Building Performance Services: Guidelines and Program Test Progress Report

Kenneth J. Anderson, PE, CEM
Project Development Engineer
Northwest Energy Efficiency Alliance
Portland, OR

Mark Tuffo
Project Coordinator
Northwest Energy Efficiency Alliance
Portland, OR

Skip Schick
Principle
Schick Consulting
Portland, OR

ABSTRACT

This paper presents the progress of the Building Performance Services (BPS) program begun in July 2002 as a partnership between the Northwest Energy Efficiency Alliance (Alliance) and northwest regional electric utilities. This paper focuses on Phase One, the newly released Building Performance Services (BPS) Implementation Tool Kit. It also presents some progress on Phase Two, a program test with three electric utilities in Washington—Puget Sound Energy, Snohomish Public Utility District No. 1 and Seattle City Light. Phase Three will incorporate the experience of the program test and in early 2004, the BPS Program will be extended to all electric utilities in Oregon, Washington, Idaho and Montana. The BPS Implementation Tool Kit provides detailed guidelines for three levels of service designed to reduce the energy use of medium and large existing commercial buildings. Operations and Maintenance, Energy Tune-Up and Commissioning are expected to save about 5%, 10% or 15% of the building's operating cost respectively.

INTRODUCTION

Early in 2002, the Northwest Energy Efficiency Alliance (Alliance) developed a program for savings energy in medium and large existing commercial buildings. In August, 2002 the Building Performance Services (BPS) program was launched based on the idea that a uniform regional program for reducing energy use in existing commercial buildings would be less expensive and have more appeal to the commercial buildings market. Market research indicated that building owners and operators often manage buildings in multiple utility service areas. Since the O&M service and building commissioning firms also operate across utility and state boundaries, they would prefer to offer services under uniform guidelines. The Pacific Northwest region has more than 100 electric utilities and many of these utilities have little or no budget to develop energy efficiency services for existing commercial buildings.

Therefore, the Alliance developed a three phase BPS program to produce guidelines, data and a uniform program approach that all regional utilities can use as they see fit. Phase 1 of BPS is nearly complete with the publication of a draft Implementation Tool Kit. The Second Phase, a test of the BPS guidelines is now beginning with three of Washington's utilities in the region's most populated area—Puget Sound—Snohomish Public Utility District No. 1, Seattle City Light and Puget Sound Energy. Phase Three will take what is learned in the test, update the Tool Kit and then offer BPS to all utilities in the region.

BPS OVERVIEW

Building Performance Services (BPS) offers three levels of service to commercial building owners and operators who are serious about reducing their cost of operations. The BPS Implementation Tool Kit provides both a process and tools for utilities to use when implementing the program. It also has information and training materials to help private service providers scope a building's savings potential based on one of the three levels of service--Enhanced O&M, Energy Tune-up and Commissioning.

The long-term goal for the BPS program is to develop a market structure that successfully promotes and supports enhanced building operating performance. Long-term indicators of success include:

- Building owners and managers value, demand and expect better building operating performance
- Service contractors and in-house facility staff are capable of and deliver better building operating performance.

The premise behind BPS is that existing commercial building operating performance can be improved. Data suggest that energy savings from 5 – 15 percent are often available through enhanced O&M practices alone. While a number of services exist in the market place, the Alliance's "gap analysis" identified a need for tools that can help building owners choose services appropriate for their circumstances. Further, because the current market is fragmented and lacks common definitions for similar services, there is a need to simplify existing choices and to present these choices in a logical sequence.

Key market barriers identified through the Alliance's market research include:

- A lack of clear definition of products and services
- Lack of credible, trusted, qualified service providers, in part due to their historical focus on equipment sales
- Lack of tools to sort through the current building stock and prioritize which buildings are most likely to benefit and which are not
- Lack of clear process for identifying specific opportunities within a building and linking those to specified products
- Inability of service providers to capture the opportunities through current products and services, apart from a small niche market for retro-commissioning.
- Lack of connection between improved efficiency and the business objectives of the building decision makers.

UTILITY PROCESS

The BPS Implementation Tool Kit provides a uniform set of guidelines that local utilities may choose to use to improve a current program or to create a new program for existing commercial buildings. The process has two levels of decision making to help select buildings and owners that will benefit from BPS.

