AQUILA NUCLEAR ENGINEERING LTD

PRAGMATIC, COST EFFECTIVE SOLUTIONS, ALWAYS

Building a Winning Formula

AQUILA NUCLEAR ENGINEERING LTD
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Contents

1. Introduction

I am a Commercial Specialist for Aquila Nuclear Engineering Limited, providing legal, commercial and compliance support to the business. This paper examines the use of commercial tools in the development of a winning formula that delivers remote handling solutions for challenging environments.

Aquila and its team have a breadth of proven experience in the bespoke design and build of remote handling equipment, working with various clients across the globe.

To consistently deliver fit for purpose solutions to its clients, Aquila regularly invests time and effort at the pre-contract phase of each project. This includes a detailed review of project requirements, constraints and risks, and ultimately contributes to the development of Aquila's risk appetite for the project.

With the aid of an Aquila case study, this paper will consider the commercial and technical effort dedicated at the pre-contract phase.

2. Case Study

2.1. AIMS AND OBJECTIVES

The project was to design, manufacture, test, install and commission remotely operated size reduction equipment in the Active Cells of the European Spallation Source (ESS) in Sweden. The objective of the ESS Active Cells is to size reduce, store and enable subsequent shipping of radioactive material that will be produced as a by-product of the ESS research operations.

Figure 1: A digital model of the European Spallation Source in Lund, Sweden. Credit: ESS

2.2. PROJECT CONTEXT

The ESS will be one of the world's largest scientific and technology infrastructure projects delivered to date. It is funded by a European Research Infrastructure Consortium (ERIC) to fulfil the international requirement for high-energy neutron source research.

The ESS will be located to the north east of Lund, in Sweden and will include a particle accelerator, target station, experimental halls and office facilities. It will also include a waste processing plant known as the "ESS Active Cells".

The United Kingdom Atomic Energy Authority (UKAEA) has been engaged by the UK's Science and Technology Funding Council (STFC) to design and supply significant parts of the ESS Active Cells, as part of the UK's in-kind contribution to ERIC.

Human access to the ESS Active Cells is highly restricted and almost all operations and maintenance activities will be undertaken remotely using a robotic handling system and size reduction equipment.
A critical component to be operated within the ESS Active Cells is the Shaft Cutting Station, which is used to size reduce large irradiated Target Components.

In order to undertake this size reduction, a cutting station was required that can receive, support and size reduce all variations of by-products created.

Aquila's Shaft Cutting Station resides in the ESS Active Cells and receives a range of waste components for disposal. It allows these components to be translated and orientated for machining operations, holding components securely, and reducing components into smaller sections. These smaller sections are then presented for removal by an in-cell robotic handling system.

