

Sheet Metal and Air Conditioning  
Contractors' National Association, Inc.  
Bidding Green Task Force

**HVAC CONTRACTOR'S  
GUIDE TO BIDDING GREEN  
BUILDING PROJECTS**

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# **HVAC CONTRACTOR'S GUIDE TO BIDDING GREEN BUILDING PROJECTS**

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**SHEET METAL AND AIR CONDITIONING CONTRACTORS'  
NATIONAL ASSOCIATION, INC.**

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# FOREWORD

Concern about the environment and the future of our planet has become the focal point of everyday conversation, political debate, and media coverage in the United States. Where this debate has been focused on the industrial, manufacturing, and transportation sectors in the past, energy usage and its associated environmental impacts have become a major issue in the building industry. Commercial and residential buildings consume about 40 percent of the energy used in the United States according to the U.S. Department of Energy's Energy Information Agency and both the amount of energy used in buildings and its percentage of the total United States' annual energy usage is expected to increase. As a result, more and more building owners including all levels of government are demanding high performance buildings and are seeking third-party certification to verify and publicly recognize their commitment to the environment. All of this has put the construction industry in a reactive mode as it adjusts to the new technical and administrative requirements that are being imposed by the project contract documents and third-party certification requirements. However, green construction doesn't have to be just another contract requirement that the HVAC contracting firm must address. Instead, the HVAC contracting firm can embrace the principles of green construction and become proactive which is not only good for the environment but also good for business.

The purpose of this guide is to introduce HVAC contracting firm personnel to green building construction and provide information that will help the HVAC contracting firm successfully bid green building construction projects. The HVAC system is a key element in any green building project because it has a significant impact on the building's energy usage and operating costs as well as the well being of the building occupants on a daily basis. When bidding a green building project the HVAC contracting firm needs to be aware of the additional requirements that it will be subject to during design if the project is design build, construction, commissioning, closeout, and the warranty period.

To make this guide easy to use, it has been formatted in a question and answer format and divided into the following twelve sections and one appendix.

- Section 1.0 introduces green buildings and construction.
- Section 2.0 discusses what it means to be a green HVAC contracting firm and things that the HVAC contracting firm and its employees can do to help the environment both in the home office and on the jobsite.
- Section 3.0 covers green building requirements with the focus being on the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED<sup>TM</sup>) Green Building Rating Systems.
- Section 4.0 discusses training for the HVAC contracting firm's office and field employees in green building construction and rating systems.
- Section 5.0 covers bidding green building construction and what the HVAC contracting firm needs to be aware of in bidding green building projects.

- Section 6.0 discusses how a green design-build building project differs from a conventional design-bid-build project and things that the HVAC contracting firm should consider when submitting a proposal for a green design-build building project.
- Section 7.0 covers what the HVAC contracting firm should look for in a green contract.
- Section 8.0 introduces green building product requirements
- Section 9.0 discusses possible impacts that a green building project will have on the HVAC contracting firm's fabrication shop operation.
- Section 10.0 covers the impact of green building requirements on field operations and productivity.
- Section 11.0 introduces green building commissioning and closeout requirements that the HVAC contracting firm may encounter on green building projects.
- Section 12.0 discusses how the HVAC contracting firm can market its green building expertise.

An appendix provides a listing of references used in preparing this guide as well as additional information that might be useful to the HVAC contracting firm entering the green building construction market.

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## **1.0 WHAT IS GREEN CONSTRUCTION AND HOW DOES IT AFFECT ME?**

### **1.1 What is a green building?**

The term “green building” is defined in ASTM Standard E2114-06a as *a building that provides the specified building performance requirements while minimizing disturbance to and improving the functioning of local, regional, and global ecosystems both during and after its construction and specified service life.* [ASTM E2114] This definition illustrates the importance of the construction process in making a building green. During construction it is about minimizing the environmental impact of the construction process on the environment through procurement, site layout and use, energy use, waste management, and construction operations.

The HVAC contractor’s impact on building sustainability doesn’t stop at substantial completion. A project delivery system that involves the HVAC contractor in the design process or provides leeway in the contract documents may allow the contractor to use materials and installation techniques based on its expertise and experience that will minimize operation and maintenance (O&M) costs over the life of the building, enhance the satisfaction and productivity of building occupants, and provide a more durable facility.

### **1.2 What’s In A Name?**

A variety of terms are used today to refer to green buildings and green building construction. Some of these terms include “sustainable buildings” and “high-performance buildings.” Throughout this guide, the term green building refers to any building that is designed and constructed with the objective of minimizing its impact on the environment throughout its life cycle which includes construction, operation, and deconstruction.

### **1.3 Aren’t green buildings just about design?**

The idea that green buildings are all about design is a common misconception that can cost you money if you are awarded a subcontract on a green building project. Green designs have to be implemented in the field and documented. Green design can impact your procurement, sequencing and scheduling of work, installation productivity, checkout and startup of equipment, and warranty period. The HVAC contractor needs to understand green building requirements and address them in its bid.

### **1.4 What do HVAC systems have to do with green buildings?**

HVAC systems are a key element of any green building from both an energy and indoor air quality (IAQ) standpoint. For example, the Energy & Atmosphere (EA) Category in the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED™) Green Building Rating System For New Construction & Major Renovations (LEED-NC) requires that the building comply with ASHRAE/IESNA Standard 90.1-2004 entitled *Energy Standard for Buildings Except Low-Rise Residential Buildings*. This prerequisite impacts the selection and layout of HVAC equipment, system, and control requirements. Further, there are credits in the EA Category for improving energy performance beyond the ASHRAE/IESNA Standard 90.1

minimum. EA Category Credit 4 addresses refrigerant management and EA Category Credit 5 requires the continuous metering of HVAC and other building equipment and system operation.

Indoor air quality is also addressed in LEED-NC both during construction and following occupancy under the Indoor Environmental Quality (EQ) Category. The prerequisite for this category requires that buildings comply with ASHRAE standard 62.1 which is entitled *Ventilation for Acceptable Indoor Air Quality*. During construction, this category includes credits for having a construction IAQ management plan and implementing this plan to provide a healthy environment for workers and any people occupying the building during construction. The construction IAQ management plan references Chapter 3 of SMACNA's *IAQ Guidelines For Occupied Buildings Under Construction*. Further, credits are available in the EQ category for post-occupancy outdoor air delivery monitoring and increased ventilation. Potentially, LEED™ requirements could impact the building's HVAC control system because EQ Category Credit 6.2 covers the controllability of HVAC systems for thermal comfort.

### **1.5 Is green construction a new market or a passing fad?**

All indications are that high-performance buildings are not a passing fad and that green buildings are moving into the mainstream of the U.S. construction industry. Increasingly, private and public owners are requiring that their building projects be designed and constructed in an environmentally responsible manner and that their buildings be recognized as green buildings through third-party rating systems and evaluation. This is in response to rising public concern about the environment and increasing energy costs. HVAC contractors that are knowledgeable in this area will have a competitive advantage over HVAC contractors that are not. Additionally, federal agencies and state and local governments are beginning to require that both public and private buildings under their jurisdiction be either certified or certifiable as green buildings using either their criteria or outside third-party criteria.

