OHERC003

12/17/97

Ontario Hydro, In-House Efficiency Program
Emission Reduction Credits
From Circulating Water Pump Operation

Strategy Summary

The Ontario Hydro 1994 report on Sustainable Energy Development (SED) identified Ontario Hydro as being the largest user of electrical power in the province. The corporate "In-House efficiency group was formed in the summer of 1994 to improve internal energy efficiency. Reducing internal consumption made good business, economic and environmental sense. It reduced costs, made more energy available for sale, reduced emissions and increased profitability.

Since 1994 four In-House projects involving the operation of Circulating Cooling Water Pumps (CCW) and Service Water Open Pumps (SWO) have saved 185,822 MWh to December 31, 1996. The projects were undertaken at Lakeview, Nanticoke, Bruce B and Lambton Generating Stations. The emission reductions associated with these projects are:

- 432 Mg of NO_2
- 755 Mg of SO_2
- 153,437 Mg of CO_2

Demonstration of Surplus

The Ontario Environmental Protection Act (Ontario Hydro Regulation 355) limits Ontario Hydro's annual system emissions of SO_2 and NO_x to 215,000 Mg, and limits system emissions of SO_2 to 175,000 Mg. Emission calculations are audited by Angus Environmental Limited semi annually.

In 1995, Ontario Hydro submitted a NOx management plan to the Ontario Minister of Environment and Energy (MOEE) which reconfirmed an earlier voluntary commitment to reduce NO_x[1] emissions to less than 38,000 Mg by the year 2000. The voluntary CO_2 commitment is that emissions will be stabilized at 1990 levels of 26 Tg by the year 2000.

The surplus nature of these reductions is based on two components. First, the baseline data is below any NO_x emission limit regulating the operation of Ontario Hydro. Second, there are no external requirements for Ontario Hydro to reduce NO_x , SO_2 or CO_2 emissions below the baseline. In the year 2000, Ontario Hydro's voluntary commitments to reduce NO_x and CO_2 become effective. Reductions made prior to implementation of the voluntary limit are therefore early and surplus.

General[2]

Establishing Credits

To receive credit for energy savings, the initiator of the project (referred to as the Business Unit) is responsible for collecting and maintaining sufficient documentation to support the claim. All supporting documentation is assembled and forwarded to the Business Unit's Energy Services advisor. The advisor verifies the savings and inputs the savings into the Results Tracking System (RTS). All projects must have a minimal duration of ten years to be eligible under the program.

The responsibility for accuracy and completeness of projects in the RTS rests jointly with the Business Unit, the energy advisor and the corporate In-House department.

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[1] NOx emissions are reported to the MOE as NO (nitric oxide) equivalent. For credit calculations the NO is converted to NO_2 (nitrogen dioxide).

[2] General information is available in the "In-House Energy Efficiency, 1994, 1995, 1996 Result Tracking Guidelines"

Quality Assurance Reviews

Once a project has been entered into the RTS, a "Quality Assurance Review" is initiated to minimize potential errors in the database. The objectives of the review are to:

- ensure the claim is supported by adequate documentation
- review at least one project from each facility that has claimed a project for any current year.
- ensure that the RTS guidelines are understood by the Business Units and field staff.

Verification

Since the inception of the In-House program, the firm of Ernst and Young has performed yearly audits of the projects in the RTS. All major projects that create savings in excess of 5 GWh are audited along with random audit of smaller projects.

For each audit, Ernst and Young contacts the Business Unit representative to verify the load impact and the permanence of the project. The auditors will also ensure that all of the checks listed above in the Quality Assurance review are satisfied.

In the event that the results cannot be verified at this level, the energy advisor may be brought in to provide additional information, to clarify information or supply the supplementary documentation.

If an audited project is found to be over reported, all non-audited project savings for that business unit will be rolled back the same percentage as the over reported project.

Circulating Cooling Water Pumps

Circulating Cooling Water (CCW) pumps are used to condense the steam exiting the low pressure turbine. The pumps, provide water at low pressure, high volume to each unit's condenser. The MWh consumption of the CW pump motors range from 0.30 to 0.67 MWh per hour. There are two means of reducing the power consumption attributed to CCW pump operation.

At the Lakeview and Nanticoke generating station the energy is saved by ensuring that all CCW pumps are shut down when the associated unit is not operating. Prior to revising the operating instructions the pumps were left in service on a continual basis. There was a requirement to run CCW pumps to provide dilution of chlorination that was being used to control zebra mussels. The Operating Instructions were changed following extensive testing that determined all CCW could be shut down without exceeding outfall chlorine limits at the facility. Previous instructions had outlined the requirement to keep CCW pumps in service to avoid exceeding chlorine concentration at the station outfall.

The Lambton, and Bruce B Generating Stations, strategy differs in that all of the savings occur while the units are generating during the non summer months. By making use of the cooler lake temperatures one CCW pump per unit can be taken out of service and still maintain the performance of the units condenser. The cooler the lake water, less flow across the condenser is required.