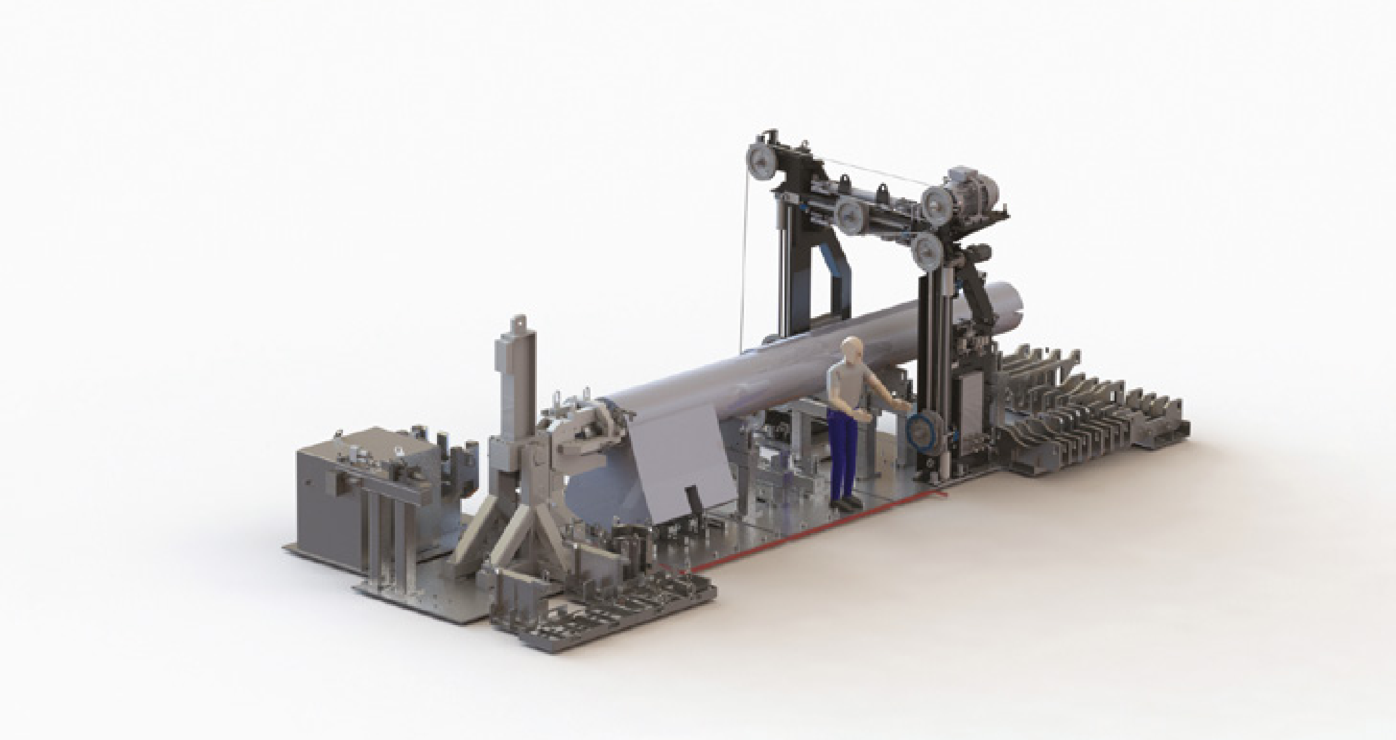

Figure 2: Aquila's Design of the ESS Shaft Cutting Station

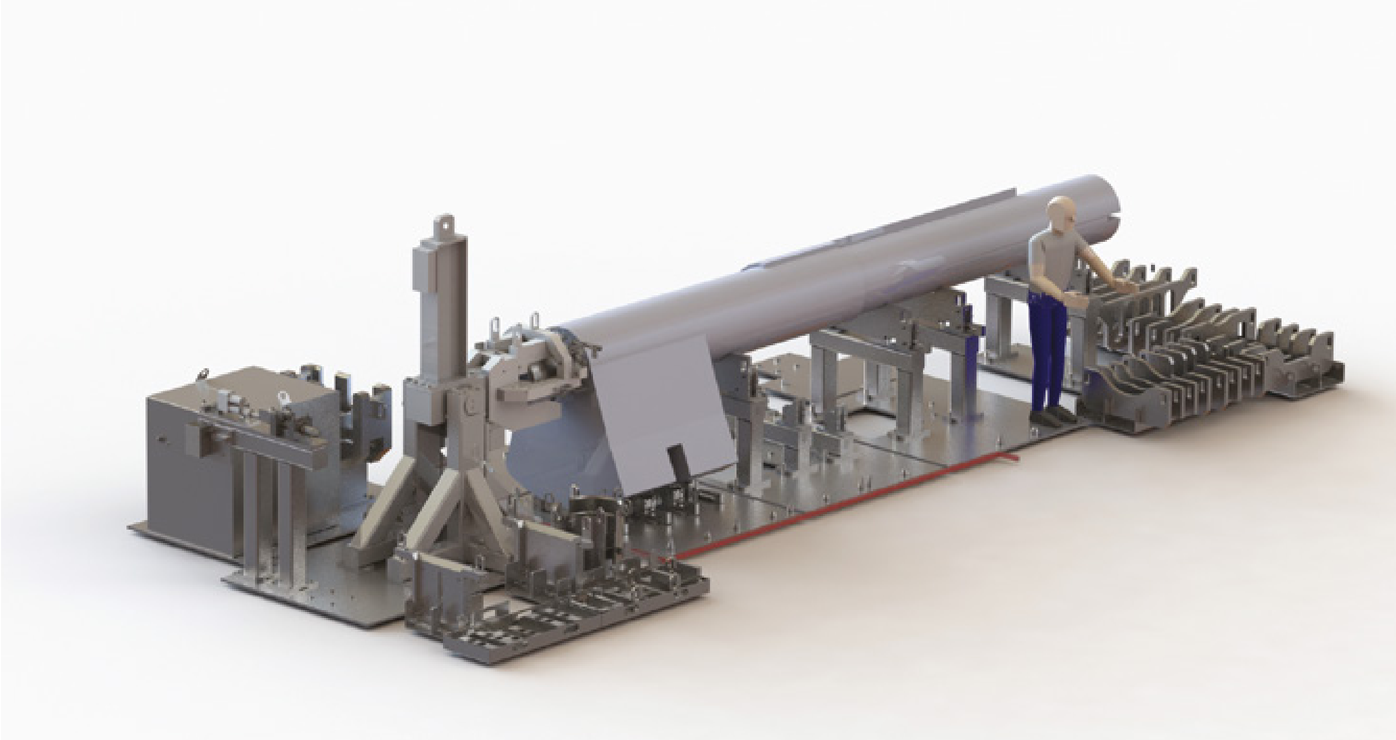

Figure 3: Static Receipt Bed loaded with Component

In 2018, UKAEA issued an Invitation to Negotiate for the design, build, test, install and commissioning of the Shaft Cutting Station. After a successful tendering process, UKAEA engaged Aquila to deliver the Shaft Cutting Station, employing remotely operated diamond wire technology in an active environment.

2.3. EQUIPMENT DESCRIPTION

Aquila's Shaft Cutting Station comprises:

- Diamond Wire Cutting Assembly
- Static Receipt Bed
- Component Pivot Assembly
- Storage Rack

2.3.1. DIAMOND WIRE CUTTING ASSEMBLY

Aquila employed proven diamond wire technology to fulfil size reducing requirements. The Diamond Wire cuts each component by inducing downward pressure as the component is held on a Static Receipt Bed.

Owing to the operating environment and with human access prohibited, the Diamond Wire Cutting Assembly is designed to be a line replaceable unit, meaning sub-components could be easily replaced and maintained individually of each other. This avoids the need to replace the entire Assembly which will have added to operating times in the ESS Active Cells.

Aquila proposed the use of diamond wire to UKAEA because it de-risked various elements of the cutting process:

- it minimises and prevents the spread of airborne contamination;
- it creates a manageable amount of swarf which is presented for collection / removal by the in-cell robotic handling system; and
- it avoids the need for water-cooling during the cutting process, negating a need for water supplies to be held within the Active Cells

2.3.2. STATIC RECEIPT BED

A receipt assembly was required in order to hold components and position these under the selected cutting technology. Aquila's design consists of a Static Receipt Bed, avoiding the need for any moving parts. Instead, the Diamond Wire Assembly is relocated by the in-cell robotic handling system, along each component to undertake individual cuts.

The Static Receipt Bed is designed to accommodate removable inserts and stands which help support individual components which vary in size and shape. It also incorporates a swarf collection feature which will collect swarf during cutting and allow access for a vacuum system to access and remove the swarf.

