Introduction
The York Resource Recovery Center was constructed and completed for the York County Solid Waste and Refuse Authority by Westinghouse Electric Corporation in October 1989. The design incorporated three Westinghouse O'Connor Rotary Combustors fitted with Deltak Boilers to provide a state-of-the-art incineration system for the 400,000 residents of York County. Westinghouse incorporated many of their industrial products into the plant including their Westinghouse Data Processing Family Control System (WDPF) for control of the plant combustion and generation process.

The WDPF Control System served the plant needs well from start-up in 1989 until the present requiring only software revisions to maintain its performance.

The original plant computer system was comprised of five distributive processing units (DPU’s) and a series of remote mounted Westinghouse Numalogic Serial Interface Units installed and linked via a dual coaxial communication interface.

The Numalogic Serial Interface Units (SIU’s) expanded the capability of the five distributive processing units without adding additional panels to the architecture of the plant’s control room. Field wiring between the WDPF and the SIU Input / Output remote panels were preassembled at the factory to reduce the probability of wiring and termination errors and ease the cost and time of installation.

Westinghouse used the Remote Input / Outputs to expand the capabilities of the WDPF System and keep the plant’s construction cost lower by using the less expensive SIU’s. In addition to the 5 redundant DPU Panels, the control room housed the main control board, two electrical switchboard panels for the plant substation, an auxiliary panel for boiler and emissions equipment, an air conditioning unit, and a small office for shift supervisory personnel.

The Remote Numalogic SIU’s were placed in the motor control centers of the three boiler units, the turbine generator, the cooling tower, the Air Pollution Controls, and the Continuous Emissions Monitoring System (CEMS).

Westinghouse Electric Corporation experienced a series of business divestitures during the 1990’s that impacted the York Resource Recovery Center in two ways. Westinghouse sold many of its core industrial businesses.

The Westinghouse Process Control Division, the manufacturing division that manufactured and provided technical support of the WDPF Control System, was sold to Emerson.

Westinghouse also excited the waste-to-energy business by selling its operation and maintenance contracts for the four plants it owned and/or operated. The York Resource Recovery Center was
one of three of those O&M contracts assumed by Montenay Power Corporation.

Shortly after Montenay began operating the York Resource Recovery Center, Emerson notified the new operator that the WDPF computer control equipment was on a short time line for obsolescence. This meant that technical support as well as spare parts availability would soon stop. To further complicate things at the Center, another company that purchased the Westinghouse Numalogic Programmable Control line of products dropped the line from manufacture and support as well.

Control System Upgrade Options
Montenay York and its customer, the York Solid Waste Authority, were faced with the decision to upgrade or replace the control system. Montenay Power, operates two other WTE plants with similar WDPF Control Systems.

The YRRC and the SERRF Plant (Long Beach, CA) had an immediate need to upgrade or replace their WDPF control systems. A third plant, the Bay County Plant (Panama City, FL) had completed a successful migration from the WDPF System to the new Emerson Ovation System before its transition to Montenay Power. The migration from the WDPF to the Emerson Ovation was an option for the York and SERRF Plants.

The Montenay operated Dutchess County Plant (Poughkeepsie, NY) was also evaluating the installation of a new control system and was also evaluating the use of the Emerson Ovation System as a possible replacement of their module type control system. They had a need for better historical data retrieval and overall control performance.

Both the York and the Long Beach Plant had recent proposals from Emerson who proposed to upgrade the existing WDPF Systems to their Ovation line. Another vendor, Rockwell, provided quotes for a complete replacement control system.

Montenay York Staff and members of the York County Solid Waste Refuse Authority Staff visited the Emerson factory and training center near Pittsburgh in June 2002. Our Senior Instrument and Controls Technician who led our project visited a trade show in Los Angeles, California that featured the proposed Rockwell Control System that was an alternative to our WDPF.

The options of upgrading the existing system or replacing it were seriously evaluated and considered. Both options contained certain obstacles and benefits for our plant.

Several factors related to our municipal waste and air quality operating permits, the contractual and economics contained in the agreement between the York Authority and Montenay, and the plant’s historical processing record of not bypassing waste were issues that also had to be considered prior to upgrading or replacing the plant’s control system.

Our state air quality permit allows the Facility’s boilers to be out-of-service for 72 continuous hours before contingency plans to bypass waste and find proper disposal of stored waste begins. At 120 hours, waste must be removed from the plant to a proper disposal site. The Authority and Montenay agreed that stopping waste, removing waste, or approaching the state’s department of environmental protection for a waiver were not desirable solutions even though we both believed that an exception might be granted based on the environmental record of the Facility.

