Cromwell, CT — It’s common for smaller municipalities to band together to create a regional public service facility. It’s not so common for them to do such a good job that the project turns into a money-making operation by providing services to other communities in neighboring cities and states.

That’s exactly what the Mattabassett District has done. This state-of-the-art sewage treatment facility in central Connecticut was created as a regional entity in 1961. Over the years it has continually been upgraded to meet the wastewater handling needs of 135,000 customers in the cities of New Britain, Cromwell and Berlin (CT) and has given the Mattabassett River back to nature. In the process it also has become the fourth largest capacity plant in the state, has joined the ranks of the top 10 per cent of treatment plants in the country — and most importantly, has turned into a revenue generator that earns the region approximately $4 a minute, 24 hours a day, year-round.

This unique status was achieved because district management took a long hard look at its manual operations five years ago and decided to reduce the projected large increases in labor overhead by automating plant activities. Instead of purchasing a turnkey distributed control system, however, they reached this goal more cost-effectively by hiring system integrator NIC Systems Corporation, in nearby Plantsville, CT, to develop and implement their own solution. They created a network of off-the-shelf 486/33 personal computers (PCs), standard industrial programmable logic controllers (PLCs) made by Allen-Bradley, and the InTouch™ man-machine interface (MMI) software from Wonderware Corporation to provide the supervisory control and data acquisition (SCADA) capabilities needed.

The result is that the labor force of 18 operators and maintenance staff has been reduced by five people instead of grown to the 35 operations staff and 10-15
maintenance people originally projected for meeting 1994 operational requirements,” explained Christian Bratina, executive director of The Mattabassett District. “We now can run the entire plant with a staff of 13 people — a minimum of one operator per shift — which frees up staff to do other things. This plant has been modernized such that it’s now a real showplace in its industry.”

**Standard Treatment Procedures**

The Mattabassett District plant is designed to treat an average wastewater flow of 20 million gallons per day (MGD) and a peak flow of 40 MGD. The plant uses standard settling techniques as the primary treatment of the wastewater, with aeration and regenerating biological treatment plus disinfection as the secondary treatment. Treated water is discharged into the Connecticut River and the bio-solids or activated sludge that results from this treatment is dewatered and incinerated.

We receive wastewater via a trunk sewer that serves the entire geological watershed of the New Britain, Cromwell and Berlin area, plus shipments of liquid wastewater sludge, industrial washer water and landfill leachates from surrounding communities such as Middletown, New Haven, New London and Simsbury,” said John Batorski, operations manager. “We also now incinerate dewatered sludge from communities in nearby states to keep our incinerator running at capacity.”

The incoming effluent is first passed through bar screens to remove large debris, then six 200 horsepower pumps move it up 37 feet to the operations level where a pair of detritors remove various grit (sand, coffee grounds, egg shells, etc.) by slowing the flow until heavier particles sink to the bottom of the tanks for removal by collection arms. Pneumatic ejectors carry this grit to a storage tank for subsequent incineration. Pulverizers then shred and remove any remaining large solids or sticks and the wastewater flows through a channel that aerates it, prevents deposition of solids and splits it for distribution into four primary clarifiers and flocculation and sedimentation basins. Each clarifier has a volume of one million gallons and detains the flow for 2.4 hours to remove about half of the suspended solids and reduce the biological oxygen demand (BOD). Heavier organic solids and most of the remaining inorganic solids are settled out as sludge.

The effluent continues on to four one million gallon aeration tanks and the beginning of the secondary treatment process. Four 2,400 volt, 700 horsepower blowers provide compressed air to fine-bubble diffusers at the floor of the aeration tanks. The effluent is mixed with activated sludge from secondary clarifiers to form a biological mass called “mixed liquor,” thus beginning a continuously regenerating biological loop. During the five-hour flow through this system, the mixed liquor microorganisms settle to the bottom of the tanks where they’re returned to the aeration tanks to close the biological loop. The clear liquid atop the four 120-foot diameter secondary clarifiers overflows V-notch weirs and flows on to a final mixing chamber, where chlorine is added to disinfect the treated effluent before it flows into the outfall line below the surface of the Connecticut River. The river itself provides enormous dilution and oxidizing power with its 17 billion gallons per day flow.

The sludge from the treatment is gathered in two half million gallon storage tanks where it passes through a grinder and is pumped to four belt filter presses. The presses remove about 75 per cent of the water and the dewatered sludge is conveyed to the fluidized bed incinerator. Here it is burned, along with the grit removed earlier, on a 19-ton charge of “boiling” sand (at 1500º F). The sterile ash and excess bed sand from the incinerator are removed and disposed of at the district’s ash disposal site or used for cover material at other landfills.
In parallel with the wastewater processing, the district's chemistry laboratory monitors plant effectiveness in meeting government agency standards and provides continuous operational information for use in plant process control. The lab staff analyzes upstream pipeline inputs and river cleanliness and maintains a close relationship with the state Department of Environmental Protection.

