Form ESA-B4. Final Public Report ESA-128-2

Company	General Motors	**ESA Dates**	October 16-17
Plant	Pontiac Assembly Center	**ESA Type**	Pumping systems
Product	Vehicles	**ESA Specialist**	Don Casada
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ENERGY SAVINGS OPPORTUNITY SUMMARY INFORMATION					
	Savings/yr				
Identified Opportunity		**kWh**	**MMBtu**	**Fuel Type**	**N,M,L**
Provide accurate end-of-loop pressure data to enable operators to better control closed loop delta-p setpoint (and speed)		134,873			N
Install smaller, adjustable speed-driven boiler feed pump with reduced operating pressure and lower recirculation flow rate		96,790			M
Review the weld water cooling and cooling tower pumping systems for possible adjustable speed drive (weld water) and on/off (tower water) operation		942,135			L

IDENTIFIED PLANT BEST PRACTICES

1. Closed loop cooling is operated with a supply/return temperature differential of about 19 F. This is excellent in terms of pump load, and more significantly, in terms of chiller performance.
2. The powerhouse operation is exceptionally well operated and maintained. Both cleanliness and pump control practices are excellent.

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:
The GM Pontiac Assembly plant assembles consumer vehicles

Objective of ESA
The goal of the ESA was to apply the PSAT program, associated screening, measurement and analysis methodologies to several systems in order to train plant personnel on the use of the DOE tools and methods, and identify savings potential in the selected systems.

Methodology
The primary focus, from the plant's standpoint was on powerhouse-related pumping systems, with brief reviews of other plant systems. It was not practical to bring pumping system test (flow, pressure, electric power) equipment into this facility, so the assessment effort was somewhat limited in scope.

Systems considered
The following power house systems were considered:
- Closed loop cooling/heating (area comfort)
- Air compressor cooling tower
- Chiller cooling tower
- Boiler feedwater
- Process makeup booster

In addition, cursory reviews of the weld water cooling and south end fire water booster pumping applications were conducted.

General Observations of Potential Opportunities
<u>Closed loop cooling/heating</u>
The closed loop cooling pumps are Worthington (Flowserve) 10LR17B model with a 15.3" impeller, and are driven by 300HP, 460V, 1780 rpm motors with adjustable speed drives (ASDs).

Differential pressure control and associated opportunities
The system delivers temperature-conditioned water to multiple heat exchangers throughout the facility. As a closed loop systems, the system theoretically has no static head. However, the ASD speed is controlled based on operator-specified differential pressure (delta-P) between the supply and return lines. The delta-P is measured inside the power house. By design, delta-P information at extreme ends of the loop are available, but these sensors have not been maintained over time, and therefore do not provide power house operations personnel with critical system operating parameters – namely, the driving delta-P that exists at the ends of the loop.

These end-of-loop delta-Ps are, in many closed loop applications, the preferred control signal. In the GM operation, they are needed as operational feedback so that operators can be assured that flow is going through all portions of the system, especially during winter periods when there is a freeze potential if some lines become essentially stagnant. The historical operating practice has been to maintain a delta-P between 5 and 15 psid, with 15 psid being the normal setpoint during winter. Operators recognize that this is quite high, but establish this as a conservative practice because of the unavailability of end-of-loop delta-P data.

In order to estimate the potential energy savings from operating with lower delta-P settings, a series of flow, delta-P, and electrical data were collected (from permanently-installed instruments) as the delta-P setpoint was changed from 5 to 15 psid. The raw data and estimated powers are shown in Table 1.

Table 1. Fluid and electrical data from closed loop test sequence

Indicated differential psid	Flow rate, gpm	Pump discharge psig	Pump suction psig	ASD output volts	ASD output amps	ASD frequency, Hz	Estimated ASD input kW*
5.1	440	90	70	170	65	22	16.9
7.3	720	90	70	207	76	28	24.1
10.2	940	95	68	251	95	33	36.6
15	1600	100	67	316	139	42	67.4

* ASD input kW estimated, assuming motor power factor = 0.85 and drive efficiency = 96% for all conditions.