In-county waste has never been diverted or bypassed to a landfill or alternative site since the plant began operation in October 1989. We did not want an extended outage to replace or upgrade the control system that might terminate this operational record. Alternative disposal was not economical for either party.

Evaluating Control System Options
The option of replacement was further examined with the thought that an entire system could be purchased and installed parallel to the existing system. The operating program could be somewhat field tested prior to connecting the field wiring. This option would require a lengthier period of downtime since more overall field work would be required and extensive retesting of circuits would have to be completed to insure a safe restart. The proposal for a replacement system did offer the benefit of initial savings in cost but when further examined several issues were raised:

1. A replacement system would require 100% instrument loop tests as well as 100% plant system functional tests similar to a new plant start-up
process to insure a certain level of reliability of the
new programs. An upgraded system would retain
our proven control schemes and logic. It would be
automatically translated by computer using the
same similar language.
A replacement program would have to be
translated and reprogrammed into a new language.
More risk is involved with human interfacing than
would be required to develop the new control
scheme thus making it more susceptible to error.
2. The overall estimated manpower of field work
would be greater and more expensive than an
upgrade project. Most work would be performed by
specialized workers, electricians and instrument
technicians, who command higher wages. A
replacement system would require 100% of the
cables to be re-terminated while an upgraded
system would only require that cables connected to
the obsolete remote I/O’s be re-terminated.
3. Additionally training would be needed by both
operations and maintenance personnel to acquire an
equal level of knowledge and ability of the new
operating system. A learning curve would be
experienced by both operations and maintenance
personnel to achieve the same level of confidence of
a new system. Process graphics would be retained
in an upgraded system which would give operators
another level of comfort.
4. Spare parts purchases for a new system would
be substantially higher than with an upgraded
system since some of the present spare parts
inventory could be used in the upgraded system (Q­
Line Cards). Emerson assured us that the Q-Line
I/O Product line is extensively used and has their
long-term commitment to assure availability of
replacement cards for now and into the foreseeable
future.
The amount of total downtime to complete either
a replacement of the control system or to upgrade
the existing one was one of the paramount
considerations in making our decision. A lengthy
shutdown was not desirable for Montenay or our
customer.
In short, the least risk option in terms of system
availability and capital expenditure was to upgrade.
It was the lowest cost in the long run when initial
capital and operating costs were considered.
Our final decision was to upgrade the existing
WDPF System to the new Ovation System.
Extensive planning and preparation would be
necessary to do it on our proposed time line.
Migrating to the Ovation System
The basic migration to Ovation would not work at
York because it would not resolve the issue of the
Westinghouse Remote SIU’s used so extensively
throughout the plant. The obsolete Remote SIU’s
would require replacement to Q-Line Remote I/O
products to be compatible with the new Ovation
System.
Field mounted Numalogic SIU’s would be
replaced with Remote Q-Line I/O Panels. These Q­
Line I/O Panels would be field installed near
existing Numalogic I/O Panels to minimize the cost
of rerouting cables and the labor to complete this
work as the field cables were re-terminated.
Downtime would be minimized since the new Q­
Line Panels could be installed ahead of a planned
shutdown.
An upgrade from the WDPF System to the new
Ovation System for the YRRC would not be a
simple one-for-one type of hardware exchange.
Several issues had to be evaluated and resolved.
The original WDPF Distributive Processing
Units (DPU’s) consisted of a panel containing two
redundant racks of eight processing control boards.
Those boards contain the shared memory, the
functional processors, the operating systems, and
the interfacing systems that were the heart and
brains of the control system itself. DC power
supplies are housed in the middle section of each
DPU. The lower sections of the DPU racks contain
various types of input and output cards, known as
“Q-Line Cards”. Card arrangements vary
depending on how many of each type are needed for
the various inputs and outputs.
A simple and basic migration from WDPF to
Ovation System replaces the upper and middle
racks that contain the processor, interfaces,
operating system, memory, and power components
of the system. The new Ovation is preprogrammed
to provide a bump less transition in control scheme
logic, graphics, and data retrieval functions.
The Ovation System would provide powerful,
fully redundant PC-based controllers with
embedded advanced algorithms, an industry
standard 100 Mbs Fast Ethernet control and
information network, easy connections for third-
party devices for business reporting and data capture, a CAD-based control builder, and the ability to seamlessly incorporate field bus networks into Emerson's PlantWeb digital plant architecture.

Other plans to modernize the look of the control room were made by replacing the old control panel with an updated office look now available. The coaxial network communication highway would be updated and replaced with new fiber optics.