## **2.0 CAN MY FIRM BE GREEN WITHOUT HAVING A GREEN PROJECT?**

### **2.1 Can my firm be proactive about the environment?**

Constructing a building requires the involvement of a number of different entities. The decision to build green or not is far removed from the HVAC contracting firm's involvement in a traditional competitively bid plan and specification project. The owner typically makes this decision during the early planning stages of the project and then the design team implements this decision during the design process. By the time the construction team including the HVAC contracting firm gets involved, building green is often viewed as another contract requirement that needs to be addressed during the building construction and commissioning process.

There is a common perception that a green building project is more expensive than conventional construction and this is true when the project design includes energy efficient equipment and systems. However, if you isolate the construction process from the design and view green construction as planning and managing a construction project in accordance with the contract documents in order to minimize the impact of the construction process on the environment the HVAC contracting firm is put in a proactive position with regard to the environment. The HVAC contracting firm bids the work in accordance with the contract documents as it always has being mindful that selection will probably be based on price. Then in planning and managing the HVAC work, the project team looks for opportunities to conserve energy and resources that do not adversely impact its project budget and may even reduce costs and increase productivity.

### **2.2 Are there advantages to being green?**

Improved productivity and reduced costs at the jobsite as well as reduced home office overhead costs provide tangible benefits of going green that the HVAC contracting firm can measure. However, there may be a number of other benefits of being green that are more difficult to quantify but may benefit the HVAC contracting firm. For one, by focusing on green construction everyday the HVAC contracting firm's personnel will become more knowledgeable about the possibilities and when an actual green construction project comes along they will have a better understanding of the actual work and costs involved and be a more effective construction team member. Similarly, a commitment to being green both in the office and field will appeal to many of the HVAC contracting firm's employees and enlisting their help in this initiative will build camaraderie and commitment to the firm. Finally, the HVAC contracting firm's service and construction customers are becoming increasingly environmentally conscious and are looking for the same commitment in the firms they work with.

The building commissioning process is addressed in Section 11.0 in detail. However, the HVAC contracting firm can benefit from implementing a unilateral commissioning process more detailed than the equipment and system inspection and startup process required by manufacturers and the contract documents on a conventional building project. HVAC system commissioning should be a standard operating procedure for the HVAC contracting firm on conventional building projects as it is on green and high-performance building projects where HVAC system commissioning is typically required.

Where specific commissioning requirements are not included in the contract documents or where commissioning is required but no specific procedures or outcomes specified, SMACNA's *HVAC Systems Commissioning Manual (Commissioning Manual)* provides commissioning procedures, tests, and documentation that the HVAC contracting firm can use as the basis for its own commissioning program or submit as a formal commissioning plan for approval if required. SMACNA's *Commissioning Manual* includes the following three levels of HVAC commissioning that the HVAC contractor can choose from in formulating its commissioning plan for a particular project:

- Level 1: Basic Commissioning
- Level 2: Comprehensive Commissioning
- Level 3: Critical systems Commissioning

In addition, the *Commissioning Manual* also includes a chapter on recommissioning for existing HVAC systems. The *Commissioning Manual* is intended to be a quality assurance tool for the HVAC contracting firm and may not meet all of the requirements of the green building rating system used on a project.

### **2.3 Should building commissioning be part of my quality assurance program?**

A detailed HVAC system commissioning plan should be a part of the HVAC contracting firm's documented quality assurance (QA) program. Like QA, HVAC commissioning is proactive about ensuring that the installed HVAC system meets the owner's requirements as expressed in the contract documents. Quality control (QC) is reactive and on conventional building projects involves the inspection of the HVAC system by the owner and design team which results in a punchlist of deficiencies that need to be corrected by the HVAC contracting firm. Building commissioning is a proactive process that attempts to identify and correct problems throughout the installation process. Building commissioning like QA increases customer satisfaction and employee morale as well as reduces nonconforming work and the cost of correcting nonconforming work at the end of the project. In addition, building commissioning reduces warranty work and call backs during the HVAC contracting firm's warranty period. Commissioning also involves the owner's operating personnel and provides an excellent opportunity to introduce the owner to the HVAC contracting firm and its service personnel and capabilities.

### **2.4 Is green the same as lean?**

Lean construction is all about removing waste from the HVAC contracting firm's business and construction processes in order to make it more efficient. Green construction is also focused on removing waste from the construction process and adds an environmental dimension to lean construction. When procuring materials and equipment, the HVAC contracting firm can work with suppliers to better package and bundle materials that could both reduce waste and improve productivity. Similarly, off-site prefabrication of materials can reduce waste at the jobsite and improve productivity. When expendables such as sealants and adhesives

are purchased, low-emitting materials could be substituted for traditional materials improving the working environment and productivity.

### **3.0 WHAT GREEN BUILDING REQUIREMENTS WILL AFFECT MY BUSINESS?**

#### **3.1 What are green building rating systems and why do they exist?**

The purpose of a green rating system is to provide an objective standard for certifying that a building is environmentally friendly or “green.” As a result of the public’s growing concern about the environment and energy consumption there is a growing movement among both public and private building owners to have their buildings certified as “green” by an objective third-party rating system. In addition, many federal, state, and local governments and governmental agencies are beginning to require that their buildings as well as private buildings under their jurisdiction either be certified or certifiable using a third-party green building rating system.

Although the foundation for green building certification is laid during the design process, the design intent must be implemented throughout construction process. The HVAC contracting firm needs to be aware of the green building rating system’s requirements because they can impact material and equipment procurement, as construction requirements and costs, and commissioning and closeout. These impacts include not only direct construction costs but also project overhead due to the additional documentation, owner training, and post-occupancy requirements that may be required. In addition, understanding the requirements of the green building rating system being used on a project will allow the HVAC contracting firm to effectively analyze and value engineer the project within those requirements for the owner.

#### **3.2 What green rating system will I most likely encounter?**

There are a number of green building rating systems that are in use or being developed. These systems are being developed and promulgated at the international, national, and local levels. All of these rating systems are similar in the green building criteria they address but they can be very different in their intent, criteria, emphasis, implementation, and in other important ways. The HVAC contracting firm needs to be aware of the specific requirements included in the green building rating system being used on a project prior to bidding the project.

In the United States, the most often encountered green building rating system in commercial and institutional construction is the U.S. Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED™) Green Building Rating System. The USGBC is an industry organization whose membership is made up of all parts of the construction industry including owners, designers, and contractors. The USGBC promotes the construction of environmentally friendly, high-performance buildings through its sponsorship of the LEED™ Green Building Rating System.

Since this rating system is currently the most commonly used in the United States and either similar to or the basis for many other systems being used by federal, state, and local governments, the USGBC’s LEED™ Green Building Rating Systems will be referenced throughout this guide. The HVAC contractor should note, however, that the green building market is an emerging market and universal standards and rating systems for green buildings do

not exist. The HVAC contracting firm needs to keep abreast of changes in this market and the rating systems being used in the industry and by its customers.

