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UNIQUE ELEMENTS OF THE OLMSTED COUNTY FACILITY EXPANSION

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ABSTRACT

Olmsted County is currently expanding their existing waste-to-energy facility in Rochester, Minnesota to add a third mass burn waste combustor. The new unit will have a capacity of 200 TPD, effectively doubling the size of the existing capacity. This paper will discuss some of the unique aspects of this project and review the current status. Some of the interesting and unique features to be discussed include:

1. Environmental Permitting – The county decided to do a voluntary EIS
2. Project approach – The county is using a Construction Manager at Risk approach for construction of the facility
3. Engineering – The engineering scope includes several separate procurements of major equipment packages, balance of plant design and several auxiliary projects related to the ‘utility’ system.
4. Operator Collaboration – Olmsted County is one of a few public owners that operate their facility. Their knowledge of the existing facility and of operating a mass burn facility has been used extensively in the planning and design of the new unit.

INTRODUCTION

The leaders of Olmsted County have consistently demonstrated vision, going back to the inception of the original facility. This vision and leadership has resulted in an integrated system unlike any other for a mid-sized city in the United States. In 2001, leaders in the Solid Waste Division of Olmsted County Public Works recognized that the growth of the solid waste stream would result in quantities greater than the existing Olmsted Waste-to-Energy Facility (OWEF) could process. It is no surprise that when it came to developing an expansion of the OWEF, this leadership and vision has led to many unique

elements of the project. This project is unique for several reasons:

THE OWNER

The unique approach to this project starts with the philosophy of Olmsted County. The County and the region truly are ambassadors of environmentally sound solutions to waste disposal. The county has developed an integrated solid waste system that includes every conventional and sound management technique. This includes recycling, composting, Waste-to-Energy (WTE), and landfilling. In addition, a public education program has been developed and instituted that includes a solid waste education module that is included in many middle school environmental resources curriculums in the County. The curriculum typically includes a tour of the OWEF. This facility is the largest WTE facility operated by a governmental entity. Olmsted County makes WTE a part of the solid waste program because WTE:

1. Reduces greenhouse gas emissions in comparison to landfill emissions by offsetting fossil fuel use;
2. Is a renewable, sustainable clean energy source;
3. Is a preferred solid waste disposal after reduce, reuse, and is compatible with recycling;
4. Supports Olmsted County’s energy-efficient Combined Heat and Power (CHP) system; and,
5. Produces cleaner leachate from ash landfilled materials in comparison to solid waste landfilling.

THE PERMITTING APPROACH

As the first major facility retrofit in Minnesota in recent years, the county felt a responsibility to take a conservative approach. Decisions don’t come fast or easy from the state regulator, the Minnesota Pollution Control Agency (MPCA). As such, the county evaluated whether to complete an Environmental Impact Study (EIS) when an Environmental Assessment was determined to have met regulations. Important factors considered in this decision included:

1. A desire to continue to protect the environment as fully as possible
2. A policy of full disclosure in the county operation
3. A need to conserve landfill space and obtain the required permits in as timely manner as possible

THE PROJECT APPROACH

The original intent was to execute the project with a design-build contract. The design-builder would have been responsible for completing engineering, specification, and procurement of equipment, and construction of the facility. A design-build contractor was hired and the initial development of the project moved forward. The owner found this approach to be unsatisfactory, primarily due to lack of control over design details and cost.

Olmsted County terminated the design-build agreement and considered other project delivery models for the design and construction of the expansion. One model that has been used successfully on large projects is the Construction Manager at Risk (CM at Risk) approach. Local institutions that use this method for large projects include The Mayo Foundation and The University of Minnesota. There are two primary benefits of this method of designing and constructing a facility: Cost control through establishment of a Guaranteed Maximum Price, and collaboration between the Owner, Design Engineer, and CM at Risk.

The CM at Risk provides cost control by establishing a Guaranteed Maximum Price (GMP) at an early point in the project. The GMP commits the CM at Risk to deliver the project for that cost or less. The CM at Risk plays an important role during the design phase of the project by providing pre-construction services, and offering input on technical issues and construction means that could improve the project and/or reduce its cost.

