Final Public Report for ESA-047-3

Company	United States Steel Corporation	**ESA Dates**	March 18 – 20, 2008
Plant	Midwest Plant	**ESA Type**	Steam System
Product	Finished rolled sheet steel	**ESA Specialist**	Richard J. Jendrucko, Ph.D.

Brief Narrative Summary Report for the Energy Savings Assessment:

1. Introduction:

This plant, constructed from 1959 – 1960 is one of several company-owned sites. The plant has undergone additions and ownership changes over the years. The current approximately 400 acre site has approximately 1,000 employees working three shifts daily, 7 days/week. Raw materials include rolls of sheet steel produced in and received from a nearby company steel plant. Processing includes furnace-heating (where needed) and immersion surface treatments (e.g. anodizing, galvanizing, chrome plating) of stock unrolled at the front end of each line and re-rolled at the terminal end. Numerous processing tanks are steam-heated to temperatures ranging from 150°F to 180°F. Moderately-superheated steam (210 psig, 505°F) is produced in a separately-owned co-generation facility operating a natural gas-fired turbine generator and two high-pressure (1,500 psig) boilers. Extraction steam from the combined-cycle steam turbine-generator supplies plant processes and building space heaters. Total steam supplied to the plant typically ranges from about 100 klb/hr to 140 kbl/hr. The two (2) auxiliary boilers do not have sufficient capacity to supply the current late fall to early spring steam demand, thus the gas-fired turbine generator must be operated from approximately October 1 to May 1 each year. During summer months, depending on economic conditions, either 1) the gas turbine is not operated and needed steam is supplied by one boiler operated at high load, while the second unit is maintained on a low-fire condition, or 2) the gas turbine is operated and both boilers maintained on a low-fire condition, which results in significant venting of low pressure (20 psig) steam (average rate: 20 klb/hr). Steam exhausted from the co-generation system turbine at 20 psig is used for steam generator water treatment.

2. Objective of ESA:

The objective of this ESA was twofold:
a) To train company/plant personnel in the use of the DOE Steam Tool software.
b) To perform a "training assessment" of plant equipment and processes leading to the recommendation of measures for achieving substantial plant energy savings.

3. Focus for Assessment:

The ESA focused on the reduction of steam consumption and cost in the plant. While the primary focus was on plant steam systems, opportunities for energy efficiency improvement in the partner co-generation system were considered.

4. Approach for ESA:

The ESA Specialist worked directly and continuously on-site with the Plant Utilities Operations Manager (Todd), and the Utilities Maintenance Manager (Bilow). Additional assistance was provided by the Plant Energy Management Coordinator (Connelly) and the Corporate Energy Management Leader (Mills). After an extended period of general discussion and data assimilation, a typical processing line and the co-generation plant were toured. Afterwards, further discussion clarified the major areas of steam and natural gas use and a list of 15 prospective steam energy-savings measures was developed. The ESA Expert then introduced the use of the SSAT tool which was used to analyze selected projects. Project screening included consideration of energy saving projections, technical feasibility and projected payback period. Based on screening results, a final set of 8 energy-saving measures were recommended for implementation.

5. Plant Annual Energy Consumption and SSST Evaluation:

a) Purchased energy annual consumption (2006):

Natural gas (Purchased and supplied to cogeneration facility and used in direct-fired equipment in plant buildings)
Consumption: 5,667,063 MMBtu/yr.

Electricity (Purchased from cogeneration facility and the local utility supplier)
Consumption: 366,245,000 kWh/yr.

Steam (Purchased from cogeneration facility)
Consumption: 1,002,390 Mlb

Demineralized (hot) Water (Purchased from cogeneration facility)
Consumption: 642,842 Mgal.

b) DOE Steam System Assessment Tool (SSST) Results:

Steam system profiling: 72/90 pts. = 80%
Steam system operating practices: 90/140 pts. = 64%
Boiler plant operating practices: 55/80 pts. = 69%
Distribution, end use, recovery and operating practices: 16/30 pts. = 53%
Overall score: 233/340 pts. = 69%

The SSST results reflect a typical or average system performance overall in comparison to similarly large industrial manufacturers using steam. There are significant opportunities for improvement in the steam system, particularly in the areas of distribution, end use, recovery and operating practices.

6. Energy Saving Opportunities:

The savings projections for the recommended energy-saving measures listed in the summary table above (and discussed below) should be considered approximate, with accuracy subject to the limitations of the plant data available for analysis at the time of the ESA. Furthermore, due to the complexity of the integration of the plant energy systems with the supplier co-generation system, there may be interactions resulting from implementing more than one of the recommendations. Therefore, further analysis should be done to validate the technical feasibility and savings projections for recommended measures before implementation. Finally, the projected payback periods for the recommended measures may vary widely with one or more measures having relatively long payback periods. In such cases where the company payback threshold cannot be met, it is still useful to retain projects on a list for regular re-evaluation as energy market prices can vary and change the relative attractiveness of some measures. It should also be noted that the indicated percentages of natural gas saving for the measures discussed below are modest, due mainly to the fact that a large fraction of the purchased natural gas energy results in the production of electricity in the cogeneration system.