A competing green building rating system that is currently being introduced into the United States is the Green Globes™ certification by The Green Building Initiative (GBI). Green Globes™ has its origins in the Building Research Establishment Assessment Method (BREEAM) that was developed in the United Kingdom as a voluntary green building rating system. BREEAM was subsequently adopted by the Canadian Standards Association (CSA) and published as BREEAM Canada for Existing buildings in 1996. BREEAM Canada is administered by ECD Energy and Environment, Ltd. that developed a full Web-based version of the rating system that was licensed by GBI in 2005. GBI adapted Green Globes™ for use in the United States using U.S. codes, standards, and units. One of the unique aspects of Green Globes™ is that it uses a fully web-based self-assessment system in addition to providing on-site third party verification and certification based on the self-assessment. Additional information about GBI and Green Globes™ can be obtained as follows:

The Green Building Initiative  
 2104 SE Morrison  
 Portland, Oregon 97214  
 Telephone: (877) 424-4241  
 Telefax: (503) 961-8991  
 e-mail: info@thegbi.org  
 Website: [www.thegbi.org](http://www.thegbi.org)

### **3.3 How does LEED™ certification work?**

LEED™ certification of a building project starts with the owner’s decision that the project will be a “green” project. In the early stages of design, the owner registers its intent to have the building project LEED™ certified with the USGBC. The owner’s decision and registration must happen early in the design process because the decision to have a building LEED™ certified will drive many fundamental decisions throughout the design process including site selection.

LEED™ certification is based on the ability of the owner to demonstrate that the building project meets the requirements of the LEED™ green building rating system being used. The USGBC has developed or is in the process of developing a number of different rating systems for different project and building types including the following:

<b>LEED™ DESIGNATOR</b>	<b>RATING SYSTEM SCOPE</b>
LEED-NC	New Construction & Major Renovations
LEED-CS	Core & Shell
LEED-EB	Existing Buildings: Upgrades, Operations, & Maintenance

A current listing of LEED™ rating systems, their scope, current version, status, and requirements can be found on the USGBC website.

The *Green Building Rating System For New Construction & Major Renovations* (LEED-NC) is the most commonly encountered LEED™ rating system and will be used to illustrate green building requirements throughout this guide. As part of the LEED-NC registration process, the owner establishes goals for the project in the following six categories:

- Sustainable Site (SS)
- Water Efficiency (WE)
- Energy & Atmosphere (EA)
- Materials & Resources (MR)
- Indoor Environmental Quality (EQ)
- Innovation & Design Process (ID)

Each of these categories includes mandatory requirements referred to as prerequisites as well as points referred to as credits for meeting criteria in excess of the category prerequisites. Table 1 summarizes the categories, points and prerequisites for Version 2.2 of LEED-NC which was issued in October 2005 by USGBC.

Throughout design and construction, the owner, designers, and contractors document how they are meeting both the category prerequisites and credits for points toward certification. Beyond fulfilling category prerequisites, the owner is free to determine what categories and credits within those categories that will be pursued to obtain certification. Not every credit within the LEED™ rating system needs to be addressed in the building design and construction. The number of credits earned by the project will, however, determine the level of LEED™ certification. Credits required to earn the various levels of LEED™ certification are as follows:

<b>CERTIFICATION LEVEL</b>	<b>POINTS REQUIRED</b>
Certified	26 – 32
Silver	33 – 38
Gold	39 – 51
Platinum	52 – 69

At the completion of the project, the owner submits an application to the USGBC for LEED™ certification which consists of the required project documentation to substantiate each prerequisite and credit claimed, other supporting documentation including a project narrative that includes at least three project highlights, and the application fee. Following receipt and review of the application, the USGBC issues its preliminary findings along with a request for any additional information that it needs to perform its final review. Within 30 days, the project team makes its final submittal to the USGBC which is followed by the USGBC’s final review and award of LEED™ certification to the project.

CREDIT		DESCRIPTION	LEED PTS
<b>SUSTAINABLE SITES</b>			
SS	P 1	Construction Activity Pollution Prevention	
SS	C 1	Site Selection	1
SS	C 2	Development Density & Community Connectivity	1
SS	C 3	Brownfield Redevelopment	1
SS	C 4.1	Alternative Transportation: Public Transportation Access	1
SS	C 4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	1
SS	C 4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	1
SS	C 4.4	Alternative Transportation: Parking Capacity	1
SS	C 5.1	Site Development: Protect Or Restore Habitat	1
SS	C 5.2	Site Development: Maximize Open Space	1
SS	C 6.1	Stormwater Design: Quantity Control	1
SS	C 6.2	Stormwater Design: Quality Control	1
SS	C 7.1	Heat Island Effect: Non-Roof	1
SS	C 7.2	Heat Island Effect: Roof	1
SS	C 8	Light Pollution Reduction	1
<b>WATER EFFICIENCY</b>			
WE	C 1.1	Water Efficient Landscaping: Reduce By 50 %	1
WE	C 1.2	Water Efficient Landscaping: No Potable Water Use Or No Irrigation	1
WE	C 2	Innovative Wastewater Technologies	1
WE	C 3.1	Water Use Reduction: 20% Reduction	1
WE	C 3.2	Water Use Reduction: 30% Reduction	1
<b>ENERGY &amp; ATMOSPHERE</b>			
EA	P 1	Fundamental Commissioning Of The Building & Energy Systems	
EA	P 2	Minimum Energy Performance	
EA	P 3	Fundamental Refrigerant Management	
EA	C 1	Optimize Energy Performance	1-10
EA	C 2	On-site Renewable Energy	1-3
EA	C 3	Enhanced Commissioning	1
EA	C 4	Enhanced Refrigerant Management	1
EA	C 5	Measurement & Verification	1
EA	C 6	Green Power	1