At some point during the process, the CM at Risk will provide one or more cost estimates, which will become the GMP once the agreed upon level of design is complete. Once the GMP is set and equipment procurement or construction activities begin, the CM at Risk's role becomes more like a general contractor, but one that is acting in the owner's interest. The CM at Risk must manage and control costs so that they do not exceed the GMP, in order to avoid incurring a financial impact. A majority of the equipment procurement and various construction contracts are bid to qualified entities based on specifications and designs developed by the engineer (HDR Engineering).

Collaboration between the Owner, Design Engineer, and CM at Risk is the other primary benefit of this delivery model. Engaging the CM at Risk for the preconstruction services means they have the opportunity to provide input into the design of the facility. CMs typically have significant experience in major equipment procurement and construction of similar facilities and can provide valuable insight into the specifications and

design of the expansion. With this model, Owners also have valuable input to the specifications and design based on their experience in operating similar facilities.

This project was no exception. Olmsted County had developed a high level of technical knowledge based on the operation of the existing facility over the past 20 years and was a significant contributor to the design of the expansion. The CM at Risk delivery model allows full flexibility during the pre-construction phase for the Owner, CM at Risk, and the Designer to review and evaluate options and agree whether to incorporate them into the project. This is the essence of collaboration and has proven to be invaluable to this project.

Selection of the CM at Risk was accomplished through a competitive process. The county, assisted by HDR Engineering, developed a Request for Qualifications (RFQ) for response by potential bidders. The successful response was submitted by a joint venture of three local contractors who had prior working relationships and experience in similar projects. The joint venture is made up of Knutson Constructors, Harris Mechanical, and Hunt Electrical, and is known as KHH.

ENGINEERING AND EQUIPMENT PROCUREMENT

Modifications to existing facilities often result in many unique design requirements, and this project was no exception. Specific elements include:

1. Fuel Design Criteria
2. Reuse of existing Fabric Filter
3. Integration of Unit 1 and 2 control system
4. Steam Turbine Control Integration
5. Auxiliary Systems integration
6. Emergency Power Supply System

Special consideration and evaluation was given to the establishment of the design fuel analysis.

The fuel criteria considered when designing a combustion system includes an ultimate analysis and the higher heating value (HHV). In the event the fuel has a HHV greater than anticipated in the design phase, the ability of the facility to meet its design throughout capacity may be limited. If the facility cannot meet its design capacity, then its expected tipping fee revenues may be lower than anticipated which could compromise the project economics.

Identifying the proper fuel design criteria is not only important for proper sizing of the boiler and grate; it also affects the sizing of all associated equipment and appurtenances.

The county has collected information on the as-received waste over most of the operating life of the facility. This data includes component sort data, ultimate analysis, proximate analysis, and HHV. The data was provided as reference information for the design of Unit 3.

For the purposes of analyzing the OWEF data it is valuable to make comparisons to other available facilities. Two other sets of data were considered in this analysis. Franklin Associates is on a long-term contract with the Environmental Protection Agency (EPA) to develop assessments of municipal solid waste (MSW). The Franklin report gathers data for MSW disposed of in the United States and was used here for establishing trends in waste composition. The State of California also conducted a study in December 2004 to characterize its waste stream statewide. Both of these reports were considered for comparison to the recent OWEF composition data to consider the differences.

Table 1 makes a comparison of recent data for the OWEF, the Franklin Report, and the California data. The OWEF data has much higher quantities of paper and plastic and much lower for organics. This table shows that the average of the OWEF data since 2001 has higher quantities of paper, plastics, and organics. These constituents are the majority of the combustible materials in the stream and would be expected to have higher levels of heating value.