The plant requested that Emerson perform the migration in two three-day outages in successive years. This would keep us within the 72-hour restrictions of our operating permit and allow us to process waste in a timely enough manner to avoid pit inventory problems.

The obstacle to our proposal was the Remote Numalogic I/O devices.

The WDPF would require a program and hardware change to accept the additional schemes of the replaced Numalogic I/O in the first three-day outage. This would add some additional work and cost but could be easily done.

A two-phase plan was set to make the migration work in two separate three-day outages in the spring of 2004 and 2005. The first phase in 2004 would require the conversion of the Remote Numalogic I/O Controls to the Q-Line in the CEMS (Continuous Emissions Monitoring System) and the motor control centers of Boiler #3, the Air Pollution Controls, and the Cooling Tower.

Phase II of the Migration Plan was scheduled for March 2005. This step would upgrade the existing DPU’s from WDPF to the new Ovation System. Work was scheduled to coincide with our 5-year major maintenance turbine overhaul and the Unit #2 boiler outage.

This would provide additional time to perform loop testing of those loops and the work performed during 2004 would permit us to easily return Boiler #3 to service within 72-hours following checkouts, since loop testing was performed in 2004.

Upon agreement of work and schedules, a purchase order was placed nearly 36 weeks prior to the Phase I installation.

**Control Project Implementation**

Montenay York Instrument Technicians and Emerson Engineers went quickly to work to inventory the existing WDPF System and assemble information necessary to make the upgrade work. A hardware inventory and layout information were used to determine what could be retained for use with Ovation.

The WDPF existing control schemes were downloaded onto computer discs and provided to Emerson. Emerson would need to update the WDPF to make the first transition to accept the Numalogic I/O Controls in Phase I as well as preparing the Ovation System to be implemented into Phase II. A moratorium was placed on changes to existing logic to insure no surprises occurred once the Ovation System was developed and installed.

Site technicians began verifying the I/O list, so to provide documentation that gives the accurate information as to what input or output is connected at a certain computer terminal point.

Computer terminations points are relatively simple to identify from drawings but field cable identifications attached may have identification numbers that have become cryptic or missing after years of service. Cable marker technology has improved over the past years but older ones may become lost or illegible after fifteen years in a remote cabinet in a waste to energy plant environment such as ours. If field cables were moved to a new remote panel, old ones would have to be not only verified but identification markers would need to be replaced with newer ones that would withstand the rigors of being pulled, rerouted, fed through cable penetrations, and terminated. This would be a time consuming task that would have to be performed while the plant continued to operate or during different periods of downtime through the year.

Field cables were left in place at the Numalogic I/O Panels and new cables were run from the new Q-Line Panels to them. Cables terminated in the remote programmable controller panels were verified in a step-by-step process that included tracing the cable back to its designated device. This insured that the input or output was indeed what it was identified to be. The plan worked well during Phase I of the project. Only two incorrect terminations were uncovered during 1400 loop checks performed.
The original interconnecting data highway for the WDPF System consisted of dual coaxial cables separated by field runs in separate trays, raceways, or conduits for reliability and integrity. Dual fiber optic cables to replace these coaxes were run in the same fashion. This work was done well in advance of the Phase I schedule.

The Q-Line Panels that replaced the Remote Numalogic I/O Panels were set in as close proximity as possible to existing panels. Some of the Numalogic I/O Controls were located inside cubicles of the motor control centers themselves and were not readily accessible for work and troubleshooting. The new Q-Line Panels consolidated what had been in separate Numalogic Panels and placed in a better location for accessibility. Care was always taken to position them where the cables could be pulled back and installed without replacing or splicing.

Phase I work, the Remote Numalogic I/O’s associated with DPU 5/55 (DPU 55 is redundant DPU for DPU 5) was converted to Q-Line and two WEStation Control Consoles were connected during a three-day system outage before Unit #3 was returned to service following necessary loop checks and operational verifications. The WEStation Consoles are the control console and interface with the WDPF and Ovation Systems.

The WEStations gave Emerson Engineers access to on-line control schemes and the ability to research information necessary to insure a quality transition. Emerson has much experience in converting WDPF Systems to Ovation as well as converting the Numalogic I/O to the Q-Line Upgrade.

Plant graphics translation were achieved prior to Phase I and verified with the WEStation that were installed early. Emerson achieved this by translating existing graphics through field proven software conversion tools. Translated graphics looked very similar to originals and made editing an easy task. This was possible since point identifications in the WDPF and Ovation Systems were the same and Montenay was encouraged to participate in the preparation of the graphics to make them as user friendly and informative as possible.