**TABLE 1**  
**LEED-NC PREREQUISITES & CREDITS**

**Table 1/LEED-NC Prerequisites & Credits (Continued)**

CREDIT		DESCRIPTION	LEED PTS
<b>MATERIALS &amp; RESOURCES</b>			
MR	P 1	Storage & Collection Of Recyclables	
MR	C 1.1	Building Reuse: Maintain 75% Of Existing Walls, Floors, & Roof	1
MR	C 1.2	Building Reuse: Maintain 95% Of Existing Walls, Floors, & Roof	1
MR	C 1.3	Building Reuse: Maintain 50% Of Interior Non-Structural Elements	1
MR	C 2.1	Construction Waste Management: Divert 50% From Disposal	1
MR	C 2.2	Construction Waste Management: Divert 75% From Disposal	1
MR	C 3.1	Material Reuse: 5%	1
MR	C 3.2	Material Reuse: 10%	1
MR	C 4.1	Recycled Content: 10% (Post-Consumer + ½ Pre-Consumer)	1
MR	C 4.2	Recycled Content: 20% (Post-Consumer + ½ Pre-Consumer)	1
MR	C 5.1	Regional Materials: 10% Extracted, Processed & Manufactured Regionally	1
MR	C 5.2	Regional Materials: 20% Extracted, Processed & Manufactured Regionally	1
MR	C 6	Rapidly Renewable Materials	1
MR	C 7	Certified Wood	1
<b>INDOOR ENVIRONMENTAL QUALITY</b>			
EQ	P 1	Minimum IAQ Performance	
EQ	P 2	Environmental Tobacco Smoke (ETS) Control	
EQ	C 1	Outdoor Air Delivery Monitoring	1
EQ	C 2	Increased Ventilation	1
EQ	C 3.1	Construction IAQ Management Plan: During Construction	1
EQ	C 3.2	Construction IAQ Management Plan: Before Occupancy	1
EQ	C 4.1	Low-Emitting Materials: Adhesives & Sealants	1
EQ	C 4.2	Low-Emitting Materials: Paints & Coatings	1
EQ	C 4.3	Low-Emitting Materials: Carpet Systems	1
EQ	C 4.4	Low-Emitting Materials: Composite Wood & Agrifiber Products	1
EQ	C 5	Indoor Chemical & Pollutant Source Control	1
EQ	C 6.1	Controllability Of Systems: Lighting	1
EQ	C 6.2	Controllability Of Systems: Thermal Comfort	1
EQ	C 7.1	Thermal Comfort: Design	1
EQ	C 7.2	Thermal Comfort: Verification	1
EQ	C 8.1	Daylight & Views: Daylight 75% Of Spaces	1
EQ	C 8.2	Daylight & Views: Daylight 90% Of Spaces	1
<b>INNOVATIVE DESIGN</b>			
ID	C 1.1	Innovation In Design	1
ID	C 1.2	Innovation In Design	1
ID	C 1.3	Innovation In Design	1
ID	C 1.4	Innovation In Design	1
ID	C 2	LEED Accredited Professional	1
<b>TOTAL POINTS POSSIBLE &amp; REQUIRED PROJECT POINTS</b>			<b>69</b>
<b>POINTS REQUIRED IN ADDITION TO REQUIRED PROJECT POINTS</b>			
<b>TOTAL PROJECT DESIGN POINTS REQUIRED</b>			

### **3.4 Where can I get copies of the LEED™ rating system?**

To assist the project team in meeting the requirements of the LEED™ rating system, the USGBC publishes the *LEED™ Reference Guide* and *LEED™ Letter Templates*. The *LEED™ Reference Guide* provides invaluable information about the intent of each prerequisite and credit, requirements and submittals required, design strategies, case studies, and other information. *LEED™ Letter Templates* help the construction team prepare the LEED™ certification application by providing electronic forms for documenting that prerequisite and credit performance requirements have been met. Both the LEED™ rating system and letter templates are available on the USGBC website and the reference guide can be purchased from the USGBC. The USGBC's contact information is as follows:

U.S. Green Building Council  
1800 Massachusetts Avenue NW  
Suite 300  
Washington, D.C. 20036  
Telephone: (202) 828-7422  
Telefax: 202-828-5110  
e-mail: [info@usgbc.org](mailto:info@usgbc.org)  
Website: [www.usgbc.org](http://www.usgbc.org)

### **3.5 What are some common green requirements that I need to be aware of?**

The following requirements are provided as examples of what you might encounter on a green building project. The purpose of these examples is to provide an idea of the type of requirements you might encounter as well as their potential impact on your work and costs. These examples are not intended to be inclusive and you need to review the bid documents for each project to determine specifically what green requirements you are responsible for and how they will impact your scope of work and bid price.

**Building Commissioning.** Prerequisite 1 for the Energy & Atmosphere (EA) category requires that the owner hire an independent commissioning authority to verify that the building systems are installed and operate as intended. The HVAC contracting firm needs to be aware of the commissioning requirements for the HVAC system that it installs. The contract specifications may require the HVAC contracting firm to prepare its own commissioning plan and submit it to the owner's commissioning authority for approval or it may require that the HVAC contracting firm commission the HVAC system in accordance with the procedures developed by the commissioning authority. If the commissioning authority's plan is not available at bid time or if the criteria for developing a commissioning plan are vague, then the HVAC contracting firm may be putting itself at risk. A more extensive commissioning plan than anticipated during bidding and negotiations could result in unanticipated costs and delayed completion for the HVAC contracting firm.

**Construction Waste Management.** Credit 2 of the Materials & Resources (MR) category addresses minimizing the amount of demolition and construction waste that is sent to a landfill by recycling that waste. A specific area on the construction site will be set up for recycling by the general contractor or construction manager and a percent goal based on weight or volume will be established in order to earn this credit. This means that the HVAC contracting firm will need to track its waste as well as move it to the project recycling area and sort it as required which could increase its costs. In addition, if the project involves HVAC demolition the HVAC contracting firm should determine who owns the scrap that is removed from the project before it submits a bid if it plans to retain the proceeds from salvaged materials and equipment.

**Construction IAQ Plan Required.** Credit 3.1 of the Indoor Environmental Quality (EQ) category requires the preparation and implementation of an indoor air quality (IAQ) plan to protect the HVAC system from contamination during construction and to provide a healthy environment for construction workers and occupants. To achieve the point toward certification under this credit, the IAQ plan must meet or exceed the requirements of Chapter 3 of SMACNA's *IAQ Guidelines For Occupied Buildings Under Construction*. Success in this area requires coordination and cooperation among the trades as well as the general contractor or construction manager. The HVAC contracting firm should carefully consider these requirements and how they will be met when submitting a bid or a proposal for a green building project.

**Ductwork & Air Handling Equipment Delivery & On-Site Storage.** As noted above, the construction IAQ plan must also address the protection of the HVAC system from contamination during construction. This includes protecting ductwork and other air handling equipment from contamination by dust and moisture prior to installation. This could restrict the HVAC contracting firm from delivering and storing ductwork on site in advance of installation as it often does. It may also require that ductwork and equipment be delivered with openings protected. Green building projects may require increased coordination with the HVAC contracting firm's fabrication shop and suppliers to allow just-in-time delivery of ductwork and air handling equipment to avoid storage on site and possible contamination.

**Use Of Solvent-Based Adhesives & Sealants.** Credit 4.1 of the Indoor Environmental Quality (EQ) category requires the use of adhesives and sealants that emit low-levels or volatile organic compounds (VOCs) to reduce indoor air contaminants both during construction and after occupancy. In order to achieve this credit, the HVAC contracting firm will be required to use sealants and adhesives that meet the VOC limits specified in the South Coast Air Quality Management District's (SCAQMD) Rule #1168 covering adhesives, sealants, and sealant primers.

It is critical that the HVAC contracting firm's field and warehouse personnel are aware of these requirements and that the use of any adhesives or sealants that do not meet the VOC requirements will result in the loss of a point toward certification for the entire project or require rework by the HVAC contracting firm. Also, the HVAC contracting firm needs guard against unauthorized purchases by field personnel of materials that don't meet the VOC requirements. This is an area that may require the HVAC contracting firm to have specific procedures to avoid inadvertently using the wrong product.

### **3.6 How will green requirements affect my cost of doing business?**

Prior to bidding or negotiating a contract on a project that is working toward LEED™ certification, the HVAC contractor needs to make sure that it knows and understands what the green requirements are for the project including the increased record keeping that may be required to document that the requirements have been met.

### **3.7 Are green building rating systems a passing fad?**

Currently, it appears that green building rating systems will continue to grow in popularity with both public and private building owners. Also, federal, state, and local governments seem increasingly interested in requiring that their buildings as well as the private buildings within their jurisdiction be certified or certifiable as a green building based on meeting the requirements of a green building rating system. In addition, the scope and requirements of these rating systems will also continue to expand to become more comprehensive in the building systems they address and more specific in the types of projects and buildings they cover.

