Project Alpha - Public Private Partnership

UK's first ever PPP for the bulk supply of potable water serving almost 50% of Northern Ireland's population

by
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Project Alpha is a Public Private Partnership (PPP) between Northern Ireland Water (NI Water) and Dalriada Water Limited (a joint venture company incorporating AECOM Design Build [formally Earth Tech Engineering], Kelda Water Services and Farrans Construction). The project objectives were to provide new water treatment facilities and infrastructure to achieve EU drinking water quality compliance and to operate the facilities for the balance of 25 years delivering bulk potable water to Northern Ireland Water at 10 Delivery Points in their distribution network. The project achieved Financial Close in May 2006 and Service Commencement in December 2008.

Castor Bay WTW *Courtesy of Dalriada Water Services Ltd*

Of all UK PFI/PPP Water projects, Project Alpha has been the fastest to achieve financial close and the fastest to service commencement. The 25 year DBFO project includes major upgrade work on four existing WTW facilities with a total capacity of 400 Ml/d and the construction of three new link mains totalling 65 km at a combined capital cost of £110m. The facilities will provide NI Water with potable water to the most stringent quality and testing standards in Europe to serve almost 50% of Northern Ireland's population (approx 850,000) until the year 2031. The four WTW facilities are located at Dunore Point, Antrim (180 Ml/d), Castor Bay, Craigavon (147 Ml/d), Ballinrees, Coleraine (50Ml/d) and Moyola, Magherafelt (19 Ml/d).

Background

After many years of historic under-investment and without the benefit of Capital and Operating efficiencies achieved through water reform elsewhere in the United Kingdom, the initial public sector sponsor, the Department of Regional Development (NI) chose PPP as the means to finance and deliver essential upgrades to 50% of the potable water production infrastructure in Northern Ireland. At the out-set 56 companies registered interest leading ultimately to full bids at the final stage from 4 consortia. In addition to the compliant bid, Dalriada's submission included 14 variant proposals representing a wide range of technical and commercial innovation. Several of these variants were incorporated into the final contract. Overall, Dalriada's winning Bid was benchmarked by the client as: -

- 25% below the CAPEX estimate for reference bid
- 15% below benchmarked OPEX

This was without compromise as the bid also met all of the other threshold assessment criteria, achieving the highest score for Technical and Legal and the 2nd highest score for Financial (marginally off 1st).

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Overview

In many PFI concessions there are conflicts between short and long term interests – between capital expenditure and whole life cost. Learning from these experiences Dalriada determined to find a new way of structuring the concession which would deliver excellent performance combined with the world leading capital and operating cost efficiencies achieved over the last 20 years in the UK water industry. The solution was a fully integrated Construction and Operating company, Dalriada Water Services, to finance, build and operate the works. This construct combines the benefits of a utility operating company with a capital program delivery Alliance at the heart of its creation. The company was established with offices in Belfast and resourced with a combination of new staff, people seconded from the parent companies to work directly for Dalriada Water Services, and latterly transferees from the client. By integrating the staff in this way, the company was able to establish it's own culture and the Dalriada way of working at the outset. This approach was underpinned by a fully integrated management system encompassing both the Works and Service delivery and all of the essential linkages (accredited to ISO 9001 / 14001 & OHSAS 18001).

From the very start of the bid process, the new company had the advantage of an integrated team including project and construction management staff and water treatment operations specialists reflecting the core strengths of both AECOM and Kelda Water Services respectively. Throughout the project and particularly the design phase, all of the key decisions benefited from a balanced input of needs from both capital construction and plant operation perspectives.

Technical Solution

The source for much of Northern Ireland's drinking water is Lough Neagh. This natural Lough is the largest fresh water lake in the UK (392km^2), with a catchment extending to cover 43% of Northern Ireland's land area. The Lough itself is surrounded by agricultural land which results in a substantial load of nutrient run-off into the Lough. It is also a very shallow Lough which means that water temperatures rise very quickly in the spring and summer; together with the high nutrient levels this causes considerable algal growth. As a result, the raw water quality and treatability is highly variable. The water is typically medium hard with low colour and medium turbidity levels. Manganese is also present in the raw water intermittently.

The two major works (Dunore and Castor Bay) formally utilised a combination of Ozone and Slow Sand Filtration in order to reduce organics levels in the treated water. Dalriada carried out extensive jar tests and determined that in order to meet the stringent water quality requirements a coagulation process would be needed (using Aluminium Sulphate). All of the sites were designed to have the same basic process chemistry. Clarification is achieved by Dissolved Air Flotation, followed by Primary Filtration through dual media Rapid Gravity Filters. Manganese Contactors were installed and Ozone/Granular Activated Carbon (GAC) was also chosen as a final treatment step to further reduce organic levels.

UV254 monitoring has been installed at two stages of the treatment process. On the Raw water the reading is used to control the Coagulant Dosing based on a feed forward algorithm. Post GAC is monitored for low level organics levels using a low range UV monitor. This reading is used to assess GAC performance and use as a warning that re-generation may be necessary.

Fine THM control is ensured by a control algorithm that calculates potential THM formation based on Temperature, Chlorine decay and Residence Time. The algorithm controls THM formation by adjusting the residence time in the final water contact tank.

