POWER
BUSINESS AND TECHNOLOGY FOR THE GLOBAL GENERATION INDUSTRY

POWER magazine's 2016 Top Plants Award

OFFICIAL ENTRY FORM

(All nominations are due no later than April 29, 2016.)

Instructions

E-mail this completed nomination form and any supporting materials to **awards@powermag.com.** Your nomination package will be acknowledged by a return e-mail within a day or two. If you do not receive a confirmation e-mail within a week, please resubmit.

All supporting materials must be emailed. Also e-mail any questions about your nomination package or the requirements or the selection process if they are not answered by the information at http://www.powermag.com/power-awards/.

Please fill out this form electronically to ensure that we can read your submission and process it appropriately.

1. Name of plant being nominated: Valley Power Plant

2. Parent company: We Energies

3a. Fuel category (gas, coal, nuclear, renewable): Gas

3b. Plant type (specific technology): Cogeneration

4. Units/MW rating: Two 140 MWe generating units with two 640,000 lb/hr boilers and one steam turbine generator per unit

5. City/State/Country: Milwaukee, Wisconsin, USA

6a. Name of nominating company: AECOM

6b. Relation to nominated plant: Contractor

6c. Contact at nominating company

Name Diane McKernan Title Sr. Proposal Specialist

Company AECOM

Street Address 510 Carnegie Center

City/State/Zip Princeton, NJ 08543

Telephone 609-720-2260 E-mail diane.mckernan@aecom.com

7. Contact information of individual to whom correspondence regarding this entry should be addressed (should be person who can answer questions regarding plant):

Name Ron Geida Title Project Director

Company AECOM

Street Address 510 Carnegie Center

City/State/Zip Princeton, NJ 08543

Telephone 609-720-2989 E-mail ronald.geida@aecom.com

8. Include a 100- to 250-word description (below or as a separate document) explaining why the nominee deserves the award based on the criteria outlined. You may also include other supporting materials (including photos) that help demonstrate why your plant should be considered.

Please return this form, description, and any supporting materials via e-mail to awards@powermag.com by April 29, 2016.

Use *Top Plant Award nomination* as your subject line.

We Energies Valley Station – Gas Conversion Project (231 words)
The scope of AECOM services included:

- Engineering
- Procurement
- Construction
- Startup

Project Duration: April 2014 through November 2015

AECOM provided engineering, procurement and construction services to We Energies for the conversion of the Valley Station from coal to natural gas.

The plant has two 140 MWe generating units with two 640,000 lb/hr boilers and one steam turbine generator per unit. The plant produces electricity and is the single source of steam for downtown Milwaukee.

The gas conversion offers lower electricity and steam generating costs and increased reliability for the export steam system because it eliminates much of the mechanical equipment associated with handling and burning coal. Also, emissions have been significantly reduced.

Before beginning detailed engineering, AECOM conducted several analyses, including:

- Reliability, availability, and maintainability analysis
- Export steam system transient analysis
- NFPA 85 and 850 Code reviews
- Boiler modeling and performance predictions post gas conversion

Based on the studies, the following tasks were executed:

- Replacement gas burners (six per boiler), including all required NFPA 85 valves and vents
- New gas control valve station (one per boiler)

- New main gas supply system
- New Flue Gas Recirculation System (one FGR fan per boiler) to control NOx emissions
- Replacement boiler letdown stations (one per unit)
- Replacement boiler superheater attemperator spray system
- DCS upgrades
- Modifications to (or abandonment of) existing systems associated with coal handling and combustion.

Valley Power Plant
Gas Conversion Project

Background

Plant:	Valley Power Plant
Project:	Gas Conversion Project
Location:	Milwaukee, Wisconsin
Owner:	We Energies
Plant Type:	Cogeneration (Coal-fired)
Units/MW:	Two 140 MW units (280 MW total)
Project Start:	April 1, 2014
Completion:	November 22, 2015

Vendors/Contractors instrumental to the Project's success:

Major Participants	**Function/Role**
We Energies	Owner
AECOM	Engineering, Procurement, Construction, and Start-up
Subcontractors:	
Van Ert	Electrical
Hunzinger	Civil, Concrete
Brand	Scaffolding
Sprinkmann Sons Corporation	FGR Insulation

Summary

AECOM provided engineering, procurement and construction services to We Energies for the conversion of the Valley Power Plant from coal to natural gas.

