

**The Role of the Sellafield Ltd Centres of Expertise in Engaging with the Science, Environment and Technology Supply Chain and University Sector to Support Site Operations and Decommissioning in the UK Nuclear Industry – 13018**

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**ABSTRACT**

The development and maintenance of the broad range of the highly technical skills required for safe and successful management of nuclear sites is of vital importance during routine operations, decommissioning and waste treatment activities..

In order to maintain a core team of technical experts, across all of the disciplines required for these tasks, the approach which has been taken by the Sellafield Ltd has been the formation of twenty five Centres of Expertise (CoE), each covering key aspects of the technical skills required for nuclear site operations.

Links with the Specialist University Departments

The CoE leads are also responsible for establishing formal links with university departments with specialist skills and facilities relevant to their CoE areas. The objective of these links is to allow these very specialist capabilities within the university sector to be more effectively utilized by the nuclear industry, which benefits both sectors.

In addition to the utilization of specialist skills, the university links are providing an important introduction to the nuclear industry for students and researchers. This is designed to develop the pipeline of potential staff, who will be required in the future by both the academic and industrial sectors.

**SELLAFIELD SITE HISTORY**

The Sellafield site (owned and operated by Nuclear Management Partners on behalf of

the Nuclear Decommissioning Authority), located in West Cumbria in the United Kingdom, is one of the most compact and technically complex nuclear licensed sites in the world. The site, originally established during the Second World War as a Royal Ordnance Factory, was subsequently transferred to the nuclear industry in 1947, for the construction of the UK's first generation of nuclear reactors.

The site occupies approximately 680 acres (2.8 square kilometers) and consists of 1,400 buildings. Of these, 240 buildings are either operating nuclear facilities or legacy buildings, which contain radioactive materials requiring treatment.

A very wide range of nuclear operations have been performed at Sellafield including

- Construction, operation and shutdown of six uranium metal fueled reactors
- Construction, operation and decommissioning of the Windscale Advanced Gas Cooled Reactor (WAGR)
- Spent fuel storage
- Spent fuel reprocessing plants
- Fuel fabrication
- Effluent treatment operations
- Research and development facilities
- Low and intermediate level waste treatment by cement encapsulation
- High level waste storage, evaporation and treatment by vitrification
- Storage of treated wastes awaiting a UK Geological Disposal Facility

Reprocessing operations for spent fuel discharged from both metal and oxide fueled reactors along with the operation of the supporting downstream plants is ongoing, however the site is now transitioning to the new mission of site cleanup and the decommissioning of facilities. The size of the site, scale of the challenges and complexity of the mission mean that the current Lifetime Plan for the cleanup of the site is for completion by 2120 [1].

The plants on the site were built and operated from the late 1940's through to present time, with their construction and operation reflecting the differing practices prevalent during this time. The requirement to understand the history of the site, its operations and the technical basis for these

along with the maintenance of this knowledge until decommissioning has been completed is critical for the successful discharge of the mission.

## **DEFINING THE SKILLS AND FACILITIES REQUIRED**

The timescales and the complexity of the operations required for site cleanup necessitate significant, detailed forward planning to ensure that the personnel, skills, knowledge and facilities remain available.

The framework used to collate and coordinate these requirements is the Site Lifetime Plan, which describes the totality of the activities which are required in order to take the site from its current state and mission to the assumed agreed site end state. Within this are the 23 Site Programmes each of which include an Execution Plan, which is used to develop Technology Road Maps (TRM) for each Programme area.

The TRM are used to identify the technical skills and facilities which will be required, with detailed information provided over the first 5 years, along with an overview of the capabilities expected to be needed over the entire site lifetime out to 2120. This information is used by the Technical Centres of Expertise (CoE) to determine the skill and facility requirements in each of the functional areas.

The TRM are reviewed on an annual basis to ensure that they reflect any changes to site strategy and technical knowledge are incorporated.

