

CASE STUDY: RETROFLO RPC_2000

Client: South West Water/Grundfos

Station name and location: Ilsham Valley Sewage Pumping Station, Torquay

No. of Pumps and Installation type: Four - Submerged in Wet-Well

Operating arrangement: Duty/Assist/Assist/Standby

Date of Retroflo RPC_2000 installation: June 2009



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SUMMARY

Ilsham Valley SPS was built in 2003 and is a coastal station serving the town of Torquay and its surrounding area. Located on a trunk sewer it receives flows of unscreened domestic and commercial raw sewage, plus rainwater run-off, from the Torbay catchment area with a population in the region of 200,000. The liquid is transferred by the submersible pumps, via the main pipeline, a distance of approximately six miles to the Brokenbury Treatment Works which includes an elevation of 50 meters. The station has a consented flow of 531 litres/sec which must be achieved during storm conditions and, if necessary, for extended periods.

Like many sewage pumping stations today, Ilsham receives large quantities of fibrous material [rag] and other non-specific debris, transported by the inflow, which must be pumped forward to the treatment works. This material has a history of both partially and entirely blocking the pumps, a situation most prevalent during storms and high incoming flow conditions.

In order to ensure pumps remained operational and the station continued to pass forward its consented flow, avoiding spillage into Torquay Bay, South West Water Operations and Maintenance Engineers would manually unblock pumps, sometimes for several days continuously. In addition to the obvious consequences of losing an operational pump due to blockage, plus the man-hours expended clearing debris from impellers and volutes, partial blockages could remain for many running hours, limiting hydraulic performance, rendering the pumps inefficient and consuming excess electrical power.

Over a period of years many attempts had been made to overcome the blockage problems. The Retroflo RPC_2000 became available on the open market early in 2009 and so South West Water, Grundfos and Retroflo were able to collaborate on a permanent solution during the summer of the same year.

The RPC_2000 was retro-fitted to control existing pumps, VSDs and the PLC at Ilsham Valley Pumping Station. In the six months following commissioning the station has recorded a vast reduction in pump blockages and general maintenance costs, while pump performance has risen and a much cleaner wet well has been observed.

SCOPE OF WORK

With the main objective of alleviating the regular pump blockage problem and its associated consequences a Retroflo RPC_2000 was installed and integrated into the station control system. Retroflo Ltd took responsibility for the entire design, installation and commissioning which included modification to existing instrument, controls and motor starter circuitry. With support from South West Water software engineers the existing PLCs were modified to allow the RPC_2000 to take full control of the station. The option was provided to easily revert to the original control system at any time should this be required. Close liaison with Grundfos ensured that pump performance would be optimised without any detrimental effect on machine reliability or ultimate longevity.

In order to determine an accurate performance benchmark all pumps and the wet-well itself were cleaned and examined at the commencement of the project. Primary settings and data installation, dedicated to the Ilsham Valley Station, were entered by Retroflo, on site, during installation and commissioning, whilst optimisation of the station control, also by Retroflo, was undertaken during the weeks immediately following.

SYSTEM FUNCTIONALITY

The key features provided by the RPC_2000 are:

- Operator Selected Batch or Constant Level Pumping
- Operator Selected Cycling Pump Duty or Fixed Pump Duty
- Pre-Blockage Detection
- Pump Self-Cleansing Routine
- Intelligent Flushing Cycle
- Periodic Efficiency Testing
- Consented Flow Security
- Real Time and Historical Data Review and Storage.

Interface with the RPC_2000 is via a dedicated, easy-view, full language and menu-driven touch-screen. Navigation and interrogation of parameters, settings, operating data and logs is straightforward with password protection ensuring that adjustments and changes are carried out only by authorised personnel.

Once logged in, the operator can easily select and change the feature options using the full English language entries on the screen. System settings, real-time and historic data, including trends data, can be viewed using a few simple touch-screen commands on the RPC_2000 display.

OPERATOR SELECTED BATCH OR CONSTANT LEVEL PUMPING

The currently selected mode for Ilsham Valley is Batch Pumping, as this was determined the most suitable for the Ilsham Station design. As the liquid level in the well rises to pre-determined levels, one, two or three pumps will be operated together. Each time a pump is called to run a short reverse cycle is initiated, followed by maximum-speed boost period, ensuring any debris that may have settled in a pump or its pipe-work is flushed clear. This flushing feature is also repeated at each pump stop. At high inflows, when three pumps operate simultaneously, the RPC_2000 utilises a PID control function and, based on the signal from the station flow meter, adjusts the speed of all three pumps to maintain the consented flow of 531 litres/sec.

OPERATOR SELECTED CYCLING PUMP DUTY OR FIXED PUMP DUTY

The operator can choose between an automatic selection of the duty and assist pumps or fix the duty arrangement when, for instance, there is a pump maintenance requirement. Under normal conditions Cycling Pump Duty is selected and the operation will rotate around the four pumps based on a run-timer, currently set for 30 minutes. In this particular installation it is important to avoid long periods of continuous, individual pump operation, as it can increase the potential for blockage to occur. Configuring the feature for Ilsham Valley and adjusting the parameters was all accomplished via the display screen.