Table 1 – Comparison of Composition Data

| | Olmsted | US 01-03 | Cal 03 |
|--------------|----------------|-----------------|---------------|
| Paper | 36.3 | 27.3 | 26.9 |
| Plastics | 17.1 | 15.1 | 12.1 |
| Organics | 34.7 | 39.9 | 39.0 |
| Inorganics | 3.7 | 2.2 | 6.0 |
| Metals | 4.9 | 7.2 | 9.8 |
| Glass | 3.0 | 6.3 | 2.9 |
| Other | 0.5 | 2.0 | 3.2 |
| Total | 100.1 | 100 | 99.9 |

The Olmsted County-specific data that was provided is reasonably consistent with the national data. Specifically, the quantity of plastics has been trending upward, while paper has been trending slightly downward over the long-term. Recent trends show very little change. For the design of Unit 3 at OWEF, HDR recommended that the trends be considered flat for the future operating period.

Based on the information developed in this Technical Memorandum, HDR developed the following fuel specification:

Table 2 - Recommended Fuel Specifications

| MSW Ultimate Analysis | Typical | Range |
|------------------------------|----------------|--------------|
| Carbon | 29.83 | 21 - 35 |
| Hydrogen | 3.81 | 2.8 - 4.5 |
| Oxygen | 21.08 | 16.5 - 29 |
| Nitrogen | 0.88 | 0.2 - 3.2 |
| Sulfur | 0.08 | 0.05 - 0.4 |
| Chlorine | 0.45 | 0 - 1.5 |
| Fluorine | 0.01 | 0 - 0.15 |
| Moisture | 26.67 | 12 - 38 |
| Ash | 17.19 | 13 - 25 |
| HHV | 5425 | 4000 - 6400 |

Another unique element was the fact that the fabric filters (FF) currently in place for removing particulate on Units 1 and 2 were planned to become the FF for Unit 3. When the air pollution control retrofit was completed on Units 1 and 2, the new FFs were installed in the area of future Unit 3. The intent at that time was to reuse the old electrostatic precipitator (ESP) housings as containers for a combined FF/ESP but this plan was later changed to call for removing the ESP housings and installing two FF in their place. This allowed erection of the new equipment adjacent to the existing plant and shortened the required tie-in outage significantly.

The challenge it presented for the Unit 3 project was how to incorporate the existing FFs into the chute-to-stack equipment procurement so that overall emissions guarantees could be made. This approach also required that new FFs be installed for the existing units.

A separate bid package was developed and awarded to SPE Environmental to supply and erect the new FFs and demolish the old precipitator casings. The new FFs were specified and designed to utilize the precipitator support steel and foundations. The emissions guarantees for Unit 3 were incorporated into a single package that included the combustion system, boilers, dry scrubber (SDA), ID fan, and modifications to the FF. Modifications were limited but included new bags and cages, combined inlet and outlet ductwork, and control logic changes. The inclusion of FF modifications allowed the “chute-to-stack inlet” provider to take responsibility for all emissions guarantees.

Like many plants that were built in the same era, the existing control system has undergone some upgrades. The owner recognized an opportunity to upgrade the existing plant controls to be consistent with the anticipated new system for Unit 3. The

county has standardized on a Fisher Delta V system. As part of this project, it was decided to put all of the controls for existing systems into the Delta V. The systems for Units 1 and 2 will all be converted over to Delta V prior to completion and start-up of Unit 3. Adding complexity to this conversion is that fact that all three units will be tied together to allow full operating flexibility.

After the expansion, the facility will include three steam turbines. The original plant included one back-pressure turbine that exhausts at 60 psig, and one condensing turbine. The expansion will add another turbine that has an extraction point at 60 psig and can operate in full condensing mode. The control logic for steam pressure control includes developing a philosophy for the main steam header (600 psig), the 250 psig header, and the 60 psig header.

Coordinated operation of the following equipment will accomplish 600 psig pressure control:

- TG No. 1 Woodward Governor
- TG No. 1 600/60 Bypass Valve
- TG No. 3 Woodward Governor
- TG No. 3 600 to Main Condenser #2 Bypass Valve

Normal operation of the plant is to have the manual isolation valve between the Boilers No. 1 and No. 2 header and the Boiler No. 3 600-psig header closed, thus operating each side of the 600# header independently. It is possible to operate the 600 psig header with the isolation valve open, but in this mode consideration must be given to feedwater flow between Units 1 and 2, and Unit 3.

