

EXECUTIVE SUMMARY
HVAC Excellence Workshop:
"Delivery and Operations of High Performance Buildings"
Albuquerque, New Mexico, May 5 – 7, 2009

Objective. Since the last HVAC Excellence Workshop in Bellevue, Washington in June 2008, significant changes have occurred in national and Federal policies, including the passage of "The American Recovery and Reinvestment Act" (ARRA 2009, i.e., "Federal Stimulus Package"). The objective of this workshop was to explore means and methods through which HVAC Excellence will impact the delivery and operations of "high performance buildings" as defined by the current requirements.

Background. The U.S. General Services Administration (GSA) is dedicated to providing quality Federal facilities for our nation and improving the effectiveness of our Federal workforce by ensuring a quality work environment for them. The HVAC Excellence Program was created in 1998 as a tool to enhance GSA's portfolio of both new and renovation projects in response to evolving business practices and client expectations.

The HVAC Excellence Program has been consistently identified as an opportunity for GSA to increase tenant satisfaction while achieving energy efficiency and ease of operations and maintenance.

Responding to the anticipated changes required in ARRA 2009 and the Energy Independence and Security Act (EISA 2007) as an opportunity, the Office of Design and Construction Programs (ODCP) and the Office of Facilities Management and Service Programs (OFMS) jointly requested that The National Institute of Building Sciences (NIBS) facilitate a National HVAC Excellence Workshop to address the issues of: "Fostering integration between design of HVAC systems and operations and maintenance issues, focusing on the long term performance of our buildings which are to be modernized or renovated, as well as for new buildings that are to be designed and delivered, in accordance with these new Acts and policies."

Workshop Summary. The workshop was held in Albuquerque, New Mexico, from May 5 – 7, 2009. Participants included Regional Property Managers, HVAC Advocates, representatives from the Central Office and the Regions, and technical experts from the private sector, totaling over 75 attendees. Copies of the prepared presentations are available at <ftp://nibs.org>.

Vijay Gupta, P.E., Chief Mechanical Engineer, ODCP, worked closely with NIBS in all phases of workshop planning. In his opening remarks he welcomed the participants and speakers, including: Bill Harrison, ASHRAE President and Gordon Holness ASHRAE President-Elect: Charlie Hart, Director of Property Development Division (7D); William Holley, Chief Engineer in ODCP; Patrick Fee, Director of Building Operations and Maintenance, and Dr. Get Moy, Chairman of the NIBS High Performance Building Council, who presented the keynote address. Vijay welcomed the participation of property managers from all GSA regional offices and the opportunity for meaningful dialogue between HVAC Advocates and those with the responsibility of running and maintaining our buildings. Further, he stressed the importance of defining the requirements of high performance buildings and implementing lessons learned from post occupancy evaluations. He also stressed the importance of selecting the lead architects, production architects and consulting engineers who are sensitive and experienced with the local climatic and demographic conditions and are proximate to the project. Thirdly, he stressed that Property Management personnel must be involved with the planning and design process.

Earle Kennett, AIA, Vice President of NIBS, was introduced as Master of Ceremonies and Facilitator for the workshop.

Charlie Hart welcomed everyone to the workshop and the Region and shared highlights of the Albuquerque area, including the benefits and detriments to those who “drink the Albuquerque water.”

William Holley, Ph.D., P.E., provided a Central Office Perspective in two parts:

He described the current status of the ODCP reorganization in which a new ARRA Division will be headed by Assistant Commissioner William Guerin, and announced that a reorganized structure of Regional Coordinators is being established: Zone A for Regions 1,2, 3 and 11; Zone B for Regions 4,5, 6, and 7; and Zone C for Regions 8, 9, and 10. These Regional Coordinators will be responsible for all types of building projects: Federal Buildings, Courthouses, and LPOEs.

He also announced that ARRA 2009 authorized \$4.5 Billion for reconstruction of existing Federal buildings that are to comply with eight High Performance Green Buildings (HPGB) requirements listed in the ARRA 2009, and that a major emphasis will be on energy performance. In accordance with this emphasis, GSA has proposed

the following energy policy for Federal Offices, Courthouses and administration buildings for LPOEs:

The energy target will be the lower of two values: 30% below ASHRAE 90.1-2004 or 55% below the DOE/EAI Commercial Building Energy Consumption Survey (CBECS) values for the appropriate climate zone.

