New HPCC Powers Safety, Efficiency and Cost Savings for the UK Nuclear Industry

AT A GLANCE

- *Using the power of an OCF–built High Performance Computing Cluster (HPCC), the National Nuclear Laboratory (NNL) can now create 4D computer-based models - to support the work its customers require - with greater detail, accuracy and in significantly less time*

- *For the first time, NNL can now integrate up to seven different 4D computer-based models to produce a single set of results for customers*

- *Integrating computer-based models and processing them concurrently using the HPCC enables NNL to provide a single set of results to its customers in just 5 days, a reduction from up to 4 weeks using its previous system*

- *The HPCC enables a faster reaction/turnaround time in response to changing customer requirements during a modelling project*

- *NNL expects Return on Investment on the HPCC within 18-24 months*

BACKGROUND

From the moment Nexia Solutions Ltd (now the National Nuclear Laboratory) became a wholly owned subsidiary company in April 2005, leaving behind its non-commercial roots with British Nuclear Fuels Laboratory (BNFL), it began a programme of rationalising and consolidating its business operations. This programme would ensure it had the right workforce, skills base, sites and facilities to continue the delivery of its unique and innovative range of services. It would also ensure it was in good shape to fulfil the Government's stated intention to set-up a National Nuclear Laboratory based around the British Technology Centre in Sellafield and Nexia.

Three years into that programme, Nexia had made tremendous progress:

It employed a streamlined but highly skilled workforce (nearly all staff possessed a first class degree, PhD or MSc).

It operated impressive facilities around the UK including: the Central Laboratory at Sellafield; Windscale Laboratory, Sellafield; Springfields Laboratory and the Off-Site Workington Laboratory.

Working with IT partner Computer Science Corporation (CSC), it had a centralised IT infrastructure having consolidated multiple IT systems in use by disparate teams across the organisation.

It provided a range of services to support the complete nuclear fuel lifecycle - plant operation, decommissioning, clean-up and laboratory management. It also assisted its customers with UK nuclear policy development and implementation.

It serviced an impressive portfolio of customers such as Sellafield Ltd, UK Nuclear Waste Management Ltd, the Nuclear Decommissioning Authority (NDA), British Energy and the Atomic Weapons Establishment (AWE) at Aldermaston.

SUPERCOMPUTER CHALLENGE

Unfortunately, by early 2007 it was clear that one technology element of its rationalisation and consolidation programme was already in need of an upgrade and was not the most effective solution for supporting Nexia's work or future work as the company made the transition to become the National Nuclear Laboratory.

An early addition to the new consolidated IT infrastructure was a High Performance Computing Cluster (HPCC) built using hardware from vendor, Silicon Graphics.

The HPCC enabled Nexia's eighty computer-based modeling engineers to come together and use the power of a single machine to create 4D models, for example ground water flow or aerial dispersion modeling (time being the fourth dimension to these otherwise 3D models).

Modeling engineers would rely on the HPCC to process and run around seven different types of 4D models for customers.

However, the limited power of the HPCC meant that 4D models could only be processed in series – one after the other – a costly and time consuming process.

In addition, the 4D models could also only provide 'siloed' sets of data; Nexia had no opportunity to integrate models (and the results produced) to deliver a single view for the customer.

Processing a single model could take-up to 4 weeks. Plus, each time a customer wanted to make changes to the parameters of a model during testing, another 4 weeks would be added to the project's completion time.

In mid 2007, and now widely known as the National Nuclear Laboratory (NNL) the company took the decision to upgrade its central HPCC.

SOLUTION

Replacing the Silicon Graphics based HPCC; NNL launched 'Gemstone' (its unique name was the winning submission from a recent staff competition).

Gemstone is built on the very latest IBM hardware and uses software from both IBM and Cluster Resources Inc. to provide a powerful computer system that delivers world class ease of use and resource management capabilities.

Gemstone's design incorporates a powerful cluster of 56 IBM System x3550 Servers with Intel Woodcrest processors and 10 IBM System x3455 Servers with AMD Opteron processors. A combination of Intel and AMD processors enables NNL to take advantage of the fact that some codes for producing 4D models operate more effectively on different processors.

Voltaire Infiniband low-latency interconnect technologies enable individual processors to work together towards solving a single large 4D model.

The design enables NNL to operate Gemstone using either a Linux® or Windows® Operating System – again dependent on which Operating System the modelling code performs more efficiently on.

Data storage is provided by a 16 Terabyte (TB) Storage Area Network (SAN). Storage management is available using IBM's General Parallel File System (GPFS), a high performance file system with Information Lifecycle Management (ILM) capabilities. IBM GPFS enables additional storage capacity and performance to be added and operational in minutes with no interruption to users or applications.

The design also includes sophisticated resource management software from Cluster Resources Inc. which enables instant power allocation to departments with the greatest demands. The software takes full responsibility for scheduling, managing, monitoring and reporting of cluster workloads maximising job throughput.

"There are many aspects of Gemstone's technology that are very impressive but we particularly benefit from the Cluster Resources management system which enables us to provide resource and computer power to the team that needs it most," says Mark Bankhead, project leader, NNL. "If parts of Gemstone are not being used by a team, the management system allocates the power of Gemstone elsewhere to a team which needs it more."

The bespoke design, implementation and configuration of Gemstone are provided by OCF plc, the UK's premier High Performance Computing integrator. From initial concept stage, OCF ensured Gemstone was fully deployed and functional within 12 months (well within the schedule of works agreed with NNL).

NNL also uses OCF to manage and maintain Gemstone supplementing the manpower and skills within its own IT department and resources available through its IT services contract with Computer Sciences Corporation (CSC).

NNL – with support from OCF – also uses IBM's Cluster Systems Management (CSM) which enables it to manage Gemstone from a single point-of-control. IBM's CSM provides a range of tools including: automatic security configuration, software diagnostic tools and hardware monitoring.

OCF also provides ongoing user-training to ensure Gemstone is used to its full potential by NNL's employees.

RESULTS

NNL, using the power of Gemstone, can now create 4D computer-based models - to support the work its customers require - with greater detail, accuracy and in significantly less time.

For the first time, NNL can now integrate up to seven different 4D computer-based models to produce a single set of results for customers.

This provides NNL's customers with significantly more intelligence and enables them to undertake safer, more efficient and cost effective nuclear projects, for example, nuclear fuel manufacture and deployment, reactor operation, waste removal and reactor decommissioning.

Integrating computer-based models and processing them concurrently using the power of Gemstone enables NNL to provide a single set of results to its customers in just 5 days, a reduction from up to 4 weeks using its previous system.

Gemstone enables a faster reaction/turnaround time in response to changing customer requirements during a modelling project, e.g. changes to parameters during a modelling exercise can be incorporated and the 4D model re-processed in just 5 days, again a reduction from up to 4 weeks.

"Our existing highly skilled workforce combined with our new exceptional HPCC facility enables us to offer unique products and services to customers," adds Bankhead. "Ultimately, we are putting in place tools to support our customers as they ramp-up activity to meet the UK's new renewed focus on nuclear power."

NNL expects Return on Investment on Gemstone within 18-24 months.