#### **4.0 DO MY EMPLOYEES NEED ANY SPECIAL TRAINING OR CERTIFICATIONS TO WORK ON A GREEN PROJECT?**

##### **4.1 Why would my employees need any special training for green projects? Aren't we just going to install in accordance with plans and specifications?**

The HVAC contractor needs to understand green building requirements and its responsibilities for achieving those requirements. This includes not only project managers and estimators but also foremen and craftworkers in the field and in the shop. During bidding, it is very important that estimators know and understand each green building's project requirements. When these requirements impact the HVAC contractor's scope of work they need to be included in its bid price. Additionally, during construction it is very important that everyone understand the project's green requirements and responsibilities.

For example, if the HVAC contractor is involved in a renovation project that involves recycling materials such as ductwork or piping then it may be responsible for tracking the amount of material removed and recycled to help the project achieve its recycling goal. Similarly, if a sealant or adhesive is used indoors that does not meet the requirements for using low-emitting materials that meet specified volatile organic compound (VOC) concentration limits, the project could lose credit for this requirements or the HVAC contractor could be required to replace the material resulting in additional rework that will impact both schedule and costs.

##### **4.2 Will trained office and field personnel give me a competitive advantage on green building projects?**

Trained office and field personnel could give the HVAC contracting firm a competitive advantage in the green building market. As noted previously, the HVAC system is a key element in any green building project. Owners, general contractors, and construction managers that do green building projects understand the importance of having knowledgeable and experienced specialty contractors as part of the construction team.

To date, one of the biggest problems encountered by HVAC contracting firms on green building projects has been in not understanding the requirements and how those requirements can impact both direct construction costs and project overhead. Often, HVAC contracting firms have found themselves responsible for work required by the green building rating system that is not explicitly noted in the HVAC plans and specifications other than by reference to the green building rating system. Having knowledgeable office and field personnel will help the HVAC contracting firm avoid the mistake of overlooking green-related requirements when putting together its project bid and making on-the-job errors that could lead to costly rework..

#### **4.3 What training should my project managers and estimators have?**

Project managers and estimators should have an introduction to green buildings and green building construction. In addition, they should have training in the green building rating system being used so that they understand the equipment and system requirements as well as specific on-site issues of that rating system and their impact on the HVAC contracting firm's work. Without this training, the HVAC contracting firm may be exposing itself to risk on a green construction project.

#### **4.4 What is a LEED Accredited Professional (LEED AP) and why is this designation important?**

While not required, a LEED<sup>TM</sup> Accredited Professional can be a valuable asset to a HVAC contracting firm because of his or her knowledge of the process and requirements and the fact that many owners and prime contractors prefer subcontractors that have demonstrated knowledge and experience in green construction. Anyone can become a LEED<sup>TM</sup> Accredited Professional by taking the USGBC's examination that tests the candidate's knowledge of green construction, sustainable building design, and the LEED<sup>TM</sup> certification process. Having a LEED<sup>TM</sup> Accredited Professional on a building project is worth one extra point toward certification under Credit 2 of the Innovative Design (ID) Category.

Having one or more LEED<sup>TM</sup> Accredited Professionals on staff may be advantageous for the HVAC contracting firm both from an operational and marketing standpoint. Operationally, someone familiar with the LEED<sup>TM</sup> accreditation requirements and process would be valuable in value engineering, bid preparation, procurement, and project closeout where specific documentation is required. For instance, in the Materials & Resources (MR) Category there are prerequisites and credits for construction waste management and in the Indoor Environmental Quality (EQ) Category there are credits for indoor air quality during construction and the use of low-emitting adhesives and sealants which can impact the HVAC contracting firm's procurement and field operations. These and other LEED<sup>TM</sup> prerequisites and credits could impact the HVAC contracting firm's project costs and productivity. In addition, having a LEED<sup>TM</sup> Accredited Professional could also be a valuable marketing tool because it shows that the HVAC contracting firm is interested in sustainable construction and has personnel that understand LEED<sup>TM</sup> requirements and will be involved in the project.

#### **4.5 What training should my field personnel have and how should I provide it?**

Field personnel do not need the same type of training as project managers and estimators. Field personnel need to understand their new or additional responsibilities on a green building project as well as well as procedures such as the importance of recycling materials and how that process works at the project site. For the most part, the training of field personnel will be project specific and can be conducted at the jobsite just like safety toolbox talks.

#### **4.6 Where can I find green education and training opportunities for my employees?**

USGBC offers training in green building design and construction as well as seminars aimed at specific building types like laboratory buildings or particular green building processes such as building commissioning. These seminars are offered at the national level as well as locally if your city has a local USGBC chapter. In addition, USGBC also offers webinars so courses can be taken on line. In addition to the USGBC, there are a number of other professional societies, trade associations, professional training firms, and others offering seminars addressing green building design, construction, and operation. Some of the larger general contractors and construction managers have also developed green building courses for training their own personnel and they may provide these courses to specialty contractor personnel as well.

## **5.0 HOW DOES BIDDING DIFFER ON A GREEN BUILDING PROJECT?**

### **5.1 Where are the green requirements?**

A project's green requirements can be found just about anywhere in the bid documents. Ideally, the green requirements that specifically impact the HVAC systems will be incorporated into the applicable specification sections and drawings that comprise the HVAC contractor's scope of work. In addition, the green requirements that impact everyone on site such as construction waste management should be included in Division 01/General Requirements of the project specifications and pointed out by the prime contractor in its request for subcontractor quotations. However, green requirements are not always explicitly called out in the HVAC specifications and drawings or highlighted in the prime contractor's request for subcontractor quotations. In preparing a bid for a green building project, the HVAC contractor needs to be proactive and know what the green requirements are and what impact these requirements will have on its work.

### **5.2 If the green building requirements are not explicitly included in the HVAC contractor's scope of work, then where are they?**

Green building requirements can be incorporated into the owner's bid documents in a variety of ways. The green project requirements could be included in Division 01 and simply require that the building be certified or certifiable to a particular level using a specified third-party green building rating system. For example, the bid documents might require that the project be certified to the silver level using the LEED™ Green Building Rating System For New Construction & Major Renovations (LEED-NC). As discussed in Section 3.2, this would mean that the building would need to earn at least 33 out of the 69 possible points plus meet the requirements of category prerequisites. The owner could specify the criteria and the associated points that it has already met through design and the additional criteria that it expects to be met during construction to achieve the desired level of certification. Alternatively, the owner could leave part or all of the criteria needed to achieve the desired level of certification up to the prime contractor. In either case, the HVAC contractor needs to understand which LEED™ points are being targeted so that it can determine its responsibilities for achieving certification before submitting its bid because the green requirements will impact material and equipment costs, labor productivity, installation sequencing and scheduling, HVAC equipment and system startup and checkout, and project closeout requirements.

### **5.3 Are there other implicit green project requirements that I should watch for?**

More and more federal agencies and state and local governments are requiring that public and private buildings under their jurisdiction be either certified or certifiable as a green building based on specified criteria. Some municipalities have even adopted codes and enacted statutes requiring that buildings meet certain criteria. The HVAC contractor needs to be aware of these criteria because most specifications require that the installation meet applicable codes and local laws.