Screening

This process is best performed by the local utility as part of the BPS administrative cost. Screening identifies buildings that are using more energy than normal and it helps identify building owners who are willing to take action to reduce energy use. Screening can significantly reduce the overall program cost by improving the success rate. The two most important aspects of screening are determining if there are practical opportunities to improve building operating performance and assessing the interest and capability of the property owner and his staff in taking action. If a utility does not want to do its own screening, the Tool Kit provides PBS guidelines for private companies as well. Screening does not result in a recommended service path but it does provide good leads with a basic data set for follow-up during the scoping process.

Initial data collection and analysis to identify buildings with technical potential includes examining energy use intensities, fuel type, meter type, major energy consuming system and equipment types, building size and use. This information can be gathered from a variety of sources, and staged to avoid unnecessary data collection and analysis. Development of key metrics and benchmarks can provide a means for comparing buildings to identify the best candidates.

Assessment of the interest of the property owner, manager and facility staff can be handled through a phone conversation or a meeting. Interviews are used to evaluate ownership commitment, internal decision making practices, interest level and skills of facility staff, and investment criteria. The interviews can be accomplished through use of structured questions designed to assess customer interest and their ability to take action.

The skills needed to do the screening include: familiarity with commercial building types and systems; an understanding of how various loads contribute to a building's Energy Use Index (EUI); knowing how to apply benchmarking tools; the ability to extract information from energy accounting tools, utility bills or other sources; and the ability to conduct telephone or in person interviews.

The outcome of screening is a recommendation on whether or not to proceed with scoping. Screening provides the person doing the scoping with data for specific buildings along with an idea of how the energy use of the building compares to regional norms for the building type. The Implementation Tool Kit provides recommendations on how to present the data in a useable format, including scales, ratings, and threshold criteria.

Initial screening criteria include:

- Building size greater than 100,000 square feet
- Electric use greater than 1,000,000 kWh/year
- Relatively high EUI
- Building in a targeted business sector
- Building with known operational/energy problems
- Management highly receptive to BPS
- Owner with a history of efficiency investments.

Second screening can include:

- Owner has a good credit rating
- Building has a technical potential for energy savings
    1. High if demand profile inconsistent with operating hours
    2. High if EUI above business type benchmark, accounting for internal loads

3. High if seasonal profile inconsistent with business type
4. High if complex HVAC arrangement with digital controls.

Other factors may indicate that a particular building should be directed toward a utility retrofit program rather than BPS:

- Inefficient lighting
- Fully pneumatic control systems
- Major HVAC system components near end of life.

A key component of the BPS Implementation Tool Kit is a review Energy Accounting Tools. There is no longer a clear line between programs that simply compile and analyze data and those that collect real time data and actively manage energy use. Some longstanding programs are no longer well supported, or have been merged with building management software. The 10 energy accounting tools identified for BPS participants were selected based on availability and support. A key point is that none of the energy accounting tools will be of value unless there is someone designated to enter and evaluate the data. If there is no in-house expertise, this job may be outsourced.

Final screening criteria are associated with customer motivation and ability to take action. This could be an important exit point to avoid the age-old problem of energy audits that gather dust on forgotten shelves. The potential of a successful project is :

- High if the decision maker is excited about BPS, has clear cut decision-making authority and budget available
- High if there is interested and talented in-house staff
- High if the owner has a history of successful energy efficiency improvements
- High if the owner's team is willing and able to commit.

The last step of screening is to pass on the accumulated information to the scoping agent. This package can include:

- The Screening Summary Form
- The annotated copy of the Owner/Operator Screening Interview Guide
- Utility records
- Relevant meeting notes
- Other, if available
    1. 15 minute demand or other load shape information
    2. Previous energy efficiency reports
    3. Benchmarking output
    4. Energy accounting reports

Scoping

For high priority buildings, scoping identifies technical opportunities through an on-site review and combines these findings with the owner or operator's business objectives to recommend an appropriate course of action to improve the building's operating performance. To complete this work an Energy Services Activity Agreement, which is a contract between the owner and the BPS provider, outlines the requirements of both parties including the owner's O&M staff. Scoping must identify and cost the appropriate level of follow-on BPS activity—Enhanced O&M, Energy Tune-up, or full Commissioning. It is estimated that scoping should not require more than 10 weeks and the budget should be about $1,500 per building.

The scoping agent must develop a basic understanding of the building systems, the customer's expectations, the desired operating performance, any on-going problems already identified, existing operation and maintenance (O&M) practices and obvious training needs. By developing a broad understanding of the building, its systems and the staff capabilities, the appropriate level of effort and cost can be determined. Scoping must include the BPS service provider's estimate of cost for follow-on BPS services.