## **THE ROLE OF THE CENTRES OF EXPERTISE**

The UK civil nuclear industry has been the subject of substantial restructuring, in the period since 2005. For the Sellafield Ltd technical community, a significant change was the removal of the sites research and development division and its establishment as the UK National Nuclear Laboratory (NNL) as a standalone entity. This organization contained a substantial number of key technical staff and facilities, who performed tasks related to Sellafield site operations.

In order to determine how best to address these changes, Sellafield Ltd reviewed the approaches used by other companies operating in similar technically complex industrial sectors, to provide a benchmark. The conclusion from this exercise was that adopting specialist Centres of Expertise (CoE) which were cross organisation, represented the most appropriate solution for the strengthening of the technical skill base. These CoEs are generally virtual in structure and effectively form a network of specialist with a shared technical interest. These communities are governed and supported by the central Technical Directorate who monitor the performance of each of the CoEs and provide funding, guidance and infrastructure where required.

Each CoE is led by an experienced technical specialist, with good communications and networking skills as well as a detailed knowledge of the critical sub categories within their specific discipline. Because of the breadth and depth of specialist knowledge required, the role and responsibility for the CoE lead is to act as both a technical resource who can be called upon to provide support to projects on request and to act as an initial point of contact who will identify more suitably qualified experts, to support projects where more specialist knowledge and expertise is required.

In order to discharge the latter task the CoE lead is responsible for forming and maintaining virtual Communities of Practice within their specialist area, who can be called on for support. This network is based within the technical project community both within the Site Licence Companies and within the overall supply chain used to provide specialist technical support to the site. A full list of the Centres of Expertise is shown in Table I

Table I Sellafield Ltd Centres of Expertise

<b>Technical Centre of Expertise</b>	
Alpha Processing & Storage	Material Science
Analytical Chemistry	Modelling and Simulation
Autonomous Intelligent Systems	Nuclear Physics
Cement chemistry	Polymers
Contaminated Land and Ground water management	Safeguards
Decanning and Dismantling	Sludge
Decommissioning Technologies	Spent Fuel Storage
Decontamination	Thermal Treatment Technologies & Vitrification
Effluent technologies	U/Pu (and other actinide) Chemistry and Processing
Environmental	Uranium and Reactive metals
Flammable Gas & Radiolysis	Waste & Facility Characterisation

HALES Processes and Chemistry	Waste Segregation and Compaction
	Maths and Statistics

## **SKILLS MATRICES**

For each CoE area, a detailed matrix is produced which identifies the technical skills which are required in order to maintain the expertise base in the area and the individuals available within the Community of Practice. These are assessed against the demand for skills in specific disciplines, for current operations and projects and against the predicted future needs, based on the information provided on Technology Road Maps.

The skills matrices include data on levels of experience for each of the CoE Community of Practice members across a number of sub disciplines for each of the CoE's, including age profiles.

This process provides a check of resourcing demands in each discipline versus those available, to provide an early indication of where succession planning, recruitment and/or procurement through the supply chain will be required.

A key component of skills matrices is that Community of Practice includes individuals within the organisation and in the wider technical supply chain and the academic community. This requires the CoE leads to have a good knowledge of the total community available for support within their technical discipline, facilitated through thorough awareness of work carried out both nationally and internationally.

The skills matrices are formally reviewed on a 3 monthly basis, to capture any changes in personnel in each Community of Practice.

## **KNOWLEDGE MANAGEMENT, DISSEMINATION AND PEER REVIEW**

### **Information Sharing**

CoE's act as technical facilitators, to ensure that in a projectised structure, information commissioned in each of the technical areas is effectively disseminated across all projects performing work on related technical issues. This allows

- Commonalities across projects to be identified
- Peer sharing and challenge

- Identification of good practice
- Minimisation of the risk of duplication of work across projects
- Consistency of technical approach

### **Peer Review**

Peer review of project commissioned work is also performed by committees owned by the CoE's, with technical experts drawn from the Community of Practice, who are independent of the original work. This builds in an additional level of robustness to the checking and consistency of work, and also ensures that there sharing of expertise.

