a graduate process engineer. Having studied Chemical Engineering at Newcastle University, graduating in 2018, Nathan is now working with Jacobs in the nuclear sector.

Nathan, how did you make the move into the Nuclear Industry?

Although a rewarding experience, which undoubtedly provided the skills I needed to venture into industry, I was somewhat disappointed with the lack of content on nuclear technology, so I applied for a master's course in Physics and Technology of Nuclear Reactors at the University of Birmingham This provided the knowledge and understanding that I needed to get started in the nuclear industry. I've now been implementing the skills and knowledge from my time at university for one year on the Jacobs graduate scheme, where I'm following the IChemE professional framework as an associate member for chartership.

What does your work involve?

The Jacobs graduate scheme has provided the opportunity to get involved with many disciplines, some of which are: mechanical testing, to determine the mechanical properties of various materials to be used in the new Evolutionary Power Reactor (EPR) at Hinkley Point C; non-destructive testing (NDT), used to identify the presence and severity of defects within critical reactor components; and dynamic graphite testing, to understand the behaviour of graphite within reactor cores of the advanced gas-cooled reactors (AGRs), which currently provide the majority of the UK's nuclear energy.

What aspects of process safety feature in your work?

I'm now focusing on process engineering and safety in a new role, receiving training and developing my understanding of the team's work. We have many bespoke test rigs built to aid and enable research into new and existing nuclear technologies. These include high temperature corrosion fatigue rigs to simulate pressurised water reactor (PWR) conditions, part of a research programme being performed to support component justification for use on plant through-life. I've received training on relief valve specification which I'll be implementing on this rig design, checking positioning and sizing calculations to ensure there's the capability to safely mitigate any relief event. Part of the PWR testing process involves hydrogen, which must be carefully managed to ensure any risks associated with this gas are acceptably low. One of the ways to achieve this is through the ventilation system which is constantly working to mitigate any hydrogen release. The system is regularly reviewed in line with regulatory requirements and is currently undergoing significant upgrades. My role as a process engineer will be essential to delivering these systems to the business as my career progresses.

To accomplish the process safety goals which are specified in our labs, it's critical to have an eye for detail, to avoid complacency and to look beyond the initial problem. Our rigs can sometimes be near walkways or other rigs and workspaces. We therefore need to scrutinise every aspect of the rig design to ensure we protect not only the rig operator, but everyone in the vicinity.

What opportunities do you have to interact with other engineers?

For me, in a very early stage of my career, it's been incredibly important to use every role as an opportunity to network across the company, and even externally with other organisations. This has secured further positions in many different projects and opened avenues for professional development. Being a consultancy, the nature of the workflow can be a little hectic at times. Having the flexibility and technical competence to take on many different roles and responsibilities has been massively helpful. The combined experience and understanding of the different aspects to a project plays a huge role in developing effective safety systems.

How does your work contribute to meeting targets for global warming?

Nuclear energy is key to achieving a net-zero carbon economy. It is currently the only carbon-free source of baseload power – the guaranteed generation of the minimum power needed to meet the fluctuations in demand throughout each day, all year round. Although advanced energy storage technologies are emerging for renewables, we simply can't rely on the wind blowing and the sun shining at the right times, especially the latter here in the UK!

The work we perform at Jacobs using our rigs is critical to prolonging the operational lifetime of our existing nuclear fleet. There are currently seven nuclear power stations in operation in the UK, generating a combined output of approximately 7.6 GW. Generating the same amount of power from coal would emit 6,000 tonnes of CO_2 every hour [1]. Clearly, extending the operation of these reactors has a huge role in reducing carbon emissions. A lot of the work we perform provides the underpinning evidence for crucial plant and reactor modifications which allow life extensions to be permitted by the Office for Nuclear Regulation. Without these extensions, several of the AGRs used in six out of the seven nuclear stations still operating would have already reached the end of their operational lives, massively reducing the UK's baseload power output.

Jacobs is closely involved with research into small modular reactors (SMRs) and advanced modular reactors (AMRs). These are smaller designs which can provide clean energy, at a lower capital investment, in locations which would not be suitable for a traditional power plant. A focus of some designs is to be able to provide co-generation, or combined heat and power, where both heat and electricity is supplied to a consumer. These designs will not only make nuclear energy cheaper but will significantly improve the feasibility and accessibility of nuclear energy. Here at Jacobs, we're at the forefront of this research for two of the three AMR designs which received funding from the Department for Business, Energy and Industrial Strategy – the Urenco U-battery and the Westinghouse Lead Cooled Fast Reactor.

This research relies upon stringent process safety due to the operating temperatures and pressures of the rigs, as well as the chemistry of the process fluids. By overcoming these challenges it is then possible to generate the required test data to inform structural integrity assessments throughout the life of the reactors.

What prompted you to study chemical engineering?

The global energy challenge is my main driver for choosing a career in chemical engineering. Responding to this challenge requires everyone to do their bit, but I wanted to contribute to advances on an industrial scale, which can shape the future of the energy sector. Nuclear energy remains a pivotal technology and it's a vital industry that I'm proud to be a part of.

[1] "Carbon Footprint of Electricity Generation", Parliamentary Office of Science and Technology, Postnote, No 286, Oct 2006.