Redundancy, Redundancy

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Designed-in redundancy from lessons learned assures reliability at this critical influent pump station.

When the City of Florence, AL, decided to replace their aging wastewater treatment plant, they chose to apply a lesson that floods and other issues had taught them: if you can't handle the flow coming into the plant at all times, regardless of circumstances, you have a problem.

Consequently, they chose to make redundancy of this critical part of the plant inherent in all aspects of its design, from the power feed to the structure, and on to the control systems for the pumps.

Influent pump building (highlighted) is located in lower right of this aerial view of the plant.

Located in northern Alabama and sited on the north bank of the Tennessee River, the Cypress Creek Wastewater Treatment Plant, named for the creek that forms the site's eastern border, serves the picturesque town of Florence and its population of approximately 17,000.

Although this stretch of the Tennessee River is home to considerable heavy industry that includes pulp and paper, steel, and chemical plants, none of that waste stream is handled by Cypress Creek. As a result, only about 15 percent of the plant's waste stream is industrial, with the primary source being the town's Sara Lee plant (formerly a Jimmy Dean Sausage plant).

The current plant went on-line in 2000, with the influent pump station going on-line in 1999, ahead of the main portion of the plant. Municipal Consultants, Inc. (Birmingham, AL) handled consulting engineering on the project, and Brasfield & Gorrie (Birmingham, AL) was the prime contractor.

The plant's rated design capacity is 20-mgd, and it actually averages about 15-mgd. The entire plant is built above the 1,000-year flood level. Discharge from the plant goes into the Tennessee River through a diffuser located at a depth of approximately 20-ft, and the quality of the discharge is carefully monitored and controlled because of a federally-protected mussel area located downstream from the plant.

Exterior of the influent pump building showing wet wells and rakes (at right of building).

The plant's solids are rated Class A sludge, allowing for land dispersal. The sludge is donated to local farmers that are happy to have this high quality fertilizer. There is a lengthy list of farmers requesting the sludge, and they are served in the order of their requests based on availability of the sludge.

The pump station building is physically and electrically divided into North and South. Two sewer lines, each serving different sections of the city, deliver wastewater to the pump station. Separate 50-ft deep wet wells can operate independently or, with a sluice gate between

Looking down into a dry well from the ground level floor.

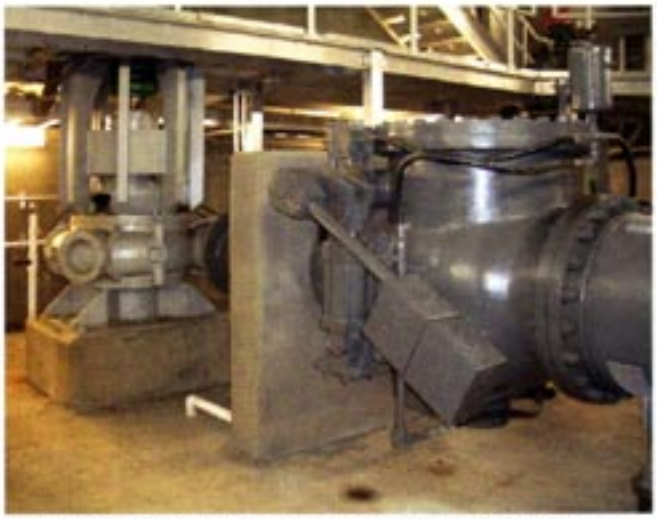
them raised, as a single unit.

The dry wells housing the pump motors are physically separated. In the event that a leak would cause one room to flood, the pumps in the other room would continue operating.

Separate utility power feeds to the plant are part of the redundancy plan. Another easy-to-overlook aspect of the plant's redundancy, especially for the influent pump station, is the attention to cooling. Large fans are located high on the pump building's end walls to provide cooling air movement in the event the building's air conditioning system fails.

One of two dry wells showing the three Patterson pumps.

Each dry well houses three Patterson pumps, each with a capacity of 6,940-gpm. Facilities were designed to accommo-



A pump and valve combination leading into the 42-in header pipe.

A PLC cabinet (left) and a drive cabinet for the North lineup.

date the addition of two pumps per dry well, giving the station an ultimate capacity of ten pumps.

Output from the pumps goes through 42-in header pipes to the headworks. In the event that the processing portion of the plant is not functioning for any reason, the pump output can be diverted to holding lagoons with a 197 million-gal capacity.

The final key to having full redundancy, and the most complex piece to achieve, lies with the pump control systems, designed and produced by Revere Control Systems (Birmingham, AL). As with the pumps themselves, the controls are divided into North and South segments.

Controls consist of Allen-Bradley 1336 variable frequency drives mounted in a Square D motor control center. This unusual combination was done at the City's request and was made possible in part by the company's status as an independent integrator with experience in producing similar configurations in the past. Auto transformer starters serve as backup for any VFD failure.

Each lineup of drives is controlled with an Allen-Bradley SLC 504 PLC. Ultrasonic level sensors in the wet wells provide the water level signals, and in keeping with the redundancy requirements, there are backup float level sensors.

Based on level sensing data, PLC programming controls pump sequencing and speeds to handle the flow being experienced. A DeviceNet card provides communication between the North and South lineups as well as with each lineup's HMI screen, with which operators can monitor and control all aspects of operation.

North and South control bay lineups.

In the event that one of the PLCs fails, the PLC for the other lineup, following a five-second delay, is instructed to take control of both lineups. This redundant control extends to the HMI screen as well, allowing full control of both lineups from a single screen. To our knowledge, this was at the time the first such redundant application of the SLC 504 in the country, making the design and programming particularly challenging for the control systems company.

We have now completed nearly seven years of operation with the influent pump station. Both the pumps and the controls have performed wonderfully for that period. During those seven years we have had no catastrophic failures and only one PLC failure. When that happened, the redundant design functioned exactly as planned, and we were able to operate the entire pump station on a single PLC until the failed unit could be replaced.

The influent pumping station is the most critical component of the treatment facility. If this station isn't operating, the rest of the plant is useless. By making redundancy a foundational element of the pumping station's design in every aspect of the station, we have assured that this critical component is always functional, thus keeping the rest of the plant functional.

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