The designer may have addressed the green technical requirements in the design of the HVAC system and specification of equipment. If the HVAC contractor is not aware of the green building requirements imposed by a referenced code or local statute, it could fail to consider the requirements that impact installation and closeout in its quotation to the prime contractor and be required to perform the additional work.

#### **5.4 What should I do if green requirements are vague in the bid documents?**

As discussed above, when bidding a green building project the HVAC contracting firm needs to determine if there are green requirements that will impact its scope and performance of work and specifically what those requirements are. If the owner's bid documents are vague as to what specific green requirements the HVAC contractor needs to meet, then the prime contractor should either clarify the owner's requirements through a pre-bid request for clarification or develop its own plan that details how the owner's requirements will be met. In either case, the HVAC contractor must determine what its responsibilities are as a subcontractor so that it can bid the project. Additionally, the HVAC contractor needs to determine if there is any testing that needs to be performed or documentation that needs to be submitted in order to clarify that its green requirements have been met.

#### **5.5 Will I need more time for product research on a green building project?**

When bidding green building projects, the HVAC contracting firm needs to allow more time for product research than on conventional building projects. This is certainly true on the first few green projects that the HVAC contracting firm bids. As experience bidding and doing green projects increases, the time to research green building projects will decrease and become second nature. However, the HVAC contracting firm should always look for new products and sources because green building construction is an emerging market and new materials and equipment are being developed and brought to market every day.

#### **5.6 Aren't most of the additional costs on a green building project really project overhead?**

Not necessarily, although project overhead will probably be higher on a green building project. Green building projects require more meetings, submittals, and record keeping than conventional building projects. For example, the HVAC contractor is a key part of the commissioning process that usually requires regular commissioning progress meetings as well as commissioning planning, scheduling, and coordination meetings. In addition, equipment submittals on a green building project will usually be more extensive than on a comparable conventional building project and will include not only the usual product submittals but also equipment test reports and certification to specific green standards or requirements, manufacturer startup and checkout procedures, and operation and maintenance manuals. The HVAC contracting firm may also be required to keep more extensive records regarding the source and characteristics of installed materials and equipment, startup and checkout of equipment, correction of nonconforming work, among other things.

## **6.0 CAN A GREEN BUILDING PROJECT BE DESIGN BUILD?**

### **6.1 Does design build work for a green building project?**

Design build can be used successfully on a green building project just like it can on a conventional building project. However, the owner's design criteria on a design-build project need to incorporate the specific green building requirements that it wants to achieve. If the owner wants the building to be certified or certifiable as a green building using a third-party rating system then the owner needs to specify the rating system and the specific certification requirements it wants to meet. For example, if LEED-NC criteria is going to be used the owner needs to specify the level of certification it wants to achieve as well as the specific credits that it wants the design builder to achieve toward certification. Any additional points needed to achieve the desired level of certification needs to be identified and specified by the design builder as part of its request for proposal from specialty contractors so that the HVAC contracting firm will know what is required from all parties when putting together its proposal.

### **6.2 How does the design process differ on a green building project?**

On a green design-build project where the HVAC contracting firm is responsible for the HVAC system design, additional time needs to be allowed for completing the design. Also, it is more likely that the HVAC contracting firm will need to retain an outside design consultant on a green building project because of the need to perform and document energy modeling and simulations which can be very expensive and will need to be accounted for in its bid or proposal price. Additionally, more time needs to be allowed for collaboration and interaction between the HVAC designer and the architect and other designers on a green building project.

### **6.3 How will green design impact project costs and schedule?**

As discussed in the previous section, designing green buildings usually takes longer than conventional buildings which may impact the HVAC contracting firm's schedule. In addition to taking longer, green design is more involved and will require more manhours than a conventional HVAC system design. This will probably increase the cost of both in-house engineers and support personnel as well as outside design fees.

## **7. WHAT SHOULD I LOOK FOR IN A GREEN CONTRACT?**

### **7.1 Are there model green contracts?**

There are no model green owner-contractor or contractor-subcontractor agreements published by professional or trade associations at this time. However, there are a number of general contractors and construction managers that have developed their own subcontracts for use on green construction projects. These contracts are designed to ensure that the HVAC contracting firm is required to meet the green project requirements and follow the prime contractor's procedures even though they might not be explicitly specified in the HVAC contracting firm's plans and specifications. These requirements and procedures can include anything from construction waste management to commissioning meetings and documentation. Just like on a conventional project, the HVAC contracting firm and its attorney should carefully review the subcontract on a green building project along with all referenced documents that form a part of that contract prior to bidding the project.

### **7.2 What green criteria do I need to be aware of?**

It is very important that the HVAC contracting firm knows and understands the green criteria for any building project that it is bidding on. The green requirements can impact procurement, sequencing and scheduling of work, commissioning, and project closeout. It is not enough just to know that a project is a green project. The HVAC contractor also needs to know how his or her work will be impacted and where out-of-the-norm cross-trade cooperation and collaboration is required. The green requirements that the HVAC contractor may be responsible for may not be explicitly included in its plans and specifications.

### **7.3 What green contractual requirements do I need to be aware of?**

It is also important that the HVAC contracting firm know and understand the project's green contractual requirements. For example, the project may be required to be certified or certifiable to a certain LEED-NC level in Division 01/General Requirements of the specifications which may also require that the project receive the one point for meeting the Indoor Environmental Quality (EQ) Credit 1 which requires carbon dioxide (CO<sub>2</sub>) monitoring of densely populated mechanically-ventilated spaces and direct outdoor airflow measurements for non-densely mechanically-ventilated spaces. Even though these monitoring devices and their respective control wiring are not shown on the HVAC system drawings, the HVAC-contracting firm may still be required to provide them as part of its subcontract. As discussed in Section 4.3, having trained project managers and estimators who understand the green building rating system being used can help the HVAC contracting firm lower its risk by avoiding these types of pitfalls.

### **7.4 Is a clearly defined scope of work more important on a green project?**

A clearly defined scope of work is important on conventional building projects and critical on a green building project. The HVAC contracting firm needs to understand exactly what green requirements for which it will be responsible. As noted in the previous section, not all green building requirements may be detailed in the plans and specifications that the HVAC

contracting firm traditionally uses to bid a project. Instead, green requirements that the HVAC contracting firm and other subcontractors are bound to meet may be included in the Division 01 of the specifications which applies to all other specification sections, other documents referenced in the HVAC contracting firm's contract documents, or the flow-through clause in the HVAC contracting firm's contract which binds it to the applicable terms and conditions of the general contractor's or construction manager's contract with the owner. Other requirements that the HVAC contracting firm might be subject to could include the use of low-emitting sealants and adhesives, controlling and monitoring its construction waste, more extensive project documentation, among other things.

## **8.0 ARE THERE SPECIAL PRODUCTS THAT I NEED TO USE ON A GREEN BUILDING PROJECT?**

### **8.1 What are some typical material and equipment requirements on a green building project?**

Only building projects can be LEED™ certified. The USGBC does not certify building products for use on LEED™ projects. The focus of LEED™ prerequisites and credits is on building life-cycle performance and meeting specific goals that are aimed at improving the environment, reducing energy use, and increasing occupant comfort and productivity. In the LEED™ Green Building Rating System certain products can be instrumental in earning a point but no product will earn a point by itself no matter what the product manufacturer claims.