The plant has two 140 MW generating units with two 640,000 lb/hr boilers and one steam turbine generator per unit. The plant is a cogeneration power plant that provides electrical energy to the electrical transmission grid and is the sole source of steam for the downtown Milwaukee Steam System.

The gas conversion offers lower operating costs and increased reliability for the export steam system because it eliminates much of the mechanical equipment associated with handling and burning coal. Also, emissions have been significantly reduced, providing environmental benefits.

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- Reliability, availability, and maintainability analysis
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Unit 1 attained Commercial Operation on schedule in November 2014. Unit 2 finished five days ahead of schedule and began Commercial Operation in November 2015.

Project Overview

The We Energies Valley Power Plant is critical to the City of Milwaukee, as it is the only Cogeneration plant that provides district heating steam service to the entire City of Milwaukee. If this power plant should go off-line, there is no back-up to the facility. Heating and process steam users would be without steam until the plant is back on line. This would be a serious issue in the winter, as it would interrupt more than 400 customers including hospitals and other critical facilities.

We Energies' Valley Power Plant (VAPP), which was completed in the 1969, is a nominal 280 MW (gross) fossil power cogeneration plant located in Milwaukee, Wisconsin. The plant consists of two distinct power group units; each consisting of two coal-fired natural circulation boilers feeding a steam turbine generator set. The units provide electrical power to the grid, voltage support and supply heating and process steam to the district heating system. The existing coal facility had been built with many redundant systems, all of which had to be kept intact with the new gas conversion project. To keep steam supplied to the district heating system, the plant can export steam using two different methods: extraction from the steam turbine, which takes advantage of the benefits of co-generation, and direct extraction from the boiler using a pressure and temperature reducing valve.

In September 2012, We Energies commissioned AECOM (then URS) to perform engineering studies to determine the costs and technical feasibility of converting VAPP from a coal to natural gas firing plant. There were more than 20 different studies performed to validate the new design. The studies included examining the low NOx burners for environmental compliance, and implosion studies, which examined the boiler reaction to loss of flame with the new gas fuel operations.

These studies confirmed the feasibility of the project and identified the process and equipment modifications required to maintain the system's high availability and redundancy required for the district heating system. The detailed engineering and design for the project started in the last quarter of 2012.

Engineering Challenges during Design

Defining the requirements and goals of the conversion required paying close attention to the specific operation of the existing plant. During the initial engineering phase, weekly meetings were held on site with all stakeholders to ensure all needs were addressed. Aside from AECOM's engineering staff and We Energies' capital project personnel, We Energies assigned dedicated site staff familiar with the plant's original design and daily operations as part of the team to ensure that all requirements of the plant would be met. Everyone's design input was considered for the project.

Due to the plant's unique role as a sole source of steam to users in the metropolitan Milwaukee area, the construction schedule and unit downtime for equipment tie-ins needed to follow strict planned outage schedules in order to have no impact on critical winter heating periods. Unlike most power facilities, the yearly outages for the Valley Steam plant occur in the summer—when steam demands are very low.

Because of the importance of this facility year round, but especially in the winter months, the gas conversion had to occur in stages. Unit One, or boilers 1 and 2, and turbine one were converted first, then after a successful start-up and commissioning, Unit Two and its associated boilers were converted the following year.

One of the project's challenges was the purchase of long lead items. Once approved, the project started its construction/demolition in April of 2014. Long lead items such as the burners, and FGR fans had to be purchased in February to meet the 30-36 week delivery schedule. To ensure the equipment was on site to meet the construction dates, "limited notices to proceed" were issued for the burners, FGR fans and steam letdown station valves. Every month, these items had to be tracked and delivery dates confirmed with the applicable vendors. When approval from the state of Wisconsin was received in April 2014, the team was able to issue full releases to the various equipment vendors.

