RETROFIT PROGRAM

Sample Measurement & Verification (M&V) Plan
Variable Frequency Drive Applied to Pump Motor

Disclaimer:

- This sample report is an example for projects installing Variable Frequency Drives on pump motors as an energy conservation measure.
- The report was developed with reference to the Save on Energy Project Measurement and Verification Procedures.
- It is suitable for use as a sample or reference M&V Plan for projects requiring 'Basic' M&V through the Save on Energy Retrofit program.
- However, approval of the M&V Report is at the discretion of the Save on Energy Technical Reviewer. Details need to be revised for the specifics of your project.
- This sample M&V Report is provided for guidance purposes only.
- The savings estimation methodology, input assumptions or other considerations may vary depending on your actual baseline and project details.

1.0 Project Information

Application Identifier

Building Name: Waterside Community Water Treatment Plant

Building Address: 123 Main St, Pleasantville ON, A1B 2C3

Building Type: Water Treatment Plant

Local Distribution Company (LDC): City Hydro Inc.

Application #: 123,456

This M&V Plan is provided for: Mr. John Doe

Company Name: Corporation of the City of Pleasantville

Company Address: 123 Main St, Pleasantville ON

Contact Information: john@watersidecc.ca

This M&V Plan is provided by: Ms. Jane Smith, CMVP

Company Name: Energy Consulting Inc.

Company Address: 123 Elm Drive, Pleasantville ON, D4E 5F6

Contact Information: jane@energyconsulting.ca

Facility Overview

- Waterside Water Treatment Plant is a conventional water treatment plant constructed in the late 1960s.
- The Waterside Water Treatment Plan provides full potable watering servicing to the City of Pleasantville and its surrounding community.
- The Intake pump (pump 6) draws raw water from the wells and delivers the water to the Waterside Water Treatment Plant.
- The operating hours of the plant is 8,760 hours/year and the total annual energy consumption of pump 6 is 754,978 kWh.

Table 1: Pump 6 Specification

Pump	Model	Type	HP	Motor RPM	Quantity	Operating Hours
Pump 6	Peerless 14 HH	Vertical Turbine	200	1,775	1	8,760 hr/year

Estimated Start Date: January 3, 2017 (date for illustration purposes only)

Estimated Completion Date: April 30, 2017 (date for illustration purposes only)

Note to Reader: dates are for illustration purposes only.

2.0 Energy Conservation Measures (ECM) Intent

- The measure involved the replacement of the current intake pump (pump 6) with a new efficient pump.
- The new pump is marginally more efficient than the existing pump, but will be controlled using a VFD.
- The majority of savings are achieved from use of the VFD and related controls.
- The previous motor and pump worked by delivering a constant volume with a throttling valve.
- With the VFD installed, the pump in now controlled based on operational needs.
- The operational needs are monitored in real time and there is a historical record of operations that can be used to predict future need.
- Operator records of throttle valve position have also been considered.

3.0 Baseline: Period, Energy, and Conditions

This section documents the baseline operating conditions and energy data that was collected within the measurement boundary, which are summarized below:

Baseline Calculation

Operating Period

- Metered data consists of one day of power data (kW) on a 15 minute interval of the current 200 HP pump.
- As confirmed by applicant, one day of data is representative of year round operation of the current pump.
- The basic M&V plan does not require actual site measurements.
- However, the data was readily available on site and hence used in the analysis.

Baseline Demand (kW)

1. Averaging the kW data during the peak demand periods
2. i.e. 1pm to 7 pm from Monday to Friday as per the section 3 of Project Measurement & Verification Procedures, April 2016

Baseline Consumption (kWh)

1. Summed metering data provided to obtain energy consumption (kWh) for metering period.
2. Metering period of 1 day was extrapolated for 365 days to obtain energy consumption (kWh) per year.
3. The daily water demand for the pump is consistent through out the year which is confirmed by the applicant.

Note: Refer to Excel Calculation Sheet for calculation detail(s).

4.0 Reporting: Period, Energy, and Conditions

This section documents the reporting operating conditions and energy data that was collected within the measurement boundary, which are summarized below:

Reporting Calculation:

Operating Period:

- Metered data consisted of one day of power data (kW) on a 15 minute interval of the retrofit pump with VFD.
- As confirmed by applicant, one day of data is representative of year round operation of the new pump (with VFD).
- The basic M&V plan does not require actual site measurements.

- However, the data was readily available on site and hence used in the analysis.

Method:

- The following steps will be taken to analyse the post-retrofit data.
- Unlike the plan which used the pump's performance curve to estimate savings, the report utilized actual metered data to determine the energy savings.

Retrofit Demand (kW)

- Averaging the kW data during the peak demand periods
- i.e. 1pm to 7 pm from Monday to Friday as per the section 3 of Project Measurement & Verification Procedures, April 2016.

Retrofit Energy Consumption (kWh)

- Summed metering data provided to obtain energy consumption (kWh) for metering period.
- Metering period of 1 day was extrapolated for 365 days to obtain energy consumption (kWh) per year.
- The daily water demand for the pump is consistent through out the year which is confirmed by the applicant.

Note: Refer to Excel Calculation Sheet for calculation detail(s).

5.0 Basis for Adjustment

- Monthly production data for 2015, 2016, and 2017, including average raw water flowrate(s) was compiled.
- Based on the flowrate(s) provided, it is reasonable to assume that both baseline and retrofit conditions are comparable and there will be no need for adjustment.

6.0 Analysis Procedure

This section outlines the steps taken to determine the actual demand and energy consumption

Actual Demand (kW) and Energy Consumption (kWh) Calculation

Electricity consumption after implementation of the measure is calculated using the following equation:

Figure 1: Calculation for Electricity Savings and Peak Demand Savings

The electricity savings and peak demand savings are calculated using the following equations:

$$E_{Savings} = E_{Baseline} - E_{Retrofit}$$

$$P_{Savings} = P_{Tot,Baseline} - P_{Tot,Post-Retrofit}$$

Where:

- $E_{Savings}$ is the annualized electricity savings (kWh) estimate.
- $E_{Baselline}$ is the electricity consumption (kWh) before the measure is implemented.
- $E_{Retrofit}$ is the actual electricity consumption (kWh) after the measure is implemented.
- $P_{Savings}$ is the peak demand savings (kW) estimate
- $P_{Tot, Baseline}$ is the base case average power of the existing pump during peak demand period
- $P_{Tot, Post-Retrofit}$ is the post-retrofit average power of the new pump (with VFD) during peak demand period.

Since the facility is in operation throughout the peak demand period (weekdays from 1 PM to 7 PM during the months of June, July and August) and the water treatment plant does not exhibit any seasonality, the peak demand savings are expected to be the same as the average demand savings.

Application of the above savings estimation algorithm results in an annualized electricity savings of 182,837 kWh and peak demand savings of 25 kW.

The retrofit project saved 182,837 kWh.

The incentive amount is calculated at $15,438.22 based on the 10% capping from the estimated incentive amount of $14,034.75 in the pre-project phase.

7.0 Cost Savings

Anticipated cost savings are estimated to be $23,769 per year because of reduced electricity consumption (at a rate of $0.13/kWh).

8.0 Facility Operating Staff Input

Facility operating staff provided feedback for this M&V report including details regarding operating condition(s) and more conservative estimates regarding potential O&M savings resulting from the pump retrofit.