### **Commissioning of Work**

Whilst the majority of work, is funded by projects, to meet specific needs, the Centres of Expertise will commission work, where there are cross cutting themes, which will be of benefit to multiple projects. Examples of include

- Assessment of activity release fractions data from uranium based on plant experience
- Development and testing of alternative encapsulants
- Development of remote inspection devices
- Assessment of accelerated ageing of wastefoms
- Sponsorship of international forum for sharing of sludge handling experience

### **UNIVERSITY LINKS PROGRAMME**

Sellafield has a long track record of sponsoring work in the university sector both as a mechanism to research specific technical issues, and for the identifying and training students as possible future employees within the nuclear sector.

In the late 1990's, a risk of the closure of the last operating university radiochemistry department in the UK was identified, which would have very adversely affected both research and the supply of suitably qualified graduates for the industry. As a result, the then site operating company embarked on the formation of a number of University Research Alliances (URA's) in the areas of

- Radiochemistry

- Materials
- Waste Management
- Particle Science and Technology

These were successful in creating a stable research and training community in these technical areas, which then became self funding through other sources of income, including directly from nuclear industry programme areas.

This URA model is now being utilised by Sellafield Ltd in order to create and access further specialist research capabilities and to maintain the pipeline of potential technical specialists into the nuclear industry. The Centres of Expertise have established links to a number of universities, shown in Table II.

Each of these are long term collaborations, with an initial term of five years, designed to strengthen our capability in these core area of our cleanup mission.

Table II - Sellafield Ltd University Links

Technical Area	University Link
Sludges	University of Leeds
Uranium and Reactive Metals	University of Bristol
Flammable Gases	London South Bank University
Decontamination and Effluents	University of Manchester

Sellafield engages with the universities for a range of purposes

### **Direct Research**

This is fundamental and applied research which will increase the knowledge base in the technical area. It is designed to underpin the existing knowledge and address topics specific to ongoing projects.

Sellafield provides a base level of funding to the universities to fund staff and post-doctoral researchers to maintain a continuity of approach and knowledge in the area. The universities are expected to apply for PhD project funding from other bodies such as the UK Engineering and

Physical Sciences Research Council (EPSRC). This has allowed research groups to be formed, who are dedicated for the performance of specific Sellafield related projects.

The research performed, as well as increasing the knowledge is a means to train potential future employees for the nuclear industry, by providing the opportunity to understand the key technical issues, early in their careers.

### **Ad-hoc Technical Advice**

University collaborators are invited to project technical review and progress meetings, to provide an external perspective on the issues. This provides the university teams with an opportunity to understand the wider technical issues associated with nuclear industry projects, and raises their profile with a larger group of industrial contacts.

### **External Peer Reviewers**

The expertise base within the universities is also utilised to perform external peer reviews on specialist areas of work. This independent view, strengthens the process, by bringing in alternative viewpoints and knowledge to assist the projects.

## **CONCLUSIONS**

- A range of highly skilled staff will be required to perform decommissioning of the Sellafield site, scheduled to be completed by 2120.
- Technology Road Maps are used as the basis for determining the profile of skills and facilities required to carry out the decommissioning work.
- Sellafield Ltd maintains the skill base through Centres of Expertise, these are virtual Communities of Practice and utilise individuals from within Sellafield Ltd, the technical supply chain and the specialist academic community.
- In order for the Centres of Expertise to function effectively it is important that the CoE lead maintains a good understanding of the work being performed in project areas and by Community of Practice personnel.
- Detailed skill matrices, which identify the skills areas and the individuals available within the Centres of Expertise Communities of Practice are used to generate demand versus supply curves.



- The role of the Centres of Expertise includes, knowledge management and dissemination and provision of technical peer reviews.
- External links to a number of key university departments been established. These perform research work, provide expert advice and peer review.
- The university link programme is designed to increase the supply of potential future employees in the overall nuclear industry.