AECOM managed the installation of the gas conversion equipment including natural gas piping, burners and flue gas recirculation system. All major equipment was specified by AECOM and purchased directly by We Energies. Successful emissions testing of the new firing system was proven on the last boiler in September of 2015.

Collaboration Drives Success

Daily morning Plan of the Day meetings were held on site between AECOM, We Energies, and site subcontractors to facilitate collaboration. Team members discussed daily activities and interface points so that they could quickly identify and resolve potential issues. A daily conference call with AECOM's field construction and home office engineering staff ensured that the fast-track engineering process supported construction. Routine multi-day site visits by discipline engineers provided hands-on assistance and support to the field engineers for expeditious resolution of issues and responses to questions.

Technical Excellence and Innovation

The We Energies Gas Conversion Project was one of the first co-generation gas conversion projects in the industry; it paved the way for many more gas conversion projects to come. Early on in the project, the process team needed to run detailed models to calculate the effects of higher boiler temperatures; this led to the resizing of the desuperheating attemperation stations. The engineering team had to size new desuperheater water spray valves for the new operating conditions.

Various trip scenarios had to be run at different steam loads to calculate the response times when there was a boiler trip due to loss of flame. The loss of flame on gas occurs much more quickly than on coal, which had to be taken into consideration. Implosion pressure curves also had to be developed. A boiler implosion can be caused by the collapse of the fire ball, which could suck the boiler walls inward toward the center of the boiler.

At first, it looked as though the outside boiler walls would need to be re-enforced with a large amount of steel cross bracing—which would have been extremely expensive. At this point in time, the team looked to other ways the implosion event could be addressed. Several options were considered; the final option led to the replacement of the ID fan actuators to physically move the inlet vanes on the fans faster in the event of a loss of fuel (gas fired). With a quicker response time, the boiler implosion event could be caught in time before physical damage to the boiler walls could occur. This modification would have to be tested later during start-up. At various steam loads, the boiler flame was tripped, the ID fan louvres responded as calculated, and the potential implosion event was avoided.

Finally, the team had to ensure that the gross BTUs entering the boiler would be similar to the original design. On a cold start, uneven heating of the drum could occur and ultimately delay start-up times, if firing rates were not controlled. With the gas burners, the team ultimately selected burners that had both a main firing and “pilot” firing capability. This enabled the boilers to be started up on the pilot gas and warm the drum evenly, and then switch over to the main guns and run up in load. The new burners not only led to a smoother start-up, but also allowed the boilers to meet a 10:1 turndown ratio without taking any of the main guns out of service. This led to faster and smoother ramp rates for the boilers.

Safety Excellence

As soon as the Capital Approval (CA) was received allowing construction to move forward, the team had approximately two weeks to mobilize to the site and start the civil underground work. This presented a challenge to the safety team. The safety team needed to assemble their detailed plan in accordance with the client’s safety plan, and get the lock-out tag-out (LOTO) procedures in place. Within one week, the safety plan was developed, reviewed and approved by the client.

This effort led the development of a good safety orientation program that covered all of the details for both AECOM and We Energies procedures. During the second week, the team was holding safety orientations with various craft personnel.

As stated earlier, the project was run in two phases, Unit 1, in which the first two boilers were converted in 2014, and Unit 2, in which boilers 3 and 4 were converted in the second year (2015). There was a four-month period in the winter of 2014 to perform pre-outage work in preparation for the next Unit outage.

When the next outage came along (Unit 2), the safety team re-instituted the same safety plan, with the same procedures, meeting schedules, and safety walk downs. The majority of the construction personnel that worked on the first Unit were employed to work on the second Unit— the scope of work was basically the same. This seemed like an easy path to success. Unfortunately, during the first month of the pre-outage phase for Unit 2, there was a slip and fall on an icy patch—which led to a recordable incident.

When the Unit 2 outage started, with most of the same construction work staff on site, there was a hand injury recorded, and a near miss incident recorded. The recordable and near miss happened in the first two weeks of the outage.