At this time, however, there is no clear guidance on who is accountable for achieving and maintaining energy consumption within these targets. He stated that "the only person who will be accountable is the owner."

Patrick Fee also presented the perspective of the Office of Facilities Management and Service Programs (OFMS) in two parts:

He announced that OFMS is being reorganized to be coordinated with the reorganization in ODCP. He stated that currently 95% of operations and maintenance are contracted out. This has presented a continuity problem due to the former administration policy that workers were terminated with the contract. He also stated that control technicians were not consistently contracted for projects. In accordance with current administration policies, OFMS is now working on resolutions to these problems. A major issue raised in his discussion is "where does OFMS fit in the design process?"

OFMS is currently focusing on three Core Programs:

The Energy Efficiency Program which includes chiller checks, replacements with premium efficiency motors, and lighting (non-ARRA) projects.

The Management Analysis Review System (MARS) program which is responsive to OMB 123 requirements (accountability).

POE projects from which to develop Facilities Criteria for the P100 and enhanced operations and maintenance.

William Harrison, P.E., President-of ASHRAE, provided an update on his presentation at last year's workshop. He emphasized that his participation in the HVAC Excellence Workshop last year in Bellevue, WA, influenced his work in carrying out his Presidential Theme this year: "*Maintain to Sustain: Delivering ASHRAE's Sustainability*"

Promise." He emphasized ASHRAE'S priorities, initiatives and challenges in being a global leader in education, certification, and advancement of sustainable design and operation. He announced that two new documents on maintenance and operations were now available: 1) ASHRAE Guideline 4-2008 – *Preparation of Operating and Maintenance Documentation for Building Systems*; and 2) the 2008 CIBSE Guide on *Maintenance Engineering and Management*.

Gordon Holness, P.E., President-elect of ASHRAE, discussed his Presidential Theme for next year: *"The Path to Net Zero Energy Buildings."* He defined Net Zero Energy Buildings as "Buildings which, on an annual basis, use no more energy than is provided by on-site renewable energy sources." He announced ASHRAE's energy goals that have been set for its Standards and Advanced Energy Design Guides (AEDGs). For example, the building energy goals, including plug loads, for 2020 are 24 kBtu/sf for Standard 90.1, 18 kBtu/sf for Standard 189.1, and zero kBtu/sf for AEDGs. He noted that the AEDGs have been developed for small buildings under 50,000 sf and that they are free as PDF files through ASHRAE. He also discussed ASHRAE's plans to focus on improving performance of existing buildings through its Standard 100 and its Guidelines on Commissioning and Retrocommissioning. In response to a question, Gordon answered that accountability for achieving these goals is not an inherent part of ASHRAE's Standards and Guidelines.

Get Moy, Ph.D., P.E., Chairman of the NIBS High Performance Building Council, presented the keynote address: *"Delivery and Operations of High Performance Buildings."* Several definitions of High Performance Buildings, including those in EPACT 2005 and EISA 2007 were cited. He emphasized that although there are many building codes and standards that specify minimum performance, "there is no single standard on High Performance Buildings." He also pointed out that it is not affordable to ask for high performance of all building attributes. He described the work that is now being done by the Council:

- Identify specific performance attributes that would be used to define a high performance building.
- Identify specific performance metrics and benchmarks for providing for performance goals.

- Catalogue existing industry standards and programs that are used to measure or validate the specific performance metrics including the identification of gaps and standards needed to measure and validate high performance buildings.
- Harmonize these standards.

The fundamental issue that remains to be addressed is “how to measure a high performance building”

Other highlights include:

* Two presentations highlighted different approaches to the evaluation of building performance. In the first, **Earle Kennett**, presented quantitative results from a set of Post-Occupancy Evaluations (POEs) conducted for four Federal Courthouses with the specific objective to learn lessons that would improve functionality, customer satisfaction, sustainability and resource performance in GSA buildings through development of appropriate criteria and requirements for Facilities Standards for the Public Building Service (PBS P100); initiation of improved processes through GSA; and improved integration of LEED™ certification within GSA design. In the second, **Dr. Spiro Pollalis**, Professor of Design, Technology and Management at Harvard Design School, presented six qualitative case studies of GSA facilities with the general objective to evaluate the effect of the Design Excellence Program on building performance. Although the approaches were different, common conclusions resulted:

The Design Excellence Program must extend past fancy envelopes and architectural complexity. Require integrated design practice and include property management and O/M input. Consider separate design contracts for design architects and mechanical engineers. Require post occupancy evaluation with the GSA stakeholders.