With the 600 psig header isolation valve closed, primary control of the 600 psig headers and associated drum pressures will be accomplished by the TG Woodward Governor. Secondary control of the header will be done with the TG bypass which will have a slightly higher set point, making the TG the preferred route. In the event of a trip of TG, the bypass valve will automatically assume 600 psig header pressure control at the elevated set point valve.

It will be possible to operate the 600 psig header with the manual isolation valve open but this is not considered a “normal” operating mode. When operating in this mode the operator must be aware of the complexity associated with staging the set point values of the TG units and associated bypass valves. In addition, balancing of flows between the Unit 1 and 2 de-aerators must be considered.

Primary control of the 60 psig steam header will normally be accomplished by the TG No. 2 Woodward Governor operating in IPC mode. In the event 60 psig header pressure drops below the desired value it is anticipated that the following steam sources will be used to maintain pressure in order of precedence (operator assigned set point values decreases in this order):

- TG No. 3 Woodward Governor Extraction Control
- TG No. 3 600/60 Bypass Valve
- 250/60 psig Pressure Reducing Valve (normally operated in manual)

Coordinated operation of the following equipment will accomplish 250 psig pressure control:

- 600/250 psig Pressure Reducing Valve (PRV)
- Auxiliary boiler Firing Rate Control

With the Nebraska Boiler (auxiliary boiler) out of service the 250 psig steam system pressure is maintained at an operator assigned set point value using the 600/250 psig PRV. When the auxiliary boiler is in service 250 psig steam system pressure is maintained by the boiler pressure master (firing rate control).

In any expansion project consideration must be given to the coordination of auxiliary systems. There are many options available for combining systems. In general, one must determine whether the auxiliary system will operate independently or will be interconnected with the same system for Units 1 and 2. Auxiliary systems were considered in detail and several technical memorandums were developed. These systems include:

- Compressed air and instrument air
- Water Treatment and chemical feed
- Lime Handling and Lime Slurry
- CEMS System
- Boiler Feed System
- Carbon Injection