Overall 200,000 hours were worked with no loss time accidents.

At this point in time, management realized that the Unit 1 proven safety plan and procedures were not working. The team had to increase safety awareness with additional signage, additional safety meetings, additional daily reminders on site and finally, the team added an additional safety person—just to monitor field activities.

The above changes started to turn things around at the site, morale was improving and the safety message was being received. To aid in this turnaround, the project manager hired a motivational speaker to come to the site to talk about why safety is #1 at construction sites and why it is imperative that everyone follow the proper safety procedures.

Throughout the five-month outage, the team instituted small safety reminder activities. If there were no safety incidents the previous week, a small token of the management team's gratitude was handed out every Friday. This led to a successful safe completion of the project.

Operational Excellence

In addition to the engineering challenges that had to be met in the planning phase, there was a unique challenge for the team that came up during the commissioning of the first Unit. These are 0-640,000 #/hour steam boilers, and during the commissioning of boiler one a unique "rumbling noise" between 560,000 and 620,000#/hr. load was noticed. The rumble was bad enough to shake the rear end of the boiler. The vibration was large enough in the rear convection pass to disable one of the O2 probes. The first thing the team did was to immediately measure the vibration changes on critical support steel throughout the external portions of the boiler. There was no appreciable change measured that would lead one to predict a support failure. The readings did show a change large enough that could (over time) cause premature failure of internal tube elements.

The team next contacted the OEM and burner supplier to ensure this was not a problem caused by changing out the burners. Several outside experts were also hired to study the "rumble." After several weeks of testing, the conclusion was made that this was not a burner-induced vibration or "rumble." This only occurred on boiler one, not on boiler two. All four boilers were alike in terms of design except for the superheater sections which were changed out in the early 2000s.

Finally, after multiple discussions with the burner supplier, the cause was attributed to vortex shedding flow induced phenomenon. This occurs when air flows through the boiler and the frequency of the air flow matches the natural frequency of the boiler—at specific load conditions the vibration noise can be amplified. The burner supplier said that they had witnessed this kind

of vibration noise previously on another gas conversion project. They recommended a small engineering firm (Sirios Engineering) to further study the flow-induced vibration.

Sirios Engineering took detailed readings throughout the back pass of the boiler—and confirmed it was not a burner-induced vibration. After several analytical runs on a proprietary software program, the engineering firm concluded the only way to negate this vibration was to break up the vortex standing wave in the back pass (superheater sections) of the boiler. This could only be done by installing metal plates at strategic locations in the superheater sections of the boiler. Twelve metal plates, roughly 30'x 22' in size had to be hung between various sections of the superheater tubes.

The project team ordered the materials and had the plates fabricated. Finally, six weeks after commissioning, an opportunity to take down the #1 boiler occurred and the plates were properly installed.

The boiler was restarted and run several times through the problematic "rumble zone". All vibration and noise subsided and the problem was resolved. This resolution took good analytical thinking, and required exhaustive hours spent on eliminating any potential cause for the rumbling vibration. The boiler is now released to run throughout its entire load range.

Environmental Benefits

In order to meet increasingly stringent environmental regulations, Valley Power Plant required additional environmental controls. Various technologies were evaluated with converting from coal to natural gas being the most economic option, while still meeting anticipated future emission levels. The conversion resulted in a substantial reduction in emissions including SO2, NOx, Hg, and CO2.