Study and disseminate performance, economics and suggested policy. Demonstrate compliance with P100 at all stages.
Prohibit modified building operation from design intent.

Go beyond LEED™ rating. Develop and require correlation between LEED™ and PBS P100. LEED™ certification to be based on verification after at least one year of occupancy.

* The importance of *Reliability Centered Maintenance* (RCM), in the development of maintenance programs for HVAC systems was presented by **Alan Pride**, who is a Principal at PMA Consulting and a Certified Maintenance and Reliability Professional (CMRP). He made the strong points that RCM, like commissioning, involves functional testing, should begin with the initial planning and design phases of the project, and should continue through operations.

* **Alan Edwards**, who is the Program Manager for the Solar/Renewable Energy Program for the Federal Prison Industries (FPI), also known as UNICOR, focused his presentation on *Photovoltaic Systems and Service Offerings* by FPI/UNICOR. This service can assist government agencies with meeting federal renewable energy mandates by providing an all-inclusive turnkey photovoltaic system for any federal agency. The major components of UNICOR's PV system and service offerings include design, supplies, construction and financing. Additional details regarding interagency agreements are provided in his posted presentation. **Alan** can be contacted at aedwards@central.unicor.gov.

* **Stuart L. Knoop**, FAIA, co-founder of Oudens Knoop Knoop + Sachs Architects, reported on a study he has recently completed for NIBS and GSA: *Evaluation of Standards and Performance of Green Products in Buildings*. This study was conducted after the results of the four POE studies indicated that the "green" product performance was not as expected (See the POEs on the reference website: Morse, Rogers, Arnold, and Simpson Federal Courthouses). Five types of green products were evaluated: paint, cleaning supplies, carpets, sealants, and millwork. They were evaluated for cost, maintainability, durability, and comparative performance to conventional products. General conclusions were:

Most "green" products are now under some forms of product standards.

Not all conventional products have equivalent "green" versions, including paints and sealants.

Most such products are becoming competitive in cost and performance, though not all.

Industry is rapidly adapting to the demand for "green" products, and technologies are improving.

* In his presentation on *High Performance Glazing*, **Stephen Selkowitz**, Ph.D., Head, Building Technologies Department, Lawrence Berkeley National Laboratory, showed that significant progress has been made with regard to minimizing heat transfer while maintaining the quality of daylight through glazing. He indicated that LBNL now has software tools available on their website with which to analyze the performance of various glazing. He also indicated that the California Energy Commission now has an Energy database of 3,000 – 4,000 buildings in the State.

* *Understanding Total Building Commissioning* was the topic of the presentation by **Edward Faircloth**, President of the Building Commissioning Association. He pointed out that many of the definitions of commissioning do not address the performance of all subsystems that comprise a building as a system, and emphasized that Total Building Commissioning goes beyond the definitions that are commonly employed by ASHRAE, USGBC, USDOE and others. He proposed that Total Building Commissioning “is a combination of several processes that complement each other to achieve a High Performance Facility. It is the verification and documentation that confirms that the building is functioning at the efficient level designed and ensures that the facility is documented so that future repairs can be accomplished that maintain this efficiency.” He also emphasized that the Total Building Commissioning process must begin early in the planning phase of the project, that clear commissioning criteria must be established, and that the criteria must be reviewed and approved by the entire design/construction/operations team and incorporated into bid documents.

