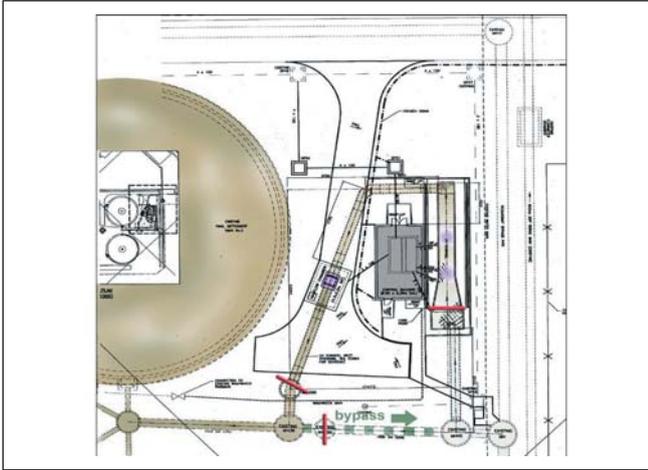


Northumbrian Water's £12m UV disinfection programme

by Eur Ing Brendan D. Carty BEng(Hons), MSc,CEng, MICE, MCIWEM

Northumbrian Water UV Disinfection programme was a time constrained and technically complex programme of works which commenced with a £0.5 million prototype project at Seaton Carew. The adoption of a prototype established best practice for the ultimate delivery of a £12 million programme of works, including the largest Ultra-Violet (UV) sewage treatment plant in Europe.



Seaton Carew disinfection - general arrangement (courtesy Northumbrian Water).

Aim of the prototype was to create a viable working partnership between suppliers, contractors and designers, and identify and deliver the best available technology to NWL operations, whilst adhering to pre-defined project objectives;

- * safely;
- * by target completion date;
- * at lowest life cycle cost and highest value compatible with quality and level of service required, at acceptable risk;
- * with 'no surprises';
- * with maximum use of local resources and expertise.

Background

Ten years ago Seaton Carew was officially designated 'Britain's dirtiest beach'. During 2001 it became one of the cleanest bathing beaches in the UK, achieving European Guideline standards. The introduction of ultra-violet disinfection as a final treatment process to the sewage effluent was a major contribution to this achievement.

Seaton Carew Long Sea Outfall discharges effluent from the 139,000 population of Hartlepool in north-east England, 4km out into the North Sea, immediately north of the Tees estuary. It is the first of six NWL continuous effluent discharges funded under the UK water industry Asset Management Plan 3, the Office of Water Services required NWL to ensure operation compliant with ECC Bathing Water Directive by 31st March 2001.

The delivery target date allowed 15 months lead-time to understand the problem, implement an appropriate procurement strategy and to design and deliver a fully functioning plant. In the North East of England there was no experience of the UV disinfection process in either NWL or the Environment Agency. Indeed the EA research and development had only recently been completed. At the time, the largest UV plant in the UK served a population equivalent of

151,000. NWL intended to commence its programme with a plant serving 139,000 pe. Future UV plants were to be larger, the Newcastle catchment having a population equivalent 1,072,000 would ultimately host the largest UV plant in Europe.

Procurement

The procurement strategy was based around a series of the ECC Option-C Target Cost contracts managed by *Faithful and Gould*. Open book accounting provided unusual access to contractors cost data, this coupled with the form of contract and partnering approach, reduced scope for conflict on the contract.

One of the key procurement strategies was to minimise the contractual interfaces and develop a tight knit core team. For consistency across NWL existing assets preference was for sub contractors who had been involved in the construction of earlier secondary treatment works, thus exploiting an existing knowledge base.

Strategy for the design and Construct procurement modified *Entec's* traditional working practice as a framework consultant to NWL. *Entec's* consequent role as *Byzack's* sub-contractor enabled efficient working for both parties, providing economic, buildable designs, programmed to suit both design and construction needs.