1. Implement steam trap maintenance program (Pick List #1.14):

Blocked steam traps affect process operation and are repaired or replaced when reported. However, leaking or blowing traps do not affect process heating but result in substantial energy loss especially since condensate is not presently recovered for water and energy utilization. Plant maintenance personnel reported that to their knowledge, there has never been a systematic survey and testing of all traps. Industrial literature reports that traps fail after long periods of use and it is likely that a large proportion of plant traps are partially or fully leaking through. Since plant maintenance personnel are not experienced in trap assessment, it is recommended that an outside contractor be engaged to inventory and test all traps and repair those found to be in a failed condition. (**Short-term opportunity**; potential natural gas savings: 2.9%)

2. Reduce steam demand (Pick List #1.1); Reduce space-heating load:

The plant building shells are uninsulated and many openings allow large amounts of air infiltration and contribute to heavy heating loads during winter months. Additionally, many steam heaters are served by failed blowing steam traps which result in unintended losses of flash steam energy via venting or condensation and combination with wastewater. It is recommended to make a concerted effort to reduce space-heating energy use by a) repairing traps serving steam unit heaters b) reducing or eliminating active heating of unoccupied plant building areas c) using gas radiant heaters to replace air heaters where feasible d) Sealing truck entrances with plastic strip or powered air curtains to minimize infiltration at loading doors. (**Medium-term opportunity;** potential natural gas saving: 1.8%)

3. Change condensate recovery rate (Pick List #1.11): Recover condensate:

The original plant design did not include recovery and return of condensate to the boilers. An estimated 950 million pounds per year of formed condensate is combined with other wastewater streams, is processed in a water treatment facility and released to Lake Michigan. It is recommended to target about 50% of condensate formed in the west side of the plant and to install receivers, piping and pumps to utilize recovered condensate for one or more of the following: a) process water tank make-up b) product rinsing c) return to boilers. The latter option will require renegotiation of the contract with the co-generation company to accept hot condensate for compensation. (**Medium-term opportunity**; potential natural gas savings: 1.5%)

4. Reduce or recover vented steam (Pick List #1.21); Utilize vent steam energy:

The co-generation facility provides the plant with 215 psig. steam to meet process demands as a priority. Generated electricity associated with the provision of the 215 psig steam is also purchased. When steam demand is reduced to levels below which the electrical generation of the steam turbine can operate, more steam is passed to the (about 25 psig.) low-pressure turbine exhaust. If this low-pressure steam amount is more than needed for deareator operation and the production of hot softened water for the plant, the excess steam is vented. Venting occurs during summer months in an average amount of 6k lb/hr. of low-pressure steam. It is recommended to install piping and valving and a sparger system to duct excess low-pressure steam to the softened water storage tank to recover steam heat content. **(Medium-term opportunity**; potential natural gas energy savings: 0.3%)

5. Change boiler efficiency (Pick List #1.3); Repair vibration problem and automate O_2 control:

Two 150,000/hr. boilers supplement steam produced in the heat recovery unit of the gas-turbine in the co-generation plant. Stack gas O_2 in the two boilers is measured but combustion air control is done manually. Due to a reported vibration problem encountered when induction air is reduced to low levels, the operators control air to result in stack O_2 values of about 5%. Since the most efficient operation would be for O_2 to be controlled to 1 -3%, it is recommended to modify or repair inlet air dampers and to utilize an automatic control system to maintain O_2 values at 2% for high fire conditions. Since the boilers are owned by the cogeneration company, it will be required to negotiate an agreement for the installation of the recommended boiler equipment upgrades. (**Medium-term opportunity;** potential natural gas energy savings: 0.3%)

6. Implement a steam leak maintenance program (Pick List #1.15) Repair steam leaks:

A limited tour of the plant facilities and discussions with maintenance personnel revealed that there are a substantial number of steam leaks in the steam distribution system. It is recommended to institute a regular program for the inspection of the steam distribution system to identify the locations and relative severity of leaks. Moderate to large-size leaks should be repaired as soon as possible. An outside agency should be employed to make the needed repairs if local maintenance personnel do not have the time to address leak repair on a near-term basis. (**Short-term opportunity;** potential natural gas energy savings: 0.2%)

7. Feedwater heat recovery using boiler blowdown (Pick List #1.10); Install heat exchanger to recover heat in post-flash blowdown:

   Currently, boiler blowdown is flashed to the deareator but the hot liquid residual is combined with process wastewater for treatment and release to Lake Michigan. Since the post-flash blowdown contains substantial sensible heat, it is recommended to install a heat exchanger to extract heat for supplemental feedwater heating. Since the boilers are owned by the cogeneration company, it will be required to negotiate an agreement for the installation of the recommended boiler equipment upgrades. (**Medium-term opportunity;** potential natural gas energy savings: 0.1%)

   Summary of potential savings:
   Near-term measures: 172,265 x 10^6 Btu/yr.
   Medium-term measures: 226,894 x 10^6 Btu/yr.
   Long-term measures: 0 x 10^6 Btu/yr.

7. Management Support and Comments:

   The Plant Utilities Operations Manager and the Utilities Maintenance Manager worked continuously with the ESA Expert over a three-day period to clarify plant operations and concerns, to be trained in SSAT use and to assist in the formulation of energy-saving measures. The Corporate Energy Management Leader and the Plant Energy Management Coordinator also participated in the assessment. The Corporate Energy Management Leader and plant participants were supportive of the ESA and rated the value of the SSAT tool and overall assessment as substantially useful in guiding energy conservation and associated cost reduction actions.

8. DOE Contacts at plant/company

   Plant Contact:

   Dale Connelly, Plant Energy Management Coordinator (Points of contact listed above)

   Company Contact:

   Kenneth W. Mills, Corporate Energy Management Leader, Gary Works-M.S. 70, One North Broadway, Gary, IN 46402-1390, (219)888-3930, KWMills@USS.com