* *Potential Design Problems with High Performance Buildings* was the focus of the presentation by **Michael Ragan**, P.E., Electrical Engineer ODCP. His case study of the 26 June 2006 flooding of the Department of Justice Building, Washington, DC, demonstrated precautions that must be taken to minimize major disruptions in operations of buildings that are now undergoing recovery and reinvestment, especially in areas that are susceptible to extraordinary events. In his lessons learned slides, he summarizes four administrative and ten technical actions that should be taken during design and construction to minimize the impact of these future extraordinary events:

Administrative:

Make sure Tenants have a COOP Site (**C**ontinuity **O**f **O**perational **P**lanning)

Act Quickly

Good Selection of Contractors Available

Good Contracting Officers

Technical:

Good Drawings & Prior Contract History

Equipment Standardization Helps

Remediate Quickly & Completely

NO Critical Equipment below Flood Plain

Sump Pumps connected to Emergency power

Gravity Drains mechanically closed

Have DUAL electrical Feeds where possible

Condensate Pumps (avoid or feed from mechanical electrical panels)

PLUG all internal and exterior entry conduits

GOOD electrical Instrumentation

* The issue of *Integrated Design – Making it Happen* – was the subject of a presentation by **Stuart L. Knoop**, FAIA, and **James E. Woods**, Ph.D., P.E., Executive Director of the Building Diagnostics Research Institute, Inc. Although required in the PBS P100-2005, successful implementation of the process is difficult to achieve without a clear commitment from all stakeholders. The objective of this presentation was to provide an overview of the issues to be resolved, the roles and relationships of the integrated design team members, the technical and administrative processes that are required, and the future educational directions that are needed to “make it happen.”

* During the luncheon, a video was shown of a POE conducted approximately 10 years ago at the Bruce R. Thompson US Courthouse

in Reno, NV. Many of the lessons learned from that POE have been incorporated into the current PBS P100 and the US. Court Design Guide. However, some of the other lessons were not as well learned and have recurred in the current POEs.

* A Panel Discussion was then convened on the issue of *Lessons Learned from Post Occupancy Evaluations*. The Panel consisted of **Vijay Gupta, Spiro Pollalis, Stuart Knoop, Earle Kennett and Jim Woods**. **William Holley** served as Moderator. **Vijay** began the discussion with a history of POEs at GSA. They were begun in 1977 by the Office of Design and Construction in response to an artwork issue and continued at the rate of approximately two per year until 1998 (approximately 30 POEs). Occupant surveys were also conducted in approximately the last 20 of those POEs. After the Design Excellence Program was started in 1998, the POEs were discontinued; none were conducted by OCA after 2000. However, some web-based POEs were conducted by the Office of Applied Science. As reported by **Earle**, two POEs were conducted in 2007-2008 and two others were conducted in 2008-2009, with specific objectives to obtain lessons learned to improve the PBS P100, to improve design processes with GSA, and to improve integration of LEED™ certification with GSA design.

Spiro explained that the objectives of the Case Studies are somewhat different than POEs as the purposes for case studies, what should be measured, and the intended uses of the results are defined in more general terms.

As indicated by **Stuart, Jim and Vijay**, a common format has evolved from the four POEs that were conducted over the last three years:

Document accumulation and review was begun before the site visit and continued during and after the site visit.

A survey form was distributed to tenants and occupants of the facility, to be filled out and collected during the site visit.

Interviews were conducted with tenants, operations and maintenance personnel including subcontractors, and the project designers and contractors.

A walk-through of the facility was conducted during the site visit.

Document and data were reviewed from information accumulated.

Draft document was prepared by POE team members.

Lessons learned from the POEs are in terms of the results toward the stated objectives, and in terms of what can be done to improve usefulness of POEs in the future. Regarding the results, the POEs have provided a set of conclusions and recommendations that can be used to address each of the three objectives for which they were conducted.

Regarding the process, improvements can be made on the validity of the surveys and the independence of the interviews. Also, better documentation would be helpful to the POE team. A major lesson learned is to be as specific as possible with regards to the objectives of the POE, to communicate these objectives to all concerned, and to answer questions as directly as possible.

Based on the results of the Panel Discussion, it was concluded that GSA should form a policy to conduct POEs under the Office of Facilities Management and Services for each major project.

* A brief summary of the tour to Sandia Labs is posted on the reference website. Approximately 40 participants attended the tour.

Two sites were visited. The tour of the Distributed Energy Technologies Laboratory (DETL) was hosted by **Charley Hanley**, **Sigifredo Ganzalez**, and **Armando Fresquez**. The tour of the Photovoltaic Systems Evaluation Laboratory (PSEL) was hosted by **Michael Quintana**, **Jennifer Granata**, and **Daniel Riley**.