Benefits to Local Community, Customers, Shareholders, and Owners

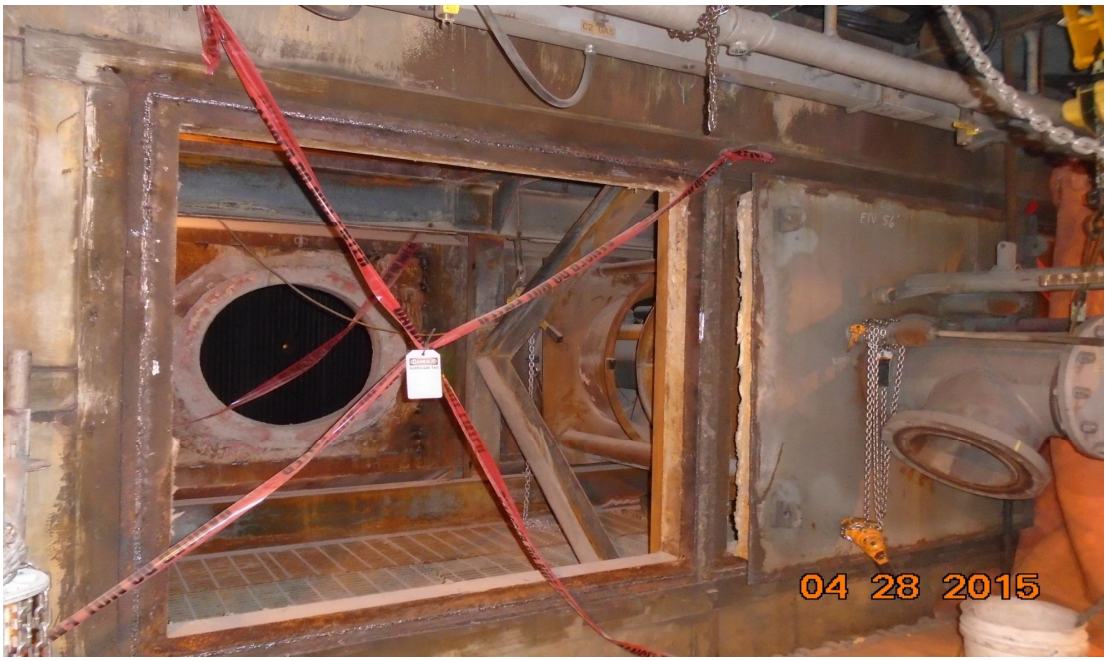
The Valley Gas Conversion Project not only yielded an economic savings for the community, it also provided an aesthetic landscape for the local neighbors and those driving past the facility. Burning gas is cleaner for the environment and eliminates the "back end" handling of both coal and residuals such as bottom ash and fly ash.

