

Testwood WSW UV Building

fast-track modular UV disinfection scheme to deliver assured quality water free from cryptosporidium

Southern Water's Testwood Water Supply Works (WSW) in Southampton, serves a population of approximately 300,000, and is the sole source of supply to Rownhams Service Reservoir, and a major source of supply for the Isle of Wight and the Esso Refinery at Fawley. The River Test supplies raw water at up to 84 MI/d and the current treatment process consists of coagulation/flocculation, clarification, sand filtration and disinfection using super-chlorination. On 10 November 2019, Testwood WSW's continuous monitoring instrumentation detected cryptosporidium at the treated water sample point; an event which activated the Emergency Crypto Recovery Team plan.



Testwood WSW UV disinfection building
Courtesy of Trant Engineering Ltd



Open excavation showing fabricated double tee hot tap
Courtesy of Trant Engineering Ltd

Emergency Crypto Recovery Team plan & solution delivery

The principal objectives of the plan were:

- To avoid the requirement for Southern Water to issue a Boil Water Notice to customers.
- To alleviate the risk of water supply interruptions to the Isle of Wight.
- To mitigate financial penalties and reputational damage.

The plan instigated a short to medium term fast-track modular UV solution for operational completion by early January 2020 to mitigate the risk of further breakthrough whilst the permanent solution was being determined.

Southern Water engaged Trant Engineering Ltd on the 14 November 2019 to provide design and build services to deliver

the plan outcome. Trant Engineering immediately engaged SNCL Atkins as the designer and work commenced immediately with teleconferencing and virtual workshops followed by on-site visits.

It was quickly determined, that in order to meet the extremely challenging timeline, a modular Design for Manufacture and Assembly (DfMA) solution was required and all involved (including subcontractors, suppliers and specialists) needed to work as a truly collaborative team to deliver it.

Southern Water, Trant and SNCL Atkins collectively led a team of suppliers and subcontractors in a true collaborative manner with all parties contributing to and owning the design. Starting effectively on a blank piece of paper, the kickoff meeting, held on site to familiarise the team, agree the scope, the modular solution concept and location.

Key elements

The solution developed was to intercept the existing treated water mains, both potable and industrial, prior to their exit from site and divert them to a new above-ground UV treatment facility. Time constraints and winter weather dictated a covered UV installation to avoid delays.

Online diversion

A facility to divert the water through the UV plant and then reintroduce the UV treated water back into the outlet pipes was required. A concept design was worked up that would allow the diversion and reintroduction to take place during the same shut down using hot taps. A line stop would then be used to permanently divert flow through the UV treatment facility.

Specialist sub-contractor, Pipeline Services (UK), modified the hot tap concept based on improved team network knowledge providing a prefabricated double tee unit incorporating a 'spectacle blind' chemical industry concept, to provide a short-circuit proof commissioning "valve" in favour of a line stop. During an 8-hour critical path shutdown period, the installation took place in a single lift that followed two simultaneous cuts to remove 4.5m length of existing pipework. For final commissioning, only a short shutdown was required to install the 'blind' i.e. blank flange once the UV system was ready to receive flows.

UV equipment & building

The UV equipment's limited market availability was immediately identified as the most critical item, and this drove the whole agile design. Xylem dispatched the UV reactor units, selected on an initial design envelope agreed between the Southern Water and Trant/SNCL Atkins teams, whilst other elements were designed. The UV equipment selection, and the pipework design surrounding it dictated the required size of the enclosure. This weatherproof enclosure was required for medium term use and had to be supplied/constructed in a number of weeks.

The selection was narrowed down to an off-the-shelf modular steel framed building with an inflatable roof (Marquee hired-in building) to cover the emergency UV base slab and fixed by anchor bolts. This gave the benefits of a 3-week delivery and 3-day erection to weather tight construction envelope. The steel frame is a 'hinge up'; cable tied, lightweight portal frame which allowed for manual erection minimising crane usage on a live site with limited working space.

The inflatable retractable roof was designed and installed in sections spanning the portal frame bays. The roof was effectively rolled onto the top of the structure, anchored down, and then inflated. The installation of the roof took a matter of hours and its sectioned nature aided pipework installation and will provide future maintenance access to plant.