* **Paul Phillips** and **Bill Sgro** from LSI Industries, Inc., provided a visual demonstration and a presentation of the progress that is being made in *Crossover to LED Lighting*. This presentation clearly showed the advances that have been made in recent years in the lumen output and color rendition that can now be provided by LEDs. The cost-effectiveness of the LED systems currently seems to be limited to outside lighting, and specialty indoor lighting. The cost-effectiveness of LED compared to high-efficiency T-8 systems is not yet reasonable.

* The issue of *Integration and Operation of Building Automation/Control Systems* was addressed by **Ronald J. Zimmer**, CAE, President and CEO of the Continental Automated Building Association (CABA). The premise of his presentation was that buildings must be intelligent. The CABA definition is that an intelligent

building is: "A building and its infrastructure which provides the owner, operator and occupant with an environment which is flexible, effective, comfortable and secure through the use of integrated technological building systems, communications and controls." He acknowledged that current control platforms have "too many standards and protocols" but proposed another overlay platform he called "Open Building Information Exchange" (OBIX) that would receive information from other platforms that are not interoperable such as Lontalk, and others. The Regional question that prompted this session was again raised: is there a truly open protocol? Unfortunately, the question remained unanswered as did a question regarding a sample specification for an open protocol.

* **J. Michael Galway**, P.E., Principal with the Integral Group, focused on a specific topic of "*Opportunities for Saving Energy in Existing Buildings.*" He emphasized that 80% of GSA buildings are more than 45 years old and offer more opportunities for energy savings than the construction of new facilities. He noted that existing buildings impose some limitations for energy savings (e.g., building orientation, massing, percentage glazing), but cautioned that these limitations do not justify relaxing criteria for occupant health, safety and welfare, system performance, or energy and economic performance. He focused on three sets of opportunities to reduce energy consumption in existing buildings:

Improvements in Operations and Maintenance procedures;

Enhancements through designs for alternations (i.e., refurbishment, major renovation, and restoration);

Improvements in quality control through construction.

In his presentation, he developed a strong foundation to indicate that a minimum energy target for cooling of an existing building is likely to not be less than 33,600 Btu/GSF plus ventilation, envelope and equipment loads. From this foundation, he showed why the value for the energy utilization index (EUI) in existing GSA buildings is expected to be approximately 61,000 Btu/GSF (i.e., this value correlates well with the median values in the historic data archived by the GSA Energy Center). He closed his presentation with several examples of means and methods that offer opportunities for reducing the EUI of a building to below this value.

* In his presentation on *Energy Analysis for New and Existing Buildings*, **Ken Schram**, P.E., Associate Partner, Syska Hennessy Group, Inc., provides an overview of the myriad of issues and assumptions that must be addressed, and the associated uncertainties defined, if the computer result is to be reliable. A major issue discussed in his presentation is that an “energy analysis is not a prediction of the future [utility bills]” but is used to make comparisons between candidate systems. As discussed by the participants, GSA expects the “energy simulation” to also provide reasonably accurate estimates of the energy that should be expected to be consumed by the delivered building, as measured by the utility meters. Moreover, for existing buildings, the energy analysis and energy simulation models, should be calibrated to the known energy use records before they are used to evaluate energy saving alternatives. These issues deserve additional attention in future workshops.

* **Kevin Powell**, Director of Research, Office of Organizational Resources, GSA, introduced his new project: *Smart Buildings*. In this presentation, he offered an operational definition of a Smart Buildings as one “which integrates major building systems on a common network.” However, this definition does not define what a Smart Building is; it only defines what it does. Kevin indicated that he will be leading an effort this year “by articulating a Smart Building plan and forming a consensus with tenants and industry, GSA will be in a position to move forward with confidence and clarity towards a more energy efficient future.”

* A General Discussion followed in which topics for future HVAC Excellence Workshops were identified. A consensus opinion was that other professional societies and organizations should be invited to participate in the future Workshops, including: SMACNA, TABB, NEBB, AABC, CIAQ, BOMA, ASCE, NSPE, and AHRI. It was also agreed that these Workshops should continue to focus on the issues that affect interactions between those involved in the planning, design, and operational phases of building performance. **William Holley** closed the Workshop by thanking all those who participated and encouraging them to plan to attend the next HVAC Excellence Workshop.