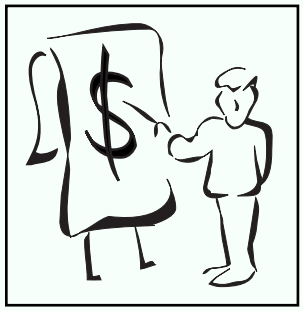

Section 8
Monitoring and Verification

Templates

All templates in this guide are available in text and PDF format on the accompanying CD ROM or on the Knowledge Network at http://kn.fcm.ca.

Planning Checklists

Monitoring and Verification planning early in the project planning process is essential as the project itself becomes defined. Baseline definitions need to be done before retrofits are implemented, and the methods and costs of savings verification need to be understood and defined especially in the energy performance contract, if that is the project implementation option being used.

The following checklists are provided as guidance for Monitoring and Verification planning through the Feasibility Study and Project Implementation stages of the MBR process.

Checklist for Monitoring and Verification Approach (Preliminary Feasibility Study)

- ❑ Project site and measures are reasonably defined.
- ❑ What savings will be claimed? (Energy, interactive effects, O&M, rate change, etc.)
- ❑ Monitoring and Verification approach (Option A, B, C or D) is defined for each measure.
- ❑ Baseline equipment and conditions.
- ❑ Plan for defining existing equipment (inventory and performance) is described.
- ❑ Plan for defining space conditions (foot-candles, temps, etc.) is described.
- ❑ How and why any baseline adjustments will be made is discussed.
- ❑ Post-installation equipment and conditions.
- ❑ Plan for defining new equipment (inventory and performance) is described.
- ❑ Plan for defining space conditions (foot-candles, temps, etc.) is described.
- ❑ Annual verification and measurement activities are described.
- ❑ Who will conduct the Monitoring and Verification activities and prepare Monitoring and Verification analyzes and documentation is described.

Checklist for Monitoring and Verification Plan and Periodic Submittals (Detailed Feasibility Study)

- ❑ Project site and measures are defined.
- ❑ What savings will be claimed? (Energy, interactive effects, O&M, rate change, etc.)
- ❑ How will these ancillary savings be treated?
- ❑ Monitoring and Verification method(s) defined.
- ❑ Details of how calculations will be made are defined. All equations are shown.
- ❑ Provided information shows how collected data and assumptions are used.
- ❑ Energy pricing information and assumptions are defined (fixed cost, inflated per EIA, etc.).
- ❑ Baseline equipment and conditions.
- ❑ Existing equipment (inventory and performance) is defined.
- ❑ Space conditions (foot-candles, temps, etc.) are defined.
- ❑ Assumptions and stipulations – show supporting information or measurements.
- ❑ How and why any baseline adjustments will be made is discussed.
- ❑ Post-installation equipment and conditions.
- ❑ Plan for defining new equipment (inventory and performance) is described.
- ❑ Plan for defining new space conditions (foot-candles, temps, etc.) is described.
- ❑ Assumptions and stipulations – show supporting information or measurements to be taken.
- ❑ Metering equipment is specified.
- ❑ Schedule of metering, including duration and when it will occur, is defined.
- ❑ Who will provide equipment, establish and ensure its accuracy and perform calibration procedures, is described.
- ❑ How data from metering will be validated and reported, including formats, are defined.
- ❑ How electronic, formatted data, directly from a meter or data logger, will be provided.
- ❑ Any sampling that will be used, sample sizes, documentation on how sample sizes were selected, is defined.
- ❑ Annual verification and measurement activities are defined.
- ❑ Who will conduct the Monitoring and Verification activities and prepare Monitoring and Verification analyzes and documentation is defined.
- ❑ How quality assurance will be maintained and repeatability confirmed is defined.
- ❑ Reports are defined, including what they will contain and when they will be provided.
- ❑ Electronic formats and software programs to be used for reporting are defined.
- ❑ Initial and annual Monitoring and Verification costs for each measure (totals only).

Monitoring and Verification Planning Template

Source: ***Federal Energy Management Program (FEMP) Sample Measurement & Verification Plans****, Draft for Public Review, Prepared by Schiller Associates for Lawrence Berkley National Laboratory, January 25, 2001*

The following are section headings that are recommended for Monitoring and Verification plans for municipal energy management retrofit projects. Each section heading lists a description of the required information. Annotations are provided to illustrate by way of example the kind of information that is likely to be needed.