### **8.2 What about expendables like duct sealant, coatings, adhesives, cleaning fluids, and other similar materials?**

Indoor air quality (IAQ) can be improved during and after construction by using expendables such as duct sealant, coatings, adhesives, cleaning fluids, and other similar materials that give off minimal emissions of volatile organic compounds (VOCs). These products are often required to meet the following product standards for volatile organic compound (VOC) limits:

- Adhesives typically must meet the VOC limits of South Coast Air Quality Management District Rule No. 1168.
- Sealants typically must meet the Bay Area Air Quality Management District Regulation 8 Rule No. 5.
- Paints and coatings must meet VOC and chemical component limits of Green Seal requirements.

The HVAC contracting firm's field personnel must understand the importance of not using adhesives, sealants, paints, and coatings that don't meet the requirements specified in the project specifications or the third-party green building rating system being used. In addition, the HVAC contracting firm's purchasing and warehouse personnel must also understand these requirements so that the wrong material is not accidentally sent to the green jobsite.

## **9.0 DO GREEN REQUIREMENTS IMPACT MY FABRICATION SHOP OPERATIONS?**

### **9.1 Will green requirements impact my shop fabrication schedule?**

Green building requirements could impact the HVAC contracting firm's shop fabrication schedule because ductwork may not be allowed to be delivered and stored on the project site. The reason for this is to prevent the stored ductwork from being contaminated by dust, moisture, particulates, volatile organic compounds (VOCs), and airborne contaminants that can result from construction activities.

### **9.2 Do we need to get our materials somewhere special?**

LEED™ Material & Resources Category Credits 3, 4, and 5 address material reuse, material recycled content, and the use of regional materials, respectively. Materials used for HVAC components such as ductwork, are not allowed to be counted toward the project's material reuse, recycled content, or regional materials under LEED-NC.

However, looking beyond the LEED requirements for counting the use of regional materials toward building certification, obtaining HVAC materials equipment locally or regionally will help the environment. If HVAC materials and equipment can be shipped from a factory 30 or 300 miles away, rather than one 3,000 miles away, the sustainability of the project will be enhanced even though a LEED credit is not earned.

## **10.0 WILL GREEN REQUIREMENTS AFFECT FIELD PRODUCTIVITY?**

### **10.1 Are there sequencing and scheduling issues on green building projects that I should be aware of?**

There may be some unusual sequencing and scheduling differences on green building projects that could impact the HVAC contracting firm's work. For instance, on a conventional building project the HVAC contracting firm may be allowed to begin installing trunk and branch ductwork prior to building enclosure. On a green building project the HVAC contracting firm may not be allowed to begin installing ductwork until the building is fully enclosed to prevent contamination by dust, moisture, and other airborne contaminants. As a result, the HVAC contracting firm needs to thoroughly review the project specifications as well as the prime contractor's schedule to avoid any sequencing or scheduling issues on a green building project.

### **10.2 What about material deliveries and on-site storage requirements?**

Material deliveries and on-site storage requirements will be stricter on green building projects for air handling and distribution components and equipment than on most conventional building projects. Again, the concern is contamination during storage at the jobsite that could lead to indoor air quality problems during occupancy. As a result, delivery and storage of air handling and distribution components and equipment such as ductwork may be restricted to only what is needed for the following few days of work. In addition, when air handling and distribution components and equipment are stored on site they may be subject to very stringent storage requirements to protect them from contamination. For instance, ductwork sections, fittings, variable-air-volume (VAV) boxes and other air supply equipment may be required to be staged in a clean area away from other construction activities. Further, the ends of these air distribution components may also be required to be protected when workers are not physically present and working on that section of duct. Duct sections may also need to be stored on wood blocks to keep them off the floor or ground until installed.

### **10.3 What about indoor air quality (IAQ) during green building construction?**

Indoor air quality during construction is important to provide a clean and healthy environment for the construction workers and building occupants during construction as well as the building occupants after construction. The HVAC contracting firm's responsibility for indoor air quality during construction will vary from project to project. The HVAC contracting firm needs to be aware of construction IAQ requirements that will affect it during construction and the time, material, and extra manpower needed to meet these requirements must be included in its bid price. Also, there may be a construction IAQ management plan for the project and the HVAC contractor needs to be aware of this plan and the requirements that will impact the HVAC contracting firm's work.

Most construction IAQ management plans are based on the requirements of SMACNA's publication entitled *IAQ Guidelines For Occupied Buildings Under Construction*. Chapter 3 addresses control measures that include the protection of HVAC equipment from dust and other contaminants. These control measures include controlling the source of pollutants; interrupting

the pathway for pollutants through pressurization, depressurization, barriers, and other methods; good housekeeping at the construction site; and scheduling.

**10.4 In addition to the usual concerns and costs associated with the early startup of the HVAC system, are there other issues that need to be considered on a green building?**

Issues involved in the early startup of HVAC equipment to condition spaces during construction are addressed in the SMACNA position paper entitled *Early Start-Up Of Permanently Installed HVAC Systems*. For green building projects, early startup of the HVAC system to provide space conditioning during construction can result in additional costs and work for the HVAC contracting firm beyond the usual warranty concerns. For example, LEED-NC Indoor Environmental Quality (EQ) Category Credit 3.1 requires that filters with a minimum efficiency reporting value (MERV) of 8 be used to cover all return air grilles to prevent contamination of the air distribution system. In addition, the HVAC contracting firm will need to replace all HVAC filters and could be expected to clean the ductwork as well prior to occupancy. If at all possible, early startup of HVAC equipment and systems should be avoided on green building projects despite the precautions.

**10.5 How will waste stream management affect my field productivity and what am I responsible for?**

The impact of waste stream management on the HVAC contracting firm's field productivity will depend on the project. In general, the impact of waste stream management on field productivity should be minimal. However, if the site is poorly laid out by the prime contractor and recycle and disposal containers are not centrally located then moving waste materials could result in additional labor costs for the HVAC contracting firm. Conversely, if the waste management scheme is well defined in the contract it may provide the HVAC contracting firm with the opportunity to estimate a lower cost for waste management.

## **11.0 ARE THERE SPECIAL COMMISSIONING AND CLOSEOUT REQUIREMENTS ON A GREEN PROJECT?**

### **11.1 How does system commissioning differ on a green building project?**

System commissioning on a green building project is much more extensive than on most building projects. On a conventional building project commissioning involves inspecting the installed equipment to ensure that it has been installed properly, pre-startup preparation, any pre-startup testing required such as bumping motors to verify direction of rotation, and then startup. Once the HVAC equipment is operational, testing, adjusting, and balancing (TAB) is performed on the air and hydronic systems, and the control system is checked out. TAB and other required testing reports, equipment operation and maintenance (O&M) manuals, and other required documentation is submitted. All this is required on a green building project and more.

The purpose of HVAC commissioning on a green building is to ensure that the HVAC system operates and can be maintained in accordance with the owner's requirements. HVAC commissioning starts with verifying that each piece of equipment has been installed properly and then each piece of equipment is started up and checked out individually just like on a conventional building project. This is often referred to as prefunctional testing on a green building project.