2.3.3. COMPONENT PIVOT ASSEMBLY

The Component Pivot Assembly consists of a fabricated, welded and mechanically fastened, mild steel stand which is mounted directly to a base plate bolted directly to the Active Cell floor embedments. The Pivot is at a fixed height and position and consists of a pin upon which a pivot tool will rotate. The pivot tool can be locked in both the horizontal and vertical orientations. Locking the pivot tool in the vertical orientation will provide a fixed receptacle for the components and will assist during component loading. Locking the pivot tool in the horizontal orientation will assist in removal of the components after cutting.

Attached to the pivot tool are stainless-steel interchangeable component receivers. Each component for size reduction has a dedicated receiver which is used to accept and locate the component onto the pivot tool when presented in the vertical orientation.

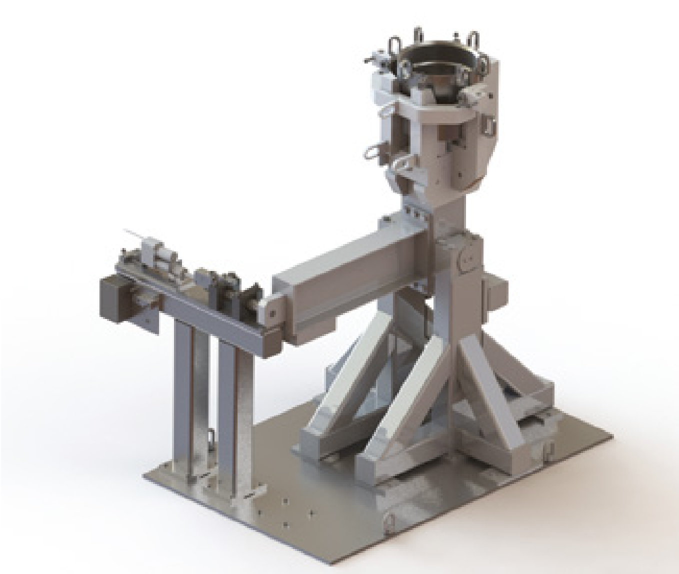

Figure 4: Pivot Assembly in receipt position

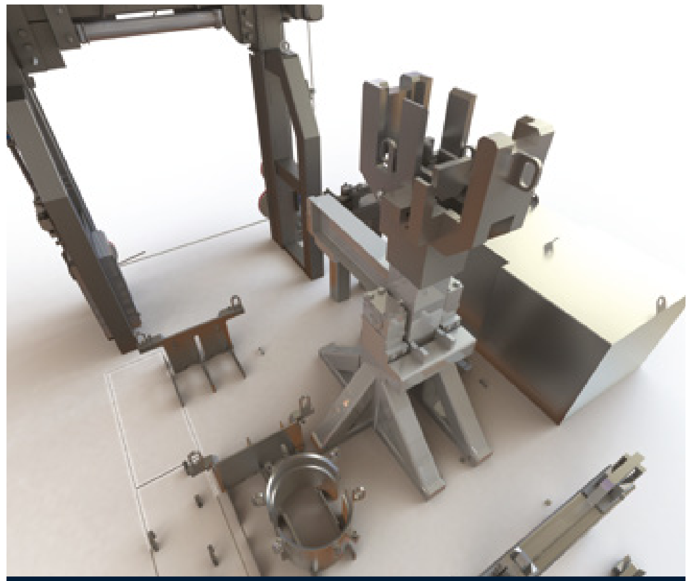

Figure 5: Pivot Assembly in receipt position

2.3.4. STORAGE RACK

When not in use, the removeable inserts used on the Static Receipt Bed and the interchangeable component receivers from the Component Pivot Assembly, are stored within a Storage Rack located within the Shaft Cutting Station space envelope. All elements are designed with incorporated lifting features suitable for use with the in-cell remote handling equipment.