Table 1 depicts the energy savings achieved at Lakeview GS. The hours not required are based on actual running hour data from the station "Operating Results and Ledgers"

Table 1

Circulating Water and Service Water Pump Energy Savings

Equipment	MWh per hour Consumption	Hours Not Required	MWh Savings
1A CW Pump	0.67	7074.2	4,029
1B CW Pump	0.67	7074.2	4,029
2A CW Pump	0.67	7218.7	4,111
2B CW Pump	0.67	7218.7	4,111
5A CW Pump	0.3	6881.6	1,755
5B CW Pump	0.3	6881.6	1,755
6A CW Pump	0.3	7124.2	1,817
6B CW Pump	0.3	7124.2	1,817

It is understood that there will be times when CW pumps are required to run when the associated unit is not generating. The main reason being to control the temperature of the discharge water back into the lake. Ontario Hydro has plant specific limits for the maximum temperature between the inlet and outlets of the plant.

Service Water Open Pumps

Included in this protocol is the revised operation of the Service Water Open pumps (SWO) at Lakeview GS. Each Lakeview unit has a 35 psi SWO pump which takes suction from the CCW system. Each pump motor is rated at 200 horsepower with an hours electrical consumption of 0.15 MW. These pumps pressurize a main header which runs the length of the plant, supplying cooling water to auxiliary equipment. The Service Water header is required to be pressurized at all times as equipment requires cooling even though the unit is not generating. i.e. transformers, compressors, etc.

Testing on flow and pressure requirements have shown that these four pumps may be taken out of service and replaced with three Standby SWO Pumps, (each Standby SWO pump motor is rated at 200 horsepower with and hourly electrical consumption of 0.15 MW). These pumps differ from the main SWO Pumps in that they take suction directly from the lake on do not require a CW pump running to provide suction. The net annual benefit being 871 MWh.

Going from four to three pump operation has had an effect on SWO header pressures. By ensuring isolation on auxiliary systems not requiring water while the units are not generating, sufficient pressure can be maintained.

The Standby SWO pumps differ in chlorination requirements, in that they are injected at closer intervals with less concentration. This alleviated the need to run CCW pumps for dilution at the station outfall channel.

It is the change in SWO pump operation that has allowed the CCW pumps to be shut down when the units are not generating.

Appendix 1 is a breakdown by year of the energy savings realized by the modified CCW and SW pump operation.

Emission Reductions

The MWh saved does not necessarily mean that an emission reduction has occurred. A correlation is made between the MWh saved by season to Fossil generation. Whenever a Fossil unit is required on line for generation, it is termed “Coal on Margin”. In the case of Lambton’s revised CCW operation, 100% of the electrical savings are while coal is on margin. Table 2 shows the percentage “Coal on Margin “ for 1994, 1995, and 1996

Table 2

Percent Coal on Margin

	Ozone Season		Non Ozone Season	
	Peak	Off Peak	Peak	Off Peak
1994	81%	49%	94%	77%
1995	100%	71%	94%	86%
1996	100%	86%	95%	83%

Table 3 contains the historic average emission rates per megawatt.

Table 3

Emission Rates by Year

Year	NO_2 (kg/MWh)	SO_2 (kg/MWh)	CO_2 (kg/MWh)
1994	2.73	5.96	880
1995	2.44	4.17	870
1996	2.66	4.17	890

Table 4 shows the electrical savings and the associated emission reduction credits attributed to the three CW/SW projects. The energy savings from appendix one have been factored by the seasonal/peak/off peak percentage "Coal on Margin" from table 3 and by the emission rates from Table 4.

Table 4

Emission Reduction Credits

Ozone Season						
	MWh on Peak	MWh off Peak	Total MWh	Mg NO2	Mg SO2	Mg CO2
1994	8,202	3,544	11,747	32.1	70.0	13,367
1995	18,095	6,424	24,519	59.8	102.3	21,332
1996	18,095	7,781	25,876	68.8	107.9	23,030
Non Ozone Season						
1994	13,625	5,581	19,206	52.4	114.5	19,133
1995	29,328	12,949	42,277	103.1	178.2	37,780
1996	30,308	13,282	43,590	115.9	181.7	38,795
Total	119,577	50,046	169,623	432	755	153,437
Total Emission Reductions						
1994				84.5	184.5	32,500
1995				162.9	280.5	59,112
1996				184.7	289.6	61,825

The total NO_2 emission reductions during the ozone season are: 166 Mg
The total NO_2 emission reductions during the non ozone season are: 273 Mg

Criteria for Evaluation

Criterion	Pros	Cons
Real	• Revised Operating Instructions are in place. • Savings are tracked through equipment running hours	
Quantifiable	• Metering has been used to verify nameplate data. • Balance of savings are based on sound engineering calculations. • All CCW projects have been audited by Ernst and Young.	• Yearly savings will vary with capacity factors.
Surplus	• The In-House program was/is voluntary. • No regulations exist for reducing internal energy consumption. • Ontario Hydro is within all regulatory and voluntary emission limits.	
Verifiable	• Equipment specific running hour data can be used in an audit procedure.	
Duration	• A major component of all In-House projects is that there be a 10 year minimal duration.	• Savings depend on the diligence of operating staff to maintain.

Supporting Documentation

The four projects are supported by the Results Tracking System. The RTS identification numbers are as follows:

- Lakeview #4099630
- Lambton #4401031
- Nanticoke #4099620
- Bruce B #4099656

Future Emission Reduction Credits

As the Circulating Water Pump and Service Water Open Pump Operations referred to in this protocol are permanent, the continuing savings will be used to claim Emission Reduction Credits in the years following December 31, 1996. The future credits claimed will include any additional related projects input into the results tracking system.