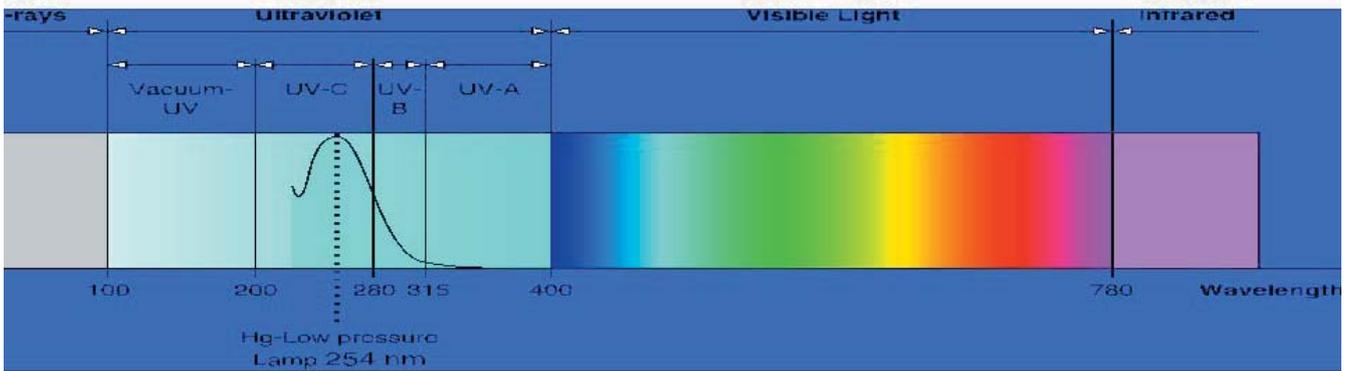
The Partnering Statement, established ideals under which the team collectively intended to operate. The principles were appraised during the award of the remaining five UV site contracts, it was no surprise to discover that all aspects of the agreement were being implemented in the spirit of the agreement with little or no effort being required by individuals.

In addition to the main contracts and reflecting the fact there was no contractual link between the Civil and Process Contractors, a bonus arrangement was agreed. This was designed to encourage cooperation between each of the parties who could materially affect the out-turn cost of the works. Consequently, flexible and supportive attitudes developed and a non-adversarial approach provided effective resolution to all problems.

Success of the procurement strategy was soon tested at Seaton Carew through agreement at a late stage of an appropriate level of UV dose with EA, leading to total, radical redesign during the Target Cost assessment period. The team produced a working design on which a revised target cost was based and construction approval provided, all within a two week time frame.

Project management

Key personnel from each company, known as the Core Team, adopted a collective problem solving approach, using meetings between empowered staff to direct the project. Fortnightly Core Team Meetings were held in an informal atmosphere, enabling a free exchange of information. The recognition of several interdependent customer relationships within the Core Team was



Spectrum (courtesy Northumbrian Water).

crucial to team equality. The meetings led to heightened awareness of others' needs, and consequent joint leadership through all challenges. Collaborative brainstorming was encouraged to generate ideas, technical jargon was discouraged, thus enabling questioning across disciplines and roles, resulting in collaborative design solutions.

In order to achieve the project objectives with a degree of certainty the Partnering Team were fully involved in the decision making process to determine how certain project management techniques would be applied.

This included collective consideration of:

- * risk analysis;
- * cost management;
- * change control management;
- * value engineering.

Early awareness of management systems and roles of others allowed potential conflicts to be highlighted and programmed out at a very early stage. This programme liaison was also extended to involve critical suppliers.

A series of out of hours team events was extended to include support staff from all contributing organisation, allowing them to share and appreciate the project in a wider sense.

Project web-site

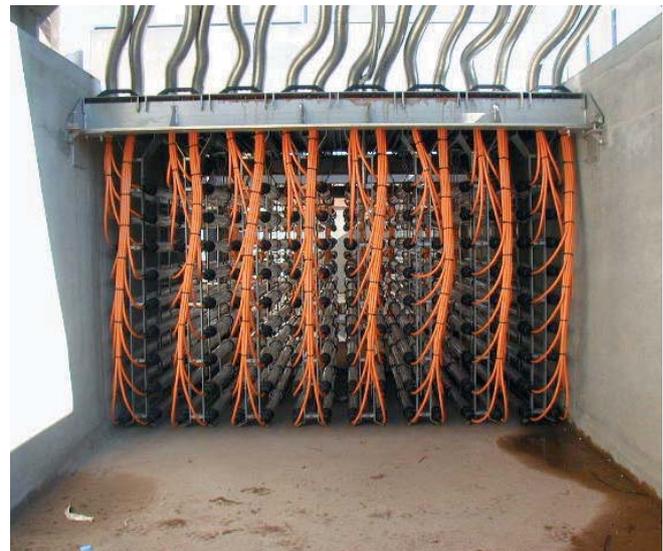
A project web-site, hosted by Arups, was established to facilitate exchange of data between diverse locations which potentially included the six NWL UV sites, various contractor locations in Manchester, the North East and Germany. The web-site was an innovation for all parties, which promoted openness during problem resolution, provided a common document repository and ultimately gave an auditable record of events.

By far the most beneficial aspect of the project web-site was the

ability to process early warning notices through to Change Control approval. In doing so, the system enabled collective appraisal of impact and collaborative agreement of final actions and costs. All consequent changes were recorded on the project web-site for all to monitor.

