

Retroflo

REVOLUTIONARY PUMP CONTROL

● CASE STUDY NWL RED ROW SEWERAGE PUMPING STATION



*NWL Red Row SPS – Bomarsund - Northumberland
Pre and Post Station refurbishment at Nov 2006 to Feb 2007
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STATION CONDITION AT JUNE 2006

The station is a conventional drywell/wet well arrangement. The Control Building consists of a ground level MCC motor floor with a dry well, containing 3 pumps and associated pipe-work, located directly below the MCC motor floor. The dry well is accessed by a steel stairway at one end of the chamber and is some 10m below ground level.



There is a separate but adjacent underground chamber containing inlet channels, comminutors, a coarse screen and 2 large wet wells linked by a central balancing penstock. The site was usually operated as one large wet well.



There is a separate outlet valve chamber and an overflow outfall into the adjacent water course.



The station is a terminal pumping station delivering flows directly to the downstream Cambois STW and as such, failure of the station causes overflows at many upstream pumping stations and CSOs.

The site was nominated by NWL as requiring refurbishment after an internal evaluation and scoring process indicated it as being:

- Unreliable due to regular pump mechanical failures.
- Aged pumps becoming un-maintainable ie: replacement parts being difficult to obtain thus requiring 'custom manufactured parts.
- Prone to consent failures.
- Pumps operating for long periods/continuously, even in dry weather conditions.
- High operational cost (physical maintenance costs and documented energy costs).

At the time historical documentation and current hydraulic analysis by NWL indicated:

- The original station design (circa 1969) was for a max. storm output of 184 l/sec by a duty/assist/standby operational arrangement of 3 installed pumps.
- Hindsight now indicated that this storm flow was a very high and 'unrealistic estimate' of the future output requirements from the site, due to anticipated future development growth.
- The current Formula A output flow for the site is = 136 l/sec.
- The near future Formula A output flow for the site to be = 152 l/sec.
- The ultimate Formula A output flow for the site to be = 164 l/sec.

NWL advised their requirement for the operational output of the refurbished station to be 'provide a storm output capacity of 152 l/sec (the site would be consented to that figure in the relatively near future)'

Site surveys and investigations indicated:

- The MCC and control system was installed in 1971.
- The MCC incomer was rated for a 400vac 600A supply (massively oversized for the current usage)
- The electricity supply fuses were 300A although only a 120A max. electricity meter was fitted.
- The motor/pump sets were rated as 60HP (44.76kw) FLC 83A at 400vac – manufactured in 1971
- The pump output performance was found to be a maximum of 100 l/sec with 3 pumps running ie. substantially below all NWL current and future predicted output flow requirements for the site.
- In an effort to provide as much output flow from the aged pumps as possible, the site control system had been modified to allow all 3 pumps to run simultaneously.
- The 3 pumps running simultaneously were causing the electricity meter to run in an electrical overload state.
- The station output rising main pipe-work (1032m of 610mm ID diam) was massively oversized even for the original unrealistic predicted output of 184 l/sec. As a result the rising main was shown to be partially blocked due to internal deposition of solids/rags caused by the extremely low flow velocity operation over the past 35 years.

In summary:

- Virtually all equipment on site was originally oversized – the expected increase in output flow requirement had never materialised.
- The pumps were completely worn out, un-maintainable, running highly inefficiently and causing electrical overload on the electricity meter.
- The rising main was partially blocked causing restricted flows and adding to the already inefficient running characteristics of the aged pumps.
- Even at the new NWL output flow requirement (152 l/sec) the pipework flow velocities would not provide self cleansing of some of the station pipe-work and all of the rising main pipework length.

THE RETROFLO DESIGN/IMPLEMENTATION SOLUTION:

1. Supply and install 3 x 45kw drywell submersible pumps (Flygt NT3202-MT with 433 impellor) controlled in a Duty/Assist/Standby operational mode – the predicted performance being:
 - 1 pump running @ 50hz = 164 l/sec
 - 2 pumps running @ 50 hz = 219 l/sec
 - 3 pumps running = Not allowed



2. Supply and install a new MCC with 3 x VSD motor starter/controllers
3. Supply and install **Retroflo Programmable Pump Control System**
4. Programmable pump control system software
5. Supply and install associated instrumentation systems including:
 - Ultrasonic level detectors
 - Output flowmeter
 - Level detection ball floats

DESCRIPTION OF THE PUMP CONTROL PHILOSOPHY PROVIDED:

- Duty/Assist/Standby pump control by measured wet well level and measured output flow.
- Duplicate ultrasonic level detection – one head per wet well, these to provide Duty/Standby operation complete with auto changeover in the event of the duty head system failure.
- Variable speed drives on all 3 pumps.
- VSD speed boost on start and stop events– provides pump impellor rag clearance at each start or stop event.

Normal operation:

- During dry weather flow and in storm event periods – The duty pump starts and runs at variable speed under PID control to maintain an output flow of 152 l/sec at all times (ie. the agreed required consent output flow for the site).
- If the well level falls to below the stop setpoint, the pump performs a speed boost routine before it ramps down to a stop.
- If the well level continues to rise the well will eventually overflow, but the duty pump will be providing the consented output flow as required by the EA.
- The duty pump is continuously monitored by the pump blockage detection system while running and is stopped, cleansed and returned to service (or tripped if determined as unviable) all by automatic control.

Note:

- The Red Row SPS assist pump is only ever used to help perform the pipework scouring cycle function as the dry weather flow output and the storm event consented flow output are both within the capability of one healthy pump.
- The standby pump is available to act as a standby replacement pump for the duty pump in times of dry weather running and storm event running. Similarly it is also available to act as a replacement pump for the pipework souring cycle function which is so important at this station.

Pipework Scouring Cycle:

- Once daily the pumps are inhibited to allow the wet well to fill to a predetermined level (limited by time) when the level is reached or the time period expires, then both duty and assist pumps are started and run at variable speed under PID control to maintain an output of 219 l/sec for the duration until the wet well empties to the stop level setpoint.
- This pipework scouring cycle ensures that both the station pipework and the outgoing rising main are flushed at a velocity above the system self-cleansing flow velocity and should remain internally clean for their lifetime.

The control system automatically provides:

- Duty rotation changeover on any pump trip event.
- Duty automatic rotation at every natural process stop point.
- Duty pump rotation after a (programmable) elapsed timed run period.
- Station auto restart and run after power supply failure and restore.
- Station auto restart and run after any detected power supply glitch and restore
- 2 out of 3 pump run interlock in all control modes (hand or auto) to prevent electrical supply overload and hydraulic pipe hammering.
- Automatic (or hand selection) of the USLM head to be used, allows either wet well to be maintained while the controls system continues to operate the plant normally.
Remote pump trip resetting via telemetry is provided.

POST REFURBISHMENT REPORT:

The Red Row SPS refurbishment was complete and the site re-commissioned in mid/end Feb 2007.

Pumping and Pump Blockages:

- Since refurbishment NWL M & E Maintenance Dept. reports that the pumping operations and general site M&E performance have been excellent.
- Only one pump has been physically removed to be unblocked and this blockage was caused by a large solid piece of wood, which NWL accepted it would be unreasonable to expect any pump to pass forward.