**Efficient SCADA Control**

Although the original impetus for upgrading the treatment plant was to keep labor costs under control, plant management and the consulting engineers from NIC Systems saw early on that there was “no such thing as being a little bit pregnant,” according to Batorski. “We jumped in and did as much as we could afford within our budget limits. Working with Project Engineer Bob Kaine and his staff at NIC Systems, the whole system was designed and installed within six months and we've been running at 100 per cent uptime for about a year. But we're still not taking advantage of all its capabilities, so we'll be enhancing it as we go along, far into the future.”

The automation system uses two Allen-Bradley PLC5 controllers plus one Allen-Bradley PLCJr with three remote drops as the control systems for pumps, motors and fan blowers throughout the plant. Data from nearly 2,000 I/O points is fed over a Wonderware A-B DDE Server, via the A-B Data Highway, to a LANtastic 6.0 network of seven IBM compatible 486/33 PCs that run the MMI software. The software was provided through Dyer Technology, Inc., the Wonderware distributor for New England, based in Hudson, NH.

This network provides supervisory control for the six 200 horsepower raw sewage pumps that bring influent from the trunk sewer to the plant operations level; the filtration and detrition equipment with associated pneumatic ejectors; aeration systems; mixing equipment; triplex sludge pumps; grinders; belt filter presses; and piston pumps that transport the sludge. In addition, all plant facilities are monitored and real-time data is acquired so that operators can tell at a glance what the status of the plant is and can call up real-time and historical trend screens to spot any out-of-bounds conditions. A workstation is also provided in the laboratory so that Chemist Liz Walters, the lab manager, can set waste rates and monitor water quality directly. This assures that lab data and plant data are coordinated and all staff are working from common information.

One unusual addition to the system is a set of video cameras that monitor the output of the sludge belt filter presses so operators can tell at a glance if there's a flow rate problem. “This provides a visual check for operators, but one of the enhancements we'd like to make is to bring the video images into InTouch via a PC video card so that the MMI could monitor the density and contrast of the pixels in the video image and pop up an alarm if it detected that a belt was plugged or if the sludge was too watery,” Batorski said.

“Of the biggest benefits of the system is that people no longer have to walk several miles a day, around the plant, just to turn equipment on and off,” he added. “They used to have to leave the operator console and walk as much as a half mile, in some cases, just to turn on belt presses, blowers, pumps and so forth. These tasks can now be launched from the console itself and, in cases where a sequenced start is required, the software now manages everything in its proper order so operators just have to click once to set things in motion.

“This is comparable to flying an airplane using an auto-pilot,” Batorski said. “One primary operator on each shift can now manage the entire facility from the control room and he still has plenty of time to
perform other tasks. We've virtually eliminated overtime costs now, and enhancements like providing a live video link would only make the supervisory job even simpler.

Another feature that's popular with Bratina and Batorski is the modem link provided on the SCADA network. This allows management to dial into the network during off-duty hours if there's a problem. “We sometimes get calls from the operators at night if there's a problem and I can dial in from home and usually manage the situation using InTouch screens on my computer at home,” Batorski said.

The historical data files and trending capabilities of the software also allow Maintenance Supervisor Gary Simpson greater latitude in scheduling regular preventive maintenance work. “Putting this system in gives us a lot of accountability that we never had before,” Simpson said. “We can respond better to emergencies because the alarms that are sounded now are related to a specific problem and we know exactly what's wrong. It saves a lot of troubleshooting. With the records we now have on cumulative runtime for major equipment, we can also prepare to do maintenance work during non-peak times, when there is less disruption to operations.” Plus, if anything were to go wrong, we'd have a proper audit trail to document what happened, when and why,” Simpson added. “Any operator actions that are taken are archived electronically and operators on other shifts automatically know what staff on another shift has done. It gives us greater consistency in facilities management.”

Only on the 10th Floor

As successful as the control system has been, the Mattabassett District has only begun to tap its potential. “I tell people we bought the World Trade Center here and we're only occupying the first 10 floors,” Batorski said. “We've automated all of our status reporting but we haven't automated all of our control systems yet. We want to add complete one-touch start-up capabilities for very complex systems like the incinerator, the 1400 kW emergency power generator, air compressors, boilers, and even plant-wide systems like security, fire alarming, etc.

Despite the fact that we still have a lot of enhancements to make, we're the only wastewater plant along the northeastern seaboard that uses a SCADA system to this extent,” he continued. “It's allowed us to become so efficient that we're now taking on work from other districts in Vermont, New Hampshire, Rhode Island and Massachusetts. About 70 per cent of our incineration volume comes from other districts. This does two things: it helps us maintain efficient incineration because the furnace runs almost continuously, and it generates revenue for us, which offsets our overall operating costs.”

The ultimate proof of the system’s success is contained in a pair of charts developed by the State of Connecticut. One shows staff size relative to volume of water processed, and the Mattabassett District ranks first at about 1.75 people per million gallons processed per day. The other chart shows plant operating costs per 1,000 gallons treated — and the Mattabassett District ranks second at a cost of about 20 cents per 1,000 gallons of water treated.