SECTION HEADINGS	DESCRIPTION
Project-level components	
Project Description	Project goals Building details – size, location, use, equipment, energy consumption characteristics ECMs – how they save energy, water or O & M costs Applicable EE or performance standards
Project Savings and Costs	Anticipated energy and cost savings for each ECM and in total Anticipated costs for Monitoring and Verification
Project Description: *The energy-efficiency project involves six measures including a lighting retrofit, HVAC system upgrades, pool heating system retrofit, operator training and occupant awareness campaign in a municipal recreation centre. The goal of the project is to reduce energy consumption by an estimated 12 per cent. Details are provided on the estimated contribution of each measure to the estimated total savings. The Monitoring and Verification process is estimated to cost approximately 3 per cent of the projected total savings.* *The savings determination is based on main electricity account #766A234-593, including demand, the auxiliary electricity account #766B122-601 serving the pool complex, and natural gas account #KHJR3333-597.*	
Responsibility Matrix	Important risks and their potential impact Responsibility for managing risks
Risk Management Responsibility: *Deregulation of the electrical utility sector is creating a risk of escalating and volatile electricity rates. The energy performance contract provides a mechanism for measuring performance in energy consumption terms and adjusting the project payback schedule to accommodate higher or lower energy unit costs.*	

SECTION HEADINGS	DESCRIPTION
Schedule	Schedule for ECM installation, Monitoring and Verification activities, reporting intervals, including: • Pre- and post-installation audits and inspections • Monitoring and analysis activities • Reporting milestones • Commissioning reports • Quarterly or annual Monitoring and Verification reports
Reports to be Prepared	Frequency, format, content of reports
Reports: *The municipality has authorized the contractor to receive energy use data directly from the electrical and gas utilities until the termination of the contract. The contractor will compute and report on energy consumption and savings on a monthly basis, with reports provided to physical plant staff, works department staff, and department management. Reporting will commence immediately after completion of installation, and continue until the termination of the contract.*	
Measure-level components	
Measure Description	Specific details about each ECM Savings to be claimed Vintage, condition, usage, operational and maintenance history of equipment to be replaced or modified Equipment standards
Monitoring and Verification Approach	IPMVP Option General description of approach Accuracy of Monitoring and Verification method Savings uncertainty and confidence level Factors most uncertain or difficult to quantify
Monitoring and Verification Approach: *Option C is to be used for savings determination because the total facility energy cost, as it is affected by the bundle of measures, is the focus of the project.*	
Assumptions	Baseline and post-installation assumptions that affect energy consumption (building occupancy schedules, equipment efficiencies, equipment operating strategies, load shapes, weather data, etc.) Energy price schedules, facility staff labour rates, etc.
Monitoring and Verification Activities: ***Baseline Period***	Who will do Monitoring and Verification activities List of activities before and after installation List of variables affecting energy consumption and how they will be quantified Equipment surveys: location, type, quantity, measured data, model numbers, etc. Critical baseline condition factors: comfort conditions, lighting intensities, temperature set points, etc.
Post-installation Period	List of variables affecting energy consumption, variance from baseline case, and how they will be quantified New equipment surveys Critical post-installation condition factors Activities to ensure equipment operating as intended

SECTION HEADINGS	DESCRIPTION
Baseline Conditions: *The baseline period is the 12 months immediately preceding the decision to proceed with the project. Documentation of this baseline period includes:* *A lighting level and system condition survey* *A summary of space temperatures and humidities during occupied and unoccupied periods* *A count of the number and size of all plug loads* *A record of the number of patron-days of use by facility sector* *The temperature set points of pool water and domestic hot water serving showers and lavatories* *The rate of water consumption in the pool, kitchen, lavatories, etc.* *Operating hours of the kitchen and cafeteria and the dollar value of food sales.*	
Baseline analysis: *Baseline energy data were analyzed using multiple linear regression techniques on monthly energy use and demand, against degree-day data published by Environment Canada, patron-day facility use data, and system operating hours. No significant correlation between electricity consumption and weather data was found for the pool complex, but there was a significant correlation between natural gas consumption and pool performance, and between electricity consumption and weather data for all other sectors of the centre.*	
Calculations and Adjustments	Equations, calculations and analysis procedures for baseline and post-installation consumption How performance models will be developed How energy savings will be calculated How adjustments will be made
Adjustments: *During the post-installation period, extra computer equipment was added to the Recreation Centre administrative office, partially replacing older computers. Nameplate data was used to calculate the net change in these loads, expressed in terms of kW demand, kWh consumption on a monthly basis. While it was estimated that there may be as much as a 50 per cent error in this estimate, the impact is small relative to the overall facility savings and it was agreed with the contractor to ignore these changes.*	
Metering Plan	Who will provide and maintain metering equipment Specifications of metering equipment, accuracy, calibration procedures How data will be collected, maintained and reported Accuracy and quality assurance procedures
Metering: *Since Option C was selected as the Monitoring and Verification approach, a "whole-building" assessment based on the service meters to the facility is being used. The contractor conducted spot measurements using metering equipment during the Feasibility Study.*	
Monitoring and Verification Budget	Time and material costs to implement Monitoring and Verification activities.