Scoping is a four-step process: development of a site-visit action plan; on-site review of the facility; a post visit analysis of the data; and a customer presentation of the results and recommendations. The first step is to develop a site visit action plan focusing on areas of major energy consumption within the building. The action plan provides direction to the scoping provider on areas of interest within the building. Development of an action plan consists of evaluating billing and other data provided by the screening process for the customer. Unusual usage, demand and other pertinent facts are noted and follow-up activities are included in the action plan for evaluation during the on-site visit.

The on-site review focuses on examining the areas and data needs as outlined in the action plan. It includes examining the building's as-built drawings and sequences of operations, reviewing general operations and maintenance practices, completing a cursory review of the systems and equipment, interviewing facility operations and maintenance

staff, and identifying and flagging potential problem areas within the facility.

The third step is the post visit data analysis. This step roughly quantifies overall potential savings of the flagged problems areas, and identifies the appropriate follow-on service activity. The intent is not to complete a detailed analysis for each of the problem areas identified, it is to identify and flag the areas within a facility that appears to be operating poorly based o a comparison of end-use energy consumption with benchmark data for the Pacific Northwest as provided in the Implementation Tool Kit. The identified problem areas may be very specific, such as poor economizer operation, or broadly characterized as the mechanical system operates 24 hours per day due to morning warm-up temperature issues.

The last step consists of the development of a site-specific plan to present to the building owner or manager for approval. The plan must consider not only the technical potential, but also the owner's objectives when recommending the BPS offering.

BPS OFFERINGS

There are three BPS offerings: Enhanced O&M Practices, Energy Tune-up, and Commissioning. Each successive service includes the previous services. It is currently estimated that Enhanced O&M can provide 5% energy savings; and the Energy Tune-Up, which includes the O&M, will provide about 10% savings. Commissioning (sometimes called retro-commissioning) includes both O&M and Tune-Up and together these three BPS offerings can save up to 15% of the building's total energy use.

While the cost of each BPS offering is dependent on many factors including building size and complexity, the Alliance completed early estimates of cost, savings and market penetration for a cost effectiveness analysis. As the BPS program progresses, an independent evaluation contractor will track the program process and help to re-evaluate the assumptions used for the cost effectiveness analysis.

Enhanced O&M Practices

The BPS O&M Practices are referred to as "enhanced" because they assume that existing O&M services are already available. However, it does not assume that basic O&M is completed properly and the first step for BPS O&M is to review existing O&M practices to identify opportunities for improvement.

The purpose of an Enhanced O&M Action Plan is to change existing O&M routines to incorporate new practices. This may include operations related actions to ensure the persistence of fixes made as a product of tune-up or commissioning service activities. O&M activities that can be routinely performed by in-house facility staff will be discussed with them to obtain their feedback and concurrence. O&M activities performed by outside contractors can be discussed to obtain feedback and to identify appropriate adjustments to service contracts.

Recommended management practices to be included in an Enhanced O&M Action Plan are:

- Revise or add preventive maintenance activities or new service contract provisions for affected equipment.
- Revise or add equipment-specific documentation of service and technical requirements including diagrams and drawings.
- Institute whole building energy tracking/benchmarking strategies
- Create a training plan and schedule for in-house staff needed to successfully implement the revised O&M practices
- Develop a time frame for moving forward, with six month and year after check-in points to review key actions.

The Implementation Tool Kit currently has detailed guidelines for the following enhanced O&M practices:

- Reviewing time-of-day schedules (HVAC and lighting) and control settings.
- Optimizing economizer operation
- Using extended surface area filters
- Timing pump impellers
- Cleaning cooling coils
- Treating water in closed systems for scale control
-
- Preventing drive belt alignment problems.