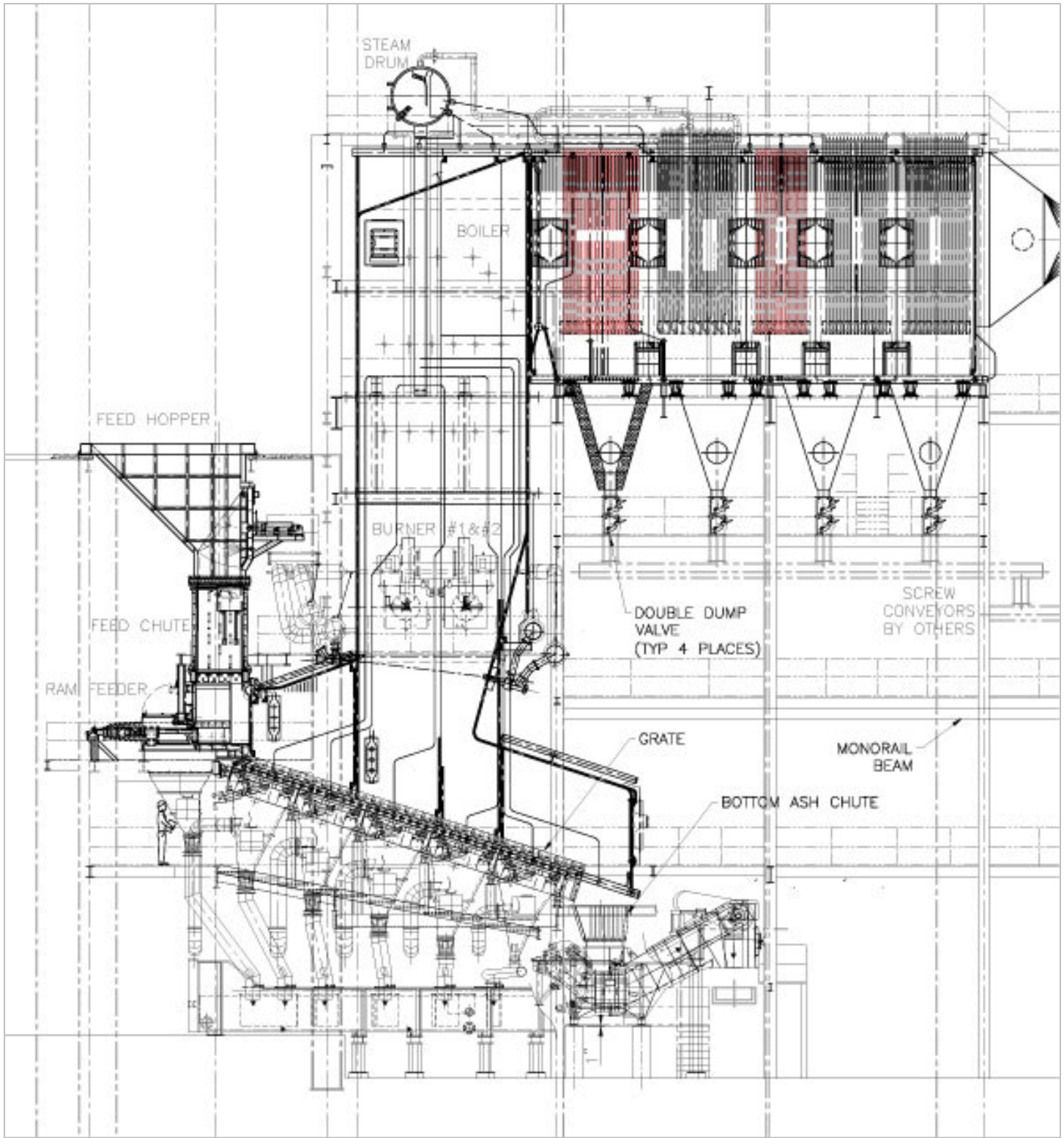
PROJECT STATUS

On March 11, 2008, construction on the expansion began with the pouring of major foundations. All major equipment packages have been awarded. The combustion grate, boiler, spray-dryer absorber, activated carbon injection system, fabric filter modifications, and ID fan were awarded as one package. AEE/Von Roll will be providing the heart of the plant from the inlet feed chute to the stack inlet.

There are some notable features of this equipment, most importantly the boiler geometry, which has all of the heat transfer surface in a horizontal pass boiler. This arrangement, shown in figure 1 (next page), allows for a mechanically rapped system and eliminates soot blowers.

Another important feature is the use of a refractory tile system in the furnace that covers all of the water walls from the grate to the roof. The roof tubes and first section of superheater are protected by iconel overlay. These features allowed AEE/Von Roll to provide an operating guarantee of continuous operation before a shut down is required for boiler cleaning.

Figure 1, Boiler Side Elevation



Additional equipment was specified and awarded to qualified vendors, including:

1. Stack – 150 foot steel stack provided by Warren Environmental
2. Unit 1 and 2 Fabric Filter – SPE Environmental
3. Steam Turbine Generator – Dresser Rand
4. Air Cooled Condenser – SPX
5. Boiler Feed Pumps – ITT Goulds
6. De-aerator – Kansas City De-aerator
7. Bottom Ash Conveyor extension – Triple S
8. Emergency Standby Power System – Ziegler/Caterpillar
9. Auxiliary Power Transformer – VanTran Industries
10. Motor Control Centers – Allen Bradley

The detailed engineering was completed on the structural and architectural package. This includes the building enclosure and all foundations. KHH began foundation work, shown in figure 2 and 3, on November 27, 2007. The remaining detail engineering is nearly complete as of April 1.



Figures 2 and 3.

The contractor selected to supply and erect the fabric filter on Unit 1 and 2 was mobilized February 25 and began demolition activities. Removal of the old ESP housing is shown in figure 4.



Figure 4

SUMMARY

Olmsted County has developed a project with many unique elements. The county has emphasized collaboration, robustness and operability in the specification of the equipment and design of the new unit. It is expected that these project features will result in a highly reliable and successful plant for many years to come.

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