The introduction of coagulant dosing produces a much greater sludge volume that must also be dealt with. Fully automatic sludge presses with integral cake scrapers were chosen together with covered sludge drying beds that reduce the sludge mass to a minimum before off site disposal. This process is the first large scale application in the UK

Dunore Point WTW *Courtesy of Dalriada Water Services Ltd*

Ballinrees WTW *Courtesy of Dalriada Water Services Ltd*

and has proved highly successful, consistently achieving sludge dry solids levels >60% in the space of only 10 weeks. Re-use and recycling outlets for the sludge have been identified and are being developed.

Innovation

In total 14 innovative variations from the default solution were proposed; these were not restricted to engineering, but also covered schedule, finance, insurance and OPEX efficiency alternatives. Each variant was fully evaluated on a Life Cycle basis and many were included in the final project scope, including the following examples:

- The Reference bid was a '5 treatment works site' solution, but Dalriada's alternative '4 site' solution was demonstrated to be the lowest life cycle cost option
- A power efficiency mechanism was proposed; this was incorporated into the operating contract to drive year on year savings in electricity consumption and reduce carbon footprint
- The design utilised an intelligent control system; by using fibre optic networks the quantity of expensive copper cabling was drastically reduced, whilst also providing a powerful 'reach-out' control capability and improved diagnostics.

Procurement

Farrans Construction was the principal subcontractor for the civil engineering works, with responsibility for the design and construction of the civil's for all four treatment works and £20m of new potable water transfer pipelines. Key factors in the successful delivery of the civil engineering works were:

- Farrans were an integrated part of the bid team
- Price certainty was achieved through effective risk allocation
- A bespoke NEC contract was developed combining special clauses to reflect the concession Project Agreement with the sound risk management principals of the New Engineering Contract
- Shared risk and reward mechanism were included that fully aligned Farrans with Dalriada's goals and critical success factors
- The civil engineering works were integrated into the project schedule in full Level 3 detail; this enabled early mechanical installation to be carried out in many areas bringing considerable overall schedule and health and safety benefits.

The mechanical, electrical and control systems were procured directly by Dalriada Water Services. More than 20 other members of the supply chain have been involved with Project Alpha since the bid stage of the project. AECOM has an established relationship with all these suppliers having completed other water treatment projects in Northern Ireland over the past ten years. This provided the key to deliverability as Dalriada knew exactly the abilities, and limitations, of the equipment that was purchased enabling a seamless integration into operable and maintainable plants.

Programme

A holistic approach to programme management was adopted using a schedule that integrated the detailed programs of all the main subcontractors and suppliers. The starting point was an integrated design, procurement, construction and commissioning programme for all four sites based upon 'Theory of Constraints' scheduling principals. This approach treats the project as a whole system rather than a series of individual activities. Each activity on the programme is allocated the minimum time needed to carry out the activity, with no hidden contingency period. Instead all of the time contingencies that might normally be included within the individual activities is aggregated together into the project 'buffer.' At each programme update the burn rate of project buffer consumed is clearly visible and this provides an effective management tool for both monitoring performance, and identifying and mitigating program risks. This is reflected in all of the key subcontracts which do not have fixed

contract periods. Instead they work to target dates from within the overall programme. In this way the schedule is completely integrated and everyone is sharing the project buffer.

Health & Safety Program

Another challenging aspect of the project was the Health and Safety Programme. Health & Safety performance on construction sites in Northern Ireland is historically much lower than elsewhere in the UK (AFR in NI is historically 3 times the rate elsewhere in the UK). This required AECOM to provide strong leadership across the Programme in order to achieve world class safety performance and drive the goal of zero accidents. One of the tools that was used to do this was a Gloves and Eye protection policy; making the wearing of gloves and safety glasses mandatory on all sites. This contributed to excellent overall performance and ensured that there were no eye injuries and no serious hand injuries in over One Million Hours worked.

Summary

The Works commenced in May 2007 and the Client, NI Water certified full Service Commencement in December 2009. The successful delivery of the works to such a demanding schedule ensured that NI Water met their regulatory and statutory quality obligations ahead of time. Furthermore, there were no changes to the Scope of works, or the Financial Model and no disputes or claims to resolve, thereby ensuring that the benchmarked savings were delivered. In summary, the project is an outstanding example of the efficiencies that can be delivered through a well thought out and managed P3, delivering significant public benefit by leveraging the best skills and expertise that both the public and private sector have to offer.

From the client's perspective, Ciaran Crozier of NI Water said: "I am delighted that the Dalriada consortium has delivered upon the benefits anticipated to date on this 25 year deal. On the water quality front, the new works are in place a year ahead of the Drinking Water Authorised Departures, and this, combined with the enhanced supply potential, has delivered a robust high quality supply for NI Water at two of its biggest sources of treated water. The upgrades were completed on existing sites with minimal disruption to water supplies - showing a high level of commitment, planning and partnership from both the contractor's team and the client team."

David Mulholland Managing Director of Dalriada Water said: "Project Alpha represents a groundbreaking achievement. It was the first UK PFI for the bulk supply of potable water and achieved financial close and service commencement in record time. Dalriada's success has been underpinned by an innovative and effective partnership in the form of its integrated Construction and Operating company – aligning and optimising the respective strengths of AECOM and Kelda Water Services to maximum effect. The technical design and operating practices deployed by Dalriada have enabled it to successfully contribute to the highest quality of water ever produced in Northern Ireland and Dalriada is confident that the strong partnership it enjoys with NI Water that will continue to develop over the duration of the contract."

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