Additional practices will be added as the BPS program matures. Each enhanced O&M opportunity is described in the Tool Kit using the following out line:

Engineering Overview
Opportunity Description
Advantages and Disadvantages
Implementation
Recommend Preventative Maintenace
Costs & Annual Savings
Notes and Cautions
Resources

The early assumption for annual savings from the Enhanced O&M service is 1 kWh/year per square foot at a cost of $0.05 per square foot (SF). So for a 100,000 square foot building, savings are expected to be 100,000 kWh/year or $7,000 per year at $0.07 per kiloWatt-hour (kWh). Given that the service costs $5,000, this leads to a simple payback of less than a year for O&M service, not including additional costs for adjustments and repairs

Energy Tune-Up

The Tune-Up service identifies and implements operational changes that reduce building energy costs (gas and electricity). The goal is to produce as much energy savings as possible through operational changes that require relatively small investments and can be accomplished quickly. The Tune-Up service includes an examination of equipment and controls, discussions with building operators, and diagnostic testing including spot measurements and analysis of trend logs when necessary. Improvements may be implemented by the building owner, by vendors already under contract to the owner, or by members of the Tune-Up team. Preventative maintenance practices that are needed for the long-term maintenance of these improvements are also identified.

The Tune-up service addresses high priority problems in three groups: System/Plant Equipment, Air Side HVAC Equipment, and non-HVAC Equipment. The Implementation Tool Kit currently lists 26 problems that can be addressed by the Tune-up service.

1. Simultaneous heating/cooling
2. Equipment not shutting off as expected
3. Equipment not sequencing efficiently
4. Optimal start/stop sequence not working correctly
5. Excessive equipment cycling
6. Chilled Water temperature reset control not operating efficiently
7. Gas combustion controls not working efficiently
8. Cooling Tower Temp controller not working efficiently
9. Heating Hot Water Temp reset control not working efficiently
10. VAV box damper not operating correctly
11. VFD, inefficient operation – pumps
12. Supply Air Temperature reset control not operating efficiently
13. VFD, inefficient operation – fans
14. CO and CO2 ventilation controls not operating efficiently
15. Variable pitch control of vane axial fans not operating efficiently
16. Static Pressure reset controller not working efficiently
17. Environmental set points not optimized.
18. Heat recovery system malfunction
19. Sensors out of calibration
20. Economizer malfunction
21. Adjacent VAV boxes, Terminal Units or systems fighting each other
22. Damper not operating properly
23. Setback Thermostat not working properly
24. Valve not working properly
25. Automated lighting controls on operating as expected
26. Refrigeration head Pressure controller malfunction

These problems were identified in case studies that describe the problem, explain how it is detected, propose a fix, and suggest a method for verifying that the problem is solved. The Tool Kit also provides a guide for tune-up service providers including advice on what types of measurements are needed.

The Tune-Up service is expected to cost about $15,000 for an average building not including the cost of repairing the problems. The estimated energy savings are 10% of total building energy use or 2 kWh/SF-year for a 100,000 square foot all electric office that normally uses 20 kWh/SF-year. At $0.07/kWh the simple payback is about 1.1 years.

Commissioning

Commissioning, or retro-commissioning, is a rigorous and systematic investigation of a facility's systems and equipment to achieve optimal building performance according to the owner's operating or performance requirements and the needs of the current occupants. Given the time, effort and expense involved, use of a formal commissioning process is appropriate when chronic problems exist and the building owner recognizes the need to take significant action. Examples include buildings that may have unusually high energy costs, an

uncomfortable and/or unhealthy work environment, high maintenance bills and equipment that continually fails to reach life expectancy.

The Building Commissioning Association (BCA) considers specific attributes to be fundamental to effective building commissioning and requires that all members agree in writing to adhere to these attributes whenever they serve as a project's Commissioning Authority. Specifically:

1. The Commissioning Authority (CA) is an objective, independent advocate of the Owner. If the CA's firm has other project responsibilities, or is not under direct contract to the Owner, a conflict of interest exists. Wherever this occurs, the CA discloses, in writing, the nature of the conflict and the means by which the conflict shall be managed.
2. In addition to having good written and verbal communication skills, the CA has current engineering knowledge, and extensive and recent hands-on field experience regarding:
    - Building systems commissioning,
    - The physical principles of building systems performance and interaction,
    - Building systems start-up, balancing, testing and troubleshooting,
    - Operation and maintenance procedures, and
    - The building design and construction process

    The Commissioning process consists of the following four primary phases:
    - Planning
    - Investigation
    - Implementation
    - Hand Off

Each of the four phases and their sub-phases are listed below. Of the four phases, the planning phase involves the most input from management. When project planning is well thought out, success generally follows.