Construction

Civil design was based on a modular approach, building off-line. Where appropriate, 'as constructed' details of the existing treatment works were used to minimise design time. The time saving potential was off-set by an element of over-design and marginal excessive use of material. During contract delivery, savings were incentivised with gain share/pain share payment, but each suggestion to reduce costs was analysed before implementation, to ensure whole life savings, efficiency and appropriately shared risks.



Sewage eye view of UV disinfection installation (courtesy Northumbrian Water).

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Seaton Carew complete (courtesy Northumbrian Water).

Each of the five subsequent sites, although based on the modular prototype design had their own difficulties.

Marske UV installation was immediately downstream of a sequencing batch reactor. The intermittent discharges during decant changeover caused hourly shutdown of the UV plant on low level alarm. Control modification to the SBR software was required and demonstrates that UV is not a ‘plug-in’ technology.

At Hendon, site constraints severely limited the design options available. As a direct consequence of the available space, the process preferred two channel design was modified to a wide three bank in a single channel design which was at the limit of the available hydraulic head.

The **Billingham** installation was undertaken at the time of a separate works refurbishment contract and required a much greater degree of coordination and planning to ensure that the power and SCADA needs of the UV installation were fully appreciated by third party contractors.

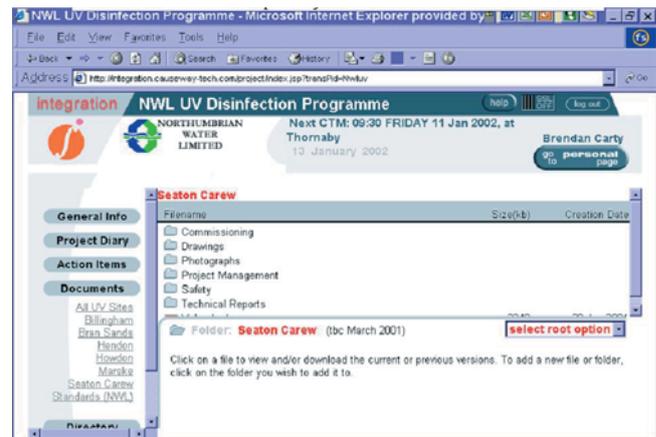
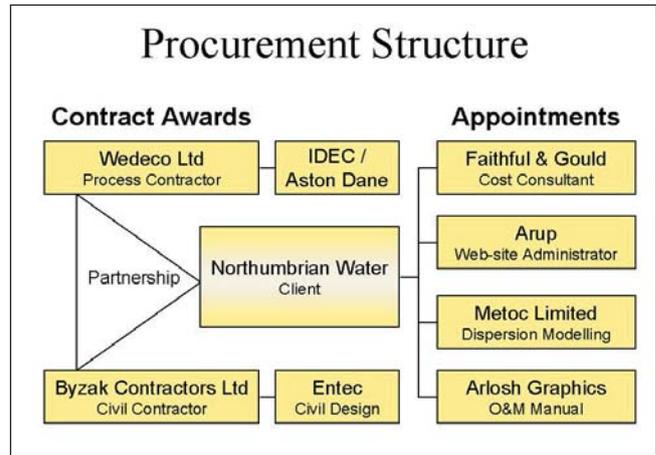
Bran Sands was the first of the four channel installations. As with all works on this chemically capped site, the UV channel structure was construction, wholly above ground with severely constrained hydraulic head available. As with all other sites the original secondary treatment site had not been arranged with tertiary treatment in mind. At Bran Sands a road diversion was required to provide the necessary construction space..

Howdon was the largest UV installation within the programme and was big relative to any installation which had preceded it. The lamps numbered 2544 with power demand of 850kW to treat a flow of 4,500 litres per second. The scale-effect from the ‘normal’ *Wedeco* installation set challenges for all.

Conclusion

Initially, the incentive of potential future contract awards motivated performance of the Seaton Carew team. As a consequence of that team’s success, contracts were negotiated for delivery of the five other UV sites. Subsequently, gain share and bonus potential across the UV programme acted as the driver for improved performance. All sites were delivered to programme in March 2002, on time and within budget, at an enhanced quality, using the processes and methodology developed during the prototype project. ■

*Note:*The author of this paper, Brendan Daniel Carty, is Project Manager, Northumbrian Water Ltd



Common document repository enabled effective communications

Credit for all illustrations (courtesy: Northumbrian Water)



UV Channel construction (courtesy Northumbrian Water).



Physically constrained UV installation at Hendon (courtesy Northumbrian Water).