The DPU code translation was verified by comparing the control schemes and drawings. Simulations were performed at their Berkley Heights Facility to verify its operation.

The operator’s console provided plant personnel with a learning tool and an opportunity to familiarize themselves with how the new consoles would function and the intricacies of the trends, graphics, and functions that would be available to them following Phase II work.

Emerson and its subcontractor assisted in loop checks during the first phase of the project after each Numalogic to Q-Line conversion was made. Montenay technicians and the subcontractors worked in teams together that gave an extra comfort level to plant management.

Control and database information is migrated to the Ovation Control Builder, and point information is mapped directly into the Ovation Oracle relational database. Migrated control loops and ladders look quite similar to their WDPF counterparts but are displayed on a Control Builder drawing sheet. Original algorithm and point names are retained. Monitor graphics are automatically generated to provide control of existing loops, ladders, and text algorithms which are retained and in most cases enhanced.

Phase II work was scheduled for March 2005. The Numalogic to Q-Line for DPU 4/54 would be performed and the final migration to the Ovation System would be implemented on all of the components of the existing WDPF.

The main control board would be replaced by a more modern architecture at this time.

The YRRC Main Control Room adjoins the turbine generator deck of the plant. The largest exit doors that would provide dimensions to remove the old control panel exited onto the turbine deck.

Phase II of the Ovation Migration was scheduled to coincide with our 5-year turbine overhaul and Unit #2 Boiler outages. This would mean that pieces and parts of the turbine might be on the deck as the console was removed.

Emerson engineers and subcontractors arrived two weeks prior to the start of Phase II to disassemble the Main Control Room Control Board. Once apart, the old control board could be moved from the control room and taken across the turbine deck to the crane bay and lowered to the ground level for disposal. This would be difficult if the
turbine work was going on and the deck covered with material and tools.

Hardware for the WDPF keyboards and monitors as well as communication cables for the original WDPF System were housed and routed within and through the old control board panel. The delicate work of removing the four consoles contained within the control board was completed by disassembling one station at a time. Work was done with the boilers and turbine in service.

The Control Room was posted with off limit restrictions for nonessential personnel including all operators except the Control Room Operator himself. The lock out / tag out computer and associated lock boxes normally stored in the Control Room were relocated to an adjoining office in the administration area.

Emerson Engineers working with YRRC I&C technicians removed and replaced each console by removing the Operators Stations one at a time and relocating them to temporary work tables with new WEStation in operation. The old console was easily removed and transported across the turbine deck before the Turbine Overhaul Contractors were on site and allowed both jobs to progress on schedule. All work was accomplished without incident or disruption to the plant.

Conclusions
The most current technology and open architecture gives us several advantages. The obvious, of course, faster operating speed and more memory capacity alone make it a worthwhile investment.

Plant efficiency may increase since more memory capacity is now available. The former system had limited memory capacity once all the controls and logic was placed into it. We were limited to a “dry trash” and a “wet trash” control scheme. Several options will be available now that a wider range of adjustments can be added to combustion controls than before. New algorithms in the Ovation will help provide better performance.

Operators did not have to learn new graphics or change operational procedures. Adjustments to the Windows-based system are much quicker for the operator. The Windows-based system provides shortcut icons on the desktop screen for many applications and is limited only by the PC’s computing power.

New and better point information is available the operator and technician. Multiple trends can be placed into a single control screen. The WDPF System limited us to just two live trends with up to 8 points. Multiple trends with more than eight points are now available to be displayed.

Additionally, the operators can now use a computer mouse in lieu of the slower keyboards. Ovation is one of the only control and information systems built completely to open standards. It replaced proprietary control hardware with widely available, off-the-shelf hardware, software, networking, and communications interfaces.

Emerson offers upgrades to keep the equipment current with technology changes in the future so this will reduce active life cycle style management by plant engineering and maintenance during the future.

Keypads, monitors, and printers will be less expensive to maintain. For example, Dell products are available at most local computer and office supply stores. The WDPF employed products that could only be acquired through the vendor. This will reduce needed spares.

The migration from WDPF to Ovation has provided a low-risk, economical alternative to a complete system replacement which allowed us to use much of our existing investments in the WDPF, including cabinetry, the entire Q-Line I/O subsystem and associated wiring, control logic, and process graphics. DPU cabinets were merely updated. Since the control strategies, databases, and process graphics were retained, migration has been virtually transparent to the operators thereby minimizing operator retraining.