Planning Phase
- Developing and Communicating the Objectives
- Reviewing and Updating Building Documentation
- The Commissioning Plan
- The Scoping Meeting

Investigation Phase
- Performing a Site Assessment
- Developing the Master List of Deficiencies and Potential Improvements
- Developing Diagnostic Monitoring and Test Plans

- Implementing the Diagnostic Monitoring and Test Plans
- Interim Commissioning Report

Implementation Phase
- Implementing Improvements
- Retesting and Remonitoring

Project Hand-Off Phase
- Commissioning Final Report
- Enhanced O&M Action Plan
- Tracking Results
- Project Close-out Meeting

Commissioning includes both Enhanced O&M and Tune-up services as well as adding a structured testing and calibration of a building's energy using equipment. Commissioning is expected to cost about $25,000 on average and it is expected to save 15% of the buildings energy usage or about 3 kWh/SF-year. For a 100,000 square foot building, this translates to a simple payback of about 1.2 years.

BPS UTILITY TEST

In June 2003, the Alliance began a test of technical aspects of the services and associated support tools with three electric utilities in the Puget Sound area of Washington State. Puget Sound Energy, Snohomish Public Utility District No. 1 and Seattle City Light represent about 21% of the electrical sales in the Pacific Northwest (Washington, Idaho, Montana and Oregon).

These utilities will apply the screening process to select up to 15 commercial buildings and owner teams. The purpose of the BPS Test is to establish the value and appropriateness of the proposed business model, confirm building owner and operator interest, validate energy savings and other benefits, refine and improve the infrastructure, products, and services, and work with market actors to learn how best to integrate building performance products and services into their business activity. The BPS test is expected to take 3 to 5 months and should be completed by the end of 2003. The budet for the BPS test is about $500,000 with the Alliance contributing about 2/3 and the three utilities contributing 1/3. The building owner teams are

committing their time and they will cover the costs of adjustments and repairs.

BPS TEST EVALUATION

The BPS program is still in the test stage and as such no formal evaluation contractor has been selected to evaluate the overall program. However, Linda Dethman of Dethman & Associates in Seattle Washington will be doing a review of the utility test. Dethman will be looking into:

- the role of the sponsoring utilities and how they affect the project shape
- the role of the implementation tool kit and its audiences
- the motivation for the audience to use the toolkit, and how it will be used
- the purpose of the test and how well it is accomplished
- how test will affect the next phases of the BPS program
- how BPS relates to other Alliance commercial programs

BPS PILOT PROGRAM

The BPS Pilot program will begin after the completion of the BPS Test, probably early 2004. It is expected to be a three-year program with a budget of about $3 million. The program will be available to all medium and large buildings in the Pacific Northwest and it is hope that electric utilities will participate as co-sponsors providing about half of the cost. The Alliance pilot program has a goal of 175 buildings; and it is hoped that by 2010 about 330 buildings will have received one or more of the BPS services. If this goal is achieved, the region is expected to save about 46 million kWh per year by 2010.

REFERENCES

Retro-commissioning Handbook for Facility Managers, Prepared for the Oregon Office of Energy by Portland Energy Conservation Inc. (PECI), March 2001.

Energy Smart Operations—Low- and No-Cost Ways to Save Energy in Your Business, School or Agency, Fourth Edition, by Reid Hart, PE, Energy Management Services, Eugene Water and Electric Board, July 2002.

Energy Star Building Manual US Environmental Protection Agency, EPA-430-B-98-004F, June 1998. http://www.energystar.gov/ia/business/BUM.pdf

1996 HVAC Commissioning Process, ASHRAE, Atlanta, GA, 1996.

"Better Buildings Through Improved O&M – A Five Building Case Study," by Tudi Haasl, Karl Strum and Mark Arney, Proceedings of the Fourth national Conference on Building Commissioning, 1996.

Energy-Efficient Operation of Commercial buildings: Redefining the Energy Manager's Job, by Peter Herzog, McGraw-Hill, New York, NY, 1997.

"Measured Energy and Demand Impacts of Efficiency Tune-ups for Small Commercial Cooling Systems," M. Hewitt, D. Bohac, R. Landry, T. Dunsworth, S. Englander and G. Peterson, Proceeding of the ACEEE 1992 Summer Study on Energy Efficiency in Buildings, Page 3.131. ACEEE, Washington D.C. 1992.

Handbook of Facility Management, J. Piper, Pretnice Hall, Paramus, N.J. 1996.

Seattle City Light Operations and Resource Assessment (ORA) Service Handbook, SBW Consulting and Willis Energy Services, in-house document used of Seattle City Light, 1997.