Select Project Photos

We Energies Valley Power Plant, Milwaukee, Wisconsin

New gas lines

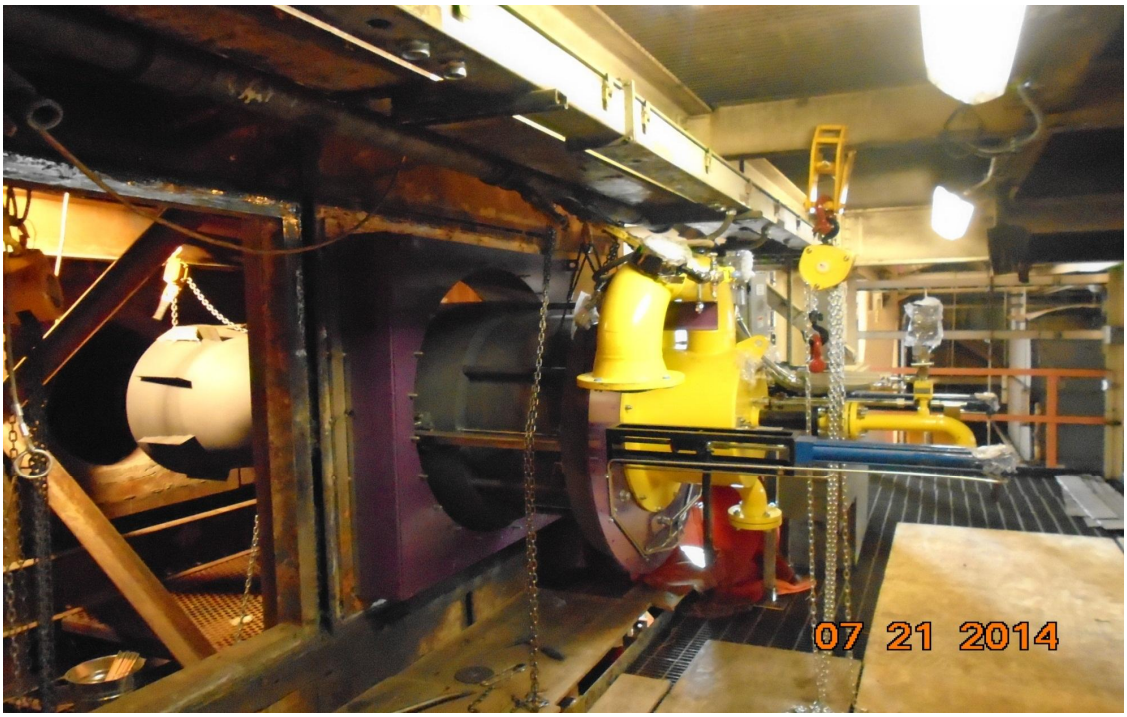
New gas regulation into the plant



Boiler preparation to add new gas burners

New gas burners

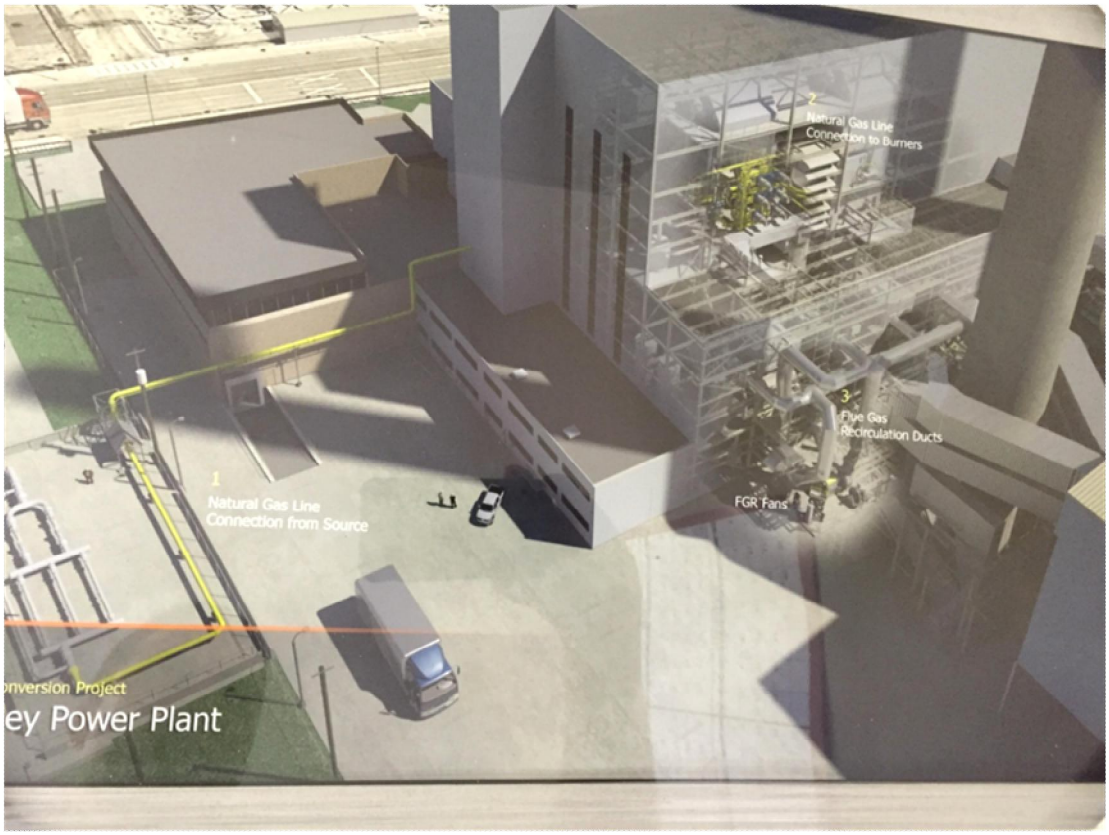
Installing new gas burners



Installing new gas burners

New FGR fans

FGR ducts leading to baghouse and stack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Natural Gas Line
Connection to Burners
3
Flue Gas
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