This advantage was realised during the testing phase where a section of pipework required replacing. The section of the roof directly above the pipe in question was deflated and rolled back to allow a direct lift of pipework using a crane. The replacement piece was then lowered in and the roof re-installed and inflated with minimal disruption to the ongoing works.

Digital design collaboration

A 3D BIM model was used to primarily present a layout of the pipework and ensure treatment quarantine lengths were provided, and also in stakeholder meetings to aid visualisation with Southern Water as client, operator, WQ regulator and engineer.

The 3D model allowed for preliminary take-offs for both the ductile Iron pipework order and SCADA/Telemetry panels fabrication whilst the final requirements were being resolved. The 3D model was also used for early engagement of local residents to gather



External view of diverted pipework into and out of UV building with inflatable roof on - Courtesy of Trant Engineering Ltd



Pipework installation and erected steel frame
Courtesy of Trant Engineering Ltd

Testwood WSW UV building: Supply chain - key participants

Role	Company
Client	Southern Water
Principal contractor	Trant Engineering Ltd
Principal designer	SNCL Atkins
Mechanical installation	Franklyn Yates Engineering Ltd
Electrical sub-contractor	GA Electrical Services Ltd
Inflatable roof supplier	Flexitec Structures Ltd
Hot tapping	Pipeline Services (UK)
UV plant supplier	Xylem Water Solutions UK Ltd
Pipeline supplier	European Pipeline Engineering (Southern)
Valve supplier	Invicta Valves Ltd

feedback on the aesthetics of a newly erected structure visible off site. Renders of the model were presented as part of the planning application showing the view from various points of interest which then quickly dictated design and remediation decisions.

Pre-fabrication

Numerous other approaches aided off-site prefabrication to deliver the programme:

- 24/7 working except Christmas and New Year's Day and a rotational shift pattern allowed safe building erection around equipment installation.
- DfMA 10' shipping container sample kiosks were delivered fully tested ready for connection.
- Nova Siria restrained flange adaptors provided length tolerance.
- Slab and plinths at the same level facilitated standard height pre-welded pipe supports.

Challenges and success factors

There were unique challenges brought about by assembling a delivery team under such short notice. The geographically dispersed team communicated effectively by use of phone, email, Skype/Teams and other digital technologies, promptly sharing the latest solution details, new design/procurement/programme issues and constraints. Formal weekly update meetings in person and by screen sharing monitored progress which was key for the meeting the delivery date.

This BIM model also enabled fast tracked safety inductions of the site team which peaked at over 80 staff. The site worked 24/7, various initiatives improved team safety and morale, including frequent full site stand downs and a fish and chip van visit to feed the entire work force.

Summary

The DWI visited Testwood 5-weeks after the project kick-off and were reassured that Southern Water was taking its responsibility seriously and would meet the target date as the UV reactor units were already on site, pipework installation was well advanced and the building already partially erected.

Only 10 weeks from the initial incident, 300,000 customers in Southampton, parts of the Isle of Wight and a major oil refinery now had assured quality water free from cryptosporidium.

Testwood WSW is now protected against future water quality failures and hence in compliance with DWI requirements. The temporary emergency UV installation has been designed to allow it to be modified in the future to become a permanent installation at a later date.

The editor and publishers would like to thank Trant Engineering & Atkins for providing the above article for publication.



Fusion Bonded Epoxy Coating of Pipework | Lining of Pipework & Tanks Using Resicoat® R4

A fully equipped facility capable of handling large items with up to 80 tonnes lift capacity, providing application of a full range of coating systems, including:-

- Large fluidised bed, 4m x 3m x 4m depth, enabling application of fusion bonded epoxy to pipes up to 7.5m long.
- Electrostatic spray of fusion bonded epoxy.
- Heated plural component airless spray of DWI approved linings.
- Thermal spray of zinc & aluminium metals.

An ISO9001:2015 registered company with a quality department providing NACE/ICorr Level 3 inspection



ABRASIVE BLAST CLEANING - THERMAL METAL SPRAY INDUSTRIAL COATINGS & LININGS - FBE POWDER COATING

Unit 22 Newton Chambers Road, Thorncliffe Park Estate
Chapelton, Sheffield S35 2PH

Tel: 0114 246 1237 | Fax: 0114 257 0151 | sales@orrmac.co.uk | www.orrmac.co.uk