Functional testing of the HVAC system begins after the prefunctional testing of each piece of equipment, TAB, and the control system is complete. Functional testing is then performed to ensure that individual system components work together as a system and respond as designed to changes in occupant requirements, internal and outside conditions, and the seasons as designed. In addition, functional testing tests building system interaction to ensure that systems work together as required to optimize building performance and occupant safety. An example of system interaction would be the interaction of the HVAC system with the fire alarm, elevator, and other building systems upon detection of smoke in the return air from a space.

### **11.2 Is testing, adjusting, and balancing (TAB) an important part of HVAC commissioning on a green building project?**

Testing, adjusting, and balancing HVAC air and hydronic systems is an important part of both conventional and green building projects. On a green building, TAB is part of the prefunctional testing and is performed after all the associated HVAC equipment has been started and tested and the control system has been checked out. TAB results are reviewed and any problems discovered are corrected before the functional testing of the HVAC system can begin.

### **11.3 Why is it important to have a commissioning plan?**

A commissioning plan on a green building project is important because first and foremost it is required. Additionally, it provides a roadmap for the commissioning process which often starts during the design phase of a green building project and completes during the warranty phase. The commissioning plan addresses both the technical and administrative requirements of the commissioning process. The technical requirements of the commissioning plan include specific testing and checkout procedures for individual pieces of equipment that include manufacturer requirements and are intended to demonstrate that the owner's operational requirements have been met by the HVAC system. The administrative portion of the commissioning plan identifies who is responsible for performing commissioning the various systems, the sequence and schedule for commissioning, and the required documentation. With planning and forethought, commissioning documents can serve the dual purpose of documenting the commissioning process and providing the paperwork required for LEED™ certification.

### **11.4 What if I am required to develop the commissioning plan?**

On small projects that don't have a commissioning authority and on larger projects where developing all or part of the HVAC commissioning plan is assigned to the HVAC contracting firm in the contract documents, you may be required to develop a commissioning plan. As a starting point, review the contract documents and discuss the objectives of the commissioning process with the commissioning authority, owner, and mechanical engineer to understand what is needed. To assist you in developing a commissioning plan, SMACNA publishes *HVAC Systems Commissioning Manual* which is intended to provide guidance on how an effective commissioning process should be planned and carried out. This manual provides information on three levels of commissioning, suggested commissioning processes and procedures, and sample commissioning checklists, forms, and reports that can be modified to fit your project.

### **11.5 Why does the project need an outside commissioning authority?**

An outside commissioning authority is often used on a green building project because it is a requirement for a number of reasons. First, green building commissioning involves not only the startup and check out of individual building systems but also testing their interaction and performance under a number of predetermined conditions. Designing and implementing a commissioning plan to verify system operation and interaction requires that the commissioning authority focus on the entire building as a system rather than as a group of independent standalone systems. Secondly, an outside commissioning authority can be more objective than someone involved directly in the design or installation of a particular building system. Lastly, the commissioning authority normally reports directly to the owner rather than the architect or prime contractor on the project. Having a commissioning authority that is an employee of a firm involved in the design or construction of the building could result in a perceived conflict of interest or loss of objectivity and make it difficult for the commissioning authority to do his or her job. LEED-NC requires an independent commissioning authority for green building projects 50,000 gross square feet and greater.

## **11.6 Are closeout activities different on a green building?**

As part of the commissioning process, the HVAC contractor will usually need to provide marked up or final record drawings of the HVAC system installation, documentation of testing performed and the results of testing, O&M manuals, equipment warranties, and other documentation just like on any conventional building project. The HVAC contractor may also need to plan, conduct, and document training the owner's operations personnel on the installed HVAC system. In addition, submission of other information and documentation of material and equipment characteristics may be required to be submitted. Additional testing may also be required during the warranty period. For example, if the HVAC system was tested during the summer at startup, the HVAC contractor may have to return in the winter to test and verify that the HVAC system is operating properly under cold conditions.

## **12.0 HOW DO I MARKET MY FIRM'S GREEN BUILDING EXPERIENCE AND EXPERTISE?**

### **12.1 How do I find out who is building green buildings in my market area?**

The best place to start is local newspapers, business periodicals, and newsletters. Owners and developers undertaking or committing to green building projects often want to be recognized for their commitment to the environment. Society is becoming increasingly aware of the environment and people interested in doing their part to improve the environment. As a result, investors, employees, customers, and tenants want to be associated with environmentally conscious companies and building and occupying a certified green building is one way that owners, developers, and tenant companies can openly demonstrate their commitment to bettering the environment.

There are also architecture and engineering firms that specialize in the design of sustainable buildings and building systems. These design firms can be a good source of information about green building construction in your market area because often preliminary studies on green buildings start early and are much more extensive than on conventional buildings. Getting to know the principals in these firms can be very advantageous to the HVAC contractor. In addition to knowing getting to know the architecture and engineering firms specializing in green building construction, these firms get to know your company and its interest and expertise in HVAC system installation. Similarly, getting to know general contractors and construction managers in your market area that regularly do green building construction projects can also be helpful.

In larger cities there are often local green building associations or local chapters of national green building organizations like the U.S. Green Building Council (USGBC) that the HVAC contractor can join and be active in. Membership in these organizations often includes owners and developers, architects and engineers, general contractors and construction managers, and others that are interested in green building construction and sustainability. In addition, many community, professional, and trade organizations are getting involved in green initiatives and issues that affect them which offers the HVAC contractor another chance to get involved and network. Not only will the HVAC contractor have an opportunity to network and learn about new and upcoming projects through participation in these organizations but it will also distinguish itself as a company that is interested in environmental issues and wanting to bring its expertise to green building.

Information on USGBC members, LEED accredited professionals, and local USGBC chapters can be found on the USGBC website. There is a member directory that website visitors can sort on organization name, membership category, or state. Similarly, there is a membership directory on the USGBC website that lists LEED accredited professionals and can be queried by name, city, state, area of practice, or affiliation. Lastly, local USGBC chapters from around the country are also provided on the USGBC website so that the HVAC contracting firm can locate the chapter closest to it or the chapters within its market areas.

## **12.2 Could my firm be the outside commissioning authority?**

Yes, your firm could be the commissioning authority on a green building project. Normally, the commissioning authority is required to be an independent outside individual or firm that is not involved in the design or construction of the building but this is not always the case. If you are interested in submitting a proposal for being the commissioning authority on a green building project, you should carefully review the project specifications and any third-party green building certification requirements that apply to see if your firm qualifies.

## **12.3 Is there a market for green service work?**

Once a green building has been commissioned, the HVAC system operation needs to be monitored and periodically tested to ensure that it continues to operate properly. Buildings are dynamic and the function and occupancy of spaces within a building are constantly changing. As a result, the demands on the HVAC system are constantly changing and the HVAC system must be adapted to meet these changing needs. In addition, equipment wears with use operating characteristics of equipment change with age. Maintaining a green building HVAC system not only involves regular corrective and preventive maintenance but also often requires regular recommissioning to make sure that the system and its components are all working as they should.

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