While the data collected during this brief test (under mild weather conditions) will not accurately reflect the winter or summer peak demands, a general indication of potential energy savings from lower delta-P operation is indicated. For example, consider the 43.3 kW difference in power required at 15 and 7.3 psid.
While a more detailed investigation, including acquiring data under much longer term operations would be necessary to accurately characterize the savings, it is clear that restoring the delta-P sensors at the end of the loop would arm powerhouse operations with information that could translate into significant pumping energy savings.

Operating system pressure
As indicated in Table 1 above, the loop average pressure is around 80 psig. This is unusually high for closed loop cooling/heating systems. While it is the differential pressure and flow rate that fundamentally determine the hydraulic load on the pump, operating at higher than necessary pressures has generally negative implications for overall reliability. Higher operating pressures translate into increased probability of system leaks, and once a leak occurs, increased leakage flow rate.

But there are also negative energy aspects related to makeup fluid. These are discussed under the makeup pump section.

A more careful review should be made, but should be feasible to simply drop the overall system operating pressure by manually reducing the cover gas pressure (or pressure setpoint) on the system expansion tank.

Bestpractice observation – closed loop cooling
The use of an ASD for control purposes is a good scheme in this system. Operations personnel noted that during the summer time cooling periods, they normally see almost a 20 degree F temperature difference between supply and return temperatures. This indicates excellent energy management for the pump load, but more importantly, for the 2000 hp chillers.

<u>Air compressor cooling tower pumps</u>
The plant compressed air system is absolutely critical to plant operations. Two compressor cooling tower pumps, driven by 40 hp and 25 hp motors, are operated continuously to provide cooling to various compressor-related loads (intercoolers, aftercoolers, etc.). Intercooler heat exchange area for the Joy compressors is a limiting factor, and the control valve for that load is full open. The only opportunity to reduce the pumping load would be related to the condition and sizing of the pumps. This would likely be minimal, and was not explored.

<u>Chiller cooling tower pumps</u>
The 2300 ton chillers are operated as required for general area cooling. They were not running during the assessment. Powerhouse operations personnel indicated that the chillers are only run when required. The plant is currently operating two shifts, and so even on days when cooling is required, chiller operation (including the chiller tower water pump), is stopped overnight and on weekends.

The chiller tower water pumps are rated at 6600 gpm, 90 ft. System flow is not throttled. At chiller rated load condition, the flow rate would be about 2.9 gpm/ton of cooling, which is in the typical range of flow (3 gpm/ton corresponds to roughly 10 degree F temperature rise at rated load). While there might be some potential to reduce flow rates to match actual demand load (for example, with an adjustable speed drive), the fact that chiller operation occurs 10% of the time or less renders modifications to the system not feasible in terms of cost recovery.

One possible minor opportunity related to this system is the further reduction of overall system operating time. To the extent that individual area loads (powerhouse operations noted the prep booth as an example) require chiller operation when other areas do not need chiller-based cooling, some investigation of establishing dedicated area cooling may be merited. It would be difficult to cost-justify changes unless significant chiller operating periods could be eliminated.

<u>Boiler feedwater pumping</u>
The boiler feedwater pumps deliver variable flow to the boilers to meet facility steam demand. Four identical 40,000 pound/hr (40 kpph), 150 psig boilers are installed, and there are four identical 12LLR-10 boiler feedwater pumps rated at 125 gpm, 500ft to support their operation. During the summer and milder weather months, boiler loads are quite light. During the assessment, a single boiler was operating at around 20 kpph.

The required feedwater flow rate for 20 kpph is 40 gpm. The pumps use a Yarway 9300 “ARC” valve which acts as a combination discharge check and minimum flow protection valve. For the conditions observed during the assessment, which reflect requirements for 50-60% of the year, the overall estimated pump flow rate was about 90 gpm (40 gpm to boiler, ~50 gpm recirculation).