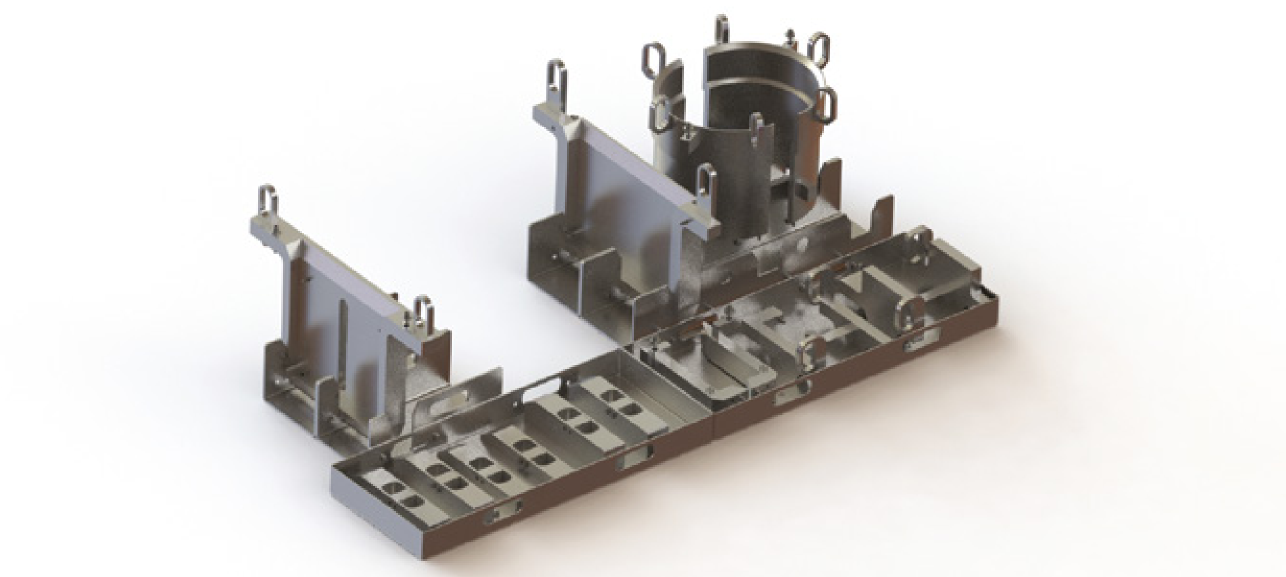

Figure 6: Inserts in Storage Racks

2.4. BUILDING THE WINNING FORMULA

2.4.1. AWARENESS

Consistently delivering workable solutions to the nuclear industry is no easy feat. It requires appropriate levels of collaboration, creativity and rationality throughout the project lifecycle. For the Shaft Cutting Station, this commenced at the pre-contract phase: Aquila developed an awareness of the project requirements and how these stacked up against previous experience and Aquila's core capability.

Aquila's initial interpretation of project requirements identified the proposed use of bandsaw technology as a critical project risk. For this reason, an alternative cutting solution was selected by the pre-contract engagement of a diamond wire technology supplier. This early identification of project risk was informed by the awareness and critical thinking of the Aquila team, taking account of experience, capability and holistic impact on project delivery.

Awareness of one's strengths and weaknesses from the outset of any project may be critical to the success of that project. The Shaft Cutting Station is no different. Aquila has undertaken various size reduction projects in the past; however, no project has presented such unprecedented risks as the Shaft Cutting Station i.e. radiation hardness, remote maintenance constraints, and serviceable lifetime requirements.

Having the awareness to engage subject matter experts in the pre-contract phase ensured solution development for the Shaft Cutting Station was well informed prior to accepting contractual obligations and liabilities.

2.4.2. SUCCESS FACTORS

Having successfully developed holistic awareness for the project, solution development is further informed by critical success factors provided by the client, UKAEA.

UKAEA is an executive non-departmental public body, entrusted with UK taxpayer's money for the purpose of developing and researching nuclear fusion power. It therefore has a duty and a need to drive value for money in designing and procuring engineered solutions.

As with all ESS Active Cell projects under UKAEA's remit, the Shaft Cutting Station has several critical success factors:

- value for money and affordability to the UK taxpayer;
- zero-harm safety performance; and
- getting the solution right, first-time.