PRE-BLOCKAGE DETECTION

Solid material that has become lodged in the impeller/volute, causing a partial blockage, is the starting point of two major issues: lost hydraulic efficiency resulting in excess energy consumption; and a build-up of further debris to the point where the ability of a pump to transfer liquid is severely compromised. The RPC_2000 utilises Pre-Blockage Detection to dynamically monitor pump operating characteristics. When a pump is monitored outside of its normal operating characteristics, indicative of a potential pump blockage event, corrective action is taken to remedy the problem in the form of a rapid reversal of the suspect pump. If successful the blockage is removed and normal operation resumes.

PUMP SELF-CLEANSING ROUTINE

As described above, on detection of debris build-up on the pump impellor the RPC_2000 initiates a pump rapid reversal cycle. This removes debris before it develops into a blockage situation and maintains pump efficiency. This self-cleansing routine is also performed at the start and stop of each pump duty.

INTELLIGENT FLUSHING CYCLE

The RPC_2000's Intelligent Flushing Cycle can be selected to operate based on time or well liquid level. With the level-based daily cycle selected at Ilsham Valley, the same volume of water is flushed at approximately the same time every day. Full safeguards are in place to ensure the flushing cycle only operates during clearly defined inflow conditions. The liquid level is permitted to rise without the pumps operating until the flushing cycle level is attained. The rapid emptying of the well ensures adequate dilution of settled solids enabling the solids to be passed forward. It also allows rising main self-cleansing velocities to be achieved, at regular intervals, to prevent deposition in the main and fat build-up in the well. Once the Flushing Cycle conditions have been met then three pumps will be operated, as described earlier, to pass forward at the consented flow rate of 531 litres/sec.

PERIODIC EFFICIENCY TESTING

The feature has provided both Operations and Maintenance teams with the ability to monitor pump wear and also compare performance between pumps. Each pump is automatically checked, on a regular basis, to compare its flow rate and corresponding power consumption against values measured during commissioning of the RPC_2000. Significant deviations will be flagged up allowing South West Water to take pre-emptive action.

CONSENTED FLOW SECURITY

Again the feature is selectable by the operator and provides both monitoring and alarm functions for the consented flow condition. During high level [storm] conditions the Pre-Blockage Detection is disabled to ensure uninterrupted pump operation. However, should measured flow fall below the consent value, then pump duty is rotated and the combination of Duty, Assist1 and Assist 2 pumps, from the four available, is changed. If consented flow is then achieved the new pump duty will remain but should flow fail to reach 531 litres/sec then the RPC_2000 will continue to try all permutations of pump operation. If Consented Flow is not achieved then the Consent Alarm is triggered. Accurate flow control is a requirement, as exceeding consented flow can create problems at the Brokenbury Treatment Works, including spillage.

REAL TIME AND HISTORICAL DATA REVIEW AND STORAGE

A unique feature of the RPC_2000 is its continuous monitoring of pump performance against the site-specific benchmark measurements stored over the full range of wet well levels and pump speeds. The system stores up to 40,000 pump and well characteristics in its memory, enabling immediate action when pump clogging occurs. The default screen displays current pump duty arrangement, availability and operating status together with wet-well level and pumped flow rate. From here navigation around the parameters and stored data is straightforward.



FEATURE DERIVED SYSTEM BENEFITS AND IMPROVEMENTS

With the RPC_2000 in control of the station the primary objective of reduced blockages was met via the Pre-Blockage Detection, the Pump Self-Cleanse Routine and the Intelligent Flushing Cycle.

Following an initial on-site training session from Lee Bishton, Retroflo Technical Director, both Operating and Maintenance Engineers at SWW quickly felt at ease accessing and reading information on the RPC_2000 colour screen.

In the six-month period following the implementation of the RPC_2000, manual unblocking of choked pumps was eliminated. This was most apparent when analysing the out-of-hours call-outs by the SWW Maintenance. Against the corresponding 6 month period of 2008, savings in overtime payments exceeded £18k. No comparison for a reduction in labour during normal working hours is available but it is fair to assume substantial savings. Not least when considering that during prolonged and heavy rainfall the station would have been continuously manned.

Of greatest interest was the record of Pre-Blockage Detection and Pump Self-Cleanse sequences in the period immediately after commissioning. This provided a clear view of when and how many times each pump was beginning to clog, together with the success of the reverse pump operation in overcoming the problem. Not only did it become unnecessary to lift and dismantle pumps to unblock them, but as the whole system became cleaner so the number of sequences subsided.

The daily Intelligent Flushing Cycle routine has also had the effect of cleansing the station wet well, pipe-work and rising main, helping to maintain the whole system at peak operating efficiency and maintain consent security. Additionally, the station wet-well is scoured as the liquid level is forced down at a maximum rate, which has contributed greatly to a reduction in the build-up of solid material, with its potential to cause blockage.

The installation of the RPC_2000 at Ilsham Valley Pumping Station has led to a vast reduction in pump blockages and general maintenance costs, while pump performance has risen and a much cleaner wet well has been observed. The cumulative effect of these cleansing functions, in the months following commissioning, also means that the station has become more energy efficient as a whole.

For more information please visit www.retroflo.com or contact us via one of the options listed below.

Telephone: 0191 497 2840

Fax: 0191 419 1579

Email: info@retroflo.com

Retroflo Limited

Unit 32 Crowther Road, Crowther Road Industrial Estate

Washington, Tyne + Wear NE38 0AQ