The net effect is that a considerable portion of the time, the pump is operating at a head that is more than 30% above that required to deliver flow to the boiler and the flow rate handled by the pump is approximately twice that needed by the boiler.

By selecting a pump that is sized for part load operation, some savings could be achieved. To illustrate the potential, PSAT analyses for the existing pump and an example alternate pump (Grundfos CR10-14) were performed assuming that the 20 kpph steam demand represented 50-70% of the annual requirements from a single pump (this would be a combination of low demand requirements that a single pump could meet as well as higher demand requirements with two pumps and boilers in operation).

Process makeup water booster pumping
The process makeup water booster pump is used to boost the discharge pressure of city water, which varies significantly (during the month of July, 2007, it ranged from around 32 to 70 psig, with an average of around 50 psig). The booster pump is a 15-hp unit with adjustable speed control that maintains 80 psig discharge pressure. Flow is used as makeup to cooling towers, boiler, and closed loop operations. The 80 psig pressure setpoint is driven by the current operating pressure in the closed loop system. By reducing the operating pressure of that system, the discharge pressure of the booster pump could be dropped as well.
This system's energy consumption is already quite low (roughly 3 kW average power), but it would be reduced further by dropping the discharge pressure setpoint.

Weld water cooling pumping
Weld water cooling, which is located outside of the power house area, has five weld water cooling pumps, each with 150 hp motors. In addition, there are four associated cooling tower pumps, each rated at 50 hp. Three of the weld water pumps and two of the cooling tower pumps are normally operated on a 24/7 schedule.

Although it was deemed not possible to collect flow, pressure, and power data on this system during the assessment period for non-technical reasons, this system appears to merit serious consideration. First, with only two operating shifts and no production on weekends, the pumps are operated at full load condition continuously even though they are only needed for production support about half of the time.

There are various reasons that plant staff have been reluctant to stop the weld water cooling pumps, including the fact that problems have historically occurred during startup after pumps have been turned off (scale, sediment, etc. breaking loose and causing operational problems being one example, and the need to do checkups during non-production being another).

If the speed of the weld water pumps could be dropped to 50% of normal and one of the tower water pumps could be turned off during 80% of the non-production periods (allowing some time for testing, etc. In addition, if adjustable speed drives were used to control system operation during production, it is likely that additional savings would accrue.

While the above estimates are based on engineering calculations, there is considerable uncertainty in them. But the magnitude is certainly sufficient to warrant a more detailed study – which should include measurement of flow rates, head (pressures), and motor power.

Management and UAW Support and Comments:
A corporate level management team and the UAW/WFG Joint Task Team encourage any effort that reduces the Energy usage at all of its plants located around the country. General Motors has a target to reduce energy use and costs by 6% this year. They have an Energy Engineer with this assignment at each facility.

The UAW/WFG Joint Task Teams have identified several Department of Energy (DOE) best practices that will have a significant impact if implemented at GM Facilities. Due to the focus of the Best Practices there is an opportunity for our UAW Skilled Trades to provide a substantial cost savings impact to the operating costs of our facilities by working jointly with the GM/WFG management organization.

UAW/WFG Joint Task Team, DOE associated Best Practices:
BMES-01 Pumping System Assessment Tool
BMES-02 Air Master + Diagnostic Tool
BMES-03 Motor Master + Diagnostic Tool
BMES-04 Steam System Assessment Tool
BMES-07 Fan system Assessment Tool
BMES-09 Chilled Water System Assessment Tool

The UAW Skilled Trades working in conjunction with the GM/WFG Energy & Utilities Services Group (EUSG) and the GM/WFG Facilities Management Group (FM) can jointly pursue the effort to optimize the operating efficiencies of these major systems that are found in GM facilities.

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