Aquila's solution for the Shaft Cutting Station echoes years of experience in pragmatic engineering and delivering quality systems while maintaining safety through project delivery and operation.

To properly achieve value for money and engineering a solution that is workable, Aquila assessed UKAEA's requirements against all known constraints and parameters within the ESS Active Cells.

For example, Aquila's solutions had to consider readily available and easy-to-maintain technology while balancing the costs for such equipment to survive the radioactive environment as well as the expected lifetime and operation of the ESS Facility.
UKAEA's critical success factors informed the development of Aquila's solution, and paved the way for collaborating with diamond wire experts early on.

It is sometimes all too easy to ignore success factors, especially in circumstances where they appear to be obvious. Nevertheless, formally documenting success factors from the outset and incorporating these into project delivery strategies ensured Aquila had a robust framework from which it could develop a workable and compliant solution.

2.4.3. COLLABORATION

Collaborative working is often a fundamental principle for Aquila both with its clients and suppliers alike. Building on the awareness and setting of success factors, collaboration equally begins in the pre-contract phase.

For the Shaft Cutting Station, it was crucial to select like-minded partners that were able to fulfil specialist requirements with a view to working together successfully throughout the project lifecycle. Again, holistic thinking informed Aquila's strategy, and collaboration commenced with pre-tender workshops between Aquila and its suppliers, and jointly attending mid-tender meetings with the client, UKAEA.

Aquila recognised the importance of sharing and transferring knowledge with UKAEA early on, whether it be project risk or interpreting the extent of requirements. The collaborative involvement of our subject matter experts ensured conversations could be held promptly between relevant people, as opposed to being filtered through various tiers of personnel.

2.4.4. ASSURANCE

Having set the foundations for collaborative working and defining the scope split between Aquila and its subject matter experts, one of the final elements in building the winning formula was to develop a comfortable level of assurance that the proposed solution was the right solution.

This assurance was not only for the benefit of UKAEA, but also Aquila and its subject matter experts: if any one party was not assured in the selection of diamond wire technology as a workable solution, all other elements of the winning formula are put at risk.

It was fundamental that all parties bought in to the solution, and therefore each party developed a vested interest in its success, beyond its contractual role in the project.

3. Summary

Aquila was engaged by UKAEA to deliver the full turnkey solution. Through early collaboration and pragmatic working practices in the pre-contract phase, Aquila developed a cost-effective solution for UKAEA and the ESS. This project is a good example of consistent innovative working to employ proven industrial technology into a challenging environment and ultimately underpins a 'winning formula' for success.

The Shaft Cutting Station will be installed and operated within the ESS Active Cells. When the Active Cells are commissioned, no human access will be permitted, and all operations will be carried out remotely using in-cell camera viewing systems and remote handling equipment. Any equipment installed within the Active Cells must therefore be capable of remote maintenance or replacement.

Although these constraints increase scope for innovation and creativity, they equally minimise the scope for achieving success factors, such as getting it right, first-time. Aquila therefore had to understand each requirement and assess readily available solutions against the need to modify and validate alternative solutions.

This was achieved by mapping out solutions to fulfil the requirements and systematically assessing those solutions, identifying the associated benefits and acknowledging any disadvantages.

Throughout assessment and review, Aquila was driven by the requirements and constraints, as well as being influenced by the success factors. These considerations, when combined, provided an informed framework from which innovation and pragmatism could flourish.

Aquila's innovation and pragmatism for the Shaft Cutting Station is exemplified through its collaboration with diamond wire experts at the pre-contract phase.

UKAEA's initial concept was for the solution to be based on bandsaw technology. However, after consultation with its key subcontractors, Aquila instead adopted diamond wire technology as the most appropriate and compliant solution that would achieve and deliver UKAEA's requirements.

Although bandsaw technology was considered a feasible solution, the integration of diamond wire technology provides both commercial and technical benefits that vastly overcome the practicality issues with bandsaw technology.

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